From: "Schoenfelder, Robert P." <R.Schoenfelder@WestonSolutions.com>
To: <RJE@nrc.gov>
Date: 04/28/2005 4:03:03 PM
Subject: ExxonMobil tube removal in Billings, MT

040-08769
SUB-1382

Mr. Evans;
Roberto Torres called to inform me that you are now the point of contact from NRC Region IV for the decommissioning activities at ExxonMobil's Billings refinery (license SUB-1382). This email will update on our activities at the site, as well as provide you the opportunity to capture email addresses for the ExxonMobil RSO (David Newburn), and the two WESTON health physicists that are contracted to ExxonMobil for this project (myself and Mark Garcia).

Mark Garcia has been in Billings since last week preparing for the tube removal activities. He and his crew set up our radiological monitoring equipment and work areas, provided basic radiation safety training to the other contractor staff, and established controlled work area boundaries. The tube removal activities started on Monday, and the tubes in the south half of the furnace have been removed and monitoring is completed on the flanges, top ends, and pigtail openings. The tubes in the north half of the furnace are being removed at this time. So far, the direct instrument measurements and wipe sample results have indicated negligible contamination, as expected.

I will keep you posted on progress as we proceed, and will immediately inform you if we encounter unexpected conditions that might significantly change our approach to the project. Please do not hesitate to contact me if you have comments or questions. Regards,
-Bob

Robert Schoenfelder, CHP
Weston Solutions, Inc.
Albuquerque, NM
(505) 837-6556

CC: "Schoenfelder, Robert P." <R.Schoenfelder@WestonSolutions.com>, "Garcia, Mark" <Mark.Garcia@WestonSolutions.com>, "ExxonMobil- David Newburn" <david.a.newburn@exxonmobil.com>

"Emails with Licensee Regarding Decommissioning of ExxonMobil Site"

From: "Schoenfelder, Robert P." <R.Schoenfelder@WestonSolutions.com>
To: <RJE@nrc.gov>
Date: 05/04/2005 2:35:03 PM
Subject: Process diagram for ExxonMobil furnace

Mr. Evans;
We received approval from ExxonMobil to release the attached drawing / process diagram in response to the NRC's earlier request. It represents the part of the facility called the hydrogen furnace circuit, which is a closed, circular process where the U-catalyst was contained years ago. Note that the location where the U-catalyst was used is indicated as "84 catalyst tubes" on the drawing.

The plant operations will be shut down for about one more week, giving us only a short time to access parts of the circuit that were not accessed during the tube removal if the NRC identifies other areas of concern. So far, the inlets and outlets of the tubes and pigtails, and the refractory drum have been monitored. The refractory drum is noted on the drawing as "D-503" directly beneath the tubes, and we monitored the inlet to the drum and the inside surfaces of the drum. We are currently checking to see what other portals are accessible in this process and we will collect wipe samples and perform instrument measurements at those points. Please let me know if there are any areas that are particularly important to you and we will work with ExxonMobil engineers to obtain access if possible.
Regards,
-Bob

Robert Schoenfelder, CHP
Weston Solutions, Inc.
Albuquerque, NM
(505) 837-6556

CC: "Schoenfelder, Robert P." <R.Schoenfelder@WestonSolutions.com>, "Garcia, Mark" <Mark.Garcia@WestonSolutions.com>, "ExxonMobil- David Newburn" <david.a.newburn@exxonmobil.com>

From: "Garcia, Mark" <Mark.Garcia@WestonSolutions.com>
To: <rje@nrc.gov>
Date: 12/12/2005 2:33:26 PM
Subject: ExxonMobil summary sheets and excel files

Mr. Evans:
I hope this help with your review of the final report please let me know if you need anything else.

Thanks

Mark G. Garcia
Weston Solutions Inc.
505-837-6586

SUB-1382
040-08769

Furnace tube attachment points and downstream equipment summary sheet : corresponds to spreadsheets on pages A-2 through A-11.

The total, average and maximum survey value for each set of attachment points and downstream components was placed into the table below and the average for the total, average and maximum was determined.

Summary table corresponds to spreadsheets on pages A-17 to A-24 of final document.

	1 - 20		21 - 40		41 - 60		61 - 80		81 - 84		Downstream	
	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi
Max. removable	1.00E+01	4.50E+00	6.00E+00	2.70E+00	6.00E+00	2.70E+00	5.00E+00	2.25E+00	4.00E+00	1.80E+00	6.00E+00	2.70E+00
Average removable	1.44E+00	6.48E-01	1.08E+00	4.84E-01	7.13E-01	3.21E-01	9.38E-01	4.20E-01	8.13E-01	3.66E-01	1.75E+00	7.88E-01
Max. total	2.02E+03	5.83E+02	2.02E+03	5.83E+02	4.55E+03	1.93E+03	3.03E+03	1.04E+03	4.00E+00	1.80E+00	9.09E+04	4.59E+05
Average total	1.40E+02	3.45E+01	1.65E+02	4.03E+01	3.13E+02	1.00E+02	1.02E+02	3.09E+01	8.13E-01	3.66E-01	8.81E+03	3.08E+04

Used in modeling: dpm/100cm2 = 1.59E+03 pCi= 5.17E+03

Note: Direct and removable contamination measurements were collected for the attachment points and downstream equipment to help in characterization due to the fact that access to the internal surfaces was limited to those areas surveyed.

F551 furnace tube attachment points "pigtail attachments upstream and downstream" tubes 1 - 20.

Constants	
15	Alpha probe active area (cm2)
0.33	Alpha efficiency for Depleted Uranium from manulactureer
15	Beta probe area (cm2)
0.22	Beta probe efficiency for Sr/Y-90 from manufactureer
Conversions	
(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2	
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
2.22E+12	dpm/Ci

Surface Area Formulas
Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area = (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information				Swipe Data	Direct Measurement Data		Activity Determination For Each Item					
Item #	Surface area (cm2)	Direct Beta-Gamma Net (cpm)	Direct Alpha Net (cpm)	Removable Alpha (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)	Total (dpm/100cm^2)	Total Alpha (dpm)	Total Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	
1A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
1B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
1C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1D-lower attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
2A-upper attachment, inside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
2B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
2C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
3B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
3D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
4A-upper attachment, inside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
4B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
4C-lower attachment, inside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
4D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
5A-upper attachment, inside	100	0	0	5	0.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	2.25E-12	0.00E+00	
5B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
5C-lower attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
5D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
6A-upper attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
6B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
6C-lower attachment, inside	100	0	0	7	0.00E+00	0.00E+00	7.00E+00	7.00E+00	0.00E+00	3.15E-12	0.00E+00	
6D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
7A-upper attachment, inside	100	20	20	5	4.04E+02	6.06E+02	1.02E+03	4.09E+02	1.21E+02	1.84E-10	5.46E-11	
7B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
7C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
7D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
8A-upper attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
8B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
8C-lower attachment, inside	100	0	0	6	0.00E+00	0.00E+00	6.00E+00	6.00E+00	0.00E+00	2.70E-12	0.00E+00	
8D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
9A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
9B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
9C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
9D-lower attachment, outside	100	0	0	5	0.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	2.25E-12	0.00E+00	
10A-upper attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
10B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
10C-lower attachment, inside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
10D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
11A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
11B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
11C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
11D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
12A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
12B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
12C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
12D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
13A-upper attachment, inside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
13B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
13C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
13D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
14A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
14B-upper attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
14C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
14D-lower attachment, outside	100	0	0	6	0.00E+00	0.00E+00	6.00E+00	6.00E+00	0.00E+00	2.70E-12	0.00E+00	
15A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
15B-upper attachment, outside	100	20	20	2	4.04E+02	6.06E+02	1.01E+03	4.06E+02	1.21E+02	1.83E-10	5.46E-11	
15C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
15D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
16A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
16B-upper attachment, outside	100	0	0	5	0.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	2.25E-12	0.00E+00	
16C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
16D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
17A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
17B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
17C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
17D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
18A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
18B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
18C-lower attachment, inside	100	0	0	10	0.00E+00	0.00E+00	1.00E+01	1.00E+01	0.00E+00	4.50E-12	0.00E+00	
18D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
19A-upper attachment, inside	100	0	0	5	0.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	2.25E-12	0.00E+00	
19B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
19C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
19D-lower attachment, outside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
20A-lower attachment,inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
20B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
20C-lower attachment, inside	100	40	40	1	8.08E+02	1.21E+03	2.02E+03	8.09E+02	4.85E+02	3.64E-10	2.18E-10	
20D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
			Total	1.15E+02	4.44E+03	6.67E+03	1.12E+04	4.56E+03	1.58E+03	2.05E-09	7.10E-10	
			Average	1.44E+00	5.56E+01	8.33E+01	1.40E+02	5.70E+01	1.97E+01	2.57E-11	8.87E-12	3.45E+01
			Maximum	1.00E+01	8.08E+02	1.21E+03	2.02E+03	8.09E+02	4.85E+02	3.64E-10	2.18E-10	5.83E+02
			Std. dev.	2.06	154.07	231.11	384.96	153.86	65.24	0.00	0.00	
				pCi					**Average (pCi)**	**2.57E+01**	**8.87E+00**	
			Average	6.45E-01								
			Maximum	4.50E+00								

F551 furnace tube attachment points "pigtail attachments upstream and downstream" tubes 21 - 40.

Constants	
15	Alpha probe active area (cm2)
0.33	Alpha efficiency for Depleted Uranium from manufactureer
15	Beta probe area (cm2)
0.22	Beta probe efficiency for Sr/Y-90 from manufacturer
Conversions	
(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2	
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
2.22E+12	dpm/Ci

Surface Area Formulas
Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
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Donut Surface Area - (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information				Swipe Data	Direct Measurement Data		Activity Determination For Each Item					
Item #	Surface area (cm2)	Direct Beta-Gamma Net (cpm)	Direct Alpha Net (cpm)	Removable Alpha (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)	Total (dpm/100cm^2)	Total Alpha (dpm)	Total Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	
21A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
21B-upper attachment, outside	100	0	0	6	0.00E+00	0.00E+00	6.00E+00	6.00E+00	0.00E+00	2.70E-12	0.00E+00	
21C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
21D-lower attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
22A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
22B-upper attachment, outside	100	0	0	6	0.00E+00	0.00E+00	6.00E+00	6.00E+00	0.00E+00	2.70E-12	0.00E+00	
22C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
22D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
23A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
23B-upper attachment, outside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
23C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
23D-lower attachment, outside	100	0	0	6	0.00E+00	0.00E+00	6.00E+00	6.00E+00	0.00E+00	2.70E-12	0.00E+00	
24A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
24B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
24C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
24D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
25A-upper attachment, inside	100	20	20	2	4.04E+02	6.06E+02	1.01E+03	4.06E+02	1.21E+02	1.83E-10	5.46E-11	
25B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
25C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
25D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
26A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
26B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
26C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
26D-lower attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
27A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
27B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
27C-lower attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
27D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
28A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
28B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
28C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
28D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
29A-upper attachment, inside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
29B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
29C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
29D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
30A-upper attachment, inside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
30B-upper attachment, outside	100	20	20	3	4.04E+02	6.06E+02	1.01E+03	4.07E+02	1.21E+02	1.83E-10	5.46E-11	
30C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
30D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
31A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
31B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
31C-lower attachment, inside	100	40	40	1	8.08E+02	1.21E+03	2.02E+03	8.09E+02	4.85E+02	3.64E-10	2.18E-10	
31D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
32A-upper attachment, inside	100	20	20	1	4.04E+02	6.06E+02	1.01E+03	4.05E+02	1.21E+02	1.82E-10	5.46E-11	
32B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
32C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
32D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
33A-upper attachment, inside	100	20	20	1	4.04E+02	6.06E+02	1.01E+03	4.05E+02	1.21E+02	1.82E-10	5.46E-11	
33B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
33C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
33D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
34A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
34B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
34C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
34D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
35A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
35B-upper attachment, outside	100	20	20	1	4.04E+02	6.06E+02	1.01E+03	4.05E+02	1.21E+02	1.82E-10	5.46E-11	
35C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
35D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
36A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
36B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
36C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
36D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
37A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
37B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
37C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
37D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
38A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
38B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
38C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
38D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
39A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
39B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
39C-lower attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
39D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
40A-lower attachment,inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
40B-upper attachment, outside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
40C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
40D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
			Total	**8.60E+01**	**5.25E+03**	**7.88E+03**	**1.32E+04**	**5.34E+03**	**1.82E+03**	**2.40E-09**	**8.19E-10**	
			Average	**1.08E+00**	**6.57E+01**	**9.85E+01**	**1.65E+02**	**6.67E+01**	**2.27E+01**	**3.01E-11**	**1.02E-11**	4.03E+01
			Maximum	**6.00E+00**	**8.08E+02**	**1.21E+03**	**2.02E+03**	**8.09E+02**	**4.85E+02**	**3.64E-10**	**2.18E-10**	5.83E+02
			Std. dev.	**1.38**	**163.19**	**244.79**	**407.85**	**163.07**	**67.07**	**0.00**	**0.00**	
									Average (pCi)	**3.01E+01**	**1.02E+01**	4.03E+01

	pCi
average	4.84E-01
maximum	2.70E+00

F551 furnace tube attachment points "pigtail attachments upstream and downstream" tubes 41 - 60.

Constants	
15	Alpha probe active area (cm2)
0.33	Alpha efficiency for Depleted Uranium from manufactureer
15	Beta probe area (cm2)
0.22	Beta probe efficiency for Sr/Y-90 from manufactureer
Conversions	
(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2	
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
2.22E+12	dpm/Ci

Surface Area Formulas
Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area ~ (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information				Swipe Data	Direct Measurement Data		Activity Determination For Each Item					
Item #	Surface area (cm2)	Direct Beta-Gamma Net (cpm)	Direct Alpha Net (cpm)	Removable Alpha (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)	Total (dpm/100cm^2)	Total Alpha (dpm)	Total Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	
41A-upper attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
41B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
41C-lower attachment, inside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
41D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
42A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
42B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
42C-lower attachment, inside	100	0	0	6	0.00E+00	0.00E+00	6.00E+00	6.00E+00	0.00E+00	2.70E-12	0.00E+00	
42D-lower attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
43A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
43B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
43C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
43D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
44A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
44B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
44C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
44D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
45A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
45B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
45C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
45D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
46A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
46B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
46C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
46D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
47A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
47B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
47C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
47D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
48A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
48B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
48C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
48D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
49A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
49B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
49C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
49D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
50A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
50B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
50C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
50D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
51A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
51B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
51C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
51D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
532A-upper attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
52B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
52C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
52D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
53A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
53B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
53C-lower attachment, inside	100	140	0	0	0.00E+00	4.24E+03	4.24E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
53D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
54A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
54B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
54C-lower attachment, inside	100	80	80	3	1.62E+03	2.42E+03	4.04E+03	1.62E+03	1.94E+03	7.29E-10	8.74E-10	
54D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
55A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
55B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
55C-lower attachment, inside	100	90	90	1	1.82E+03	2.73E+03	4.55E+03	1.82E+03	2.45E+03	8.19E-10	1.11E-09	
55D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
56A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
56B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
56C-lower attachment, inside	100	80	80	0	1.62E+03	2.42E+03	4.04E+03	1.62E+03	1.94E+03	7.28E-10	8.74E-10	
56D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
57A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
57B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
57C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
57D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
58A-upper attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
58B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
58C-lower attachment, inside	100	80	80	1	1.62E+03	2.42E+03	4.04E+03	1.62E+03	1.94E+03	7.28E-10	8.74E-10	
58D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
59A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
59B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
59C-lower attachment, inside	100	60	60	0	1.21E+03	1.82E+03	3.03E+03	1.21E+03	1.09E+03	5.46E-10	4.91E-10	
59D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
60A-lower attachment,inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
60B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
60C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
60D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
			Total	5.70E+01	8.28E+03	1.67E+04	2.50E+04	8.34E+03	9.48E+03	3.76E-09	4.27E-09	
			Average	7.13E-01	1.04E+02	2.08E+02	3.13E+02	1.04E+02	1.19E+02	4.70E-11	5.34E-11	1.00E+02
			Maximum	6.00E+00	1.82E+03	4.24E+03	4.55E+03	1.82E+03	2.45E+03	8.19E-10	1.11E-09	1.93E+03
			Std. dev.	1.02	388.39	740.06	1067.72	388.46	469.16	0.00	0.00	
									Average (pCi)	4.70E+01	5.34E+01	

	pCi
average	3.21E-01
maximum	2.70E+00

F551 furnace tube attachment points "pigtail attachments upstream and downstream" tubes 61 - 80.

Constants	
15	Alpha probe active area (cm2)
0.33	Alpha efficiency for Depleted Uranium from manufactureer
15	Beta probe area (cm2)
0.22	Beta probe efficiency for Sr/Y-90 from manufactureer
Conversions	
(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2	
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
2.22E+12	dpm/Ci

Surface Area Formulas
Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area ~ (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information				Swipe Data	Direct Measurement Data		Activity Determination For Each Item					
Item #	Surface area (cm2)	Direct Beta-Gamma Net (cpm)	Direct Alpha Net (cpm)	Removable Alpha (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)	Total (dpm/100cm^2)	Total Alpha (dpm)	Total Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	
61A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
61B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
61C-lower attachment, inside	100	40	40	1	8.08E+02	1.21E+03	2.02E+03	8.09E+02	4.85E+02	3.64E-10	2.18E-10	
61D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
62A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
62B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
62C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
62D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
63A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
63B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
63C-lower attachment, inside	100	0	0	5	0.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	2.25E-12	0.00E+00	
63D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
64A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
64B-upper attachment, outside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
64C-lower attachment, inside	100	0	0	5	0.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	2.25E-12	0.00E+00	
64D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
65A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
65B-upper attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
65C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
65D-lower attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
66A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
66B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
66C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
66D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
67A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
67B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
67C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
67D-lower attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
68A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
68B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
68C-lower attachment, inside	100	60	60	1	1.21E+03	1.82E+03	3.03E+03	1.21E+03	1.09E+03	5.46E-10	4.91E-10	
68D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
69A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
69B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
69C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
69D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
70A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
70B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
70C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
70D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
71A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
71B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
71C-lower attachment, inside	100	40	40	2	8.08E+02	1.21E+03	2.02E+03	8.10E+02	4.85E+02	3.65E-10	2.18E-10	
71D-lower attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
72A-upper attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
72B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
72C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
72D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
73A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
73B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
73C-lower attachment, inside	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
73D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
74A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
74B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
74C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
74D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
75A-upper attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
75B-upper attachment, outside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
75C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
75D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
76B-upper attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
76C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
76D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
77A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
77B-upper attachment, outside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
77C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
77D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
78A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
78B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
78C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
78D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
79A-upper attachment, inside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
79B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
79C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
79D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
80A-lower attachment,inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
80B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
80C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
80D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
			Total	7.50E+01	3.23E+03	4.85E+03	8.16E+03	3.31E+03	2.18E+03	1.49E-09	9.83E-10	2.47E+03
			Average	9.38E-01	4.04E+01	6.06E+01	1.02E+02	4.13E+01	2.73E+01	1.86E-11	1.23E-11	3.09E+01
			Maximum	5.00E+00	1.21E+03	1.82E+03	3.03E+03	1.21E+03	1.09E+03	5.46E-10	4.91E-10	1.04E+03
			Std. dev.	1.25	188.53	282.79	471.36	188.57		143.00	0.00	0.00
									Average (pCi)	1.86E+01	1.23E+01	3.09E+01

	pci
average	4.22E-01
max	2.25E+00

F551 furnace tube attachment points "pigtail attachments upstream and downstream" tubes 61 - 84.

Constants	
15	Alpha probe active area (cm2)
0.33	Alpha efficiency for Depleted Uranium from manufactureer
15	Beta probe area (cm2)
0.22	Beta probe efficiency for Sr/Y-90 from manufactureer
Conversions	
(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2	
(dpm/cm2)*(total area)/(2.22E12 C/dpm) = Ci	
(dpm/l)/(100 cm2)*(total area)/(2.22E12 C/dpm) = Ci	
2.22E+12	dpm/Ci

Surface Area Formulas
Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area - (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information				Swipe Data	Direct Measurement Data		Activity Determination For Each Item					
Item #	Surface area (cm2)	Direct Beta-Gamma Net (cpm)	Direct Alpha Net (cpm)	Removable Alpha (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)	Total (dpm/100cm^2)	Total Alpha (dpm)	Total Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	
81A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
81B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
81C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
81D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
82A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
82B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
82C-lower attachment, inside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
82D-lower attachment, outside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
83A-upper attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
83B-upper attachment, outside	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
83C-lower attachment, inside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
83D-lower attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
84A-upper attachment, inside	100	0	0	3	0.00E+00	0.00E+00	3.00E+00	3.00E+00	0.00E+00	1.35E-12	0.00E+00	
84B-upper attachment, outside	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
84C-lower attachment, inside	100	0	0	1	0.00E+00	0.00E+00	1.00E+00	1.00E+00	0.00E+00	4.50E-13	0.00E+00	
84D-lower attachment, outside	100	0	0	4	0.00E+00	0.00E+00	4.00E+00	4.00E+00	0.00E+00	1.80E-12	0.00E+00	
			Total	**1.30E+01**	**0.00E+00**	**0.00E+00**	**1.30E+01**	**1.30E+01**	**0.00E+00**	**5.86E-12**	**0.00E+00**	5.86E+00
			Average	**8.13E-01**	**0.00E+00**	**0.00E+00**	**8.13E-01**	**8.13E-01**	**0.00E+00**	**3.66E-13**	**0.00E+00**	3.66E-01
			Maximum	**4.00E+00**	**0.00E+00**	**0.00E+00**	**4.00E+00**	**4.00E+00**	**0.00E+00**	**1.80E-12**	**0.00E+00**	1.80E+00
			Std. dev.	**1.26**	**0.00**	**0.00**	**0.99**	**1.28**	**0.00**	**0.00**	**0.00**	
									Average (pCi)	**3.66E-01**	**0.00E+00**	3.66E-01

	pci
average	3.66E-01
maximum	1.80E+00

Characterization of potential impacted areas of plant.xls

Sample Location	Radionuclide Identified	Laboratory Results	Units	pCi/g	Comments
F551 Sump	Uranium	3	mg/kg	0.9	Metals analysis
F551 Sump	Uranium	3.2	mg/kg	1.1	Metals analysis
Mechanical Garage	U-238	1.1	pCi/g	1.1	Assumed equilibrium with daughters (Pb-214).
	Th-232	1.2	pCi/g		Assumed equilibrium with daughters (Ra-228).
	K-40	19.3	pCi/g		Background value.
Mechanical Garage	U-238	2.3	pCi/g	1.1	Assumed equilibrium with daughters (Th-234).
	Th-232	1.2	pCi/g		Assumed equilibrium with daughters (Pb-212).
	K-40	18	pCi/g		Background value.
F551 Perimeter	U-238	1.3	pCi/g	1.3	Assumed equilibrium with daughters (Pb-214).
	Th-232	1.8	pCi/g		Assumed equilibrium with daughters (Ra-228).
	K-40	21	pCi/g		Background value.
F551 Perimeter	U-238	1.1	pCi/g	1.1	Assumed equilibrium with daughters (Pb-214).
	Th-232	1.9	pCi/g		Assumed equilibrium with daughters (Ra-228).
	K-40	19	pCi/g		Background value.
CSA - Drain	Th-232	1	pCi/g		Assumed equilibrium with daughters (Pb-212).
	K-40	22	pCi/g		Background value.
CSA - Drain	K-40	16.2	pCi/g		Background value.
Background	Th-232	1.2	pCi/g		Assumed equilibrium with daughters (Ra-228).
	K-40	23	pCi/g		Background value.
Background	K-40	23.6	pCi/g		Background value.
			Average	**1.1**	U-238 since it is radionuclide of interest.

F551 furnace downstream processing equipment.

Constants	
15	Alpha probe active area (cm2)
0.33	Alpha efficiency for Depleted Uranium from manufactureer
15	Beta probe area (cm2)
0.22	Beta probe efficiency for Sr/Y-90 from manufactureer
Conversions	
(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2	
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
(dpm/f)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
2.22E+12	dpm/Ci
Surface Area Formulas	
Open right circular cylinder SA: (Pi x D x L)	
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)	
Box Surface Area = LxWx2 + LxHx2 + WxHx2	
Donut Surface Area ~ (Pi x L) x (Pi x D)	
Disk Surface Area = Pi / 4 x D^2	
Tray Surface Area = LxWx2 + LxHx2 + WxHx2	

Item Information				Swipe Data	Direct Measurement Data		Activity Determination For Each Item					
Item #	Surface area (cm2)	Direct Beta-Gamma Net (cpm)	Direct Alpha Net (cpm)	Removable Alpha (dpm/100cm^2)	Direct Alpha (dpm/100cm^2)	Direct Beta-Gamma (dpm/100cm^2)	Total (dpm/100cm^2)	Total Alpha (dpm)	Total Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	
D-503 Drum (D503-2)	100	100	100	3	2.02E+03	3.03E+03	5.05E+03	2.02E+03	3.03E+03	9.11E-10	1.37E-09	
D-503 Contents (D503-1)	100	120	120	5	2.42E+03	3.64E+03	6.07E+03	2.43E+03	4.36E+03	1.09E-09	1.97E-09	
D-503 pipe(D503-S1)	100	200	200	1	4.04E+03	6.06E+03	1.01E+04	4.04E+03	1.21E+04	1.82E-09	5.46E-09	
D-503 pipe (D503-S2)	100	150	150	3	3.03E+03	4.55E+03	7.58E+03	3.03E+03	6.82E+03	1.37E-09	3.07E-09	
D-503 pipe (D503-S3)	100	1800	1800	0	3.64E+04	5.45E+04	9.09E+04	3.64E+04	9.82E+05	1.64E-08	4.42E-07	
D-503 pipe (D503-S4)	100	300	300	2	6.06E+03	9.09E+03	1.52E+04	6.06E+03	2.73E+04	2.73E-09	1.23E-08	
D-503 pipe (D503-S5)	100	0	0	5	0.00E+00	0.00E+00	5.00E+00	5.00E+00	0.00E+00	2.25E-12	0.00E+00	
D-503 pipe (D503-S6)	100	0	0	2	0.00E+00	0.00E+00	2.00E+00	2.00E+00	0.00E+00	9.01E-13	0.00E+00	
D-503 pipe (D503-S7)	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
D-503 pipe (D503-S8)	100	0	0	6	0.00E+00	0.00E+00	6.00E+00	6.00E+00	0.00E+00	2.70E-12	0.00E+00	
E523-A	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
E523-B	100	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
E526-A	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
E526-B	100	20	20	0	4.04E+02	6.06E+02	1.01E+03	4.04E+02	1.21E+02	1.82E-10	5.46E-11	
T509-A	100	40	40	0	8.08E+02	1.21E+03	2.02E+03	8.08E+02	4.85E+02	3.64E-10	2.18E-10	
T509-B	100	40	40	1	8.08E+02	1.21E+03	2.02E+03	8.09E+02	4.85E+02	3.64E-10	2.18E-10	
			Total	2.80E+01	5.64E+04	8.45E+04	1.41E+05	5.64E+04	1.04E+06	2.54E-08	4.67E-07	4.92E+05
			Average	1.75E+00	3.52E+03	5.28E+03	8.81E+03	3.52E+03	6.48E+04	1.59E-09	2.92E-08	3.08E+04
			Maximum	6.00E+00	3.64E+04	5.45E+04	9.09E+04	3.64E+04	9.82E+05	1.64E-08	4.42E-07	4.59E+05
			Std. dev.	2.08	8935.28	13402.93	22337.80	8934.88	244645.25	0.00	0.00	
									Average (pCi)	1.59E+03	2.92E+04	3.08E+04

	pci
average	7.88E-01
maximum	2.70E+00

Furnace Tubes Removed from F551

Furnace tubes had 100% scan coverage performed. No swipes were collected on the furnace tubes.

Results from all tubes surveyed - corresponds to spreadsheets A-12 to A-16 in final report

	dpm/100cm2	pCi
Average	8.88E+02	1.75E+05
Maximum	2.12E+03	4.17E+05

Used in modeling: dpm/100cm2 = 8.88E+03, pCi = 1.75E+05

	A	B	C	D	E	F	Tube CharaGerization	H	I	J	K	L
1	Furnace Tube Radiological Characterization											
2												
3	Furnace tubes removed from F551 hydrogen reformer furnace. Tubes once contained depleted uranium catalyst.											
4												
5												
6	Constants											
7	15	Alpha probe active area (cm2)										
8	0.33	Alpha efficiency for Depleted Uranium from manufactureer										
9	15	Beta probe area (cm2)										
10	0.22	Beta probe efficiency for Sr/Y-90 from manufactureer										
11	Conversions											
12	(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2											
13	(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci											
14	(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci											
15	2.22E+12	dpm/Ci										
16												
17	Surface Area Formulas											
18	Open right circular cylinder SA: (Pi x D x L)											
19	Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)											
20	Box Surface Area = LxWx2 + LxHx2 + WxHx2											
21	Donut Surface Area ~ (Pi x L) x (Pi x D)											
22	Disk Surface Area = Pi / 4 x D^2											
23	Tray Surface Area = LxWx2 + LxHx2 + WxHx2											
24	Tray Dimmensions = 30" x 20" x 2"											
25	NOTE: Multiply by 2 for internal and external contamination.											
26	Parcel Information				Contamination Measurement Data			Activity Determination For Each Item				
27												
28	Item #	Description	Item Modeled As	Surface Area (cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)	Total dpm/100cm^2	Direct Alpha (dpm)	Direct Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	
29	Tube 1	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.84E+02	5.76E+02	9.60E+02	1.68E+05	2.51E+05	7.55E-08	1.13E-07	
30	Tube 2	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.44E+02	6.67E+02	1.11E+03	1.94E+05	2.91E+05	8.74E-08	1.31E-07	
31	Tube 3	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.24E+02	6.36E+02	1.06E+03	1.85E+05	2.78E+05	8.35E-08	1.25E-07	
32	Tube 4	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.25E+02	7.88E+02	1.31E+03	2.29E+05	3.44E+05	1.03E-07	1.55E-07	
33	Tube 5	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.64E+02	5.45E+02	9.09E+02	1.59E+05	2.38E+05	7.15E-08	1.07E-07	
34	Tube 6	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.65E+02	6.97E+02	1.16E+03	2.03E+05	3.04E+05	9.14E-08	1.37E-07	
35	Tube 7	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.04E+02	6.06E+02	1.01E+03	1.76E+05	2.65E+05	7.95E-08	1.19E-07	
36	Tube 8	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.44E+02	6.67E+02	1.11E+03	1.94E+05	2.91E+05	8.74E-08	1.31E-07	
37	Tube 9	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.01E+02	1.52E+02	2.53E+02	4.41E+04	6.62E+04	1.99E-08	2.98E-08	
38	Tube 10	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.03E+02	4.55E+02	7.58E+02	1.32E+05	1.99E+05	5.96E-08	8.94E-08	
39	Tube 11	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.63E+02	3.94E+02	6.57E+02	1.15E+05	1.72E+05	5.17E-08	7.75E-08	
40	Tube 12	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.02E+02	3.03E+02	5.05E+02	8.82E+04	1.32E+05	3.97E-08	5.96E-08	
41	Tube 13	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.63E+02	3.94E+02	6.57E+02	1.15E+05	1.72E+05	5.17E-08	7.75E-08	
42	Tube 14	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.64E+02	5.45E+02	9.09E+02	1.59E+05	2.38E+05	7.15E-08	1.07E-07	
43	Tube 15	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.24E+02	6.36E+02	1.06E+03	1.85E+05	2.78E+05	8.35E-08	1.25E-07	
44	Tube 16	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.65E+02	6.97E+02	1.16E+03	2.03E+05	3.04E+05	9.14E-08	1.37E-07	
45	Tube 17	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.43E+02	5.15E+02	8.59E+02	1.50E+05	2.25E+05	6.76E-08	1.01E-07	
46	Tube 18	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.05E+02	7.58E+02	1.26E+03	2.21E+05	3.31E+05	9.94E-08	1.49E-07	
47	Tube 19	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.44E+02	6.67E+02	1.11E+03	1.94E+05	2.91E+05	8.74E-08	1.31E-07	
48	Tube 20	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.25E+02	7.88E+02	1.31E+03	2.29E+05	3.44E+05	1.03E-07	1.55E-07	
49	Tube 21	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.25E+02	7.88E+02	1.31E+03	2.29E+05	3.44E+05	1.03E-07	1.55E-07	
50	Tube 22	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.44E+02	6.67E+02	1.11E+03	1.94E+05	2.91E+05	8.74E-08	1.31E-07	
51	Tube 23	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.04E+02	6.06E+02	1.01E+03	1.76E+05	2.65E+05	7.95E-08	1.19E-07	
52	Tube 24	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.66E+02	8.48E+02	1.41E+03	2.47E+05	3.71E+05	1.11E-07	1.67E-07	
53	Tube 25	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.44E+02	6.67E+02	1.11E+03	1.94E+05	2.91E+05	8.74E-08	1.31E-07	
54	Tube 26	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.84E+02	5.76E+02	9.60E+02	1.68E+05	2.51E+05	7.55E-08	1.13E-07	
55	Tube 27	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.24E+02	6.36E+02	1.06E+03	1.85E+05	2.78E+05	8.35E-08	1.25E-07	
56	Tube 28	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.45E+02	8.18E+02	1.36E+03	2.38E+05	3.57E+05	1.07E-07	1.61E-07	
57	Tube 29	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.63E+02	3.94E+02	6.57E+02	1.15E+05	1.72E+05	5.17E-08	7.75E-08	
58	Tube 30	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.83E+02	4.24E+02	7.07E+02	1.24E+05	1.85E+05	5.56E-08	8.35E-08	
59	Tube 31	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.22E+02	3.33E+02	5.56E+02	9.70E+04	1.46E+05	4.37E-08	6.56E-08	
60	Tube 32	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.64E+02	5.45E+02	9.09E+02	1.59E+05	2.38E+05	7.15E-08	1.07E-07	
61	Tube 33	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	8.08E+01	1.21E+02	2.02E+02	3.53E+04	5.29E+04	1.59E-08	2.38E-08	
62	Tube 34	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.83E+02	4.24E+02	7.07E+02	1.24E+05	1.85E+05	5.56E-08	8.35E-08	
63	Tube 35	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.42E+02	3.64E+02	6.06E+02	1.06E+05	1.59E+05	4.77E-08	7.15E-08	
64	Tube 36	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.04E+02	6.06E+02	1.01E+03	1.76E+05	2.65E+05	7.95E-08	1.19E-07	
65	Tube 37	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.43E+02	5.15E+02	8.59E+02	1.50E+05	2.25E+05	6.76E-08	1.01E-07	
66	Tube 38	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.85E+02	7.27E+02	1.21E+03	2.12E+05	3.18E+05	9.54E-08	1.43E-07	
67	Tube 39	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.83E+02	4.24E+02	7.07E+02	1.24E+05	1.85E+05	5.56E-08	8.35E-08	
68	Tube 40	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.45E+02	8.18E+02	1.36E+03	2.38E+05	3.57E+05	1.07E-07	1.61E-07	
69	Tube 41	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.21E+02	1.82E+02	3.03E+02	5.29E+04	7.94E+04	2.38E-08	3.56E-08	
70	Tube 42	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.83E+02	4.24E+02	7.07E+02	1.24E+05	1.85E+05	5.56E-08	8.35E-08	
71	Tube 43	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.01E+02	1.52E+02	2.53E+02	4.41E+04	6.62E+04	1.99E-08	2.98E-08	
72	Tube 44	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.01E+02	1.52E+02	2.53E+02	4.41E+04	6.62E+04	1.99E-08	2.98E-08	
73	Tube 45	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.64E+02	5.45E+02	9.09E+02	1.59E+05	2.38E+05	7.15E-08	1.07E-07	
74	Tube 46	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.85E+02	7.27E+02	1.21E+03	2.12E+05	3.18E+05	9.54E-08	1.43E-07	
75	Tube 47	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.43E+02	5.15E+02	8.59E+02	1.50E+05	2.25E+05	6.76E-08	1.01E-07	
76	Tube 48	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	8.48E+02	1.27E+03	2.12E+03	3.71E+05	5.56E+05	1.67E-07	2.50E-07	
77	Tube 49	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.86E+02	8.79E+02	1.46E+03	2.56E+05	3.84E+05	1.15E-07	1.73E-07	
78	Tube 50	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	6.06E+02	9.09E+02	1.52E+03	2.65E+05	3.97E+05	1.19E-07	1.79E-07	
79	Tube 51	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.43E+02	5.15E+02	8.59E+02	1.50E+05	2.25E+05	6.76E-08	1.01E-07	
80	Tube 52	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.43E+02	5.15E+02	8.59E+02	1.50E+05	2.25E+05	6.76E-08	1.01E-07	
81	Tube 53	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.63E+02	3.94E+02	6.57E+02	1.15E+05	1.72E+05	5.17E-08	7.75E-08	
82	Tube 54	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.24E+02	6.36E+02	1.06E+03	1.85E+05	2.78E+05	8.35E-08	1.25E-07	
83	Tube 55	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.83E+02	4.24E+02	7.07E+02	1.24E+05	1.85E+05	5.56E-08	8.35E-08	
84	Tube 56	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.05E+02	7.58E+02	1.26E+03	2.21E+05	3.31E+05	9.94E-08	1.49E-07	
85	Tube 57	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.02E+02	3.03E+02	5.05E+02	8.82E+04	1.32E+05	3.97E-08	5.96E-08	
86	Tube 58	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.04E+02	6.06E+02	1.01E+03	1.76E+05	2.65E+05	7.95E-08	1.19E-07	
87	Tube 59	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.85E+02	7.27E+02	1.21E+03	2.12E+05	3.18E+05	9.54E-08	1.43E-07	
88	Tube 60	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.42E+02	3.64E+02	6.06E+02	1.06E+05	1.59E+05	4.77E-08	7.15E-08	
89	Tube 61	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.64E+02	5.45E+02	9.09E+02	1.59E+05	2.38E+05	7.15E-08	1.07E-07	
90	Tube 62	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.25E+02	7.88E+02	1.31E+03	2.29E+05	3.44E+05	1.03E-07	1.55E-07	

	A	B	C	D	E	F	Tube Charaßterization	H	I	J	K	L
91	Tube 63	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.84E+02	5.76E+02	9.60E+02	1.68E+05	2.51E+05	7.55E-08	1.13E-07	
92	Tube 64	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.24E+02	6.36E+02	1.06E+03	1.85E+05	2.78E+05	8.35E-08	1.25E-07	
93	Tube 65	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.44E+02	6.67E+02	1.11E+03	1.94E+05	2.91E+05	8.74E-08	1.31E-07	
94	Tube 66	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.64E+02	5.45E+02	9.09E+02	1.59E+05	2.38E+05	7.15E-08	1.07E-07	
95	Tube 67	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.23E+02	4.85E+02	8.08E+02	1.41E+05	2.12E+05	6.36E-08	9.54E-08	
96	Tube 68	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.84E+02	5.76E+02	9.60E+02	1.68E+05	2.51E+05	7.55E-08	1.13E-07	
97	Tube 69	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.84E+02	5.76E+02	9.60E+02	1.68E+05	2.51E+05	7.55E-08	1.13E-07	
98	Tube 70	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	5.45E+02	8.18E+02	1.36E+03	2.38E+05	3.57E+05	1.07E-07	1.61E-07	
99	Tube 71	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.02E+02	3.03E+02	5.05E+02	8.82E+04	1.32E+05	3.97E-08	5.96E-08	
100	Tube 72	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.63E+02	3.94E+02	6.57E+02	1.15E+05	1.72E+05	5.17E-08	7.75E-08	
101	Tube 73	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.03E+02	4.55E+02	7.58E+02	1.32E+05	1.99E+05	5.96E-08	8.94E-08	
102	Tube 74	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.22E+02	3.33E+02	5.56E+02	9.70E+04	1.46E+05	4.37E-08	6.56E-08	
103	Tube 75	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.01E+02	1.52E+02	2.53E+02	4.41E+04	6.62E+04	1.99E-08	2.98E-08	
104	Tube 76	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.63E+02	3.94E+02	6.57E+02	1.15E+05	1.72E+05	5.17E-08	7.75E-08	
105	Tube 77	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.84E+02	5.76E+02	9.60E+02	1.68E+05	2.51E+05	7.55E-08	1.13E-07	
106	Tube 78	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	3.23E+02	4.85E+02	8.08E+02	1.41E+05	2.12E+05	6.36E-08	9.54E-08	
107	Tube 79	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.22E+02	3.33E+02	5.56E+02	9.70E+04	1.46E+05	4.37E-08	6.56E-08	
108	Tube 80	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	8.08E+01	1.21E+02	2.02E+02	3.53E+04	5.29E+04	1.59E-08	2.38E-08	
109	Tube 81	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.44E+02	6.67E+02	1.11E+03	1.94E+05	2.91E+05	8.74E-08	1.31E-07	
110	Tube 82	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	2.83E+02	4.24E+02	7.07E+02	1.24E+05	1.85E+05	5.56E-08	8.35E-08	
111	Tube 83	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.04E+02	6.06E+02	1.01E+03	1.76E+05	2.65E+05	7.95E-08	1.19E-07	
112	Tube 84	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.41E+02	2.12E+02	3.54E+02	6.18E+04	9.26E+04	2.78E-08	4.17E-08	
113	Tube 62-02	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.85E+02	7.27E+02	1.21E+03	2.12E+05	3.18E+05	9.54E-08	1.43E-07	
114	Tube 77-02	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.62E+02	2.42E+02	4.04E+02	7.06E+04	1.06E+05	3.18E-08	4.77E-08	
115	Tube 81-02	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	8.08E+01	1.21E+02	2.02E+02	3.53E+04	5.29E+04	1.59E-08	2.38E-08	
116	Tube 82-02	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	4.85E+02	7.27E+02	1.21E+03	2.12E+05	3.18E+05	9.54E-08	1.43E-07	
117	Tube 83-02	Furnace tube 4.5" dia. X 40' Length	Cylinder	43671.1	1.01E+02	1.52E+02	2.53E+02	4.41E+04	6.62E+04	1.99E-08	2.98E-08	
118				**Total**	**3.16E+04**	**4.74E+04**	**7.90E+04**	**1.38E+07**	**2.07E+07**	**6.22E-06**	**9.33E-06**	
119				**Average**	**3.55E+02**	**5.33E+02**	**8.88E+02**	**1.55E+05**	**2.33E+05**	**6.99E-08**	**1.05E-07**	1.75E+05
120				**Maximum**	**8.48E+02**	**1.27E+03**	**2.12E+03**	**3.71E+05**	**5.56E+05**	**1.67E-07**	**2.50E-07**	4.17E+05
121				**Std. dev.**	**143.20**	**214.80**	**358.00**	**62537.20**	**93805.79**	**0.00**	**0.00**	
122									**Average (pCi)**	**6.99E+04**	**1.05E+05**	1.75E+05

	A	B	C	D	E	F	Tube CharaBerization	H	I	J	K	L
123	Direct Contamination Measurement Data Entry											
124	Item #	Average Direct Beta-Gamma (net cpm)	Average Direct Alpha (net cpm)									
125	Tube #1	19	19									
126	Tube #2	22	22									
127	Tube #3	21	21									
128	Tube # 4	26	26									
129	Tube # 5	18	18									
130	Tube # 6	23	23									
131	Tube # 7	20	20									
132	Tube # 8	22	22									
133	Tube # 9	5	5									
134	Tube # 10	15	15									
135	Tube # 11	13	13									
136	Tube # 12	10	10									
137	Tube # 13	13	13									
138	Tube # 14	18	18									
139	Tube # 15	21	21									
140	Tube # 16	23	23									
141	Tube # 17	17	17									
142	Tube # 18	25	25									
143	Tube # 19	22	22									
144	Tube # 20	26	26									
145	Tube # 21	26	26									
146	Tube # 22	22	22									
147	Tube # 23	20	20									
148	Tube # 24	28	28									
149	Tube # 25	22	22									
150	Tube # 26	19	19									
151	Tube # 27	21	21									
152	Tube # 28	27	27									
153	Tube # 29	13	13									
154	Tube # 30	14	14									
155	Tube # 31	11	11									
156	Tube # 32	18	18									
157	Tube # 33	4	4									
158	Tube # 34	14	14									
159	Tube # 35	12	12									
160	Tube # 36	20	20									
161	Tube # 37	17	17									
162	Tube # 38	24	24									
163	Tube # 39	14	14									
164	Tube # 40	27	27									
165	Tube # 41	6	6									
166	Tube # 42	14	14									
167	Tube # 43	5	5									
168	Tube # 44	5	5									
169	Tube # 45	18	18									
170	Tube # 46	24	24									
171	Tube # 47	17	17									
172	Tube # 48	42	42									
173	Tube # 49	29	29									
174	Tube # 50	30	30									
175	Tube # 51	17	17									
176	Tube # 52	17	17									
177	Tube # 53	13	13									
178	Tube # 54	21	21									
179	Tube # 55	14	14									
180	Tube # 56	25	25									
181	Tube # 57	10	10									
182	Tube # 58	20	20									
183	Tube # 59	24	24									
184	Tube # 60	12	12									
185	Tube # 61	18	18									
186	Tube # 62	26	26									
187	Tube # 63	19	19									
188	Tube # 64	21	21									
189	Tube # 65	22	22									
190	Tube # 66	18	18									
191	Tube # 67	16	16									
192	Tube # 68	19	19									
193	Tube # 69	19	19									
194	Tube # 70	27	27									
195	Tube # 71	10	10									
196	Tube # 72	13	13									
197	Tube # 73	15	15									
198	Tube # 74	11	11									
199	Tube # 75	5	5									
200	Tube # 76	13	13									
201	Tube # 77	19	19									
202	Tube # 78	16	16									
203	Tube # 79	11	11									
204	Tube # 80	4	4									
205	Tube # 81	22	22									
206	Tube # 82	14	14									
207	Tube # 83	20	20									
208	Tube # 84	7	7									
209	Tube # 62-02	24	24									
210	Tube # 77-02	8	8									
211	Tube # 81-02	4	4									
212	Tube # 82-02	24	24									
213	Tube # 83-02	5	5									

Furnace tube attachment points and downstream equipment summary sheet : corresponds to spreadsheets on pages A-2 through A-11.

The total, average and maximum survey value for each set of attachment points and downstream components was placed into the table below and the average for the total, average and maximum was determined.

Summary table corresponds to spreadsheets on pages A-17 to A-24 of final document.

	1-20		21 - 40		41 - 60		61 - 80		81 - 84		Downstream	
	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi
Max. removable	1.00E+01	4.50E+00	6.00E+00	2.70E+00	6.00E+00	2.70E+00	5.00E+00	2.25E+00	4.00E+00	1.80E+00	6.00E+00	2.70E+00
Average removable	1.44E+00	6.48E-01	1.08E+00	4.84E-01	7.13E-01	3.21E-01	9.38E-01	4.20E-01	8.13E-01	3.66E-01	1.75E+00	7.88E-01
Max. total	2.02E+03	5.83E+02	2.02E+03	5.83E+02	4.55E+03	1.93E+03	3.03E+03	1.04E+03	4.00E+00	1.80E+00	9.09E+04	4.59E+05
Average total	1.40E+02	3.45E+01	1.65E+02	4.03E+01	3.13E+02	1.00E+02	1.02E+02	3.09E+01	8.13E-01	3.66E-01	8.81E+03	3.08E+04

Used in modeling: pm/100cm2 = 1.59E+03 pCi= 5.17E+03

Note: Direct and removable contamination measurements were collected for the attachment points and downstream equipment to help in characterization due to the fact that access to the internal surfaces was limited to those areas surveyed.

Furnace Tubes Removed from F551

Furnace tubes had 100% scan coverage performed. No swipes were collected on the furnace tubes.

Results from all tubes surveyed - corresponds to spreadsheets A-12 to A-16 in final report

	dpm/100cm2	pCi
Average	8.88E+02	1.75E+05
Maximum	2.12E+03	4.17E+05

Used in modeling: dpm/100cm2 = 8.88E+03, pCi = 1.75E+05

Survey Unit #1 "Top End Flanges"

Pallet of end flanges - layers were placed on the pallet and direct measurements and swipes were collected. Each end flanges was surveyed for direct and removable contamination each disk was then modeled to determine surface area to calculate pCi.

Summary table corresponds to spreadsheets on pages A-17 to A-24 of final document.

	1st layer		2nd layer		3rd layer		4th layer	
	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi
Max. removable	6.00E+00	1.37E+01	6.00E+00	1.37E+01	2.00E+00	4.56E+00	4.00E+00	9.13E+00
Average removable	3.40E+00	7.76E+00	3.40E+00	7.76E+00	1.20E+00	2.74E+00	1.20E+00	2.74E+00
Max. total	2.03E+03	4.62E+03	2.03E+03	4.62E+03	1.01E+03	2.31E+03	1.01E+03	2.31E+03
Average total	5.08E+02	1.16E+03	1.06E+03	2.43E+03	2.54E+02	5.79E+02	2.03E+02	4.64E+02

Used in modeling: dpm/100cm2= 5.06E+02 pCi= 1.16E+03

Survey Unit #3 "Nuts and Bolts from Flanges"

Pallet of nuts and bolt - layers were placed on the pallet and direct measurements and swipes were collected. Each layer was modeled as a flat surface (tray) with the dimensions of the pallet to help simplify the surface area calculation.

Summary table corresponds to spreadsheet on page A-25 of final document.

	dpm/100cm2	pCi
Max. removable	2.00E+00	3.13E+02
Average removable	1.00E+00	3.78E+01
Max. total	1.01E+03	6.34E+04
Average total	2.53E+02	1.59E+04

Used in modeling: dpm/100cm2 = 2.53E+02 pCi = 1.59E+04

Survey Unit #1 "Top End Flanges"

Pallet of end flanges - layers were placed on the pallet and direct measurements and swipes were collected. Each end flanges was surveyed for direct and removable contamination each disk was then modeled to determine surface area to calculate pCi.

Summary table corresponds to spreadsheets on pages A-17 to A-24 of final document.

	1st layer		2nd layer		3rd layer		4th layer	
	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi	dpm/100cm2	pCi
Max. removable	6.00E+00	1.37E+01	6.00E+00	1.37E+01	2.00E+00	4.56E+00	4.00E+00	9.13E+00
Average removable	3.40E+00	7.76E+00	3.40E+00	7.76E+00	1.20E+00	2.74E+00	1.20E+00	2.74E+00
Max. total	2.03E+03	4.62E+03	2.03E+03	4.62E+03	1.01E+03	2.31E+03	1.01E+03	2.31E+03
Average total	5.08E+02	1.16E+03	1.06E+03	2.43E+03	2.54E+02	5.79E+02	2.03E+02	4.64E+02

Used in modeling: dpm/100cm2= 5.06E+02 pCi= 1.16E+03

Radiological Characterization

Characterization of furnace tube top flanges.

Constants

15	Alpha probe active area (cm2)
0.33	Alpha efficiency
15	Beta probe area (cm2)
0.22	Beta probe efficiency

Conversions

(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci
2.22E+12 dpm/Ci
1.00E-12 pCi/Ci

Surface Area Formulas

Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area ~ (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information

Item #	Description	Item Modeled As	Surface Area (cm2)
Top Flange 1st -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 1st - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5

Contamination Measurement Data

Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
6.00E+00	NM	4.04E+02	6.06E+02
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	4.04E+02	6.06E+02
6.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	8.08E+02	1.21E+03
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	4.04E+02	6.06E+02
0.00E+00	NM	4.04E+02	6.06E+02
0.00E+00	NM	4.04E+02	6.06E+02
4.00E+00	NM	0.00E+00	0.00E+00
4.00E+00	NM	4.04E+02	6.06E+02
4.00E+00	NM	0.00E+00	0.00E+00
4.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	0.00E+00	0.00E+00

Activity Determination For Each Item

Removable Alpha (dpm)	Removable Beta (dpm)	Direct Alpha (dpm)	Direct Beta-Gamma (dpm)
3.04E+01	NM	2.05E+03	3.07E+03
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	2.05E+03	3.07E+03
3.04E+01	NM	2.05E+03	3.07E+03
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	2.05E+03	3.07E+03
5.06E+00	NM	4.09E+03	6.14E+03
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	2.05E+03	3.07E+03
0.00E+00	NM	2.05E+03	3.07E+03
0.00E+00	NM	2.05E+03	3.07E+03
2.03E+01	NM	0.00E+00	0.00E+00
2.03E+01	NM	2.05E+03	3.07E+03
2.03E+01	NM	0.00E+00	0.00E+00
2.03E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	0.00E+00	0.00E+00

	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
Average	3.40E+00	NM	2.02E+02	3.03E+02
Maximum	6.00E+00	NM	8.08E+02	1.21E+03
				2.03E+03

max

	Removable Alpha	Removable Beta	Direct Alpha	Direct Beta-Gamma
	1.37E+01		1.84E+03	2.77E+03
Average (dpm)	1.72E+01	NM	1.02E+03	1.53E+03
Average (Ci)	7.76E-12	NM	4.61E-10	6.91E-10
	7.76E+00			

4.62E+03

Assigned Activity	(Ci)	(pCi)	(DPM)	(dpm/100cm2)
Average beta-gamma activity	6.91E-10	6.91E+02	1.53E+03	3.03E+02
Average alpha activity	4.69E-10	4.69E+02	1.04E+03	2.05E+02
Total beta-gamma and alpha	1.16E-09	1.16E+03	2.58E+03	5.08E+02

Removable Contamination Measurement Data Entry

Item #	Swipe Results	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)*
Top Flange 1st -1	5/04/05 #1	6.00E+00	NM
Top Flange 1st -1	5/04/05 #1	6.00E+00	NM
Top Flange 1st -1	5/04/05 #1	6.00E+00	NM
Top Flange 1st -1	5/04/05 #1	6.00E+00	NM
Top Flange 1st -2	5/04/05 #2	1.00E+00	NM
Top Flange 1st - 2	5/04/05 #2	1.00E+00	NM
Top Flange 1st - 2	5/04/05 #2	1.00E+00	NM
Top Flange 1st - 2	5/04/05 #2	1.00E+00	NM
Top Flange 1st - 3	5/04/05 #3	0.00E+00	NM
Top Flange 1st - 3	5/04/05 #3	0.00E+00	NM
Top Flange 1st - 3	5/04/05 #3	0.00E+00	NM
Top Flange 1st - 3	5/04/05 #3	0.00E+00	NM
Top Flange 1st - 4	5/04/05 #4	4.00E+00	NM
Top Flange 1st - 4	5/04/05 #4	4.00E+00	NM
Top Flange 1st - 4	5/04/05 #4	4.00E+00	NM
Top Flange 1st - 4	5/04/05 #4	4.00E+00	NM
Top Flange 1st - 5	5/04/05 #5	6.00E+00	NM
Top Flange 1st - 5	5/04/05 #5	6.00E+00	NM
Top Flange 1st - 5	5/04/05 #5	6.00E+00	NM
Top Flange 1st - 5	5/04/05 #5	6.00E+00	NM

Direct Contamination Measurement Data Entry

Item #	Direct Beta-Gamma (net cpm)	Direct Alpha (net cpm)
Top Flange 1st -1	20	20
Top Flange 1st -1	0	0
Top Flange 1st -1	20	20
Top Flange 1st -1	20	20
Top Flange 1st -2	0	0
Top Flange 1st - 2	0	0
Top Flange 1st - 2	20	20
Top Flange 1st - 2	40	40
Top Flange 1st - 3	0	0
Top Flange 1st - 3	20	20
Top Flange 1st - 3	20	20
Top Flange 1st - 3	20	20
Top Flange 1st - 4	0	0
Top Flange 1st - 4	20	20
Top Flange 1st - 4	0	0
Top Flange 1st - 4	0	0
Top Flange 1st - 5	0	0
Top Flange 1st - 5	0	0
Top Flange 1st - 5	0	0
Top Flange 1st - 5	0	0

Radiological Characterization

Characterization of furnace tube top flanges.

Constants

15	Alpha probe active area (cm2)
0.33	Alpha efficiency
15	Beta probe area (cm2)
0.22	Beta probe efficiency

Conversions

(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci

2.22E+12	dpm/Ci
1.00E-12	pCi/Ci

Surface Area Formulas

Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area = (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information

Item #	Description	Item Modeled As	Surface Area (cm2)
Top Flange 2nd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 2nd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5

Contamination Measurement Data

Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	8.08E+02	1.21E+03
1.00E+00	NM	8.08E+02	1.21E+03
0.00E+00	NM	4.04E+02	6.06E+02
0.00E+00	NM	8.08E+02	1.21E+03
0.00E+00	NM	4.04E+02	6.06E+02
0.00E+00	NM	0.00E+00	0.00E+00
4.00E+00	NM	4.04E+02	6.06E+02
4.00E+00	NM	4.04E+02	6.06E+02
4.00E+00	NM	4.04E+02	6.06E+02
4.00E+00	NM	4.04E+02	6.06E+02
6.00E+00	NM	8.08E+02	1.21E+03
6.00E+00	NM	8.08E+02	1.21E+03
6.00E+00	NM	0.00E+00	0.00E+00
6.00E+00	NM	8.08E+02	1.21E+03

Activity Determination For Each Item

Removable Alpha (dpm)	Removable Beta (dpm)	Direct Alpha (dpm)	Direct Beta-Gamma (dpm)
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	2.05E+03	3.07E+03
5.06E+00	NM	2.05E+03	3.07E+03
5.06E+00	NM	2.05E+03	3.07E+03
5.06E+00	NM	4.09E+03	6.14E+03
5.06E+00	NM	4.09E+03	6.14E+03
0.00E+00	NM	2.05E+03	3.07E+03
0.00E+00	NM	4.09E+03	6.14E+03
0.00E+00	NM	2.05E+03	3.07E+03
0.00E+00	NM	0.00E+00	0.00E+00
2.03E+01	NM	2.05E+03	3.07E+03
2.03E+01	NM	2.05E+03	3.07E+03
2.03E+01	NM	2.05E+03	3.07E+03
2.03E+01	NM	2.05E+03	3.07E+03
3.04E+01	NM	4.09E+03	6.14E+03
3.04E+01	NM	4.09E+03	6.14E+03
3.04E+01	NM	0.00E+00	0.00E+00
3.04E+01	NM	4.09E+03	6.14E+03

	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
Average	3.40E+00	NM	4.24E+02	6.36E+02
Maximum	6.00E+00	NM	8.08E+02	1.21E+03
				2.03E+03

	Removable Alpha	Removable Beta	Direct Alpha	Direct Beta-gamma
Max	1.37E+01		1.84E+03	2.77E+03
Average (dpm)	1.72E+01	NM	2.15E+03	3.22E+03
Average (Ci)	7.76E-12	NM	9.68E-10	1.45E-09
	7.76E+00			4.62E+03

Assigned Activity	(Ci)	(pCi)	(DPM)	(dpm/100cm2)
Average beta-gamma activity	1.45E-09	1.45E+03	3.22E+03	6.36E+02
Average alpha activity	9.76E-10	9.76E+02	2.17E+03	4.28E+02
Total beta/gamma and alpha	2.43E-09	2.43E+03	5.39E+03	1.06E+03

Removable Contamination Measurement Data Entry

Item #	Swipe Results	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)*
Top Flange 2nd -1	5/04/05 #1	6.00E+00	NM
Top Flange 2nd -1	5/04/05 #1	6.00E+00	NM
Top Flange 2nd -1	5/04/05 #1	6.00E+00	NM
Top Flange 2nd -1	5/04/05 #1	6.00E+00	NM
Top Flange 2nd -2	5/04/05 #2	1.00E+00	NM
Top Flange 2nd -2	5/04/05 #2	1.00E+00	NM
Top Flange 2nd -2	5/04/05 #2	1.00E+00	NM
Top Flange 2nd -2	5/04/05 #2	1.00E+00	NM
Top Flange 2nd - 3	5/04/05 #3	0.00E+00	NM
Top Flange 2nd - 3	5/04/05 #3	0.00E+00	NM
Top Flange 2nd - 3	5/04/05 #3	0.00E+00	NM
Top Flange 2nd - 3	5/04/05 #3	0.00E+00	NM
Top Flange 2nd - 4	5/04/05 #4	4.00E+00	NM
Top Flange 2nd - 4	5/04/05 #4	4.00E+00	NM
Top Flange 2nd - 4	5/04/05 #4	4.00E+00	NM
Top Flange 2nd - 4	5/04/05 #4	4.00E+00	NM
Top Flange 2nd - 5	5/04/05 #5	6.00E+00	NM
Top Flange 2nd - 5	5/04/05 #5	6.00E+00	NM
Top Flange 2nd - 5	5/04/05 #5	6.00E+00	NM
Top Flange 2nd - 5	5/04/05 #5	6.00E+00	NM

Direct Contamination Measurement Data Entry

Item #	Direct Beta-Gamma (net cpm)	Direct Alpha (net cpm)
Top Flange 2nd -1	0	0
Top Flange 2nd -1	0	0
Top Flange 2nd -1	0	0
Top Flange 2nd -1	20	20
Top Flange 2nd -2	20	20
Top Flange 2nd -2	20	20
Top Flange 2nd -2	40	40
Top Flange 2nd -2	40	40
Top Flange 2nd - 3	20	20
Top Flange 2nd - 3	40	40
Top Flange 2nd - 3	20	20
Top Flange 2nd - 3	0	0
Top Flange 2nd - 4	20	20
Top Flange 2nd - 4	20	20
Top Flange 2nd - 4	20	20
Top Flange 2nd - 4	20	20
Top Flange 2nd - 5	40	40
Top Flange 2nd - 5	40	40
Top Flange 2nd - 5	0	0
Top Flange 2nd - 5	40	40

Radiological Characterization

Characterization of furnace tube top flanges.

Constants

15	Alpha probe active area (cm2)
0.33	Alpha efficiency
15	Beta probe area (cm2)
0.22	Beta probe efficiency

Conversions

(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci

2.22E+12	dpm/Ci
1.00E-12	pCi/Ci

Surface Area Formulas

Open righl circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area ~ (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information

Item #	Description	Item Modeled As	Surface Area (cm2)
Top Flange 3rd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 3rd - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5

Contamination Measurement Data

Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	0.00E+00	0.00E+00
2.00E+00	NM	4.04E+02	6.06E+02
2.00E+00	NM	0.00E+00	0.00E+00
2.00E+00	NM	0.00E+00	0.00E+00
2.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
2.00E+00	NM	4.04E+02	6.06E+02
2.00E+00	NM	0.00E+00	0.00E+00
2.00E+00	NM	4.04E+02	6.06E+02
2.00E+00	NM	0.00E+00	0.00E+00

Activity Determination For Each Item

Removable Alpha (dpm)	Removable Beta (dpm)	Direct Alpha (dpm)	Direct Beta-Gamma (dpm)
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	2.05E+03	3.07E+03
5.06E+00	NM	0.00E+00	0.00E+00
1.01E+01	NM	2.05E+03	3.07E+03
1.01E+01	NM	0.00E+00	0.00E+00
1.01E+01	NM	0.00E+00	0.00E+00
1.01E+01	NM	2.05E+03	3.07E+03
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
1.01E+01	NM	2.05E+03	3.07E+03
1.01E+01	NM	0.00E+00	0.00E+00
1.01E+01	NM	2.05E+03	3.07E+03
1.01E+01	NM	0.00E+00	0.00E+00

	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
Average	1.20E+00	NM	1.01E+02	1.52E+02
Maximum	2.00E+00	NM	4.04E+02	6.06E+02
max				1.01E+03

	Removable Alpha	Removable Beta	Direct Alpha	Direct beta-gamma
	4.56E+00		9.22E+02	1.38E+03
Average (dpm)	6.08E+00	NM	5.12E+02	7.67E+02
Average (Ci)	2.74E-12	NM	2.30E-10	3.46E-10
	2.74E+00			

2.31E+03

5.79E+02

Assigned Activity	(Ci)	(pCi)	(DPM)	(dpm/100cm2)
Average beta-gamma activity	3.46E-10	3.46E+02	7.67E+02	1.52E+02
Average alpha activity	2.33E-10	2.33E+02	5.18E+02	1.02E+02
Total beta-gamma and alpha	5.79E-10	5.79E+02	1.28E+03	2.54E+02

Removable Contamination Measurement Data Entry

Item #	Swipe Results	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)*
Top Flange 3rd -1	5/05/05 #6	1.00E+00	NM
Top Flange 3rd -1	5/05/05 #6	1.00E+00	NM
Top Flange 3rd -1	5/05/05 #6	1.00E+00	NM
Top Flange 3rd -1	5/05/05 #6	1.00E+00	NM
Top Flange 3rd - 2	5/05/05 #7	2.00E+00	NM
Top Flange 3rd - 2	5/05/05 #7	2.00E+00	NM
Top Flange 3rd - 2	5/05/05 #7	2.00E+00	NM
Top Flange 3rd - 2	5/05/05 #7	2.00E+00	NM
Top Flange 3rd - 3	5/05/05 #8	1.00E+00	NM
Top Flange 3rd - 3	5/05/05 #8	1.00E+00	NM
Top Flange 3rd - 3	5/05/05 #8	1.00E+00	NM
Top Flange 3rd - 4	5/05/05 #8	1.00E+00	NM
Top Flange 3rd - 4	5/05/05 #9	0.00E+00	NM
Top Flange 3rd - 4	5/05/05 #9	0.00E+00	NM
Top Flange 3rd - 4	5/05/05 #9	0.00E+00	NM
Top Flange 3rd - 5	5/05/05 #9	0.00E+00	NM
Top Flange 3rd - 5	5/05/05 #10	2.00E+00	NM
Top Flange 3rd - 5	5/05/05 #10	2.00E+00	NM
Top Flange 3rd - 5	5/05/05 #10	2.00E+00	NM
Top Flange 3rd - 5	5/05/05 #10	2.00E+00	NM

Direct Contamination Measurement Data Entry

Item #	Direct Beta-Gamma (net cpm)	Direct Alpha (net cpm)
Top Flange 3rd -1	0	0
Top Flange 3rd -1	0	0
Top Flange 3rd -1	20	20
Top Flange 3rd -1	0	0
Top Flange 3rd - 2	20	20
Top Flange 3rd - 2	0	0
Top Flange 3rd - 2	0	0
Top Flange 3rd - 2	20	20
Top Flange 3rd - 3	0	0
Top Flange 3rd - 3	0	0
Top Flange 3rd - 3	0	0
Top Flange 3rd - 4	0	0
Top Flange 3rd - 4	0	0
Top Flange 3rd - 4	0	0
Top Flange 3rd - 4	0	0
Top Flange 3rd - 5	0	0
Top Flange 3rd - 5	20	20
Top Flange 3rd - 5	0	0
Top Flange 3rd - 5	20	20
Top Flange 3rd - 5	0	0

Radiological Characterization

Characterization of furnace tube top flanges.

Constants

15	Alpha probe active area (cm2)
0.33	Alpha efficiency
15	Beta probe area (cm2)
0.22	Beta probe efficiency

Conversions

(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci

2.22E+12	dpm/Ci
1.00E-12	pCi/Ci

Surface Area Formulas

Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area ~ (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Item Information

Item #	Description	Item Modeled As	Surface Area (cm2)
Top Flange 4th -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th -1	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th -2	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 3	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 4	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5
Top Flange 4th - 5	Top flange - Disk "25.4 cm Dia."	Disk	506.5

Contamination Measurement Data

Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	4.04E+02	6.06E+02
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
1.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
4.00E+00	NM	0.00E+00	0.00E+00
4.00E+00	NM	4.04E+02	6.06E+02
4.00E+00	NM	0.00E+00	0.00E+00
4.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	4.04E+02	6.06E+02
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	4.04E+02	6.06E+02

Activity Determination For Each Item

Removable Alpha (dpm)	Removable Beta (dpm)	Direct Alpha (dpm)	Direct Beta-Gamma (dpm)
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	2.05E+03	3.07E+03
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
5.06E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
2.03E+01	NM	0.00E+00	0.00E+00
2.03E+01	NM	2.05E+03	3.07E+03
2.03E+01	NM	0.00E+00	0.00E+00
2.03E+01	NM	0.00E+00	0.00E+00
0.00E+00	NM	2.05E+03	3.07E+03
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	0.00E+00	0.00E+00
0.00E+00	NM	2.05E+03	3.07E+03

	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)
Average	1.20E+00	NM	8.08E+01	1.21E+02
Maximum	4.00E+00	NM	4.04E+02	6.06E+02
				1.01E+03

max

	Removable Alpha	Removable Beta	Direct Alpha	Direct Beta-Gamma
	9.13E+00		9.22E+02	1.38E+03
Average (dpm)	6.08E+00	NM	4.09E+02	6.14E+02
Average (Ci)	2.74E-12	NM	1.84E-10	2.77E-10
	2.74E+00			

2.31E+03

Assigned Activity	(Ci)	(pCi)	(DPM)	(dpm/100cm2)
Average beta-gamma activity	2.77E-10	2.77E+02	6.14E+02	1.21E+02
Average alpha activity	1.87E-10	1.87E+02	4.15E+02	8.20E+01
Total beta-gamma and alpha	4.64E-10	4.64E+02	1.03E+03	2.03E+02

Removable Contamination Measurement Data Entry

Item #	Swipe Results	Removable Alpha (dpm/100cm2)	Removable Beta (dpm/100cm2)*
Top Flange 4th -1	5/05/05 #11	1.00E+00	NM
Top Flange 4th -1	5/05/05 #11	1.00E+00	NM
Top Flange 4th -1	5/05/05 #11	1.00E+00	NM
Top Flange 4th -1	5/05/05 #11	1.00E+00	NM
Top Flange 4th -2	5/05/05 #12	1.00E+00	NM
Top Flange 4th -2	5/05/05 #12	1.00E+00	NM
Top Flange 4th -2	5/05/05 #12	1.00E+00	NM
Top Flange 4th -2	5/05/05 #12	1.00E+00	NM
Top Flange 4th - 3	5/05/05 #13	0.00E+00	NM
Top Flange 4th - 3	5/05/05 #13	0.00E+00	NM
Top Flange 4th - 3	5/05/05 #13	0.00E+00	NM
Top Flange 4th - 3	5/05/05 #13	0.00E+00	NM
Top Flange 4th - 4	5/05/05 #14	4.00E+00	NM
Top Flange 4th - 4	5/05/05 #14	4.00E+00	NM
Top Flange 4th - 4	5/05/05 #14	4.00E+00	NM
Top Flange 4th - 4	5/05/05 #14	4.00E+00	NM
Top Flange 4th - 5	5/05/05 #15	0.00E+00	NM
Top Flange 4th - 5	5/05/05 #15	0.00E+00	NM
Top Flange 4th - 5	5/05/05 #15	0.00E+00	NM
Top Flange 4th - 5	5/05/05 #15	0.00E+00	NM

Direct Contamination Measurement Data Entry

Item #	Direct Beta-Gamma (net cpm)	Direct Alpha (net cpm)
Top Flange 4th -1	0	0
Top Flange 4th -1	20	20
Top Flange 4th -1	0	0
Top Flange 4th -1	0	0
Top Flange 4th -2	0	0
Top Flange 4th -2	0	0
Top Flange 4th -2	0	0
Top Flange 4th -2	0	0
Top Flange 4th - 3	0	0
Top Flange 4th - 3	0	0
Top Flange 4th - 3	0	0
Top Flange 4th - 3	0	0
Top Flange 4th - 4	0	0
Top Flange 4th - 4	20	20
Top Flange 4th - 4	0	0
Top Flange 4th - 4	0	0
Top Flange 4th - 5	20	20
Top Flange 4th - 5	0	0
Top Flange 4th - 5	0	0
Top Flange 4th - 5	20	20

Survey Unit #3 "Nuts and Bolts from Flanges"

Pallet of nuts and bolt - layers were placed on the pallet and direct measurements and swipes were collected. Each layer was modeled as a flat surface (tray) with the dimensions of the pallet to help simplify the surface area calculation.

Summary table corresponds to spreadsheet on page A-25 of final document.

	dpm/100cm2	pCi
Max. removable	2.00E+00	3.13E+02
Average removable	1.00E+00	3.78E+01
Max. total	1.01E+03	6.34E+04
Average total	2.53E+02	1.59E+04
Used in modeling:	**dpm/100cm2 = 2.53E+02**	**pCi = 1.59E+04**

Survey Unit # 3 "Nuts and Bolts from Flanges".

Constants	
15	Alpha probe active area (cm2)
0.33	Alpha efficiency for Depleted Uranium from manufactureer
15	Beta probe area (cm2)
0.22	Beta probe efficiency for Sr/Y-90 from manufactureer
Conversions	
(cpm)/(instrument area)/(instrument efficiency) = dpm/cm2	
(dpm/cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
(dpm/l)/(100 cm2)*(total area)/(2.22E12 Ci/dpm) = Ci	
2.22E+12	dpm/Ci

Surface Area Formulas
Open right circular cylinder SA: (Pi x D x L)
Closed right circular cylinder SA: (Pi x D x L) + (2*Pi/4*D^2)
Box Surface Area = LxWx2 + LxHx2 + WxHx2
Donut Surface Area ~ (Pi x L) x (Pi x D)
Disk Surface Area = Pi / 4 x D^2
Tray Surface Area = LxWx2 + LxHx2 + WxHx2

Each layer resembles a tray 4ft. L x 4ft. W x 4in. H (122cm x 122cm x 10.2 cm)

Item Information				Swipe Data	Direct Measurement Data		Activity Determination For Each Item					
Item #	Surface area (cm2)	Direct Beta-Gamma Net (cpm)	Direct Alpha Net (cpm)	Removable Alpha (dpm/100cm2)	Direct Alpha (dpm/100cm2)	Direct Beta-Gamma (dpm/100cm2)	Total Alpha (dpm)	Total Beta-Gamma (dpm)	Alpha (Ci)	Beta (Ci)	Total	Removable
Nuts and bolts - 1st layer (A)	34,746	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nuts and bolts - 1st layer (B)	34,746	0	0	1	0.00E+00	0.00E+00	3.47E+02	0.00E+00	1.57E-10	0.00E+00	1.57E+02	1.57E+02
Nuts and bolts - 1st layer (C)	34,746	0	0	2	0.00E+00	0.00E+00	6.95E+02	0.00E+00	3.13E-10	0.00E+00	3.13E+02	3.13E+02
Nuts and bolts - 1st layer (D)	34,746	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nuts and bolts - 2nd layer (E)	34,746	20	20	0	4.04E+02	6.06E+02	1.40E+05	1.21E+02	6.32E-08	5.46E-11	6.33E+04	0.00E+00
Nuts and bolts - 2nd layer (F)	34,746	20	20	1	4.04E+02	6.06E+02	1.41E+05	1.21E+02	6.34E-08	5.46E-11	6.34E+04	1.57E+02
Nuts and bolts - 3rd layer (G)	34,746	0	0	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Nuts and bolts - 3rd layer (H)	34,746	0	0	1	0.00E+00	0.00E+00	3.47E+02	0.00E+00	1.57E-10	0.00E+00	1.57E+02	1.57E+02
			Average	**1**	**1.01E+02**	**1.52E+02**	**3.53E+04**	**3.03E+01**	**1.59E-08**	**1.37E-11**	6.34E+04	3.13E+02
			Maximum	2	*4.04E+02*	*6.06E+02*		**Total (pCi)**	**1.59E+04**	**1.37E+01**	1.59E+04	9.78E+01
						1.01E+03						
						2.53E+02						

Combine average alpha, beta, gamma (dpm) =	**3.53E+04**
Combine average alpha, beta, gamma (dpm/100cm^2) =	**2.53E+02**
Combine average alpha, beta, gamma (pCi) =	**1.59E+04**

Max
Average

From: Christepher McKenney
To: Bob Evans
Date: 04/13/2006 2:17:02 PM
Subject: Re: Question about RFo factor

I am sorry - I thought I responded to this last week but my mind must be slipping...

However, the basic answer is no. A change in RFo would require a TAR. Secondly, the default deterministic parameters from NUREG/CR-5512, Vol. 1 have been superceded (see NUREG-1757, Vol. 2, App. I, page I-58)

>>> Bob Evans 03/29/06 12:27 PM >>>
Recall that Region IV is considering a request from ExxonMobil to free release a site using DandD modeling. The licensee requested two changes to the model; loose fraction and loose resuspension factor.

I understand that licensees can change the loose fraction (with justification) based on site specific data as allowed by NUREG-1757, Volume 1, Table B.1, Footnote a. In other words, I understand that a TAR is not required for a change in loose fraction.

With regards to loose resuspension factor (RFo), I understand that changes to the RFo default parameters requires NRC approval. ExxonMobil used a resuspenstion factor of 9.6E-7 1/m based on draft NUREG-1720.

Since we talked yesterday, I found out that the rounded value for RFo (1E-6 1/m) is mentioned in NUREG-5512, Volume 1 as the recommended default value. Further, the (NRC-approved) DandD parameter help instructions has the following statement:

5.4.4.3 Information Reviewed to Define A PDF for RFo

The value for the resuspension factor recommended in NUREG/CR-5512, Vol. 1, is 1 × 10-6 m-1, based on a literature analysis of studies published from 1964 through 1990. The overall range of values obtained from these literature sources is 2 × 10-11 to 4 × 10-2 m-1. However, most data referenced are not for indoor conditions. Only two of the references cited in Volume 1 provide data for indoor resuspension. The first of these, an IAEA technical report (1970), reports a value of 5 × 10-5 m-1 which has been obtained for operating nuclear facilities. The second of these two references, a review by Sehmel (1980), provides different resuspension factors depending on the type of activity conducted within the rooms of the building (walking, vigorous sweeping, and fan). The overall range cited by Sehmel is from 1 × 10-6 to 4 × 10-2 m-1. **The lower end of this range is suggested as a default** based on the fact that surfaces are assumed to be cleaned of easily removable contamination at the time of license termination.

In summary, can the licensee change the RFo using NUREG-5512 as a reference instead of draft NUREG-1720, or does the licensee still require NRC approval (via TAR) to change the default RFo value?

Thanks for your help!

CC: Beth Schlapper; Blair Spitzberg; Dominick Orlando

From: Christepher McKenney
To: Bob Evans
Date: 04/14/2006 2:02:06 PM
Subject: Re: Question about RFo factor

for a dose assessment, the arithmetic average is the important value to use for the building/room wide dose value. If individual values are above the wide area DCGL that when you compare those to the DCGL (Elevated Measurement Concentration value).

Chris

>>> Bob Evans 04/13/06 3:45 PM >>>
thanks.

One final question (for now). If the licensee used the average surface contamination value (average of several hundred data points) and all default values in the model, then the model output is well below 25 millirems. Is this acceptable, to use the average rather than the maximum value? I can't find any discussion in NUREG-1757 about model inputs.

As always, I appreciate your opinions.

>>> Christepher McKenney 04/13/2006 2:16:55 PM >>>
I am sorry - I thought I responded to this last week but my mind must be slipping...

However, the basic answer is no. A change in RFo would require a TAR. Secondly, the default deterministic parameters from NUREG/CR-5512, Vol. 1 have been superceded (see NUREG-1757, Vol. 2, App. I, page I-58)

>>> Bob Evans 03/29/06 12:27 PM >>>
Recall that Region IV is considering a request from ExxonMobil to free release a site using DandD modeling. The licensee requested two changes to the model; loose fraction and loose resuspension factor.

I understand that licensees can change the loose fraction (with justification) based on site specific data as allowed by NUREG-1757, Volume 1, Table B.1, Footnote a. In other words, I understand that a TAR is not required for a change in loose fraction.

With regards to loose resuspension factor (RFo), I understand that changes to the RFo default parameters requires NRC approval. ExxonMobil used a resuspenstion factor of 9.6E-7 1/m based on draft NUREG-1720.

Since we talked yesterday, I found out that the rounded value for RFo (1E-6 1/m) is mentioned in NUREG-5512, Volume 1 as the recommended default value. Further, the (NRC-approved) DandD parameter help instructions has the following statement:

5.4.4.3 Information Reviewed to Define A PDF for RFo

The value for the resuspension factor recommended in NUREG/CR-5512, Vol. 1, is 1 × 10-6 m-1, based on a literature analysis of studies published from 1964 through 1990. The overall range of values obtained from these literature sources is 2 × 10-11 to 4 × 10-2 m-1. However, most data referenced are not for indoor conditions. Only two of the references cited in Volume 1 provide data for indoor resuspension. The first of these, an IAEA technical report (1970), reports a value of 5 × 10-5 m-1 which has been obtained for operating nuclear facilities. The second of these two references, a review by Sehmel (1980), provides different resuspension factors depending on the type of activity conducted within the rooms of the building (walking, vigorous sweeping, and fan). The overall range cited by Sehmel is from 1 × 10-6 to 4 × 10-2 m-1. **The lower end of this range is suggested as a default** based on the fact that