

ATTACHMENT 3 TO WESTINGHOUSE  
LETTER NO. HEM-08-36

Public Version of Letter No. HEM-08-12, Report of Concentrations of  
Radioactive Material Exceeding Limits from a Forklift  
Stored in an Unrestricted Area (Docket No. 70-36,  
License No. SNM-33) (with attachment)



Westinghouse Electric Company  
Hematite Former Fuel Cycle Facility  
3300 State Road P  
Festus, MO 63028  
USA

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

Direct tel: 314-810-3368  
Direct fax: 636-937-6380  
E-mail: [hackmaek@westinghouse.com](mailto:hackmaek@westinghouse.com)

Our ref: HEM-08-12  
Date: February 21, 2008

**Subject:** Report of Concentrations of Radioactive Material Exceeding Limits from a Forklift Stored in an Unrestricted Area (Docket No. 70-36, License No. SNM-33)

**Reference:** 10 CFR 20.2203, "Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the constraints or limits"

Dear Sir:

As required by 10 CFR 20.2203(a)(3)(ii), this letter submits the Westinghouse Electric Company LLC (Westinghouse) report of an occurrence identified at the Hematite Decommissioning Project involving levels of radioactive material in an unrestricted area that exceeded the applicable limits of 10 CFR 20, Appendix C. As detailed further in the attached report, this occurrence did not involve any significant occupational dose or exposure of an individual in excess of the limits in 10 CFR 20.1301.

Pursuant to 10 CFR 20.2203(b), the attached report describes the extent of exposure of individuals to radiation and radioactive material, including: (1) estimates of the individual's dose; (2) the levels of radiation and concentrations of radioactive material involved; (3) the cause of the elevated concentrations; and (4) corrective steps taken and planned to ensure against recurrence. The attached report is provided by the required February 22, 2008, report due date.

In accordance with 10 CFR 2.390(a)(6) and (b), Westinghouse requests that the attachment to this letter be withheld from public disclosure in its entirety as records the disclosure of which would constitute a clearly unwarranted invasion of personal privacy. The affected individuals identified by company affiliation and title could be identified given the identification of the licensee, the facility and the description of the events discussed in the report. These individuals' potential exposure, albeit extremely small, could subject them to unwanted attention. Given these facts and the inability to segregate such identifying information without it affecting the discussion of the events underlying this report, Westinghouse requests that the attached report, including all appendices, be withheld from public disclosure.



If you have any questions concerning this letter, please contact me at the number indicated above, or Matt Featherston of my staff at 314-810-3361.

Sincerely,



E. Kurt Hackmann  
Director, Hematite Decommissioning Project

**Attachment**

- cc:    Regional Administrator, NRC Region III  
      J. J. Hayes, NRC/FSME/DWMEP/DURLD  
      B. A. Watson, NRC/FSME/DWMEP/DURLD  
      G. M. McCann, NRC Region III  
      A. M. Bramnik, NRC Region III  
      J. A. McCully, Westinghouse  
      A. S. Candris, Westinghouse



REPORT OF CONCENTRATIONS OF RADIOACTIVE MATERIAL  
EXCEEDING LIMITS IN AN UNRESTRICTED AREA

This report addresses an occurrence involving the storage of a forklift containing low levels of fixed radiological surface contamination in an unrestricted area of the Hematite site; however, the levels of fixed contamination exceeded the applicable limits of 10 CFR 20, Appendix C, requiring posting and labeling pursuant to 10 CFR 20.1902 and 10 CFR 20.1904. This condition was discovered on January 23, 2008 as a result of the corrective actions implemented in response to an occurrence reported in the Westinghouse Electric Company LLC (Westinghouse) February 4, 2008, report to the NRC<sup>1</sup>.

Prior to October 6, 2006, the forklift was labeled as having fixed surface contamination and was stored in a restricted area in Hematite Building 253. Access to this restricted area was under the control of the Health Physics department. On October 6, 2006, a radiological survey was performed on the forklift to determine the suitability for on-site use. The survey showed fixed surface contamination above the release limits, but low amounts of loose surface contamination below release limits. Further detail regarding this survey is provided in Appendix 1 of this report. Based upon the survey, the former Radiation Safety Officer (RSO) determined that the forklift could be removed from the restricted area and used for site work. The RSO defined the forklift operating parameters as "for on-site use only." However, regulatory requirements for posting and labeling were not met. The forklift was not stored in a posted restricted area when not in use, and sometime between winter 2006 and summer 2007 the radiological label on the forklift apparently was removed and not replaced. This was also in violation of Westinghouse procedures and NRC requirements. This occurrence meets the reporting criteria of 10 CFR 20.2203(a)(3)(ii).

The reporting requirements of 10 CFR 20.2203(a)(3)(ii) were met in that concentrations of radioactive material in unrestricted areas were in excess of 10 times the applicable limit set forth in 10 CFR 20, Appendix C, for posting and labeling as required by 10 CFR 20 Subpart J. Therefore, Westinghouse provides the required written report meeting the content requirements of 10 CFR 20.2203(b), which states:

*Contents of reports. (1) Each report required by paragraph (a) of this section must describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:*

*(i) Estimates of each individual's dose; and*

*(ii) The levels of radiation and concentrations of radioactive material involved; and*

*(iii) The cause of the elevated exposures, dose rates, or concentrations; and*

---

<sup>1</sup> Westinghouse Letter No. HEM-08-7, "Report of Concentrations of Radioactive Material Exceeding Limits in an Unrestricted Area (Docket No. 70-36, License No. SNM-33)," dated February 4, 2008.

*(iv) Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, ALARA constraints, generally applicable environmental standards, and associated license conditions.*

1. 10 CFR 20.2203(b)(1)(i) – Estimates of Each Individual's Dose

This occurrence began on October 6, 2006 when a radiologically contaminated forklift was no longer stored in a posted restricted area. An estimate of the potential external and internal doses to an individual has been prepared based on the radiological survey data and conservative scenario assumptions. This estimate shows that an individual would receive only a small fraction of the occupational dose specified by 10 CFR 20.1201. It should be noted that use of the forklift was limited to on-site use only and was stored in areas inaccessible to members of the public; therefore, Westinghouse believes that there is no reasonable likelihood that this condition involved any exposure to any member of the public. In actuality, as described below, it is doubtful that any individual who had access to the forklift received any measurable dose.

External Dose

Due to the small levels of activity on the forklift and the limited time spent by personnel at the forklift, the estimate for external dose based on conservative assumptions result in approximately 0.4 mrem. Therefore, it is concluded that for realistic assumptions there is no measurable external dose component to any individual that may have come into contact with this forklift between October 6, 2006, and January 23, 2008.

Further detail of the calculations supporting this estimate is provided in Appendix 2 of this report.

Internal Dose

The upper bound for the estimated internal dose to the most exposed individual based on the ingestion pathway as a result of this occurrence would be less than 0.03 mrem/yr (1.3 mrem in a 50-year lifetime). This conservatively assumes that the entire amount of removable surface contamination on the surfaces of the forklift was ingested by one individual.

The upper bound for the estimated internal dose to the most exposed individual based on the inhalation pathway as a result of this occurrence would be less than 1.6 mrem.

Further details of the calculations supporting these estimates are provided in Appendix 2 of this report.

Personnel Involved

From October 6, 2006 to January 23, 2008, there have been [REDACTED] to operate the forklift. It is not believed all such individuals have operated the forklift. From interviews it is estimated that the forklift was operated less than twelve times during this time period.

[REDACTED]

When it was not in operation, it was stored in the rear area of Building 230 near other heavy equipment. This is an extremely low traffic area, and personnel do not congregate in this area. The only maintenance that was performed on this forklift during this period was the replacement of a broken seat. Based on interviews with personnel on-site at the time, this activity was performed with the proper health physics support.

- The [REDACTED] are bounded by the dose model. Their actual time spent around the forklift was much less than the 200 hours/year assumed in the dose model.
- Other [REDACTED] personnel that would have had potential access to the forklift are bounded by the dose model. It is unlikely that any of these people had physical contact with forklift. If anyone did, it would have been for a much shorter time and at greater distances, resulting in lower doses than predicted by the model.

2. 10 CFR 20.2203(b)(1)(ii) – Levels of Radiation and Radioactive Material Concentrations Involved

Surveys were performed on the forklift prior to release from the restricted area on October 6, 2006 (Appendix 1), and when investigating this occurrence on January 22, 2008 (Appendix 3). From the January 22, 2008 survey, the amount of radioactive material on the forklift was estimated to be approximately 0.77  $\mu\text{Ci}$ . Further details regarding these measurements and the associated estimate are provided in Appendix 4 of this report.

3. 10 CFR 20.2203(b)(1)(iii) – Cause of the Elevated Exposures, Dose Rates, or Concentrations

The cause of this event is inadequate health physics management oversight to ensure that work activities involving the use of radioactive materials were conducted in accordance with Westinghouse procedures. This event is considered another consequence of the inadequate management staffing at Hematite described in detail in Westinghouse's Reply to a Notice of Violation<sup>2</sup> dated December 18, 2007.

Reasons for the Event – Sequence of Events

This forklift had been used in the removal of radiological contaminated material from the Hematite Fuel Fabricating Facility during the 2004-2005 time period. At the end of this project, the forklift was stored in Building 253, a radiologically restricted area. Due to operational needs, the forklift was surveyed and removed from the restricted area on October 6, 2006. That same day, the forklift was pressure washed in the back of (southeast corner) of Building 230. The purpose was to clean the dust and debris that had accumulated on the forklift during its storage in Building 253.

As stated previously, the levels of loose surface contamination on the forklift were below free release limits; therefore, wash water did not contain any significant amounts of

<sup>2</sup> Westinghouse Letter No. HEM-07-141, "Reply to a Notice of Violation," dated December 18, 2007.



radiological material. Regardless, any debris from the forklift was washed into the radiologically posted Controlled Area.

On October 6, 2006, the forklift was limited to "site use only" by the RSO. The forklift was stored in an unrestricted area in Building 230 along with other heavy equipment. The forklift was initially labeled as having fixed contamination, but sometime between late-winter 2006 and summer 2007, the label was apparently removed and not replaced. The reason the label was not replaced has not been determined.

On January 23, 2008, the current Hematite RSO determined that the forklift contained radiological contamination in excess of the limits of 10 CFR 20 for posting and labeling. The RSO further identified that this condition involved concentrations of radioactive material in an unrestricted area at levels that required reporting pursuant to 10 CFR 20.2203(a)(3)(ii).

4. 10 CFR 20.2203(b)(1)(iv) – Corrective Steps Taken or Planned to Ensure Against a Recurrence

a. Remedial Action, Posting and Labeling

The conditions involving concentrations of radioactive material in an unrestricted area above 10 CFR 20 limits have been corrected. The proper labeling has been applied to the forklift reflecting the presence of fixed radiological contamination. The forklift is now stored in a posted restricted area. The requirements of 10 CFR 20.1902 and 1904 are being met in accordance with Westinghouse procedures.

b. Remedial Action, Expanded Surveys

Pursuant to Westinghouse's February 4, 2008, report to the NRC (see Footnote 1), of the October 15, 2007, discovery of documents containing radiological contamination in an unrestricted area, additional area, document and equipment surveys are being conducted. The discovery of this occurrence is a result of those expanded surveys. The surveys are ongoing and will be completed by March 31, 2008.

c. Corrective Action to Ensure Against Recurrence

Both the management and technical health physics staff have been significantly strengthened since the fall 2007. The new RSO assumed his duties in October 2007 and has considerable industry and decommissioning health physics experience. Additionally, two additional direct reports to the RSO were added to the staff in November 2007. Both have extensive technical and supervisory experience in health physics. This has resulted in significantly improved health physics management oversight, work practices, and staff technical capability.



## APPENDICES

1. Survey of the Forklift, October 6, 2006,
2. Hematite Radiation Safety Officer's Dose Estimates
3. Survey of the Forklift, January 22, 2008,
4. Levels of Radiation and Radioactive Material Concentrations of the Forklift





APPENDIX 2

Hematite Radiation Safety Officer's Dose Estimates  
*Additional information is located in Appendices 1, 3 and 4 of this report.*

Page 1 of 1

**Internal Dose Estimate from Ingestion**

Based on the average level of removable (alpha) contamination reported from the original survey prior to pressure washing, it was assumed that the entire surface was uniformly contaminated at that average level of 140 dpm/100cm<sup>2</sup>, or 1.4 dpm/cm<sup>2</sup>. Note that the level of removable contamination following pressure washing was likely to have been much less than this average value, however a survey was not performed after washing to provide this information. The total surface area was estimated to 79,620 cm<sup>2</sup>, and therefore the total amount of removable contamination on the forklift was calculated as follows:

$$(1.4\text{dpm/cm}^2)(79,620\text{cm}^2) = 111,468\text{dpm} = 0.05 \mu\text{Ci}$$

Based on the dose conversion factors in EPA FG No. 11, the internal dose (CEDE) if all of the removable radioactivity were ingested by one individual would be approximately 1.3 mrem over 50 years, or an annual average internal dose of 0.03 mrem/yr.

**Internal Dose Estimate from Inhalation**

Based on the average level of removable (alpha) contamination reported from the original survey prior to pressure washing, it was assumed that the entire surface was uniformly contaminated at that average level of 140 dpm/100cm<sup>2</sup>, or 1.4 dpm/cm<sup>2</sup>. Note that the level of removable contamination following pressure washing was likely to have been much less than this average value, however a survey was not performed after washing to provide this information. An estimate of the airborne radioactivity concentration was 6.3E-14  $\mu\text{Ci}/\text{cm}^3$  based on a resuspension factor of 1E-05 over a uniformly contaminated work surface. This value for resuspension was selected as a conservative estimate of the fraction of removable surface contamination that could be made available for inhalation. The duration of the exposure to this concentration was assumed to be 200 hours based on discussions with the workforce and knowledge about operations. Based on the assumptions of this scenario, the CEDE would be approximately 1.6 mrem.

**External Dose Estimate**

A MicroShield© calculation was performed using an activity amount of 0.77  $\mu\text{Ci}$  of enriched uranium (5 percent), and relative contributions of U-234 (0.801), U-235 (0.044), and U-238 (0.155). The activity value was obtained from the radiological surveys of total surface contamination, and an estimate of the total surface area. The duration of the exposure was assumed to be 200 hours based on discussions with the workforce and knowledge about operations. Based on the assumptions of this scenario, the estimates of the external dose at various distances are as follows:

Distance (cm)	Exposure Rate (mR/hr)	External Dose (mrem)
1	2.02E-03	0.4
15	9.4E-04	0.2
30	6.7E-04	0.1

**APPENDIX 3**  
 Survey of the Forklift, January 22, 2008  
**APPENDIX A**  
**RADIOLOGICAL SURVEY REPORT**

Purpose of Survey: Characterization survey Toyota forklift Model FGC 35 1/22/08										0030 B 000122		
Surveyed by: <i>W. Clark</i>					Reviewed By: <i>[Signature]</i>					Date: 1/22/08		
Tonnage LB	2	7/22/2008	GFPC	20.3	0.80	25.9%	22.40	3.30	43.5%	20.64	Time:	12:17
Lod 2224	125567	4/12/2008	43-89	125	4	14.4%	68.36	120	24.4%	176.95	Scatter Area	~ 100 cm <sup>2</sup>
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Each #	1577
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	WSP:	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Misc.	N/A

Remarks: N/A

#	Description	Removable Alpha		Removable Beta		Total Alpha		Total Beta		Cpm	Cpm	Cpm
		CPM	CPM/100cm <sup>2</sup>	CPM	CPM/100cm <sup>2</sup>	CPM	CPM/100cm <sup>2</sup>	CPM	CPM/100cm <sup>2</sup>			
1	Right fork (top)	14.20	54.9	4.70	<MDA	536.0	2953.6	2833.0	9059.0	N/A	N/A	N/A N/A
2	Right fork (top)	9.20	35.6	8.70	<MDA	754.0	4166.7	2493.0	7790.3	N/A	N/A	N/A N/A
3	Right fork (top)	6.20	24.0	12.70	29.2	746.0	4122.2	5498.0	17632.3	N/A	N/A	N/A N/A
4	Right fork (top)	13.20	51.0	11.70	28.9	664.0	3666.7	2507.0	7826.2	N/A	N/A	N/A N/A
5	Left fork (top)	13.20	51.0	12.70	29.2	937.0	5183.3	2328.0	7239.3	N/A	N/A	1 φα
6	Left fork (top)	8.20	31.7	8.70	<MDA	611.0	3372.2	5282.0	16924.6	N/A	N/A	N/A N/A
7	Left fork (top)	8.20	31.7	15.70	36.1	976.0	5400.0	4725.0	15098.4	N/A	N/A	1 φα
8	Left fork (top)	27.20	105.2	17.70	40.7	1356.0	7511.1	4368.0	13927.9	N/A	N/A	1 φα
9	Right fork (bottom)	0.00	<MDA	0.00	<MDA	48.0	244.4	183.0	205.5	N/A	N/A	N/A N/A
10	Right fork (bottom)	1.20	<MDA	0.00	<MDA	16.0	<MDA	122.0	<MDA	N/A	N/A	N/A N/A
11	Left fork (bottom)	0.00	<MDA	0.70	<MDA	113.0	605.6	212.0	301.5	N/A	N/A	N/A N/A
12	Left fork (bottom)	0.00	<MDA	0.00	<MDA	8.0	<MDA	120.0	<MDA	N/A	N/A	N/A N/A
13	Right hand tire	0.00	<MDA	0.00	<MDA	3.0	<MDA	159.0	<MDA	N/A	N/A	N/A N/A
14	Right rear tire	0.20	<MDA	0.00	<MDA	9.0	<MDA	141.0	<MDA	N/A	N/A	N/A N/A
15	Left front tire	2.20	<MDA	0.00	<MDA	7.0	<MDA	145.0	<MDA	N/A	N/A	N/A N/A
16	Left rear tire	0.00	<MDA	0.00	<MDA	9.0	<MDA	156.0	<MDA	N/A	N/A	N/A N/A
17	Deck (right side)	7.20	27.8	4.70	<MDA	525.0	2894.4	436.0	1036.1	N/A	N/A	N/A N/A
18	Deck (right side)	7.20	27.8	3.70	<MDA	1032.0	5711.1	705.0	1918.0	N/A	N/A	1 φα
19	Deck (right side)	5.20	<MDA	0.70	<MDA	596.0	3258.9	509.0	1272.1	N/A	N/A	N/A N/A
20	Deck (center)	13.20	51.0	15.70	36.1	704.0	3888.9	556.0	1429.5	N/A	N/A	N/A N/A

**APPENDIX 3**  
 Survey of the Forklift, January 22, 2008  
**APPENDIX A**  
**RADIOLOGICAL SURVEY REPORT**

Purpose of Survey : Characterization survey Toyota forklift Model FGC 35 1/22/08										0030 6 080122	
Surveyed by: <i>W. Blank</i>					Reviewed By: <i>[Signature]</i>					Date: 1/22/2008	
Terminals LD	2	7/22/2008	GPCC	20.3	0.80	25.9%	22.40	3.30	43.5%	20.64	Time: 12:17
Lug 2224	125587	4/12/2008	43-89	125	4	14.4%	68.36	120	24.4%	176.95	Beam Area ~ 100 cm <sup>2</sup>
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Batch # 1577
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	RWP: N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Misc. N/A

Remarks: N/A

No.	Description	Removable Contamination		Fixed Contamination		Total Contamination		Total Contamination		Remarks		
		CPM	MDA	CPM	MDA	CPM	MDA	CPM	MDA	CPM	MDA	
21	Deck (center)	0.20	<MDA	0.70	<MDA	386.0	2122.2	607.0	1793.4	N/A	N/A	N/A N/A
22	Deck (left side)	3.20	<MDA	2.70	<MDA	103.0	530.0	366.0	806.6	N/A	N/A	N/A N/A
23	Deck (right side)	5.20	<MDA	6.70	<MDA	38.0	189.9	185.0	213.1	N/A	N/A	N/A N/A
24	Clutch	1.20	<MDA	0.00	<MDA	514.0	2833.3	460.0	1114.8	N/A	N/A	N/A N/A
25	Brake pedal	0.20	<MDA	0.70	<MDA	244.0	1333.3	262.0	465.6	N/A	N/A	N/A N/A
26	Gas pedal	4.20	<MDA	5.70	<MDA	375.0	2061.1	444.0	1062.3	N/A	N/A	N/A N/A
27	Engine cover	7.20	27.8	5.70	<MDA	114.0	611.1	159.0	225.2	N/A	N/A	N/A N/A
28	Engine cover	14.20	54.9	14.70	33.8	375.0	2061.1	264.0	472.1	N/A	N/A	N/A N/A
29	Driver seat	0.20	<MDA	0.00	<MDA	10.0	<MDA	150.0	<MDA	N/A	N/A	N/A N/A
30	Clutch pedal	0.20	<MDA	0.70	<MDA	2134.0	11833.3	2500.0	7803.3	N/A	N/A	2 60
31	Engine block	36.20	140.0	26.70	61.4	124.0	666.7	256.0	443.9	N/A	N/A	N/A N/A
32	Counter weight	14.20	54.9	6.70	<MDA	333.0	1827.8	305.0	605.6	N/A	N/A	N/A N/A
33	Counter weight	3.20	<MDA	1.70	<MDA	182.0	988.9	205.0	278.7	N/A	N/A	N/A N/A
34	Air intake	33.20	128.4	35.70	82.1	530.0	2922.2	485.0	1196.7	N/A	N/A	N/A N/A
35	Air intake	1.20	<MDA	2.70	<MDA	24.0	111.1	116.0	<MDA	N/A	N/A	N/A N/A
36	Bottom (right side)	2.20	<MDA	7.70	<MDA	7.0	<MDA	218.0	321.3	N/A	N/A	N/A N/A
37	Bottom (right side)	4.20	<MDA	0.70	<MDA	15.0	<MDA	208.0	283.5	N/A	N/A	N/A N/A
38	Bottom (left side)	8.20	31.7	5.70	<MDA	15.0	<MDA	201.0	265.5	N/A	N/A	N/A N/A
39	Bottom (left side)	5.20	<MDA	0.00	<MDA	10.0	<MDA	156.0	<MDA	N/A	N/A	N/A N/A
40	Bottom (rear)	2.20	<MDA	4.70	<MDA	32.0	155.6	137.0	<MDA	N/A	N/A	N/A N/A

APPENDIX 4

Levels of Radiation and Radioactive Material Concentrations of the Forklift

Page 1 of 2

Evaluation of 'Big' Toyota Forklift

A radiological survey was performed to identify areas of the forklift where contamination exceeded the site limits. Using this information, total activity on the forklift can be calculated by taking the average readings (in dpm/100cm<sup>2</sup>), multiplied by the surface area (in cm<sup>2</sup>). The result will be a value in dpm per unit, in this case the unit is the entire forklift.

However the level of contamination varies across the forklift. Certain areas, such as the forks and steering wheel hub, have much higher fixed contamination levels than the rest of the forklift, like the deck and engine cover. The forklift can be separated into four different zones; left fork, right fork, steering wheel hub, deck and engine cover (remainder of the forklift). These areas will be evaluated separately in order to make a more accurate assumption about the total activity on the forklift. The tires of the forklift will be excluded from the evaluation because no readings were observed above the instrument MDA.

Uniform elevated contamination was seen on the top side of each fork. The fixed readings on the bottom of the forks were so low that the activity would make a negligible contribution to the total activity of the forklift, and will not be considered in this evaluation.

Left Fork (top side only):

Average of fixed alpha reading = 5367 dpm per 100 cm<sup>2</sup>.

Average of fixed beta reading = 13298 dpm per 100 cm<sup>2</sup>.

Total surface area = 14 cm x 140 cm = 1960 cm<sup>2</sup>.

Total alpha activity on fork = 5367 x 19.60 = 105,193 dpm = 0.047 μCi

Total beta activity on fork = 13298 x 19.60 = 260,641 dpm = 0.117 μCi

Right Fork (top side only):

Average of fixed alpha reading = 3728 dpm per 100 cm<sup>2</sup>.

Average of fixed beta reading = 10574 dpm per 100 cm<sup>2</sup>.

Total surface area = 14 cm x 140 cm = 1960 cm<sup>2</sup>.

Total alpha activity on fork = 3728 x 19.60 = 73,069 dpm = 0.033 μCi

Total beta activity on fork = 10574 x 19.60 = 207,250 dpm = 0.093 μCi

Steering wheel hub:

The total surface area of steering wheel is approximately 100 cm<sup>2</sup>. Therefore the fixed reading accurately represents total activity.

Total alpha activity on steering wheel hub = 11833 dpm = 0.005 μCi

Total beta activity on steering wheel hub = 7803 dpm = 0.004 μCi

APPENDIX 4

Levels of Radiation and Radioactive Material Concentrations of the Forklift

Page 2 of 2

Deck and Engine Cover (Remainder of Forklift):

The remainder of the forklift is a very complex surface, so a conservative estimate of the surface area will be made. If the remainder is assumed to be a box with dimensions 140 cm x 140 cm x 100 cm (which are greater than the actual dimensions), then the total remaining surface area is 75600 cm<sup>2</sup>. This estimate ignores the bottom of the forklift because the measured activity for the bottom was so low that it would make a negligible contribution to the total activity.

Average of fixed alpha reading = 2004 dpm per 100 cm<sup>2</sup>.

Average of fixed beta reading = 854 dpm per 100 cm<sup>2</sup>.

Total surface area = 75600 cm<sup>2</sup>.

Total alpha activity on remainder = 2004 x 756 = 1,515,024 dpm = 0.682 μCi

Total beta activity on remainder = 854 x 756 = 645,624 dpm = 0.291 μCi

Total Activity on Forklift

Alpha Activity:

Left fork = 0.047 μCi

Right fork = 0.033

Steering wheel hub = 0.005

Remainder = 0.682

**Total Alpha Activity = 0.767 μCi**

Beta Activity:

Left fork = 0.117 μCi

Right fork = 0.093

Steering wheel hub = 0.004

Remainder = 0.291

**Total Beta Activity = 0.505 μCi**