NRC FORM (4-95)	366	LIC	ENS See digi	SEE E reverse ts/char	VENT a for req racters f	RE uired or ea	PORT (L I number o ach block)	ER)	IY COMM	AISSION	ESTIMA INFORM LEARNE BACK ESTIMA 6 F331 20855-1 OFFICE	APPROT TED BURDEN PER ATION COLLECTIO D ARE INCORPOO TO INDUSTRY. TE TO THE INFORM U.S. NUCLEAR DOOT, AND TO THI OF MANAGEMENT	VED BY OME N EXPIRES 04/7 RESPONSE TO (ON REQUEST & IATED INTO THE FORWARD CATION AND REC ATION AND REC REGULATORY (PAPERWORK R AND BUDGET, W	IO. 315 30/98 COMPLY 6.0 HR E LICEN DMMENT CORDS N COMMISS EDUCTIO	0-0104 WITH THIS MAN 5 REPORTED SING PROCESS 5 REGARDING IANAGEMENT BR SION, WASHING IN PROJECT [31] TON, DC 20503	NDATORY LESSONS AND FED BURDEN ANCH (T- TON, DC 50-0104).
FACILITY NAM	5E (1)			н	addam	Nec	k					DOCKET NUMB	ER (2)		PAGE (3)	
TITLE (4) T	'wo Wa	orkers	Re	ceive	ed an	Int	ernal Ex	xposure	Whic	h Pote	entia	ally Exce	ec.ed Fed	iera	l Limits	
EVEN	DATE	(5)		L	ER NUME	BER (6)	REPO	RT DAT	E (7)	1	OTHER	FACILITIES	INVOL	VED (8)	
MONTH	DAY	YEAR	YEA	ARS	NUMBER	AL.	REVISION	MONTH	DAY	YEAR	FACIL	TY NAME		DOCK	ET NUMBER	
11	02	96	96	6	030		01	09	05	97	FACILI	TY NAME		DOCK	ET NUMBER	
OPERAT	ING	-	THIS	S REPO	RT IS SUI	BMIT	TED PURSU	ANT TO T	HE REQU	IREMEN	TS OF	10 CFR 5: (C	check one or	more)	(11)	
MODE	(9)	6	T	20.220	01(b)			20.2203	(a)(2)(v)		T	50.73(a)(2)(i)	TT	50.73(a''?)(v	/iii)
POW	R		X	20.220)3(a)(1)			20.2203	(a)(3)(i)			50.73(a)(2)(ii)	+++	50.73(a)(2)(x	()
LEVEL	(10)	000	X	20.220)3(a)(2)(i)			20.2203	(a)(3)(ii)			50.73(a)(2)(iii)	+-+-	73.71	
				20.220)3(a)(2)(ii)		20.2203	(a)(4)			50.73(a)(2)(iv)		OTHER	-
				20.220)3(a)(2)(ii	i)		50.36(c)	(1)			50.73(a)()	2)(v)	Spec	ify in Abstract	below
				20.220)3(a)(2)(iv	()		50.36(c)	(2)			50.73(a)(2)(vii)	OF IN	NHC Form 30	DA
CAUSE	SYST	EM CON	LETE MPONE	ONE NT M	LINE FO	OR E	REPORTABL TO NPRDS		CAUS	E SY	STEM	COMPONENT	MANUFACT	T (1: URER	3) REPORTA	ABLE
YES (If yes	comple	SUP	CTED	SUBM	REPORT	EXPE	CTED (14)	N	2	-	EXPE	CTED	MONTH	-	DAY	YEAR
On Sat mainten area c system perform plasti causing restri radiol evalua The ro poor n radiol senior	urday nance of th pri med a c bag g the cting ogica tions ot ca radio ogica man	y Nove supe le ref or to a hou g. The work g acco al co s whice auses logic al wor agement	space ambe orvi fuel seke is cess ntro ch i of al rk	er 2, sor, ing uel c action to b to b to b to b to b to b to b to b	approximation of the second se	at a co y t id. ivi creations,	y to single- 0830 h ontracto to insp Follo ty in t ited an iternall canal/ca il a d use of ere a p ices. I a rest	spaced typ nours, or refu- ect the wing of the can airbor y cont vity ose as a lic rogramm Interim tatemen	with with eling e mec comple nal wine con amina and ssessm ensee matic t of	the p mana chanic tion hich hditic ted. : restr indep break cectiv mana	olant ger al of cons icti was pende cdowr re a gemes	in Mode entered condition the insp isted of h the car iate con ng the performe ent revie h in admi ctions con nt's exp	e 6 (rei the fue of th pection placin nal and crective individ ed. Al ew team inistrat consiste ectation	fuel l tr e f the g de refu act dual lso, wer ive d o ns a	ing) a p ansfer uel trai indivi- ebris in leling c tion inc s from root re initi barrier f addit and incr	plant canal nsfe dual nto avit lude th caus ated s an iona ease

apple.

Ċ.

ð

9709160270 970905 PDR ADOCK 05000213 5 PDR

-

.

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

ACILITY NAME (1)	DOCKET NUMBER (2)		LE	R NUME	BER (6)	PAGE (3)
Haddam Neck	05000213	YEAR	SE	QUENT	AL	REVISION NUMBER	2 of 15
		96	**	030		01	20115

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

BACKGROUND INFORMATION

In the past, the inspection of the fuel transfer system was performed using impeded visual closeouts (i.e. respirators, hard hat divers). During the last refueling outage (1995), the fuel transfer cart was found jammed by a wrench and hammer that were left on the transfer cart track. Based on this it was decided, this outage, to clean the transfer canal of radioactive materials to the appropriate level (ALARA) to allow personnel to enter without respiratory protection so that a more thorough, on-location inspection could be performed of this area.

During August 1996 the transfer canal was decontaminated to contamination levels that would allow for inspections by plant personnel without respirators. From the period August 1996 until the November 2, 1996 event date, personnel have been able to enter this area in a single set of cloth protective clothing and without respirators. Up until the November 2, 1996 event, all transfer canal entry individuals received low doses (20-50 mRem), were free of contamination on exit counters, and generated no airborne activity.

EVENT DESCRIPTION

On Saturday November 2, 1996 at 0830 hours, with the plant in Mode 6 (refueling) a plant maintenance supervisor, and a contractor refueling manager entered the refueling cavity to perform an inspection of the reactor head and cavity area and then entered the fuel transfer canal area of the refueling cavity to inspect the mechanical condition of the fuel transfer cart system prior to fuel offload. Following completion of the inspection the individuals performed a housekeeping activity in the canal which consisted of placing approximately 3 pounds of debris into a plastic bag. This activity created an airborne condition in the canal and adjacent refueling cavity causing both workers to become internally contaminated.

When the two individuals exited the refueling cavity, one individual's electronic dosimetry was in alarm. A technician performed an initial survey of the bag of debris which read 20 Rem/hr on contact and 600 mR/hr at 12" as measured by an Eberline R0-2A. The workers exited the area and alarmed the containment personnel contamination monitors (PCMs). The two individuals were then directed to the main health physics control point where they were decontaminated and sent to the whole body counter for internal contamination assessment. External dose to the individuals by electronic dosimetry devices (confirmed by thermoluminescent dosimeters (TLDs) worn by these individuals) was 239 mrem to one individual and 157 mrem to the other worker.

Immediate corrective action included restricting access to the canal/cavity and restricting the individuals from the radiological control area until a dose assessment was performed. In addition, root cause evaluations were initiated which included the use of a licensee independent review team. On November 7, 1996 an initial dose assessment by the NRC indicated the workers may have received an exposure potentially exceeding federal limits due to internal contamination. Dose calculations by the

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

 FACILITY NAME (1)
 DOCKET NUMBER (2)
 LER NUMBER (6)
 PAGE (3)

 Haddam Neck
 05000213
 YEAR
 SEQUENTIAL NUMBER
 REVISION NUMBER
 3 of 15

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

licensee indicated a dose below any federal limits. A third party was contracted to perform an independent dose assessment. On November 8, 1996, at approximately 0930 hours, notification of this event was made in accordance with 10CFR20.2202(b)(2).

Follow-up actions consisted of continued whole body counting of the contaminated workers, periodic counting of the air samples taken during the event to verify longlived alpha activity, and a thorough investigation of the bag of debris for alpha to beta/gamma ratio assessment and makeup of the debris. Additionally, three fecal samples were collected for each of the two workers involved, and external dose calculations were performed using time motion studies from available electronic dosimetry printouts.

The concentrations of radioactive material and levels of radiation involved are provided in Attachment A. Each individual's final dose assessment is provided in Attachment B. The information required by 10CFR20.2203(b)(2) for each individual exposed is provided in Attachment C.

CAUSE OF THE EVENT

It was determined that the root causes of this vent were a programmatic breakdown in administrative barriers (i.e. radiological controls, work planning and control, communication) and poor radiological worker practices.

SAFETY ASSESSMENT

This event is reportable under 10CFR20.2203(a)(2)(i) which states: "In addition to the notification required by 20.2202, each licensee shall submit a written report within 30 days after learning of any of the following occurrences: (2) Doses in excess of any of the following (i) the occupational dose limits for adults in 20.1201 (specifically 20.1201(a)(1)(ii))." 10CFR20.2202(b) (2) requires 24 hour notification upon discovery that an event may have caused, or threatens to cause, an individual to receive, in a period of 24 hours, an intake in excess of one occupational annual limit on intake.

Since the initial NRC dose assessment was made using conservative assumptions of nuclide form, path of intake, particle size, initial intake and ratios of alpha to beta-gamma activitier a refined dose assessment was performed by a third party using the individual's whole body count (WBC) data and fecal sample results. Preliminary Haddam Neck internal dose calculations, as well as, refined calculations based on continued whole body count data, and the earliest fecal sample results indicated doses below any federal limits.

The potential doses and biological effects were discussed with the individuals involved. It should be noted that the doses calculated by the NRC are the maximum credible (worst case) condition and doses at this level would not place these individuals in a health threatened condition. They were also made aware of generated bounding dose assessments. Both individuals involved in this contamination event were restricted from receiving any additional exposure pending the results of the internal dose assessment. Senior

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

 FACILITY NAME (1)
 DOCKET NUMBER (2)
 LER NUMBER (6)
 PAGE (3)

 Haddam Neck
 05000213
 YEAR
 SEQUENTIAL
 REVISION

 96
 - 030
 - 01

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

management for the contractor was informed of the worker's restrictions and the possible issues regarding additional exposure at another utility.

Final dose determinations for CEDE, DDE and CDE are complete and each individual was contacted and informed of their final dose assessment. Both individuals were relieved of RCA restrictions on January 11, 1997.

CORRECTIVE ACTION

Interim Actions

Interim corrective actions consisted of additional radiological work restrictions, the issuance of a restatement of management's expectations and increased senior management oversight during the core offload process. In addition, the immediate lessons learned from this event were communicated to the health physics technicians.

Initial Corrective Actions

Lessons learned from this event were provided to all Managers and supervisors on-site and Senior Management provided small group presentations to permit a more personal and open forum to address questions and concerns. A Stand Down Day was conducted on January 28, 1997 to focus on the areas of Radiological and Industrial Safety. Management has reemphasized to site personnel that the primary function of the Health Physics Technicians is radiation protection.

Long Term Corrective Actions

The Independent Review Team, root cause investigations and the NRC inspection reports were evaluated and corrective actions were developed. These corrective actions are being integrated into procedures and program upgrades relative to performing the following:

- Enhance RWP process to ensure proper evaluation of radiological risk and controls associated with all work in the radiological controlled areas,
- Identification of High Radiological Risk activities to ensure RWP controls are commensurate with Risk,
- Enhance alpha detection and monitoring through evaluation of new equipment, methodologies and trigger values,
- Establish minimum Radiological Controls for High Risk work to ensure oversight and job controls,
- Enhance internal dosimetry program requirements for rapid sample collection, and validation of final dose calculations by an independent reviewer,
- Increased challenges to the workers by the HP staff upon signing into the RCA in knowing the scope and conditions of their job. Any unplanned or changed job scopes will result in a stop work order,
- Documented pre-job briefings for all high risk evolutions and a limitation to only workers who have received the full brief to perform work on that RWP,
- · Elimination of job site air sample checks to relax radiological controls,
- Include TEDE ALARA evaluations in the development of the RWPs.

NRC FORM 366A (4-95)

NRC FORM 366A (4-95)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

 TEXT CONTINUATION

 FACILITY NAME (1)
 LER NUMBER (2)
 LER NUMBER (6)
 PAGE (3)

 Haddam Neck
 05000213
 YEAR
 SEQUENTIAL NUMBER
 REVISION NUMBER
 5 of 15

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

ADDITIONAL INFORMATION

Attachment A - Concentrations of Radioactive Material and Levels of Radiation

Attachment B - Final Dose Assessments (by job title)

Attachment C - CONFIDENTIAL - Exposed Individuals (NRC Document Control Desk copy only)

Commitments

CY-97-095-01 Procedure upgrades and enhancements to the RWP and radiologically control process are being implemented to ensure:

- Proper evaluation of radiological risk for all work in the radiological controlled areas is performed upon the request of RWP.
- High Radiological Risk activities are identified through comparison with established criteria.
- Minimum Radiological Controls for high risk work are established to ensure proper management oversight and job controls.
- Pre-job briefings for all high risk evolution's are documented and only workers who
 have received the full brief are permitted to perform work on that RWP.
- Job site air sample checks are no longer permitted for relaxation of radiological controls,
- · TEDE ALARA evaluations are performed in the development and revision stage of RWPs.

CY-97-095-02 Enhance alpha detection and monitoring through evaluation of sample and analysis methodologies, purchase of new equipment, and verification of appropriate trigger values.

CY-97-095-03 Establish internal dosimetry program requirements for rapid bioassay sample collection, and validation by an independent reviewer of the final dose calculations.

PREVIOUS SIMILAR EVENTS

LER 86-039-00, "Personnel Overexposure"

NRC FORM 366A (4-95)	CENSEE EVENT REPORT (LER)	J.S. 1	NUCLEA	AR RE	EGULATORY	COMMISSION
FACILITY NAME (1)	DOCKET NUMBER (2)		LE	R NUM	BER (6)	PAGE (3)
Haddam Neck	05000213	YEAR	SE	QU'SNT	IAL R	REVISION	6 of 15
		96	**	030		01	0 01 10

TEXT(If more space is re. red, use additional copies of NRC Form 366A) (17)

ATTACHMENT A CONCENTRATIONS OF RADIOACTIVE MATERIAL AND LEVELS OF RADIATION

1. Discussion:

The reactor cavity entry made by the Licensee maintenance supervisor and contractor refueling manager involved inspection of the reactor head flange, then inspection and housekeeping in the fuel transfer canal, where the event occurred. Concentrations of radioactive material and levels of radiation are provided for the reactor head, fuel transfer cana[°] und the bag of debris that was collected in the fuel transfer canal.

The concentrat s of airborne radioactive material in the fuel transfer canal resulting from the event re Cetermined based on analysis of the air samples taken during and after the event that were used for the initial NRC dose assessment. The concentrations of removable surface radioactive contamination, in Section 4, on the reactor head and in the fuel transfer canal are based on radiological surveys. The concentrations of radioactive material constituting the bag of debris are based on analysis of five samples of the debris material. The analyses of the air samples and debris samples were performed by a licensed vendor laboratory using gamma and alpha spectroscopy. The Tables in Sections 3 and 5, below, include only those isotopes with measured activity by spectroscopy. All other isotopes were less than the minimum detectable activity. The strentium values as reported are provided.

The levels of radiation, in Section 6, are based on radiological surveys of the reactor head and fuel transfer canal, the electronic dosimetry system exposure history (integrated accumulated dose and differentiated dose rate in one minute intervals) retrieved from the system for the electronic dosimeter worn by the Licensee maintenance supervisor, and a TLD study of the bag of debris.

2. Summary:

Since the air sample beta-gamma to alpha ratios used for initial internal dose assessments were applied to the known concentration of Co-60 from whole body counts, they should have been based on the known concentration of Co-60 on the air samples (from licensee gamma spectroscopy), instead of the sample gross beta-gamma counts. This would have resulted in ratios of 100.7 to 1 and 98 to 1 versus the gross ratios of 88.4 to 1 and 81.3 to 1.

The results of vendor gamma and alpha spectroscopy analysis of the air samples presented in Section 3, indicates that the gross alpha analysis is conservative, with actual Co-60 to alpha ratios of 146 to 1 and 122 to 1 respectively. The average Co-60 to alpha ratio based on gamma and alpha spectroscopy analysis of the five debris samples is 190 to 1 (refer to Section 5). NRC FORM 366A (4-95)

LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

FACILITY NAME (1)	DOCKET NUMBER (2)		LER NUMB	ER (6)	PAGE (3)
Haddam Neck	05000213	YEAR	SEQUENTI	AL	REVISION NUMBER	7 of 15
		96	030		01	10110

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

The dry active waste (DAW) conservative scaling factor for Co-60 to transuranics for the last cycle indicates a ratio of 147 to 1 which matches well with the results above.

3. Concentrations of Airborne Radioactive Material:

a. Fuel Transfer Canal Job Coverage, 11/2/96: Air Sample Number 110201; Sampl: Time = 35 minutes (0830-0905); Sample Volume = 9.91 E5 ml

Licensee Analysis:

Type of	Analysis	Gross Beta	Gamma Spectroscopy (Co-60)	Gross Alpha
Activity	(µCi/ml)	7.48-9	8.21E-9	8.15E-11
DAC	Fraction	0.74	0.82	20.38*
		c	0-60 to Gross Alpha Ratio	101-1

* Stochastic Am-241 DAC 4.0 E-12 µCi/ml

Vendor Laboratory Analysis:

DAC Used	Stock	nastic			Non-8	Stochastic	And all fight descent and shared and shared state	terra de reconstructor de las por
Isotope (Class)	C0-60 (Y)	Cs-137 (D)	Gross Alpha	Pu-238 (W)	Pu-239 (W)	Am-241 (W)	Cm-242 (W)	Cm-244 (W)
Activity (µCi/ml)	7.23E-9	7.96E-11	5.1E-11	1.2E-11	5.0E-12	2.0E-11	1.6E-12	1.18-11
DAC Fraccion	0.72	0.0013	12.75	4.0	1.67	6.67	0.016	2.2
Co-60 to ' Activ	Transuran: ity Ratio	ic Isotope s (µCi/ml)	142-1	603-1	1,446-1	362-1	4,519-1	657-1

Total Stochastic DAC Fraction; Vendor Analysis= 0.721Total Stochastic DAC Fraction; Licensee Analysis= 0.82Total Non-Stochastic DAC Fraction; Vendor Analysis= 14.556 (actual activities)Total Non-Stochastic DAC Fraction; Licensee Analysis= 20.73 (gross alpha counts)Co-60 to Gross Alpha Ratio:Licensee = 100.7-1;Vendor = 142-1

U.S. NUCLEAR REGULATORY COMMISSION

Actual Alpha Activity by Spectroscopy = 4.96E-11 µCi/ml Co-60 to Actual Alpha Activity Ratio

= 146-1

Vendor Laboratory Analysis:

Type of Analysis	Sr-89	Sr-90
Activity(µCi)	< 3. E+05	<2. E-05
Concentration (uCi/ml)	< 3.03 E-11	<2.02 E-11

NRC FORM 366A (4-95)

NRC FORM 366A U.S. NUCLEAR REGULATORY COMMISSION (4-95) LICENSEE EVENT REPORT (LER) TEXT CONTINUATION FACILITY NAME (1) DOCKET NUMBER (2) LER NUMBER (6) PAGE (3) YEAR SEQUENTIAL REVISION Haddam Neck NUMBER NUMBER 05000213 8 of 15 96 030 01 TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

b. Reactor Cavity, Vacuum Stud Holes, Job Coverage, 11/2/96 (after the event): Air Sample Number 110203; Sample Time = 15 minutes (0910-0925); Sample Volume = 4.25 E3 ml

Licensee Analysis:

Type of Analysis	Gross Beta	Gamma Spectroscopy (Co-60)	Gross Alpha
Activity (μ Ci/ml)	3.0E+8	3.472-8	3.54E-10
DAC Fraction	3.0	3.47	88.5*
		Co-60 to Gross Alpha Ratio	98-1

* Stochastic Am-241 DAC 4.0 E-12 µCi/ml

Vendor Laboratory Analysis:

DAC Used	Stock	hastic			Non-St	ochastic		and the second second second second second second
Isotope (Class)	C0-60 (Y)	Cs-137 (D)	Gross Alpha	Pu-238 (W)	Pu-239 (W)	Am-241 (W)	Cm-242 (W)	Cm-244 (W)
Activity (µCi/ml)	2.95E-8	2.5E-10	2.5E-10	6.2E-11	2.5E+11	9.6E-11	7.3E-12	5.2E-11
DAC Fraction	2.95	0.025	62.5	20.67	8.33	32.0	0.073	10.4
Co-60 to Activ	Transuran ity Ratio	ic Isotope s (µCi/ml)	118-1	471-1	1,168-1	304-1	4,000-1	562-1

Total Stochastic DAC Fraction; Vendor Analysis Total Stochastic DAC Fraction; Vendor Analysis= 3.47Total Stochastic DAC Fraction; Licensee Analysis= 71.47 (actual activities)Total Non-Stochastic DAC Fraction; Licensee Analysis= 85.5 (gross alpha counts)Total Non-Stochastic DAC Fraction; Licensee Analysis= 85.5 (gross alpha counts) Co-60 to Gross Alpha Ratio: Licensee = 98.1;

2.975

Vendor = 118-1

Actual Alpha Activity by Spectroscopy = 2.42E-10 µCi/ml Co-60 to Actual Alpha Activity Ratio

= 122-1

Vendor Laboratory Analysis:

Type of Analysis	Sr-89	Sr-90
Activity(µCi)	< 4. E-05	1.8 E-05
Conceptration (uci/ml)	< 9.4 E-09	4.2 E-09

-96)							1	J.S. N	UCLEA	R REC	ULATO	RY COM	AMISSI
			LIC	ENSI	EE EVENT	REPORT (LER)						
ACILITY NAME	(1)			****	DOCKET	NUMBER (2)		LER	NUMB	ER (6)		P	AGE (3)
	Made	am black			0.0	000040	YEAR	SEO		ALT	REVISIO	N	100 (0)
	Hadd	am Neck			050	000213	96		030		01	5	a of 1
XT(# more spi	ace is required, u	se addition	al copies of I	VRC Fan	m 366A/ (17)	and a first defendance of the set		boscorden					
c. Fuel Air S Sampl	Transfer C ample Numb e Volume =	anal fo er 1102 5.66 E	110w-up 121 Sau 5 ml	Deco mple	n, Job Co Time = 20	verage, 1 minutes	L/2/96 (1625-	(af 1645	ter);	the	even	t):	
Licen	see Analys	18:											
Ту	pe of Anal	ysis	Gross Beta		Gamma Sp (C	o-60)	Y		Gros	a A	lpha		
Acti	vity in µC	i/ml	2.9E-8		2.	99E-8			9.	04E-	11		
	DAC Frac	tion	2.9		2	.99			2	2.6	*		
				Co	-60 to Gro	oss Alpha	Ratio		3	31-	1		
Vendo	r Laborato	ry Anal	ysis:			Non C	tophas						
DAC Used Isotope (Class)	r Laborato: Stock C0-60 (Y)	ry Anal hastic Cs-13 (D)	ysis: 7 Gr Al	oss pha	Pu-238 (W)	Non-S Pu-239 (W)	Lochas Am- (1	stic 241 W)	0	2m - 2 (W)	42	Cm - : (W	244
Vendo DAC Used Isotope (Class) Activity (µCi/ml)	r Laborato: Stoci C0-60 (Y) 2.67E-8	ry Anal hastic Cs-13 (D) 2.6E-	ysis: 7 Gr Al 10 3.7	oss pha E-11	Pu-238 (W) 6.8E-12	Non-S Pu-239 (W) 1.6E-12	Lochas Am- (1 1.31	tic 241 W) E-11	2	2m-2 (W) .1E-	42	Cm-: (W 5.4E	244 1) 1-12
Vendo DAC Used Isotope (Class) Activity (µCi/ml) DAC Fraction	r Laborato: Stoc) C0-60 (Y) 2.67E-8 2.67	ry Anal nastic Cs-13 (D) 2.6E- 0.004	ysis: 7 Gr Al 10 3.7 4 9	088 pha E-11 .25	Pu-238 (W) 6.8E-12 2.27	Non-S Pu-239 (W) 1.6E-12 0.53	Am- (1 1.3)	1000 241 W) E-11	2	(W) .1E- 0.02	42	Cm-: (W 5.4E	244 /) :-12 08
Vendo DAC Used Isotope (Class) Activity (µCi/ml) DAC Fraction Co-60 to Activ	r Laborato: Stoch C0-60 (Y) 2.67E-8 2.67 Transurani Vity Ratios	ry Anal hastic Cs-13 (D) 2.6E- 0.004 c Isoto s (µCi/t	ysis: 7 Gr Al 10 3.7 4 9 ope nl) 72	088 pha E-11 .25 2-1	Pu-238 (W) 6.8E-12 2.27 3,927-1	Non-S Pu-239 (W) 1.6E-12 0.53 16,688-1	2,05	stic 241 W) E-11 33 54-1	2	2m-2 (W) .1E- 0.02	42 -12 21 4-1	Cm-: (W 5.4E 1.0 4,94	244 1) :-12 08 4-1
Vendo DAC Used Isotope (Class) Activity (µCi/ml) DAC Fraction Co-60 to Activ Total Sto Total Sto Total Sto Total Non Co-60 to	r Laborato Stoch CO-60 (Y) 2.67E-8 2.67 Transurani rity Ratios ochastic Di ochastic Di ochastic Di ochastic Di n-Stochast Gross Alpi Actual Ali Co-60 to J Vendor Lai	ry Anal hastic Cs-13 (D) 2.6E- 0.004 c Isoto t (µCi/r AC Frac ic DAC ic DAC ic DAC ha Rati pha Act Actual borator	ysis: 7 Gr Al 10 3.7 4 9 ope nl) 72 tion; Ve tion; L: Fraction Fraction o: ivity by Alpha Ad y Analy: sis	oss pha E-11 .25 2-1 endor icens 1, Li Lice y Spe ctivi sis:	Pu-238 (W) 6.8E-12 2.27 3,927-1 Analysis ee Analysis ndor Analysis censee Ana nsee = 1 ctroscopy ty Ratio	Non-S Pu-239 (W) 1.6E-12 0.53 16,688-1 16,688-1 is ysis alysis 331-1; = 2 = 91	Am- (1 1.31 4. 2,0 2,0 2 = 2 = 2 = 2 Vend 89 E- 24-1	241 W) E-11 33 54-1 .674 .99 .23 2.6 or 11 μ Sr-	(act (gro = 7 Ci/m	(W) .1E- 0.02 2.71 ual 85 22- 1	42 -12 21 4-1 alpha 1	Cm-: (W 5.4E 1.1 4,94 vitie cour	244)) (-12 08 4-1 (ss) (ts)
Vendo DAC Used Isotope (Class) Activity (µCi/ml) DAC Fraction Co-60 to Activ Total Sto Total Sto Total Non Total Non Co-60 to	r Laborato Stoch CO-60 (Y) 2.67E-8 2.67 Transurani rity Ratios ochastic Di ochastic Di och	ry Anal hastic Cs-13 (D) 2.6E- 0.004 c Isoto f (µCi/r AC Frac ic DAC ha Rati pha Act Actual borator f Analy rity(µCi	ysis: 7 Gr Al 10 3.7 4 9 ope nl) 72 tion; Ve tion; L: Fraction Fraction o: ivity by Alpha Ac y Analys sis	oss pha E-11 .25 2-1 endor icens n; Ven ticens n; Li Lice y Spe ctivi sis:	Pu-238 (W) 6.8E-12 2.27 3,927-1 Analysis ee Analysis ee Analysis ndor Analysis censee Analysis ndor Analysis censee Analysis	Non-S Pu-239 (W) 1.6E-12 0.53 16,688-1 16 is ysis alysis 331-1; = 2 = 91	tochas Am- (1 1.31 4. 2,0 2,0 2 = 2 = 2 = 2 = 2 Vend 89 E- 24-1	tic 241 W) E-11 33 54-1 .674 .99 .23 2.6 or 11 μ Sr- 8.	(act (gro = 7 Ci/m 90 E-06	(W) .1E- 0.02 2.71 ual ss 22-: 1	42 -12 21 4-1 alpha 1	Cm-: (k 5.4E 1.1 4,94 vitie cour	244)) (-12 08 4-1 (ss) (ts)

NRC FORM 366A (4-95)

з,

1-95)	JODA		LICI	ENSEE EV TEXT C	ENT REPORT	(LER)	J.S. NUCLEA	R REGUL	ATORY C	OMMISSIC
ACILITY N	AME (1)			1	DOCKET NUMBER (2	2)	LER NUMB	ER (6)		PAGE (3)
		Haddam No.	ek.	10.1	05000212	YEAR	SEQUENTI	AL REV	ABER	10.11
		naduani iyo	UN .		05000213	96	030	0	1	10 01
EXT(# me	ore space is req	uired, use additi	onal copies of N	RC Form 366A	/ (17)	e endere more soler	h			
4. <u>Cs</u>	oncentrati	ions of Re	movable Su	rface Rad	licactive Cor	ntaminat	ion:			
a. 5	Reactor Ca Floor	vity - A - A	verage 113 verage 1.6	3K dpm/10 5K dpm/10	0 cm² beta-ga 0 cm² alpha;	amma; Ma Maximum	ximum 25 3K dpm/	0K dp	m/100	cm ²
b. 1	Reactor He Flange	ead - F - I	ange from less than :	20K to 4 20 dpm/10	0K dpm/100 c 0 cm² alpha	m² beta-	gamma			
C. 1	Fuel 'iran Canal	sfer - 4 - 4	Average 28 Average 18	4 mrad/1 6K dpm/1	00 cm ² beta; 00 cm ² alpha;	Maximum Maximu	80 m.r.ad 1m 35K dj	i/100 pm/100	cm ² cm ²	
C. I C. I C. S. R. S. S. S. V.	Fuel Trans Canal adioactiv ample 2-C endor Lab	sfer - A - A ity Concen oratory An	Average 28 Average 18 trations c alysis:	.4 mrad/1 .6K dpm/1	00 cm ² beta; 00 cm ² alpha; <u>Material</u> :	Maximum Maximu	1 80 m.cao 1m 35K dj	i/100 pm/100	cm ²) cm ²	
C. I C. I C. I C. C. I C. C. I C. C. I C. I	Fuel Trans Canal adioactiv ample 2-C endor Lab Isotope	oratory An	Average 28 Average 18 trations c alysis:	4 mrad/1 6K dpm/1 of Debrin	00 cm ² beta; 00 cm ² alpha; Material:	Maximum Maximu Am-241	0 80 m.rad m 35K dj	i/100 pm/100	cm ²) cm ²	
C. I C. I C. I C. I C. I C. I C. I C. I	Fuel Trans Canal adioactiv ample 2-C endor Lab Isotope Activity	oratory An	Average 28 Average 18 trations c alysis: Cs-137	4 mrad/1 6K dpm/1 of Debris Pu-238	00 cm ² beta; 00 cm ² alpha; Material: Pu-239	Maximum Maximu Am-241	0 80 m.rad im 35K dj Cm-24:	i/100 pm/100	cm ²) cm ² Cm-244]
C. I C. I C. I C. I C. I C. I C. I C. I	Fuel Trans Canal adioactiv ample 2-C endor Lab Isotope Activity (.Ci/gm)	oratory An Co-60	Average 28 Average 18 trations c alysis: Cs-137 3.79E-2	4 mrad/1 6K dpm/1 of Debrin Pu-238 8.3E-3	00 cm ² beta; 00 cm ² alpha; Material: Pu-239 2.2E-3	Maximum Maximu Am-241 1.0E-2	0 80 m.cad m 35K dj Cm-24 2.8E-4	i/100 pm/100	Cm ²) cm ² Cm-244 6.0E-3	
C. I C. I C. I C. I C. I C. I C. I C. I	Fuel 'iran Canal adioactiv ample 2-C endor Lab Isotope Activity (:Ci/gm) Co Isoto	oratory An Co-60 6.23E+0 coe to Tra	Average 28 Average 18 trations of alysis: Cs-137 3.79E-2 ansuranic ty Ratios	4 mrad/1 6K dpm/1 of Debrin Pu-238 8.3E-3 751-1	00 cm ² beta; 00 cm ² alpha; Material: Pu-239 2.2E-3 2,832-1	Maximum Maximu Am-241 1.0E-2 623-1	0 80 m.rad m 35K dj Cm-24 2.8E-4 22,250	i/100 pm/100	cm ² cm ² cm ² cm-244 6.0E-3 L,038-	1
C. 1 C. 1 C. 1 C. 1 C. 1 C. 1 C. 1 C. 1	Fuel Trans Canal adioactiv ample 2-C endor Lab Isotope Activity (:Ci/gm) Co Isoto ctual Co-	oratory An Co-60 6.23E+0 co-60 to Tra pe Activit	Average 28 Average 18 trations c alysis: Cs-137 3.79E-2 ansuranic ty Ratios ay to Total	4 mrad/1 6K dpm/1 of Debris Pu-238 8.3E-3 751-1 L Alpha Ad	00 cm ² beta; 00 cm ² alpha; Material: Pu-239 2.2E-3 2,832-1 ctivity Ratio	Maximum Maximu Am-241 1.0E-2 623-1 0 = 23	0 80 m.rad im 35K dj Cm-24: 2.8E-4 22,250 33-1	i/100 om/100	cm ² cm ² cm ² cm-244 6.0E-3 L,038-	1
C. I C. I C. I C. I C. I C. I C. I C. I	Fuel Trans Canal adioactiv ample 2-C endor Lab Isotope Activity (:Ci/gm) Co Isoto ctual Co- Vend	oratory An Co-60 6.23E+0 -60 to Tra pe Activit 60 Activit	Average 28 Average 18 Average 18 Average 18 Average 18 Average 28 CS-137 3.79E-2 Ansuranic ty Ratios Average 28 CS-137 3.79E-2 Ansuranic ty Ratios	4 mrad/1 6K dpm/1 of Debris Pu-238 8.3E-3 751-1 L Alpha Au sis:	00 cm ² beta; 00 cm ² alpha; Material: Pu-239 2.2E-3 2,832-1 ctivity Ratio	Maximum Maximu Am-241 1.0E-2 623-1 0 = 23	0 80 m.rad m 35K dj Cm-24 2.8E-4 22,250 33-1	i/100 pm/100	Cm ² Cm-244 6.0E-3	1
C. 1 5. Ri a. Si V(Fuel Trans Canal adioactiv ample 2-C endor Lab Isotope Activity (:Ci/gm) Co Isoto ctual Co- Vend Typ	efer - A - A ity Concen oratory An Co-60 6.23E+0 -60 to Tra ope Activit 60 Activit or Laborat	Average 28 Average 18 Average 18 Average 18 Average 18 Cs-137 3.79E-2 Ansuranic ty Ratios Sy to Total cory Analys ysis	4 mrad/1 6K dpm/1 of Debris Pu-238 8.3E-3 751-1 Alpha Au sis: Si	00 cm ² beta; 00 cm ² alpha; Material: Pu-239 2.2E-3 2,832-1 ctivity Ratio	Maximum Maximu Am-241 1.0E-2 623-1 0 = 23	0 80 m.rad im 35K dj 2.8E-4 22,250 33-1 Sr-90	i/100 om/100	cm ² cm ² cm ² cm-244 6.0E-3 L,038-	1

Vendor Laboratory Analysis:

Isotope	Co-60	Cs-137	Mn - 54	Pu-238	Pu-239	Am-241	Ctn-242	Cm-244
Activity (µCi/gm)	5.48E+1	1.21E+0	4.1E-1	1.2E-1	5.1E-2	1.3E-1	4.8E-4	7.3E-2
	Co-0 Isotope	50 to Tran e Activity	suranic / Ratios	457-1	1,075-1	422-1	114K-1	751+1

.

Actual Co-60 Activity to Total Alpha Activity Ratio = 146-1

4

(4-95)

FA

U.S. NUCLEAR REGULATORY COMMISSION LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

CILITY NAME (1)	DOCKET NUMBER (2)		PAGE (3)				
Haddam Neck	05000213		SEQUENTIAL REV NUMBER NU			REVISION NUMBER	11 01 15
	05000215	96		030		01	11 01 15

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

Vendor Laboratory Analysis:

Type of Analysis	Sr-P9	Sr-90
Activity(µCi/gm)	< 1.2 E-02	< 6.5 E-01

c. Sample 5-D

Vendor Laboratory Analysis:

Isotope	Co-60	Cs-137	Pu-238	Pu-239	Am-241	Cm-242	Cm-244	U-234
Activity (µCi/gm)	2.89E+1	5.6E-1	6.8E-2	2.5E-2	9.1E-2	4.0E-4	5.6E-2	3.1E-5
Co-6 Isotope	0 to Tran Activity	suranic Ratios	425-1	1,156-1	318-1	72K-1	516-1	932K-1

Actual Co-60 Activity to Total Alpha Activity Ratio = 120-1

Vendor Laboratory Analysis:

Type of Analysis	Sr-89	Sr-90
Activity(µCi/gm))	< 5. E-03	< 4.9 E-01

d. Sample 8-B

Vendor Laboratory Analysis:

Isotope	Co-60	Cs-137	Pu-238	Pu-239	Am-241	Cm-242	Cm-244
Activity (µCi/gm)	1.16E+2	3.4E+0	1.9E-1	1.0E-1	3.3E-1	9.4E-4	1.5E-1
Co-I Isotop	60 to Tran e Activity	suranic / Ratios	611-1	1,160-1	352-1	123K-1	773-1

Actual Co-60 Activity to Total Alpha Activity Ratio = 150-1

Vendor Laboratory Analysis:

Type of Analysis	Sr-89	Sr-90
Activity(µCi/gm)	< 1. E-02	4.8 E-01

.

(4-95)

4

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

TEXT CONTINUATION

ACILITY NAME (1)	DOCKET NUMBER (2)		LE	PAGE (3)		
Haddsm Neck	05000213	YEAR SEQUENTIAL REVISION NUMBER NUMBER		12 of 15		
		96		030	++	01

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

e. Sample 0-D

Vendor Laboratory Analysis:

Isotope	Co-60	Cs-137	Mn - 54	Pu-238	Pu-239	Am-241	Cm-242	Cm-244	U-234
Activity (µCi/gm)	1.32E+2	1.3E-0	4.6E+0	1.4E-1	6.7E-2	1.6E-1	5.7E-4	7.0E-2	4.1E-5
	Co-6 Isotope	0 to Tran Activity	suranic Ratios	943-1	1,970-1	825-1	232K-1	1,886-1	322K-1

Actual Co-60 Activity to Total Alpha Activity Ratio = 302-1

Vendor Laboratory Analysis:

Type of Analysis	Sr - 89	Sr-90
Activity(µCi/gm)	< 6. E-03	5.0 E-01

NRC FORM 366A (4-95)	ICENSEE EVENT REPORT (ULER)	I.S. 1	NUCLE	AR RI	GULATORY	COMMISSION
FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)				PAGE (3)	
Haddam Neck	05000213	YEAR	SE	NUMBER		REVISION	13 of 15
		96		030	+*	01	15 01 10

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

6. Levels of Radiation:

- a. Reactor Head General area radiation levels at waist level around the base of the reactor head averaged 113 mRem/hr, with an average general area level of 580 mRem/hr at waist level on the reactor head flange. The average dose rate recorded by the electronic dosimeter worn by the Licensee maintenance supervisor during the reactor head flange inspection was 429 mRem/hr.
- b. Fuel Transfer Canal The average radiation levels if an individual is standing on the fuel transfer cart track are 333 mRem/hr on contact with the track (maximum 800 mRem/hr) and 233 mRem/hr at waist level (maximum 600 mRem/hr). The average radiation levels if an individual is standing on the floor on either side of the transfer cart track are 361 mRem/hr on contact with the floor and 280 mRem/hr at waist level. The maximum dose rates on either side of the track are 25 Rem/hr contact and 8 Rem/hr at waist level from a small localized spot on the floor. These dose rates were not included in the averages due to the highly localized nature of the radiation field.

c. Bag of Debris - As noted in the EVENT DESCRIPTION, the initial survey of the bag of debris indicated 20 Rem/hr on contact and 600 mRem/hr at 12" as measured by an Eberline R0-2A. After the event, a TLD study was conducted of the bag of debris collected in the fuel transfer canal to calculate average gamma dose rates per minute at contact, 1 foot and 2 feet. The results of the study are as follows:

•	Contact (extremity TLD ring):	- 76.65 mRem/minute
	Contact (whole body TLD):	- 61.28 mRem/minute
•	1 Foot (side of bag; whole body TLD):	- 10.48 mRem/minute
•	1 Foot (bottom of bag; whole body TLD:	- 31 mRem/minute
	2 Feet (side of bag; whole body TLD):	- 5.14 mRem/minute

Three of eight whole body TLDs on contact with the bag indicated an average beta dose rate of 1,083 mrad/hr. The two whole body TLDs positioned one foot from the bottom of the bag indicated an average beta dose rate of 429 mrad/hr.

NRC FORM 366A (4-95)	LICENSEE EVENT REPORT (LER)	1.5.	NUCLEA	AR RE	GULATORY	COMMISSION
FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)					PAGE (3)
Haddam Neck	05000213	YEAR	SE	QUENTIAL REVISION			
		96	**	030		01	14 01 10

TEXT(If more space is required, use additional copies of NRC Form 366A) (17)

.

1

ATTACHMENT B FINAL DOSE ASSESSMENTS

Dose for Event - Licensee Maintenance Supervisor

DOSES (in rem)		
DEEP DOSE EQUIVALENT	(DDE)	0.385
EYE DOSE EQUIVALENT TO LENS OF EYE	(LDE)	0.397
SHALLOW DOSE EQUIVALENT, WHOLE BODY	(SDE,WB)	0.399
SHALLOW DOSE EQUIVALENT, MAX EXTREMITY	(SDE,ME)	1.165
COMMITTED EFFECTIVE DOSE EQUIVALENT	(CEDE)	0.250
COMMITTED DOSE EQUIVALENT, MAXIMALLY EXPOSED ORGAN	(CDE)	3.000
TOTAL EFFECTIVE DOSE EQUIVALENT (DDE + CEDE)	(TEDE)	0.635
TOTAL ORGAN DOSE EQUIVALENT, MAX ORGAN (DDE + CDE)	(TODE)	3.385

Dose for Event - Contractor Refueling Manager

DOSES (in rem)			
DEEP DOSE EQUIVALENT	(DDE)	0.213	
EYE DOSE EQUIVALENT TO LENS OF EYE	(LDE)	0.213	
SHALLOW DOSE EQUIVALENT, WHOLE BODY	(SDE,WB)	0.213	
SHALLOW DOSE EQUIVALENT, MAX EXTREMITY	(SDE,ME)	0.441	
COMMITTED EFFECTIVE DOSE EQUIVALENT	(CEDE)	0.440	
COMMITTED DOSE EQUIVALENT, MAXIMALLY EXPOSED ORGAN	(CDE)	5.400	
TOTAL EFFECTIVE DOSE EQUIVALENT (DDE + CEDE)	(TEDE)	0.653	
TOTAL ORGAN DOSE EQUIVALENT, MAX ORGAN (DDE + CDE)	(TODE)	5.613	
COMMENTS: Maximally Exposed Organ is the Bone Surface mrem DDE, 260 mrem SDE,WB and 183 mrem SDE, ME from o 1996 which are not included in the totals above.	e. Individual hat ther licensees of	as 260 during	

.

NRC FORM 366A (4-95)