

**Enclosure (6)**

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**CA06454 CEAEA**

**Radiological Consequences**

**Design Basis Calculation**

**Using AST**

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ESP No.:	ES200100401	Supp No.	000	Rev. No.	000	Page 1 of 1
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## FORM 19, CALCULATION COVER SHEET

## A. INITIATION (Control Doc Type - DCALC)

Page 1 of 125

DCALC No.: CA06454

Revision No.: 000

Vendor Calculation (Check one): ☐ Yes ☒ No

Responsible Group: FOSU

Responsible Engineer: Gerard E. Gryczkowski

## B. CALCULATION

ENGINEERING  
DISCIPLINE:☐ Civil☐ Instr & Controls☒ Nuc Engrg☐ Electrical☐ Mechanical☐ Nuc Fuel Mngmt☐ Other:☐ Reliability Engrg

Title: CEA EJECTION EVENT USING ALTERNATE SOURCE TERMS

Unit

☐ 1☐ 2☒ COMMON

Proprietary or Safeguards Calculation

☐ YES☒ NO

Comments: NA

Vendor Calc No.: NA

REVISION NO.: NA

Vendor Name: NA

Safety Class (Check one):

☒ SR☐ AQ☐ NSR

There are assumptions that require Verification during walkdown:

AIT #: NA

This calculation SUPERSEDES: NA

## C. REVIEW AND APPROVAL:

Responsible Engineer: Gerard E. Gryczkowski

06/06/2005

Printed Name and Signature

Date


Independent Reviewer: Ian Sommerville

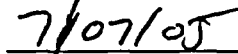
7-05-05

Printed Name and Signature

Date

Approval:

  
 Printed Name and Signature

  
 Date

IF the results or conclusions of this calculation or revision might affect a procedure or the basis of a procedure, a Change Notification Form (Form 14) shall be forwarded to the Procedure Development Unit with a summary of the calculation's purpose and results.

## 2. LIST OF EFFECTIVE PAGES

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011	0	012	0	013	0	014	0	015	0
016	0	017	0	018	0	019	0	020	0
021	0	022	0	023	0	024	0	025	0
026	0	027	0	028	0	029	0	030	0
031	0	032	0	033	0	034	0	035	0
036	0	037	0	038	0	039	0	040	0
041	0	042	0	043	0	044	0	045	0
046	0	047	0	048	0	049	0	050	0
051	0	052	0	053	0	054	0	055	0
056	0	057	0	058	0	059	0	060	0
061	0	062	0	063	0	064	0	065	0
066	0	067	0	068	0	069	0	070	0
071	0	072	0	073	0	074	0	075	0
076	0	077	0	078	0	079	0	080	0
081	0	082	0	083	0	084	0	085	0
086	0	087	0	088	0	089	0	090	0
091	0	092	0	093	0	094	0	095	0
096	0	097	0	098	0	099	0	100	0
101	0	102	0	103	0	104	0	105	0
106	0	107	0	108	0	109	0	110	0
111	0	112	0	113	0	114	0	115	0
116	0	117	0	118	0	119	0	120	0
121	0	122	0	123	0	124	0	125	0

### 3. REVIEWER COMMENTS

(1) p. 13 - # 29 a - The basis for the values 109.2 and 49.27 is not obvious

Response: Secondary steam releases from Section 9.3.

(2) p. 13 - Where do the values 0.10, 0.01, etc in the second table come from?

Response: Flashing fractions from Section 9.5.

(3) p. 13 - #29c - The basis for the values 107.28 is not obvious

Response: Secondary steam releases from Section 9.4

(4) p. 20 -  $t_1$  and  $t_2$  - 1800 – 21600 ? - 21600 should be 28800

Response: Corrected.

(5) p. 21 -  $W_{tot}$  should be the summation of the various W's ; not Q's

Response: Corrected.

(6) p. 22 - The values for  $h_f$  and  $h_{fg}$  at 538°F seem to taken at 544°F rather than 538°F.

Response: Corrected.

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## 5. INTRODUCTION

10 CFR 50 Appendix A GDC 28 requires that postulated reactivity accidents include consideration of the control rod ejection accident.

Standard Review Plan (SRP) 15.4.8 (Ref.38) and Regulatory Guide (RG) 1.77 (Ref.37) provided additional guidance for the offsite dose consequences of a Control Element Assembly Ejection Event (CEAEE). The offsite dose consequences will be well within the guidelines of 10 CFR 100, where well within is defined as 25% of 10 CFR 100 exposure guideline values or 75 rem for thyroid and 6 rem for whole body doses. Two fission product release paths to the environment are considered independently.

- The failed/melted fuel activity, resulting from a postulated CEAEE and consisting of 100% of the noble gases and 25% of the iodines contained in the fuel which is estimated to reach initiation of melting and 10% of the noble gases and iodines which are contained in the gas gaps of the fuel which experience clad failure, is released into the primary system, which is released in its entirety into the containment via the ruptured control rod drive mechanism housing. The released activity is instantaneously and uniformly mixed in the free volume of the containment and is then released at the containment TS leak rate into the environment.
- The failed/melted fuel activity, resulting from a postulated CEAEE and consisting of 100% of the noble gases and 50% of the iodines contained in the fuel which is estimated to reach initiation of melting and 10% of the noble gases and iodines which are contained in the gas gaps of the fuel which experience clad failure, is released into the primary system, which is then transmitted into the secondary system via the TS steam generator tube leakage. The condenser is assumed to be unavailable due to loss of offsite power. Environmental releases occur from both steam generators via the ADVs and MSSVs.

The actual doses resulting from a postulated CEAEE would be a composite of doses resulting from portions of the release going out via the containment and portions via the secondary system. If regulatory compliance to dose limits can be demonstrated for each of the scenarios, the dose consequences of a scenario that is a combination of the two will be encompassed by the more restrictive of the two analyzed scenarios. The fuel melting temperature criterion used for release of large fractions of fission gases will correspond to the initiation of melting. If the temperature is insufficient to cause incipient fuel melt but is sufficient to cause clad damage, then the gas gap activity of the affected fuel pins is assumed to be released instantaneously and uniformly into the primary system. The amount of activity accumulated in the fuel gap should be assumed to be 10% of the iodines and noble gases accumulated at the end of core life, assuming maximum full power operation.

10 CFR 50 Appendix A GDC 19 requires that a control room shall be provided from which actions can be taken to operate the nuclear unit safely under normal conditions and to maintain it in a safe condition under accident conditions. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident.

UFSAR 14.13 presents the licensing basis evaluation of the CEA Ejection Event. A CEAEE is defined as a rapid, uncontrolled, total withdrawal of a single or dual CEA, where a dual CEA is two CEAs connected to a single CEA extension shaft. The event is postulated to occur as a result of a complete instantaneous circumferential rupture of either the Control Element Drive Mechanism (CEDM) pressure housing or the CEDM nozzle from the reactor vessel closure head. The pressure of the Reactor Coolant System (RCS) causes the ejection of the extension shaft through the rupture and the movement of the CEA to a fully-withdrawn position. The most limiting CEA Ejection Event is a rapid total withdrawal of the highest worth CEA within 0.05 seconds and the breaching of the RCS pressure boundary. The immediate reactor core response is an exponential increase in nuclear power. At 112.2% (i.e., maximum analysis setpoint including uncertainties) of Reactor Thermal Power (RTP), a Variable High Pressure Trip (VHPT) is initiated. The negative Doppler feedback due to the increasing fuel temperature partially offsets the ejected CEA worth and terminates the power excursion. The insertion of the CEAs will terminate the event. Although both the HFP and HZP cases were analyzed, the HFP case is more limiting with respect to dose (more failed fuel and a higher steaming potential). The design basis CEA Ejection Event accounts for extended burnup. Additional evaluations concluded that ZIRLO, Erbia, and replacement steam generators will not significantly impact the results, and thus the current results remain bounding. The worst-case results show that no fuel rod will

experience clad damage and only a small fraction will reach incipient centerline melt condition (8%). The results are well within the 10 CFR 100 exposure guidelines, specifically Thyroid<50 Rem and Whole Body<1.5 Rem.

Previously, power reactor licensees have typically used the U.S.A.E.C Technical Information Document TID-14844, "Calculation of Distance Factors for Power and Test Reactor Sites," (Ref.18) as the basis for Design Basis Analysis (DBA) source terms. TID-14844 is referenced in 10 CFR 100.11, the power reactor siting regulation, which contains offsite dose limits in terms of whole body and thyroid doses. In December 1999, the Nuclear Regulatory Commission (NRC) issued a new regulation, 10 CFR 50.67, "Accident Source Term," which provided a mechanism for licensed power reactors to replace the traditional accident source term used in their DBA analyses with an Alternate Source Term (AST) methodology. Regulatory guidance for the implementation of these ASTs is provided in Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" (Ref.08). Section 50.67 of 10 CFR requires a licensee seeking to use AST to apply for a license amendment and requires that the application contain an evaluation of the consequences of affected DBAs. As part of the implementation of the AST, the Total Effective Dose Equivalent (TEDE) acceptance criterion of 10 CFR 50.67 replaces the previous whole body and thyroid dose guidelines of 10 CFR 100.11 and 10 CFR 50, Appendix A, GDC-19 for the loss-of-coolant accident (LOCA), the main steam line break (MSLB), the steam generator tube rupture (SGTR), the seized rotor event (SRE), the fuel handling accident (FHA), and the control element assembly ejection accident (CEAEE). The TEDE accident dose criteria are listed in Table 6 of RG 1.183 for offsite doses and in 10 CFR 50.67 for control room doses, which limit is 5 Rem TEDE. The Nuclear Steam Supply System (NSSS) response to the CEAEE was simulated using the CESEC computer code for the eight hour accident scenario.

The current work utilizes the alternate source term methodology of 10 CFR 50.67 and Regulatory Guide 1.183 to calculate offsite and control room doses for a CEAEE. The CEAEE was evaluated for both the containment and secondary release pathways. In addition, the secondary pathway was analyzed for both a 2 hour and an 8 hour time to shutdown cooling (SDC). A bounding control room inleakage value of 3500 cfm was assumed. The following modifications and TS changes are proposed to comply with regulatory requirements.

- Modification of the control room emergency ventilation system to a nominal 10000 cfm flow with a 90% filtration efficiency for elemental and organic iodine and 99% for particulate iodine was credited.
- Also credited was installation of automatic isolation dampers and radiation monitors at Access Controls 11 and 13 on the Auxiliary Building Roof. This modification limits activity ingress into the control room to either the West Road Inlet or the Turbine Building, thus limiting the atmospheric dispersion coefficient value.
- The Technical Specification (TS 3.4.15) limit for RCS activity was reduced from 1.0  $\mu\text{Ci/gm}$  to 0.5  $\mu\text{Ci/gm}$ .
- The maximum allowable containment leakage rate  $L_a$  contained in the Containment Leakage Rate Testing Program of TS 5.5.16 was reduced from 0.20 percent per day at Pa to 0.16 percent per day at Pa.

The exclusion area boundary (EAB), low population zone (LPZ), and control room (CR) doses for the design-basis CEAEE calculated in Attachments Q - AA are detailed in the following table.

Results	EAB	LPZ	CR
	Rem	Rem	Rem
8 Hour Secondary Pathway	0.32616	0.08735	4.59461
2 Hour Secondary Pathway	0.35658	0.08394	1.45292
30 day Containment Pathway	0.4567	0.1187	0.9679
CEAEE Worst-Case Doses	0.5000	0.2000	4.6000
Regulatory Limits	6.3000	6.3000	5.0000

Note that all values are below the regulatory limits.



## 6. INPUT DATA

The input data to determine the exclusion area boundary (EAB), low population zone (LPZ), and control room (CR) doses from a CEAEE are the following:

(01) Initial thermal power is 2754 MWt (UFSAR 3.2.1/Ref.1).

(02) The pin power peaking factor is 1.70. Per the Core Operating Limits Reports for Units 1 and 2, (Refs.2-3), the total integrated radial peaking factors ( $F_r^T$ ) are less than or equal to 1.65. For conservatism, a pin power peaking factor of 1.70 will be used in this work.

(03) The isotopic half-lives ( $t_i$ ) were extracted from Ref.06 and are listed in column A of Attachment A. The decay constants ( $\lambda_i$ ), listed in column B of Attachment A, are readily calculated via the following algorithm:

$$\lambda_i = \ln(2) / t_i$$

(04) Failed fuel for the CEA Ejection Event falls into three categories: clad failure, incipient centerline fuel melt, and full centerline fuel melt. Bechtel in 1970 (Ref.9) calculated EAB doses of 12.06 Rem Thyroid and 0.028 Rem Whole Body and LPZ doses of 4.22 Rem Thyroid and 0.011 Rem Whole Body assuming a HFP incipient centerline melting fraction of 3.6%.

Based on a NRC Request for Additional Information in 1987 (Ref.10), Combustion Engineering performed the NRC requested dose calculations at the EAB for two hours following a CEA ejection accident initiated from HZP for Unit 2 Cycle 8 in which 10% of the fuel fails. This assumption was very conservative, since it implied that all the fuel which experienced clad failure also reached the incipient fuel melting threshold. The CEA ejection analysis performed for Unit 2 Cycle 8 predicts that less than 1% of all the fuel reaches this threshold. This was acknowledged by the NRC in the SER of 6/30/87 (Ref.11).

Refs.33-34 concluded that no fuel pins will experience fuel or cladding damage or incipient centerline melt conditions during a CEAEE for U1C12 HZP and HFP cores. For the Unit 1 Cycle 15 CEA Ejection Event analysis (Ref.12), the fraction of fuel experiencing incipient centerline melting was 8.0% for HFP and 0.824% for HZP.

The CCNPP current design basis, UFSAR 14.13, shows that no fuel rod will experience clad damage and only a small fraction will reach incipient centerline melt condition (8%). The results are well within the 10 CFR 100 exposure guidelines, specifically Thyroid <50 Rem and Whole Body <1.5 Rem.

Thus, an overall fuel damage fraction of 10% will be assumed per our design and licensing bases, of which 8% experiences incipient centerline melting and 2 % clad damage per the most conservative analysis of record. This assumption is listed in columns L and M of Attachment A.

(05) Per Regulatory Guide 1.183 (Ref.8) and Regulatory Guide 1.77 (Ref.37), the release fractions are the following:

- the amount of activity accumulated in the fuel gap should be assumed to be 10% of the iodines and noble gases (Column F of Attachment A).
- For activity released directly to the containment, 100% of the noble gases and 25% of the iodines contained in the fuel which is estimated to reach initiation of melting are assumed to be released to the containment (Column E of Attachment A).
- For activity released to the primary system for release via the secondary system via primary-to-secondary leakage, 100% of the noble gases and 50% of the iodines contained in the fuel which is estimated to reach initiation of melting are assumed to be released to the primary coolant (Column D of Attachment A).

(06) Per Refs.8 and 37, the released activities are assumed to be released instantaneously and homogeneously throughout the containment or the primary system at the initiation of the accident. This is incorporated into the failed fuel iodine and noble gas release fraction and timing files.

(07) Based on Inputs 4, 5, and 6, the release fraction and timing input files can be generated.

Files	Release Timing	Iodine Release	Noble Gas Release	Attachment
	Hours	Fraction	Fraction	
CEAFFI.RFT	0.0001	$0.08 \cdot 0.5 + 0.02 \cdot 0.1 = 0.042$	0.0000	H
CEAFFN.RFT	0.0001	0.0000	$0.08 \cdot 1.0 + 0.02 \cdot 0.1 = 0.082$	I
CEAPRI.RFT	0.0001	1.0000	0.0000	J
CEAPRN.RFT	0.0001	0.0000	1.0000	K
CEASEC.RFT	0.0001	1.0000	0.0000	L
CEACTMT.RFT	0.0001	$0.08 \cdot 0.25 + 0.02 \cdot 0.1 = 0.022$	$0.08 \cdot 1.0 + 0.02 \cdot 0.1 = 0.082$	M

(08) The dose conversion factors (DCFs) were extracted from Refs.20-21 and inserted into input files for use by RADTRAD. This data is included in the Conversion Factor Files FGR63.INP in Attachment N for use with failed fuel isotopics, FGR14.INP in Attachment O for use with primary system isotopics, and FGR05.INP in Attachment P for use with secondary system isotopics. Note that the cloudshine data in the Conversion Factor Files corresponds to the FGR-12 data, while the inhaled chronic data in the Conversion Factor Files corresponds to the worst-case effective data in FGR-11. The remaining data in the Conversion Factor Files is extraneous and not used by RADTRAD.

(09) Per Ref.08, iodine releases from the steam generators to the environment should be assumed to be 97% elemental and 3% organic. Iodine released from the failed fuel is assumed to be 95% particulate, 4.85% elemental, and 0.15% organic.

(10) For the secondary system release pathway, the duration of the cooldown from HFP, defined as 574.5°F and 2250 psia per UFSAR Table 4.1 and Figure 4.9, to SDC, defined as 300°F and 270 psia per the EOPs, is limited by the TS 3.4.3 maximum cooldown rate of 100°F/hr. Two CEAE accident durations are utilized. The first scenario assumes a long 8 hour cooldown period based on actual plant operation (See Attachment B for the Unit 2 Cycle 15 cooldown to SDC). The second scenario assumes a 2 hour cooldown period to maximize the two-hour EAB doses.

For the containment release pathway, the accident duration is 30 days per RG 1.183 (Ref.08).

(11) Primary and Secondary Masses and Volumes

1	RCS(cf)	7286.18		Total RCS and PZR volumes normalized to STP
	Vrcs(cf)	9576		RCS volume per UFSAR T4.1
	VpZR(cf)	600		PZR volume per UFSAR T4.7
	vrcs(cf/lbm)	0.022132		Ref.31 Specific Vol @ 574.5 F and 2250 psia - UFSAR T4.1 F4.9
	vpZR(cf/lbm)	0.02703		Ref.31 Specific Vol @ 653 F and 2250 psia - UFSAR T4.7
	Mrcs(lbm)	432676.67		RCS mass: Vrcs/vrcs
	MpZR(lbm)	22197.56		PZR mass: VpZR/vpZR
	Mtot(lbm-gm)	454874.23	206327482	RCS + PZR mass: Mrcs+MpZR
	vstp(cf/lbm)	0.016018		Ref.31 Specific Vol @ 1 gm/cc
	Vtot(cf)	7286.18		Mtot*vstp @ STP
2	SG(cf)	4420.04		Total SG volume normalized to STP
	M2sg(lbm-g)	275942.00	125165188	SG mass per Ref.32 Sheet 30 - 102% Full Power
	V2sg(cf)	4420.04		M2sg*vstp @ STP
3	AFW(cf)	10000.00		Auxiliary Feedwater Volume
4	Environment			
5	Control Room	289194 cf		Control Room Volume (Ref.19)

(12) Containment volume:

- Net free volume: 1.989E+06 cf (UFSAR Tab.14.20-3, Ref.39)
- Containment sprayed volume: 1.446E+06 cf  
Volume fraction: 0.7273 (Ref.40)
- Containment unsprayed volume: 0.543E+06 cf  
Volume fraction: 0.2727 (Ref.40)

Note: Assumes sprayed and unsprayed volume fractions remain unchanged from Ref.40.

(13) Containment sprays were not credited in this work.

(14) Per UFSAR 6.7.2, SIAS automatically starts three recirculation filter units of  $20000 \pm 10\%$  per TS 5.5.11. Each unit has the capacity of 50% of the design air flow and consist of activated charcoal filters preceded by HEPA filters. If offsite power is not available, the emergency diesel generators are started. Each of two emergency diesel generator busses carries the load of two recirculation filter units (UFSAR Table 8-7). Thus for the CEAE, two 18000 cfm recirculation filter units are credited after a 20 minute delay, consistent with manual initiation. A filter efficiency of 90% for inorganic iodine species and 30% for organic iodine species was assumed per RG 1.52 (Ref.28).

(15) Reduction in aerosol airborne radioactivity in the containment by natural deposition within the containment was credited per RG 1.183 (Ref.08). The 10th percentile Powers aerosol decontamination model (Ref.41) for PWR design basis accidents as incorporated into the RADTRAD analysis code was utilized. Aerosol particles grow by coagulating with other aerosol particles or because steam condenses on them thus gravitational settling of aerosols is usually the dominant aerosol removal process. Plateout of elemental and organic iodine species was not credited in this work.

(16) Three 110000 cfm cooling units are normally in operation in containment. Upon receipt of a SIAS, the fourth cooling unit is automatically started on the 55000 cfm low speed setting and simultaneously the other three units are switched to low speed operation. If offsite power is not available, the emergency diesel generators are started. Each of two emergency diesel generator busses carries the load of two cooling units (UFSAR 6.5.3 and 6.5.4). Thus for the CEAE, two 55000 cfm cooling units are credited.

(17) The maximum allowable containment leakage rate  $L_a$  contained in the Containment Leakage Rate Testing Program of TS 5.5.16 will be reduced from 0.20 percent per day at Pa to 0.16 percent per day at Pa. Per RG 1.183, the containment should be assumed to leak at the leak rate incorporated in the technical specifications for the first 24 hours, and at 50% of this leak rate for the remaining duration of the accident.

(18) Per Ref.08, the primary to secondary leakage of 200 gpd (TS 3.4.13) should be assumed to exist until shutdown cooling is in operation and releases from the steam generators have been terminated. Per the Emergency Operating Procedures, Shutdown Cooling (SDC) commences when the Core Exit Thermocouple (CET) temperatures are less than 300°F and when the pressurizer pressure is less than 270 psia.

(19) The breathing rates are extracted from Ref.08:

Time (hours)	Breathing Rate (m3/sec)
0-8	3.5E-04
8-24	1.8E-04
24-720	2.3E-04

(20) The control room occupancy factors are extracted from Ref.08:

Time (hours)	Occupancy Factor
0-24	1.0
24-96	0.6
96-720	0.4

(21) Control room inleakage: The control room inleakages for the two trains Air Conditioning Units (ACU) 11 and 12 were measured by NUCON International Inc. via sulfur hexafluoride (SF<sub>6</sub>) tracer gas tests as documented in Refs.23-26 (Attachment AB). An additional inleakage test was performed by Brookhaven National Laboratory (BNL) via a perfluorocarbon tracer gas (PFT) test as documented in Ref.27 (Attachment AC).

	ACU 11	ACU 12
SF <sub>6</sub> Test 11/11/97	4300±300 cfm	3000±300 cfm
SF <sub>6</sub> Test 11/11/97	3600±600 cfm	2550±450 cfm
SF <sub>6</sub> Test 11/11/97	2900±250 cfm	2750±380 cfm
SF <sub>6</sub> Test 1/18/00	2600±200 cfm	3000±250 cfm
PFT Test 5/1/02	2930±185 cfm	2930±185 cfm

The latest SF<sub>6</sub> and PFT tests show fairly good agreement, as indicated above. A conservative value of 3500 cfm will be utilized in this work.

The control room inleakage points were deduced from the PFT testing carried out by Brookhaven National Laboratory and include the Auxiliary Building West Road inlet (WR), the Turbine Building inlet (TB), Access Control 11 (AC11), Access Control 13 (AC13), the Switchgear Rooms (SWGRs), and the Main Steam Isolation Valve Rooms (MSIVs). AC11 and AC13 will be equipped with dampers and radiation monitors, which will isolate this leakage path in case of an accident. The SWGRs are in continual recirculation mode and thus are also isolated from the environment. The MSIV rooms are also isolated from the environment, except for the Main Steam Line Break Accident which occurs in these rooms, due to the thermal buoyancy of the air in these rooms and due to the J-neck exhaust. For conservatism, all of the measured inleakage will be assumed to enter the control room from the most conservative pathway of either the West Road or Turbine Building inlets.

(22) Control room recirculation flow:

- Flowrate: 10000±1000 cfm  
(Note that this value will be the result of a new modification.)
- Initiation delay time: 20 minutes  
(Ref.29 conservatively assumes a 20 minute time delay for a manual start of the Control Room Emergency Ventilation System.)
- Filter efficiencies: 90% for elemental and organic iodine species  
(Ref.28 and Technical Specification 5.5.11 allow a 95% filter efficiency for a 2" activated carbon bed depth; however, NRC Generic Letter 99-02 (Ref.30) requires plants that test their activated charcoal to the ASTM D3803-1989 standards to use a safety factor of two. This results in a maximum credited efficiency of 90% for accident analyses.)
- Filter efficiencies: 99% for particulate iodine  
(Per Ref.28, an engineered-safety-feature air filtration system satisfying a filter penetration less than 0.05% at rated flow can be considered to warrant a 99% removal efficiency for particulates in accident dose evaluations.)

(23) The atmospheric dump valve (ADV) to site boundary, two-hour, atmospheric dispersion coefficient of 1.44E-4 sec/m<sup>3</sup> was calculated via the Gifford wake model extracted from UFSAR 2.3.6, as follows

$$\chi/Q = 1/[\mu * (\pi\sigma_y\sigma_z + cA)] = 1.44E-4 \text{ sec/m}^3$$

where for 1150 m exclusion area boundary distance and 5% frequency

$\mu$  = average wind speed = 1 m/sec

$\sigma_y$  = standard deviation of the distribution in the lateral direction = 92 m (UFSAR Table 2-14)

$\sigma_z$  = standard deviation of the distribution in the vertical direction = 24 m (UFSAR Table 2-14)

c = wake factor

A = cross-sectional area of structure from which material is released = 0 m

(24) The containment to site boundary X/Q of 1.30E-4 sec/m<sup>3</sup> was extracted from UFSAR 2.3.6.

(25) The atmospheric dispersion coefficients from the ADV to the low population zone (2 miles)  
(UFSAR Fig.2.3-3/UFSAR 14.24.3)

Time (hours)	$\chi/Q$ (sec/m <sup>3</sup> )
0-2	3.39E-05
2-24	2.20E-06
24-720	5.40E-07

Note that the 0-2 hour value was adjusted via the Gifford wake model for a point release rather than a containment release.

(26) The atmospheric dispersion coefficients from the containment to the low population zone (2 miles)  
(UFSAR Fig.2.3-3/UFSAR 14.24.3)

Time (hours)	$\chi/Q$ (sec/m <sup>3</sup> )
0-2	3.30E-05
2-24	2.20E-06
24-720	5.40E-07

(27) Atmospheric dispersion coefficients from the ADV to the Control Room: (Ref.19)

The initial secondary activity together with initial primary activity and failed fuel activity released to the primary that then leaks into the secondary will escape out of the steam generators via the ADVs. The main control room inleakage points include the west road inlets, the turbine building, and Access Controls 11 and 13 on the Auxiliary Building roof. Installation of automatic isolation dampers and radiation monitors at Access Controls 11 and 13 on the Auxiliary Building Roof are credited in this work.

Atmospheric Dispersion Coefficients (sec/m <sup>3</sup> )				
	radv1-tb	radv2-tb	radv1-wr	radv2-wr
0-2 hr	3.70E-03	3.83E-03	1.40E-03	1.35E-03
2-8 hr	2.78E-03	3.25E-03	1.08E-03	9.39E-04
8-24hr	1.03E-03	1.32E-03	4.73E-04	3.78E-04
1-4 days	8.24E-04	9.92E-04	3.48E-04	2.52E-04
4-30 days	6.31E-04	7.92E-04	2.44E-04	1.66E-04

The atmospheric dispersion coefficients corresponding to the Unit 2 ADV to the turbine building will be conservatively utilized in this work. Note that neither thermal buoyancy nor vertical effluent velocity are credited in this work.

(28) Atmospheric dispersion coefficients from the containment to the Control Room: (Ref.19)

The failed fuel activity released into the containment atmosphere is assumed to escape into the environment through the containment wall. Note that leakage through containment penetrations into the auxiliary building penetration room, which has a filtered release path into the environment, is not credited for this accident. The main control room

inleakage points include the west road inlets, the turbine building, and Access Controls 11 and 13 on the Auxiliary Building roof. Installation of automatic isolation dampers and radiation monitors at Access Controls 11 and 13 on the Auxiliary Building Roof are credited in this work.

Atmospheric Dispersion Coefficients (sec/m <sup>3</sup> )				
	U1-WR	U2-WR	U1-TB	U2-TB
0-2 hr	1.11E-03	1.04E-03	1.02E-03	1.02E-03
2-8 hr	7.29E-04	5.95E-04	7.10E-04	7.98E-04
8-24hr	3.19E-04	2.29E-04	2.57E-04	3.19E-04
1-4 days	2.36E-04	1.64E-04	2.19E-04	2.56E-04
4-30 days	1.98E-04	1.14E-04	1.77E-04	2.14E-04

The atmospheric dispersion coefficients corresponding to the Unit 1 containment to the west road inlet on the auxiliary building will be conservatively utilized in this work.

(29) Additional RADTRAD Inputs for 5 secondary release pathway cases:

(a) Failed fuel and primary iodine via the 8 hour secondary release pathway:

Pathways: Iodine					cfm
1	rsc-env	0.0-0.25 hr	200 gpd	0.10	0.001857
		0.25-8.0 hr	200 gpd	0.01	0.000186
2	rsc-sg	0.0-0.25 hr	200 gpd	0.90	0.016710
		0.25-8.0 hr	200 gpd	0.99	0.018381
3	sg-env	0.0-0.5 hr	109.2 cfm	0.01	1.0920
		0.5-8.0 hr	49.27 cfm	0.01	0.4927
4	afw-sg	0.0-0.25 hr			1.0753
		0.25-0.50 hr			1.0736
		0.50-8.00 hr			0.4743
5	env-cr		3500 cfm		3500
6	cr-env		3500 cfm		3500

(b) Failed fuel and primary noble gas via the 8 hour secondary release pathway:

Pathways: NG				cfm
1	rsc-env	0-8 hrs	200 gpd	0.018567
2	rsc-sg	0-8 hrs	NA	
3	sg-env	0-8 hrs	NA	
4	afw-sg	0-8 hrs	NA	
5	env-cr	0-720 hrs	3500 cfm	3500
6	cr-env	0-720 hrs	3500 cfm	3500

(c) Failed fuel and primary iodine via the 2 hour secondary release pathway:

Pathways: Iodine					cfm
1	rsc-env	0.0-0.25 hr	200 gpd	0.10	0.001857
		0.25-2.0 hr	200 gpd	0.01	0.000186
2	rsc-sg	0.0-0.25 hr	200 gpd	0.90	0.016710
		0.25-2.0 hr	200 gpd	0.99	0.018381
3	sg-env	0.0-0.5 hr	107.28 cfm	0.01	1.0728
		0.5-2.0 hr	107.28 cfm	0.01	1.0728
4	afw-sg	0.0-0.25 hr			1.0560
		0.25-0.50 hr			1.0544
		0.50-2.00 hr			1.0544

5	env-cr		3500 cfm		3500
6	cr-env		3500 cfm		3500

(d) Failed fuel and primary noble gas via the 2 hour secondary release pathway:

Pathways: NG				cfm
1	rsc-env	0-2 hrs	200 gpd	0.018567
2	rsc-sg	0-2 hrs	NA	
3	sg-env	0-2 hrs	NA	
4	afw-sg	0-2 hrs	NA	
5	env-cr	0-720 hrs	3500 cfm	3500
6	cr-env	0-720 hrs	3500 cfm	3500

(e) Failed fuel iodine and noble gas via the containment release pathway:

Pathways			
1	csp-cunsp	110000 cfm	0-720 hrs
2	cunsp-csp	110000 cfm	0-720 hrs
3	csp-env	0.16%/day	0-24 hrs
	csp-env	0.08%/day	24-720 hrs
4	cunsp-env	0.16%/day	0-24 hrs
	cunsp-env	0.08%/day	24-720 hrs
5	env-cr	3500 cfm	0-720 hrs
6	cr-env	3500 cfm	0-720 hrs

## 7. TECHNICAL ASSUMPTIONS

The following technical assumptions were utilized in this work:

- (01) The 8% of the fuel that experiences incipient centerline melting and the 2% that experiences clad failure are assumed to occur in the highest powered fuel rods.
- (02) No credit is taken for the containment spray system.
- (03) Two containment filters are credited at 20 minutes into the accident, consistent with manual operation.
- (04) No credit is taken for deposition of the plume on the ground or decay of isotopes in transit to the site boundary.
- (05) Buildup of daughter nuclides is taken into account as source term nuclides decay.
- (06) Note that per the requirements of Regulatory Guide (RG) 1.183 (Ref.08), the release of fission products from the secondary system should be evaluated with the assumption of a coincident loss of offsite power (LOOP). Thus, the use of condensers can not be credited in this work.
- (08) The steam generator tubes remain covered for the duration of the event, therefore the gap iodines have a partition coefficient of 100 in the steam generators. A conservative flashing fraction is assumed (10% for the first 15 minutes and 1% thereafter); however, no credit for scrubbing in the steam generator is assumed.
- (09) Based on the large quantity of material ejected from the primary system during the containment release pathway, a Safety Injection Actuation Signal (SIAS) will be generated due to high containment pressure (>4.25 psig) or low pressurizer pressure (<1600 psia). This is consistent with the RG 1.183 assumption of peak accident containment pressure for the CEAAE.



## 8. REFERENCES

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- (05) "Control Room Habitability Source Term Calculations", CA06358.
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## 9. METHODS OF ANALYSIS

### (9.1) RADTRAD Computations

The current work re-analyzes control room habitability for a CEAE based on the alternate source term methodology of Ref.08 and control room inleakage of 3500 cfm. This was accomplished by utilizing the RADTRAD computer code (Refs.13-15).

The RADTRAD computer code calculates TEDE and thyroid doses to personnel at the site boundary, low population zone, and control room per 10 CFR 50.67 resulting from any postulated accident which releases radioactivity within the containment, spent fuel pool, or within any primary or secondary system. RADTRAD models the transport of up to 63 radionuclides from the source region, through a secondary region if any, and then to the environment and to the control room. The code includes the capability to model time-dependent activity release; time-dependent spray/filtration/deposition removal processes, piping/filter/inleakage transfer mechanisms, atmospheric dispersion; and natural decay. RADTRAD is documented and benchmarked in Refs.13-17.

The CEAE model is constructed in three parts: containment release pathway, 8-hour secondary release pathway, and 2-hour secondary release pathway. The containment release pathway model is composed of iodine and noble gas radionuclides generated from incipient centerline melted and clad ruptured failed fuel. The secondary release pathway model is composed of iodine and noble gas radionuclides generated from incipient centerline melted and clad ruptured failed fuel, iodine and noble gas radionuclides from the primary TS activity limit, and iodine radionuclides from the secondary TS activity limit.

For the containment release path scenario, the failed/melted fuel activity, resulting from a postulated CEAE and consisting of 100% of the noble gases and 25% of the iodines contained in the fuel which is estimated to reach initiation of melting and 10% of the noble gases and iodines which are contained in the gas gaps of the fuel which experience clad failure, is released into the primary system, which is released in its entirety into the containment via the ruptured control rod drive mechanism housing. The released activity is instantaneously and uniformly mixed in the free volume of the containment and is then released at the containment TS leak rate into the environment. Cleanup via aerosol natural deposition and containment filtration is credited, although the two containment filters are assumed to start at 20 minutes into the accident consistent with manual initiation.

For the secondary release path scenario, the failed/melted fuel activity, resulting from a postulated CEAE and consisting of 100% of the noble gases and 50% of the iodines contained in the fuel which is estimated to reach initiation of melting and 10% of the noble gases and iodines which are contained in the gas gaps of the fuel which experience clad failure, is released into the primary system, which is then transmitted into the secondary system via the 200 gpd TS steam generator tube leakage. The condenser is assumed to be unavailable due to loss of offsite power. Environmental releases occur from both steam generators via the ADVs and MSSVs. No cleanup mechanisms are assumed in the primary or secondary systems.

The activity released to the environment is transported to the site boundary and to the control room via appropriate atmospheric dispersion coefficients. While time-dependent control room inleakage can be modeled by RADTRAD, it is a constant 3500 cfm in this work. Control room filtration is credited based on a modification to increase recirculation flow to a nominal 10000 cfm. A charcoal filter efficiency of 90% is credited for elemental and organic iodine, while a HEPA efficiency of 99% is credited for particulate iodine. The control room and site boundary doses are calculated based on appropriate breathing rates and occupancy factors and on FGR 11 and 12 dose conversion factors.

### (9.2) Gas Gap, Primary, and Secondary Release Activities

An EXCEL spreadsheet (CEA.XLS(CEAE.SG) displayed in Attachment A) was developed to calculate the activity released to the primary and secondary systems post-CEAE. Three sets of isotopic activities were generated:

- Iodine and noble gas activities released via fuel failure

- Technical Specification Primary iodine and noble gas activities
- Technical Specification Secondary iodine activities

#### (9.2.a) Failed Fuel Release Activities

The isotopic activities released from the incipient centerline melted and clad ruptured failed fuel in Ci/MWt can be calculated from the total core isotopic activities extracted from case CRCB in Ref.5. For the containment pathway, all 63 isotopic activities are stored in the nuclear inventory file CRCB63.NIF listed in Attachment G. For the secondary pathway, the 14 relevant iodine and noble gas isotopic activities are stored in the nuclear inventory file CEA14.NIF, listed in Attachment D and also in column C of Attachment A. To utilize these isotopic source terms, it is necessary to multiply them by the relevant power level in MWt and by the relevant release fractions.

#### (9.2.b) Primary Specific Activities

The initial primary specific activities in  $\mu\text{Ci/gm}$  consistent with the TS 3.4.15  $1.0 \mu\text{Ci/gm}$  limit were extracted from Ref.4 and are listed in column G of Attachment A. These were converted to total primary isotopic source terms in Attachment A column H via the following algorithm:

$$A_{i0} = AST_i * M_{RCS} * 0.000001 \text{ Ci}$$

where  $AST_i$  = Isotopic activity per unit mass ( $\mu\text{Ci/gm}$ ) (Ref.04)  
 $M_{RCS}$  = Water mass in RCS (gm)

The total primary isotopic source term was then halved in Attachment A column I to reflect that the TS 3.4.15 limit for primary activity will be reduced from  $1.0 \mu\text{Ci/gm}$  to  $0.5 \mu\text{Ci/gm}$ .

These isotopic activities were inserted into the nuclear inventory file PRI14.NIF for use by RADTRAD. The file is listed in Attachment E and consists of the 14 primary noble gas and iodine isotopes. The activities are the total primary activities and are not per unit power. Thus a power of one should be designated when employing this file.

#### (9.2.c) Secondary Specific Activities

The initial secondary specific activities in  $\mu\text{Ci/gm}$  consistent with the TS 3.7.14  $0.1 \mu\text{Ci/gm}$  limit were extracted from Ref.4 and are listed in column J of Attachment A. These were converted to total secondary isotopic source terms in Attachment A column K via the following algorithm:

$$A_{i0} = AST_i * M_{2SG} * 0.000001 \text{ Ci}$$

where  $AST_i$  = Isotopic activity per unit mass ( $\mu\text{Ci/gm}$ ) (Ref.04)  
 $M_{2SG}$  = Water mass in both SGs (gm)

These isotopic activities were inserted into the nuclear inventory file SEC05.NIF for use by RADTRAD. The file is listed in Attachment F and consists of the 5 iodine isotopes. The activities are the total secondary activities and are not per unit power. Thus a power of one should be designated when employing this file.

#### (9.3) 8-Hour Secondary Steam Release Calculations

The methodology for the 8 hour cooldown from HFP to SDC was extracted from Ref.42. Although it was developed for the Seized Rotor Event, it should be applicable with minor corrections to the CEAE. The steam release from the first 1800 seconds was taken directly from a CESEC execution. The steam release from 1800 seconds to 8 hours is based on a simple energy balance methodology; that is, the steam released from 1800 seconds to 8 hours is based on the amount of steam required to remove the residual heat from the primary and secondary systems, the decay heat generated in the core, and the reactor coolant pump heat. The steam release rates in cfm calculated below are divided by the partition coefficient of 100 (RG 1.183) and entered into RADTRAD.

			Steam Release Calculations for First 1800 Seconds
dt	1800	sec	First 1800 sec, CESEC with no operator action from CA03516
W	204500	lbm	SG mass release, CESEC with no operator action from CA03516
dW/dt	113.6111	lbm/sec	W/dt
vstp	0.016018	cf/lbm	Specific volume from Steam Tables @ 1 gm/cc (STP) per Reg Guide 1.183
dV/dt	109.1894	cfm	dW/dt * vstp * (60 sec/min)
			Steam Release Calculations from 1800 Seconds to 8 Hours
msg	86500	lbm	SG secondary water mass @ 537.7F saturated from CA03516
cpsg	1.27	btu/lbm-F	SG specific heat capacity @ 537.7F saturated from CA03516
mprs	6630	lbm	PZR steam mass @ 658.6F and 2325.8 psia from CA03516
cpprs	3.46	btu/lbm-F	PZR steam specific heat @ 658.6F and 2325.8 psia from CA03516
mprw	23000	lbm	PZR water mass @ 574.0F and 2325.8 psia from CA03516
cpprw	1.31	btu/lbm-F	PZR water specific heat @ 574.0F and 2325.8 psia from CA03516
mrscs	410000	lbm	RCS water mass @ 540.3F and 2332.8 psia from CA03516
cprcs	1.22	btu/lbm-F	RCS water specific heat @ 540.3F and 2332.8 psia from CA03516
mrscsm	4248300	lbm	RCS metal mass from CA03516
cprscsm	0.12	btu/lbm-F	RCS specific heat @ 540.3F and 2332.8 psia from CA03516
dT	241	F	Delta RCS temperature between 541F and 300 F
dt	27000	sec	Delta time between 8.0 hours and 0.5 hours
Qres	10469.40	btu/sec	(msg*cpsg+mprs*cpprs+mprw*cpprw+mrscs*cprcs+mrscsm*cprscsm)*dT/dt
Prpc	17	MW	Reactor coolant pump power from UFSAR Table 14.6.1
Qrcp	16112.88	btu/sec	Prpc*(4 RCPs/4 RCPs)*(947.8167 btu/sec/MW)
t1	1800	sec	Decay heat generated between 1800-28800 sec
t2	28800	sec	Decay heat generated between 1800-28800 sec
Po	2754	Mwt	Initial power per UFSAR 3.2.1 and RG 1.49
A	0.13		Constant from CA03516
a	0.283		Constant from CA03516
Pdec	25.14	Mwt	Decay heat rate $P_{dec} = P_o * A * [t_2^{1-a} - t_1^{1-a}] / [(1-a) * (t_2 - t_1)]$ from CA03516
SF	1.25		CA03516 Safety Factor
Qdec	29789.68	btu/sec	$P_{dec} * SF * (947.8167 \text{ btu/sec/mw})$
Qtot	56371.96	btu/sec	Qres+Qrcp+Qdec
hg	1179.7	btu/lbm	Enthalpy of steam in SG @ 300 F
hfw	80.0	btu/lbm	Enthalpy of Aux Feed entering the SG (CA03516)
dWs/dt	51.26	lbm/sec	Steam Release Rate Qtot/(hg-hfw)
Ws	1384052.96	lbm	Integrated steam release dWs/dt*(t2-t1)
dVs/dt	49.2661	cfm	Steam Release Rate dWs/dt*vstp*60

#### (9.4) 2-Hour Secondary Steam Release Calculations

The methodology for the 2 hour cooldown from HFP to SDC is based on a simple energy balance methodology; that is, the steam released from 0 seconds to 2 hours is based on the amount of steam required to remove the residual heat from the primary and secondary systems, the decay heat generated in the core, and the reactor coolant pump heat. The steam release rates in cfm calculated below are divided by the partition coefficient of 100 (RG 1.183) and entered into RADTRAD.

			Steam Release Calculations from 0 Seconds to 2 Hours
msg	275942	lbm	SG secondary water mass @ 525.2F saturated from SP-0811 & WEC-222-7811-A45
cpsg	1.24	btu/lbm-F	SG specific heat capacity @ 525.2F saturated from Steam Tables
Qsg	77056251.6	btu	SG residual heat = msg*cpsg*(525.2-300)
mprs	5765	lbm	PZR steam mass @ 6536F & 2250 psia from UFSAR Table 4.7 (900cf/0.15613 cf/lbm)
cpprs	3.55	btu/lbm-F	PZR steam specific heat @ 653F and 2250 psia from Steam Tables
Qprs	7224409.75	btu	PZR steam residual heat = mprs*cprs*(653-300)
mprw	22198	lbm	PZR water mass @ 653F and 2250 psia from UFSAR Table 4.7 (600cf/0.02703cf/lbm)
cpprw	2.119	btu/lbm-F	PZR water specific heat @ 653F and 2250 psia from Steam Tables
Qprw	16604259.4	btu	PZR water residual heat = mprw*cprw*(653-300)
mrscs	432677	lbm	RCS water mass @ 574.5F and 2250 psia from Input 11
cprcs	1.335	btu/lbm-F	RCS water specific heat @ 574.5F and 2250 psia from Steam Tables
Qrcs	158557732	btu	RCS water residual heat = mrscs*cprcs*(574.5-300)
mrscsm	4248300	lbm	RCS metal mass from CA03516
cprscsm	0.12	btu/lbm-F	RCS specific heat @ 574.5F from CA03516
Qrcsm	139939002	btu	Reactor residual heat = mrscsm*cprscsm*(574.5-300)
Qtot	399381654	btu	Total residual heat = Qsg + Qprs + Qprw + Qrcs + Qrcsm
dt	7200	sec	Delta time between 0 hours and 2 hours
Wres	55469.67	btu/sec	Qtot/dt
Prcp	17	MW	Reactor coolant pump power from UFSAR Table 14.6.1
Wrcp	16112.88	btu/sec	Prcp*(4 RCPs/4 RCPs)*(947.8167 btu/sec/MW)
t1	0	sec	Decay heat generated between 0-7200 sec
t2	7200	sec	Decay heat generated between 0-7200 sec
Po	2754	Mwt	Initial power per UFSAR 3.2.1 and RG 1.49
A	0.13		Constant from CA03516
a	0.283		Constant from CA03516
Pdec	40.44	Mwt	Decay heat rate Pdec=Po*A*[t2*(1-a)-t1(1-a)]/[(1-a)/(t2-t1)] from CA03516
SF	1.25		CA03516 Safety Factor
Wdec	47906.83	btu/sec	Pdec*SF*(947.8167 btu/sec/mw)
Wtot	119489.38	btu/sec	Wres+Wrcp+Wdec
hg	1150.5	btu/lbm	Enthalpy of steam in SG @ 212 F (conservative)
hfw	80.0	btu/lbm	Enthalpy of Aux Feed entering the SG (CA03516)
dWs/dt	111.62	lbm/sec	Steam Release Rate Wtot/(hg-hfw)
Ws	803665.177	lbm	Integrated steam release dWs/dt*(t2-t1)
dVs/dt	107.2759	cfm	Steam Release Rate dWsdt*vstp*60
vstp	0.016018	cf/lbm	Steam Tables @ 1 gm/cc

#### (9.5) Flashing Fraction Calculations

Per Regulatory Guide 1.183 Appendix E (Ref.8), upon periods of steam generator dryout, all of the primary-to-secondary leakage is assumed to flash to vapor and be released to the environment with no mitigation.

Since the steam generator tubes remain covered for the duration of the event, a portion of the primary-to-secondary leakage will flash to vapor, based on the thermodynamic conditions in the primary and secondary systems. Per RG 1.183 Appendix A, the flashing fraction, FF, should be determined using a constant enthalpy, h, process:

$$FF = (h_{f1} - h_{f2}) / h_{fg}$$

where  $h_1$  is the enthalpy of the primary system liquid,  $h_2$  is the enthalpy of the secondary system liquid, and  $h_g$  is the heat of vaporization at secondary system conditions.

To determine the flashing fractions associated with a cooldown to shutdown cooling, it is necessary to know the temperature difference between the primary and secondary systems as a function of time. The following table lists the results of the EXCEL spreadsheet CEA.XLS(FlashingFraction). This spreadsheet calculates the temperature difference required to cool the primary system to 300°F over an 8 hour period.

Temperature Difference between Primary and Secondary Based on Energy Balance						
Time	Decay Heat	Decay Heat	RCPs	Residual	SG Heat Loss	delta Temp
	Fdec	Wdec	Wrcp	Wres	Wtot	dT
	%	btu/hr	btu/hr	btu/hr	btu/hr	deg F
0	100	9397033560.00	58006380	37689840.00	9492729780.00	76.65
1 sec	7.769	730055537.28	58006380	37689840.00	825751757.28	6.67
25 sec	5.471	514111706.07	58006380	37689840.00	609807926.07	4.92
50 sec	4.852	455944068.33	58006380	37689840.00	551640288.33	4.45
100 sec	4.28	402193036.37	58006380	37689840.00	497889256.37	4.02
900 sec	2.541	238778622.76	58006380	37689840.00	334474842.76	2.70
1800 sec	2.0334	191079280.41	58006380	37689840.00	286775500.41	2.32
2700 sec	1.7792	167192021.10	58006380	37689840.00	262888241.10	2.12
1 hr	1.597	150070625.95	58006380	37689840.00	245766845.95	1.98
2 hr	1.2646	118834886.40	58006380	37689840.00	214531106.40	1.73
8 hr	0.8681	81575648.33	58006380	37689840.00	177271868.33	1.43
Fdec = Decay heat fraction from BTP ASB 9-2: Residual Decay Energy for LWRs for Long-Term Cooling						
Wdec = Decay heat in btu/hr from BTP ASB 9-2: Residual Decay Energy for LWRs for Long-Term Cooling						
Wrcp = RCP power from Section 9.3						
Wres = Residual power from Section 9.3						
Wtot = Wdec + Wrcp + Wres						
Wtot = $0.266 \cdot K \cdot dT \cdot A / t = 123849700 \cdot dT$ = Total SG Heat Loss in btu/hr						
K = Alloy Inconel 690 thermal conductivity in btu-in/ft <sup>2</sup> -hr-F (93 @ 200F, 107 @ 400F, 122 @ 600F) (Attachment C)						
dT = Trcs - Tsg in degrees F						
A = heat transfer area in ft <sup>2</sup> (2 * 92008 ft <sup>2</sup> per SP-0811 Ref.43)						
t = SG tube wall thickness in in (0.046 in max per SP-0811 Ref.43)						

Note that at HFP the RCS hot leg (601°F - UFSAR Figure 4-9) is ~76°F hotter than the SG (525.2°F - SP-0811). This temperature difference drops to less than 5°F within 25 seconds post-trip. The magnitude of the temperature difference is verified by inspection of the RCS and SG cooldown temperatures from Unit 2 Cycle 15 displayed in Attachment B. Based on a conservative 6°F temperature difference, the flashing fractions between HZP and SDC can be calculated. Note that the flash fraction remains below 1% throughout the cooldown.

Flashing Fraction Based on 6 Degree F Temperature Difference Between RCS and SG during Cooldown					
RCS	RCS	SG	SG	SG	Flash
Temperature	Fluid Enthalpy	Temperature	Fluid Enthalpy	Fluid-Gas Enthalpy	Fraction
544 @ 2000 psia	540.1	538	534.2	660.6	0.0089
500 @ 1700 psia	487.6	494	480.8	722.1	0.0094
400 @ 1000 psia	376	394	368.6	831.6	0.0089
300 @ 270 psia	270.1	294	263.5	914.5	0.0072

The flash fraction for leakage from the RCS to the SG at HFP and from the RCS to the Refueling Water Tank (RWT) are also calculated. Note that flash fraction for leakage from the RCS to the SG at HFP is ~ 8.84%. Also note that the leakage from the RCS to the RWT is ~ 10%, which is consistent with the recommended value in RG 1.183 (Ref.8).

Flashing Fraction Based on HFP Conditions and RWT Leakage					
RCS	RCS				Flash
Temperature	Fluid Enthalpy	Temperature	Fluid Enthalpy	Fluid-Gas Enthalpy	Fraction
574.6 @ 2250 psia	578.5	SG 525.2 Sat	SG 518.4	SG 679.55	0.0884
212 @ Saturation	180.2	RWT 100	RWT 68.0	RWT 1037.1	0.1082

Based on the above data, a 10% flash fraction will be assumed during the first 15 minutes after the accident, and a 1% flash fraction will be assumed for the remaining duration of the accident.



## 10. CALCULATIONS

The following computations were performed in this calculational package for the CEA Ejection Event 8 hour steam generator release:

CEA Ejection Event Files for 8 Hour Steam Generator Release					
Activity Source	Failed Fuel		Primary		Secondary
Radionuclide Component	Iodine	Noble Gas	Iodine	Noble Gas	Iodine
Case Input Files	ceaffi.psf	ceaffn.psf	ceapri.psf	ceaprn.psf	ceasec.psf
Dose Conversion Factor File	fgr14.inp	fgr14.inp	fgr14.inp	fgr14.inp	fgr05.inp
Release Fraction/Timing File	ceaffi.rft	ceaffn.rft	ceapri.rft	ceaprn.rft	ceasec.rft
Nuclear Inventory File	cea14.nif	cea14.nif	pri14.nif	pri14.nif	sec05.nif
Case Output Files	ceaffi.o0	ceaffn.o0	ceapri.o0	ceaprn.o0	ceasec.o0

The following computations were performed in this calculational package for the CEA Ejection Event 2 hour steam generator release:

CEA Ejection Event Files for 2 Hour Steam Generator Release					
Activity Source	Failed Fuel		Primary		Secondary
Radionuclide Component	Iodine	Noble Gas	Iodine	Noble Gas	Iodine
Case Input Files	ceaffi2.psf	ceaffn2.psf	ceapri2.psf	ceaprn2.psf	ceasec2.psf
Dose Conversion Factor File	fgr14.inp	fgr14.inp	fgr14.inp	fgr14.inp	fgr05.inp
Release Fraction/Timing File	ceaffi.rft	ceaffn.rft	ceapri.rft	ceaprn.rft	ceasec.rft
Nuclear Inventory File	cea14.nif	cea14.nif	pri14.nif	pri14.nif	sec05.nif
Case Output Files	ceaffi2.o0	ceaffn2.o0	ceapri2.o0	ceaprn2.o0	ceasec2.o0

The following computations were performed in this calculational package for the CEA Ejection Event 720 hour containment release:

CEA Ejection Event Files for Containment Release	
Activity Source	Containment
Radionuclide Component	Iodine/Noble Gas
Case Input Files	ceactmt.psf
Dose Conversion Factor File	fgr63.inp
Release Fraction/Timing File	ceactmt.rft
Nuclear Inventory File	crcb63.nif
Case Output Files	ceactmt.o0

## 11. DOCUMENTATION OF COMPUTER CODES

This work employed the RADTRAD computer code, which was verified, benchmarked, and documented in Refs.13-17 and which models the transport of halogen and noble gas isotopes from a primary containment to a secondary containment and thence to the environment and control room. The installation of RADTRAD is detailed in Ref.16 and the validation in Ref.17.

The RADTRAD computer code can calculates TEDE and thyroid doses to personnel at the site boundary, low population zone, and control room per the alternate source term methodology 10 CFR 50.67 and Regulatory Guide 1.183 or can calculates whole body and thyroid doses to personnel at the site boundary, low population zone, and control room per the standard source term methodology of TID-14844 (Ref.18) resulting from any postulated accident which releases radioactivity within the containment, spent fuel pool, or within any primary system. RADTRAD models the transport of radioactivity from up to 63 radioisotopes from the sprayed and unsprayed regions of a primary containment or a SFP area, through the secondary containment if any, and then to the environment and to the control room. The code includes the capability to model time-dependent activity release; containment spray, filtration, and leakage; control room filtration and inleakage; primary and secondary containment purge filters; control room intake filters; atmospheric dispersion; and natural decay. Doses are calculated for individuals residing at the site boundary or low population zone and in the control room.

Some inputs for the RADTRAD computer program were generated via an EXCEL spreadsheet.

## 12. RESULTS

UFSAR 14.13 presents the licensing basis evaluation of the CEA Ejection Event. A CEAEE is defined as a rapid, uncontrolled, total withdrawal of a single or dual CEA, where a dual CEA is two CEAs connected to a single CEA extension shaft. The event is postulated to occur as a result of a complete instantaneous circumferential rupture of either the Control Element Drive Mechanism (CEDM) pressure housing or the CEDM nozzle from the reactor vessel closure head. The pressure of the Reactor Coolant System (RCS) causes the ejection of the extension shaft through the rupture and the movement of the CEA to a fully-withdrawn position. The most limiting CEA Ejection Event is a rapid total withdrawal of the highest worth CEA within 0.05 seconds and the breaching of the RCS pressure boundary. The immediate reactor core response is an exponential increase in nuclear power. At 112.2% (i.e., maximum analysis setpoint including uncertainties) of Reactor Thermal Power (RTP), a Variable High Pressure Trip (VHPT) is initiated. The negative Doppler feedback due to the increasing fuel temperature partially offsets the ejected CEA worth and terminates the power excursion. The insertion of the CEAs will terminate the event. Although both the HFP and HZP cases were analyzed, the HFP case is more limiting with respect to dose (more failed fuel and a higher steaming potential). The design basis CEA Ejection Event accounts for extended burnup. Additional evaluations concluded that ZIRLO, Erbia, and replacement steam generators will not significantly impact the results, and thus the current results remain bounding. The worst-case results show that no fuel rod will experience clad damage and only a small fraction will reach incipient centerline melt condition (8%). The results are well within the 10 CFR 100 exposure guidelines, specifically Thyroid<50 Rem and Whole Body<1.5 Rem.

Previously, power reactor licensees have typically used the U.S.A.E.C Technical Information Document TID-14844, "Calculation of Distance Factors for Power and Test Reactor Sites," (Ref.18) as the basis for Design Basis Analysis (DBA) source terms. TID-14844 is referenced in 10 CFR 100.11, the power reactor siting regulation, which contains offsite dose limits in terms of whole body and thyroid doses. In December 1999, the Nuclear Regulatory Commission (NRC) issued a new regulation, 10 CFR 50.67, "Accident Source Term," which provided a mechanism for licensed power reactors to replace the traditional accident source term used in their DBA analyses with an Alternate Source Term (AST) methodology. Regulatory guidance for the implementation of these ASTs is provided in Regulatory Guide (RG) 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" (Ref.08). Section 50.67 of 10 CFR requires a licensee seeking to use AST to apply for a license amendment and requires that the application contain an evaluation of the consequences of affected DBAs. As part of the implementation of the AST, the Total Effective Dose Equivalent (TEDE) acceptance criterion of 10 CFR 50.67 replaces the previous whole body and thyroid dose guidelines of 10 CFR 100.11 and 10 CFR 50, Appendix A, GDC-19 for the loss-of-coolant accident (LOCA), the main steam line break (MSLB), the steam generator tube rupture (SGTR), the seized rotor event (SRE), the fuel handling accident (FHA), and the control element assembly ejection accident (CEAEE). The TEDE accident dose criteria are listed in Table 6 of RG 1.183 for offsite doses and in 10 CFR 50.67 for control room doses, which limit is 5 Rem TEDE. The Nuclear Steam Supply System (NSSS) response to the CEAEE was simulated using the CESEC computer code for the eight hour accident scenario.

The current work utilizes the alternate source term methodology of 10 CFR 50.67 and Regulatory Guide 1.183 to calculate offsite and control room doses for a CEAEE. The CEAEE was evaluated for both the containment and secondary release pathways. In addition, the secondary pathway was analyzed for both a 2 hour and an 8 hour time to shutdown cooling (SDC). A bounding control room leakage value of 3500 cfm was assumed. The following modifications and TS changes are proposed to comply with regulatory requirements.

- Modification of the control room emergency ventilation system to a nominal 10000 cfm flow with a 90% filtration efficiency for elemental and organic iodine and 99% for particulate iodine was credited.
- Also credited was installation of automatic isolation dampers and radiation monitors at Access Controls 11 and 13 on the Auxiliary Building Roof. This modification limits activity ingress into the control room to either the West Road Inlet or the Turbine Building, thus limiting the atmospheric dispersion coefficient value.
- The Technical Specification (TS 3.4.15) limit for RCS activity was reduced from 1.0  $\mu\text{Ci/gm}$  to 0.5  $\mu\text{Ci/gm}$ .

- The maximum allowable containment leakage rate La contained in the Containment Leakage Rate Testing Program of TS 5.5.16 was reduced from 0.20 percent per day at Pa to 0.16 percent per day at Pa.

The exclusion area boundary (EAB), low population zone (LPZ), and control room (CR) doses for the 8-hour secondary pathway are presented in Attachments Q, R, S, T, and U and are detailed in the following table:

8 Hour CEAAE Results from Secondary Pathway			
	EAB	LPZ	CR
	Rem	Rem	Rem
Failed Fuel Iodine	1.2503E-01	3.6870E-02	4.1672E+00
Failed Fuel Noble Gas	2.0073E-01	5.0370E-02	4.1885E-01
Primary TS Activity Iodine	1.5225E-06	4.5645E-07	5.5874E-05
Primary TS Activity Noble Gas	3.6795E-05	9.9443E-06	1.5932E-04
Secondary TS Activity Iodine	3.6208E-04	9.7236E-05	8.3421E-03
Total	0.32616	0.08735	4.59461
Regulatory Limits	6.3000	6.3000	5.0000

Note that besides the iodine and noble gases released from the failed fuel, doses resulting from the release of the primary and secondary TS activities through the steam generators was also calculated and included in the results. Note that all values are below the regulatory limits.

The exclusion area boundary (EAB), low population zone (LPZ), and control room (CR) doses for the 2-hour secondary pathway are presented in Attachments V, W, X, Y, and Z and are detailed in the following table:

2 Hour CEAAE Results from Secondary Pathway			
	EAB	LPZ	CR
	Rem	Rem	Rem
Failed Fuel Iodine	1.5521E-01	3.6538E-02	1.2435E+00
Failed Fuel Noble Gas	2.0073E-01	4.7255E-02	2.0440E-01
Primary TS Activity Iodine	1.8994E-06	4.4715E-07	1.6344E-05
Primary TS Activity Noble Gas	3.6795E-05	8.6621E-06	5.2343E-05
Secondary TS Activity Iodine	6.0024E-04	1.4131E-04	4.9484E-03
Total	0.35658	0.08394	1.45292
Regulatory Limits	6.3000	6.3000	5.0000

Note that besides the iodine and noble gases released from the failed fuel, doses resulting from the release of the primary and secondary TS activities through the steam generators was also calculated and included in the results. Note that all values are below the regulatory limits.

The exclusion area boundary (EAB), low population zone (LPZ), and control room (CR) doses for the 30-day containment pathway are presented in Attachment AA and are detailed in the following table

30 Day CEAAE Results from Containment Pathway			
	EAB	LPZ	CR
	Rem	Rem	Rem
Failed Fuel Iodine and Noble Gases	0.45664	0.11862	0.96789
Regulatory Limits	6.3000	6.3000	5.0000

Note that all values are below the regulatory limits.

### 13. CONCLUSIONS

All CEAAE offsite and control room doses are below the regulatory limits.

Results	EAB	LPZ	CR
	Rem	Rem	Rem
8 Hour Secondary Pathway	0.32616	0.08735	4.59461
2 Hour Secondary Pathway	0.35658	0.08394	1.45292
30 day Containment Pathway	0.4567	0.1187	0.9679
CEAAE Worst-Case Doses	0.5000	0.2000	4.6000
Regulatory Limits	6.3000	6.3000	5.0000

This work supports the following changes in plant operation:

- This analysis supports a pin power peaking factor of 1.70
- A time to shutdown cooling of 8 hours was assumed..
- Containment sprays were not credited in this work.
- Two containment filters were credited after a 20 minute delay, consistent with manual initiation.

This work relies on the following modifications and new methodologies:

- Alternate Source Term Methodology was employed.
- Modification of the control room emergency ventilation system to a nominal 10000 cfm flow with a 90% filtration efficiency for elemental and organic iodine and a 99% efficiency for particulate iodine was credited.
- Installation of automatic isolation dampers and radiation monitors at Access Controls 11 and 13 on the Auxiliary Building Roof was credited. This modification limits activity ingress into the control room to either the West Road Inlet or the Turbine Building, thus limiting the atmospheric dispersion coefficient value.
- The Technical Specification (TS 3.4.15) limit for RCS activity was reduced from 1.0  $\mu\text{Ci/gm}$  to 0.5  $\mu\text{Ci/gm}$ .
- The maximum allowable containment leakage rate La contained in the Containment Leakage Rate Testing Program of TS 5.5.16 was reduced from 0.20 percent per day at Pa to 0.16 percent per day at Pa.

## 14. ATTACHMENTS

### ATTACHMENT A CEA EJECTION EVENT RELEASE ACTIVITIES

Calculation of CEA Ejection Event Release Activities							
	Halflife	lambda	Core	SG	Containment	Gap	
			Source	Release	Release	Release	
	sec	1/sec	Ci/MWT	Fraction	Fraction	Fraction	
	A	B	C	D	E	F	
Kr-85	3.3830E+08	2.0489E-09	3.7180E+02	1.00	1.00	0.10	
Kr-85m	1.6128E+04	4.2978E-05	7.9679E+03	1.00	1.00	0.10	
Kr-87	4.5780E+03	1.5141E-04	1.6208E+04	1.00	1.00	0.10	
Kr-88	1.0224E+04	6.7796E-05	2.2658E+04	1.00	1.00	0.10	
I-131	6.9466E+05	9.9783E-07	2.7562E+04	0.50	0.25	0.10	
I-132	8.2800E+03	8.3713E-05	3.9464E+04	0.50	0.25	0.10	
I-133	7.4880E+04	9.2568E-06	5.5715E+04	0.50	0.25	0.10	
I-134	3.1560E+03	2.1963E-04	6.2858E+04	0.50	0.25	0.10	
I-135	2.3796E+04	2.9129E-05	5.2964E+04	0.50	0.25	0.10	
Xe-133	4.5317E+05	1.5296E-06	5.5707E+04	1.00	1.00	0.10	
Xe-135	3.2724E+04	2.1182E-05	1.7708E+04	1.00	1.00	0.10	
Xe133m	1.8922E+05	3.6632E-06	1.7354E+03	1.00	1.00	0.10	
Xe135m	9.1800E+02	7.5506E-04	1.1635E+04	1.00	1.00	0.10	
Xe138	8.4600E+02	8.1932E-04	4.9330E+04	1.00	1.00	0.10	
	1 microCi/g	1 microCi/g	0.5 microCi/g	0.1 microCi/g	0.1 microCi/g	Incipient	Failed
	Primary	Primary	Primary	Secondary	Secondary	Centerline	Fuel
	Source	Source	Source	Source	Source	Melt	Clad-Damage
	microCi/g	Ci	Ci	microCi/g	Ci	Fraction	Fraction
	G	H	I	J	K	L	M
Kr-85	3.8761E+01	7.9975E+03	7.9975E+03			0.08	0.02
Kr-85m	2.0344E+00	4.1975E+02	4.1975E+02			0.08	0.02
Kr-87	1.1747E+00	2.4238E+02	2.4238E+02			0.08	0.02
Kr-88	3.6579E+00	7.5473E+02	7.5473E+02			0.08	0.02
I-131	7.7893E-01	1.6071E+02	8.0357E+01	8.9260E-02	1.1172E+01	0.08	0.02
I-132	2.5868E-01	5.3372E+01	2.6686E+01	2.2758E-03	2.8485E-01	0.08	0.02
I-133	1.0972E+00	2.2638E+02	1.1319E+02	5.7417E-02	7.1866E+00	0.08	0.02
I-134	1.4798E-01	3.0532E+01	1.5266E+01	5.2168E-04	6.5297E-02	0.08	0.02
I-135	6.0207E-01	1.2422E+02	6.2112E+01	1.3584E-02	1.7003E+00	0.08	0.02
Xe-133	4.0021E+02	8.2574E+04	8.2574E+04			0.08	0.02
Xe-135	9.5607E+00	1.9726E+03	1.9726E+03			0.08	0.02
Xe133m	5.7016E+00	1.1764E+03	1.1764E+03			0.08	0.02
Xe135m	1.2511E+00	2.5814E+02	2.5814E+02			0.08	0.02
Xe138	6.6019E-01	1.3622E+02	1.3622E+02			0.08	0.02

A	Half-lives: Chart of the Nuclides Fifteenth Edition'				
B	Decay constants: $\ln(2)/A(i)$				
C	Core source in Ci/MWt: CA06358				
D	SG Release Fractions RG 1.183				
E	Containment Release Fraction per RG 1.183				
F	Gap Release Fraction per RG 1.183				
G	Primary Source in microCi/gm: CA06422				
H	Primary Source in Ci for 1.0 microCi/gm total ( $F \cdot M_{tot} \cdot 1.e-6$ ): CA06422				
I	Primary Source in Ci for 0.5 microCi/gm total: CA06422				
J	Secondary Source in microCi/gm: CA06422				
K	Secondary Source in Ci for 0.1 microCi/gm total ( $I \cdot M_{2sg} \cdot 1.e-6$ ): CA06422				
L	Melt Fraction SER-108 and BGE-to-NRC 3/27/87				
M	Failed Fuel Clad Damage Fraction				

ATTACHMENT B  
RCS AND SG TEMPERATURES DURING COOLDOWN FOR U2C15

time/date	T15	T01	P3991	P4008			PA911	PWR	
	incore T/C	incore T/C	S/G pres	S/G pres	S/G temp	delta T	MWth	%	
2/22/05 20:00	578.7441	566.4422	860.0844	860.9044	528	50.74	1566.43	50	
2/22/05 20:15	566.002	554.975	866.2637	867.7706	529	37.00	1144.26		
2/22/05 20:30	558.8608	549.1283	876.4542	878.4052	531	27.86	772.418		
2/22/05 20:45	556.1724	547.0767	873.8704	875.7279	531	25.17	711.863		
2/22/05 21:00	554.9191	546.7604	873.238	875.0824	531	23.92	612.762		
2/22/05 21:15	553.6187	545.7773	875.0209	876.7194	531	22.62	583.02		
2/22/05 21:30	528.0092	526.1494	826.0601	827.7929	524	4.01	0	RX tripped at 21:18	
2/22/05 21:45	531.4954	529.6996	851.4368	852.9307	527	4.50	0		
2/22/05 22:00	531.9566	529.9861	854.554	856.0984	528	3.96	0		
2/22/05 22:15	532.7553	530.8712	861.4042	863.3385	529	3.76	0		
2/22/05 22:30	537.0707	535.1683	892.9442	895.0641	533	4.07	0		
2/22/05 22:45	537.0485	535.04	893.3041	894.1574	533	4.05	0		
2/22/05 23:00	536.9429	535.3205	892.8889	894.4975	533	3.94	0		
2/22/05 23:15	537.4091	534.8431	893.3578	894.4955	533	4.41	0		
2/22/05 23:30	536.9704	535.2005	893.1202	894.6226	533	3.97	0		
2/22/05 23:45	534.7727	533.3892	873.0486	874.682	530	4.77	0	started cooldown	
2/23/05 0:00	507.568	506.1674	682.9695	684.3099	502	5.57	0	at 23:40	
2/23/05 0:15	486.4295	485.2568	565.0845	567.0615	482	4.43	0		
2/23/05 0:30	477.68	475.6797	516.7318	518.6068	473	4.68	0		
2/23/05 0:45	455.5023	453.9149	411.658	413.5607	451	4.50	0		
2/23/05 1:00	430.1253	428.2714	312.3168	314.3121	425	5.13	0		
2/23/05 1:15	413.5529	412.3058	260.2605	262.4067	409	4.55	0		
2/23/05 1:30	390.885	389.1119	198.0988	200.5414	387	3.88	0		
2/23/05 1:45	369.2405	368.2268	150.1976	153.0631	366	3.24	0		
2/23/05 2:00	352.8415	350.7658	118.4433	121.7126	349	3.84	0	22A, 22B RCPs	
2/23/05 2:15	345.1859	343.6995	105.3893	106.6911	341	4.19	0	secured at 01:56	
2/23/05 2:30	333.6378	331.6456	87.99626	88.99712	329	4.64	0		
2/23/05 2:45	323.0352	321.4279	75.10741	76.11856	320	3.04	0		
2/23/05 3:00	316.7439	315.2555	67.55364	68.04358	314	2.74	0		
2/23/05 3:15	309.7081	307.7081	59.99987	60.46406	307	2.71	0		
2/23/05 3:30	303.925	302.502	53.75203	54.16422	301	2.92	0		
2/23/05 3:45	291.8372	290.0799	42.79893	42.7024	290	1.84	0		
2/23/05 4:00	283.292	281.8082	37.41241	37.11428	283	0.29	0		
2/23/05 4:15	284.2902	283.0165	37.65192	37.22566	284	0.29	0		
2/23/05 4:30	284.2399	283.4768	37.89143	37.33705	284	0.24	0		
2/23/05 4:45	284.4097	282.8159	38.13094	37.44844	283	1.41	0		
2/23/05 5:00	283.261	281.8333	38.00369	37.47907	283	0.26	0		
2/23/05 5:15	282.609	281.2734	37.46102	36.94158	283	-0.39	0		
2/23/05 5:30	282.2056	280.8308	36.91834	36.40408	282	0.21	0		
2/23/05 5:45	281.752	280.463	36.37567	35.86658	282	-0.25	0		
2/23/05 6:00	273.5653	272.2971	31.01966	30.17249	274	-0.43	0		
2/23/05 6:15	260.2524	258.7529	23.95011	22.08722	262	-1.75	0		



2/23/05 6:30	249.1637	247.2722	19.26105	17.22444	254	-4.84	0		
2/23/05 6:45	243.2102	242.1935	16.21292	14.05667	248	-4.79	0		
2/23/05 7:00	261.2776	252.1104	14.28907	12.09798	244	17.28	0		
2/23/05 7:15	251.0412	247.4352	13.05073	10.81788	241	10.04	0	Shutdown cooling	
2/23/05 7:30	236.9769	234.4763	13.5385	11.23184	242	-5.02	0	initiated at 07:21	
2/23/05 7:45	241.9588	238.4225	13.12522	10.53991	241	0.96	0		
2/23/05 8:00	226.6613	223.1887	11.31852	8.82128	237	-10.34	0		
2/23/05 8:15	212.6437	208.8708	8.247018	5.75316	229	-16.36	0	S/G Blowdown secured	

ATTACHMENT C  
INCONEL ALLOY 690 DATA

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THE ALLOY EXPERTS

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## INCONEL® alloy 690

INCONEL alloy 690 is a high-chromium nickel alloy having excellent resistance to many corrosive aqueous media and temperature atmospheres. The alloy's high chromium content gives it excellent resistance to aqueous corrosion by acids (especially nitric acid) and salts, and to sulfidation at high-temperatures. In addition to its corrosion resistance, 690 has high strength, good metallurgical stability, and favorable fabrication characteristics.

**UNS:** N06690**W.Nr.:** 2.4642**Technical Bulletin ([PDF, 165KB](#))****Available Product Forms:** Pipe, tube, plate, round bar and forging stock

### Technical Papers

Alloy Solutions to Metal Dusting Problems in the Petrochemical Industry ([PDF, 1.6MB](#))Performance of Commercial Alloys in Simulated Waste Incineration Environments ([PDF, 1.2M](#))The Role of Protective Scales in Enhancing Oxidation Resistance ([PDF, 2.34MB](#))[<<Back to Previous Page](#)[Home](#) | [About Us](#) | [Products](#) | [Services](#) | [Sales](#) | [Contact Us](#) | [Site Credits](#)

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INCONEL® alloy 690 (UNS N06690/W. Nr. 2.4642) is a high-chromium nickel alloy having excellent resistance to many corrosive aqueous media and high-temperature atmospheres. In addition to its corrosion resistance, alloy 690 has high strength, good metallurgical stability, and favorable fabrication characteristics.

The chemical composition of INCONEL alloy 690 is listed in Table 1. The substantial chromium content gives the alloy outstanding resistance to oxidizing chemicals and to high-temperature oxidizing gases. The high level of nickel imparts resistance to stress-corrosion cracking in chloride-containing environments as well as to sodium hydroxide solutions.

The properties of INCONEL alloy 690 are useful for various applications involving nitric or nitric/hydrofluoric acid solutions. Examples are tail-gas reheaters used in nitric acid production and heating coils and tanks for nitric/hydrofluoric solutions used in pickling of stainless steels and reprocessing of nuclear fuels.

The alloy's resistance to sulfur-containing gases makes it an attractive material for such applications as coal-gasification units, burners and ducts for processing sulfuric acid, furnaces for petrochemical processing, recuperators, incinerators, and glass vitrification equipment for radioactive waste disposal.

In various types of high-temperature water, alloy 690 displays low corrosion rates and excellent resistance to stress-corrosion cracking. Thus, alloy 690 is widely used for steam generator tubes, baffles, tubesheets, and hardware in nuclear power generation.

Table 1 - Limiting Chemical Composition, %, of INCONEL alloy 690\*

Nickel .....	58.0 min.
Chromium .....	27.0-31.0
Iron .....	7.0-11.0
Carbon .....	0.05 max.
Silicon .....	0.50 max.
Manganese .....	0.50 max.
Sulfur .....	0.015 max.
Copper .....	0.50 max.

\*Amendments for nuclear applications: 28-31 Cr, 0.04 max. C, 0.10 max. Co.

## Physical Constants and Thermal Properties

Table 2 gives melting range and some physical constants at room temperature for INCONEL alloy 690. Table 3 contains values for thermal and electrical properties over a range of temperatures. Values for specific heat were calculated; other values were measured. Modulus of elasticity in tension, determined by a dynamic method, is shown for temperatures to 1600°F (870°C) in Table 4. All measurements of physical properties were done on annealed specimens.

Table 2 - Physical Constants

Density, lb/in. <sup>3</sup> .....	0.296
Mg/m <sup>3</sup> .....	8.19
Melting Range, °F .....	2450-2510
°C .....	1343-1377
Specific Heat, Btu/lb-°F .....	0.107
J/kg-°C .....	450
Electrical Resistivity, ohm-circ mil/ft .....	691
μΩ-m .....	1.148
Permeability at 200 oersteds (15.9 kA/m) .....	1.001
Young's Modulus, 10 <sup>3</sup> ksi .....	30.6
GPa .....	211
Poisson's Ratio .....	0.289

Publication Number SMC-079

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INCONEL® alloy 690



**INCONEL® alloy 690**

Table 3 - Thermal and Electrical Properties

Temperature	Thermal Conductivity	Coefficient of Expansion <sup>a</sup>	Specific Heat	Electrical Resistivity
°F	Btu-in./ft <sup>2</sup> -h-°F	10 <sup>-6</sup> in./in.-°F	Btu/lb-°F	ohm-circ mil/ft
75	-	-	0.107	691
200	93	7.80	0.112	698
400	107	7.97	0.119	710
600	122	8.11	0.126	723
800	136	8.29	0.133	736
1000	151	8.53	0.140	745
1200	165	8.87	0.148	745
1400	179	9.14	0.155	749
1600	194	9.38	0.162	753
1800	207	9.63 <sup>b</sup>	0.169	760
2000	-	9.87 <sup>b</sup>	0.176	768
°C	W/m-°C	µm/m-°C	J/kg-°C	µΩ-m
25	-	-	450	1.148
100	13.5	14.06	471	1.162
200	15.4	14.31	497	1.180
300	17.3	14.53	525	1.199
400	19.1	14.80	551	1.219
500	21.0	15.19	578	1.235
600	22.9	15.70	604	1.239
700	24.8	16.18	631	1.241
800	26.6	16.60	658	1.247
900	28.5	17.01 <sup>b</sup>	684	1.255
1000	30.1	17.41 <sup>b</sup>	711	1.265
1100	-	17.79 <sup>b</sup>	738	1.278

<sup>a</sup>Between 75°F (24°C) and temperature shown.<sup>b</sup>Extrapolated values.

Table 4 - Modulus Data (Annealed)

Temperature, °F °C	Young's Modulus, 10 <sup>3</sup> ksi MPa	Shear Modulus, 10 <sup>3</sup> ksi MPa	Poisson's Ratio
70 21	30.0 206.9	11.5 79.3	0.30
200 93	29.3 202.0	11.35 78.3	0.29
400 204	28.5 196.5	10.95 75.5	0.30
600 316	27.6 190.3	10.5 72.4	0.31
800 427	26.6 183.4	10.15 70.0	0.31
1000 538	25.3 174.4	9.75 67.2	0.30
1200 649	23.9 164.8	9.35 64.5	0.28
1400 760	22.5 155.1	8.8 60.7	0.28
1600 871	21.3 146.9	8.2 56.5	0.30
1800 982	19.8 136.5	7.35 50.7	0.33
2000 1093	18.2 125.5	6.70 46.2	0.36 <sup>*</sup>

<sup>\*</sup> Extrapolated value.**Mechanical Properties**

INCONEL alloy 690 has high strength over a broad range of temperatures. Mechanical properties of the alloy vary with product form and temper. Alloy 690 is normally used in the annealed temper, and strength characteristics described below are representative of annealed material. The usual annealing temperature is approximately 1900°F (1040°C). The effect of different annealing temperatures on the tensile properties of cold-worked material is shown under "Fabrication" in Figure 8.

**Tensile Properties**

At room and elevated temperatures, INCONEL alloy 690 displays high yield and ultimate strengths along with good ductility. Table 5 lists results of room-temperature tensile tests on annealed material. As indicated by the values, tensile properties may vary with product form and size. At high temperatures, alloy 690 retains a substantial level of tensile properties with temperatures of over 1000°F (540°C) required to produce significant declines in strength. Figure 1 shows the results of short-time tensile tests performed at temperatures to 1800°F (982°C). The curves represent average values for both cold-worked and hot-worked products in the annealed temper.

**Fatigue Strength**

The results of low-cycle fatigue tests performed at room temperature are shown in Figure 2. The specimens were tested under axial strain with fully reversed loading.

ATTACHMENT D  
NUCLEAR INVENTORY FILE CEA14.NIF

Nuclide Inventory Name:

Normalized MACCS Sample 3412 MWth PWR Core Inventory

Power Level:

0.1000E+01

Nuclides:

14

Nuclide 001:

Kr-85

1

0.3382974720E+09

0.8500E+02

3.7180E+02

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 002:

Kr-85m

1

0.1612800000E+05

0.8500E+02

7.9679E+03

Kr-85 0.2100E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 003:

Kr-87

1

0.4578000000E+04

0.8700E+02

1.6208E+04

Rb-87 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 004:

Kr-88

1

0.1022400000E+05

0.8800E+02

2.2658E+04

Rb-88 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 005:

I-131

2

0.6946560000E+06

0.1310E+03

2.7562E+04

Xe-131m 0.1100E-01

none 0.0000E+00

none 0.0000E+00

Nuclide 006:

I-132

2

0.8280000000E+04

0.1320E+03

3.9464E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 007:

I-133

2

0.7488000000E+05

0.1330E+03

5.5715E+04

Xe-133m 0.2900E-01

Xe-133 0.9700E+00

none 0.0000E+00

Nuclide 008:

I-134

2

0.3156000000E+04

0.1340E+03

6.2858E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 009:

I-135

2

0.2379600000E+05

0.1350E+03

5.2964E+04

Xe-135m 0.1500E+00

Xe-135 0.8500E+00

none 0.0000E+00

Nuclide 010:

Xe-133

1

0.4531680000E+06

0.1330E+03

5.5707E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 011:

Xe-135

1

0.3272400000E+05

0.1350E+03

1.7708E+04

Cs-135 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 012:

Xe-133m

1

0.1892200000E+06

0.1330E+03

1.7354E+03

Xe-133 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 013:

Xe-135m

1

0.9180000000E+03

0.1350E+03

1.1635E+04

Xe-135 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 014:

Xe-138

1

0.8460000000E+03

0.1380E+03

4.9330E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

End of Nuclear Inventory File



ATTACHMENT E  
NUCLEAR INVENTORY FILE PRI14.NIF

Nuclide Inventory Name:

Normalized MACCS Sample 3412 MWth PWR Core Inventory

Power Level:

0.1000E+01

Nuclides:

14

Nuclide 001:

Kr-85

1

0.3382974720E+09

0.8500E+02

7.9975E+03

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 002:

Kr-85m

1

0.1612800000E+05

0.8500E+02

4.1975E+02

Kr-85 0.2100E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 003:

Kr-87

1

0.4578000000E+04

0.8700E+02

2.4238E+02

Rb-87 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 004:

Kr-88

1

0.1022400000E+05

0.8800E+02

7.5473E+02

Rb-88 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 005:

I-131

2

0.6946560000E+06

0.1310E+03

8.0357E+01

Xe-131m 0.1100E-01

none 0.0000E+00

none 0.0000E+00

Nuclide 006:

I-132

2

0.8280000000E+04

0.1320E+03

2.6686E+01

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 007:

I-133

2

0.7488000000E+05

0.1330E+03

1.1319E+02

Xe-133m 0.2900E-01

Xe-133 0.9700E+00

none 0.0000E+00

Nuclide 008:

I-134

2

0.3156000000E+04

0.1340E+03

1.5266E+01

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 009:

I-135

2

0.2379600000E+05

0.1350E+03

6.2112E+01

Xe-135m 0.1500E+00

Xe-135 0.8500E+00

none 0.0000E+00

Nuclide 010:

Xe-133

1

0.4531680000E+06

0.1330E+03

8.2574E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 011:

Xe-135

1

0.3272400000E+05

0.1350E+03

1.9726E+03

Cs-135 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 012:

Xe-133m

1

0.1892200000E+06

0.1330E+03

1.1764E+03

Xe-133 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 013:

Xe-135m

1

0.9180000000E+03

0.1350E+03

2.5814E+02

Xe-135 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 014:

Xe-138

1

0.8460000000E+03

0.1380E+03

1.3622E+02

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

End of Nuclear Inventory File

ATTACHMENT F  
NUCLEAR INVENTORY FILE SEC05.NIF

Nuclide Inventory Name:

Normalized MACCS Sample 3412 MWth PWR Core Inventory

Power Level:

0.1000E+01

Nuclides:

05

Nuclide 001:

I-131

2

0.6946560000E+06

0.1310E+03

1.1172E+01

Xe-131m 0.1100E-01

none 0.0000E+00

none 0.0000E+00

Nuclide 002:

I-132

2

0.8280000000E+04

0.1320E+03

2.8485E-01

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 003:

I-133

2

0.7488000000E+05

0.1330E+03

7.1866E+00

Xe-133m 0.2900E-01

Xe-133 0.9700E+00

none 0.0000E+00

Nuclide 004:

I-134

2

0.3156000000E+04

0.1340E+03

6.5297E-02

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 005:

I-135

2

0.2379600000E+05

0.1350E+03

1.7003E+00

Xe-135m 0.1500E+00

Xe-135 0.8500E+00

none 0.0000E+00  
End of Nuclear Inventory File

ATTACHMENT G  
NUCLEAR INVENTORY FILE CRCB63.NIF

Nuclide Inventory Name:

Normalized MACCS Sample 3412 MWth PWR Core Inventory

Power Level:

0.1000E+01

Nuclides:

63

Nuclide 001:

Co-58

7

0.6117120000E+07

0.5800E+02

8.0012E+02

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 002:

Co-60

7

0.1663401096E+09

0.6000E+02

9.8625E+02

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 003:

Kr-85

1

0.3382974720E+09

0.8500E+02

3.7180E+02

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 004:

Kr-85m

1

0.1612800000E+05

0.8500E+02

7.9679E+03

Kr-85 0.2100E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 005:

Kr-87

1

0.4578000000E+04

0.8700E+02

1.6208E+04

Rb-87 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 006:

Kr-88

1

0.1022400000E+05

0.8800E+02

2.2658E+04

Rb-88 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 007:

Rb-86

3

0.1612224000E+07

0.8600E+02

5.9034E+01

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 008:

Sr-89

5

0.4363200000E+07

0.8900E+02

3.3293E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 009:

Sr-90

5

0.9189573120E+09

0.9000E+02

3.1769E+03

Y-90 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 010:

Sr-91

5

0.3420000000E+05

0.9100E+02

3.8931E+04

Y-91m 0.5800E+00

Y-91 0.4200E+00

none 0.0000E+00

Nuclide 011:

Sr-92

5

0.9756000000E+04

0.9200E+02

4.0190E+04

Y-92 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 012:

Y-90

9

0.2304000000E+06

0.9000E+02

3.4567E+03

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 013:

Y-91

9

0.5055264000E+07

0.9100E+02

4.2527E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 014:

Y-92

9

0.1274400000E+05

0.9200E+02

4.0519E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 015:

Y-93

9

0.3636000000E+05

0.9300E+02

2.9622E+04

Zr-93 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 016:

Zr-95

9

0.5527872000E+07

0.9500E+02

5.8246E+04

Nb-95m 0.7000E-02

Nb-95 0.9900E+00

none 0.0000E+00

Nuclide 017:

Zr-97

9

0.6084000000E+05

0.9700E+02

4.9425E+04

Nb-97m 0.9500E+00

Nb-97 0.5300E-01



none 0.0000E+00

Nuclide 018:

Nb-95

9

0.3036960000E+07

0.9500E+02

6.0839E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 019:

Mo-99

7

0.2376000000E+06

0.9900E+02

5.0834E+04

Tc-99m 0.8800E+00

Tc-99 0.1200E+00

none 0.0000E+00

Nuclide 020:

Tc-99m

7

0.2167200000E+05

0.9900E+02

4.5424E+04

Tc-99 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 021:

Ru-103

7

0.3393792000E+07

0.1030E+03

4.8774E+04

Rh-103m 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 022:

Ru-105

7

0.1598400000E+05

0.1050E+03

3.1455E+04

Rh-105 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 023:

Ru-106

7

0.3181248000E+08

0.1060E+03

1.9695E+04

Rh-106 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 024:

Rh-105

7

0.1272960000E+06

0.1050E+03

2.8507E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 025:

Sb-127

4

0.3326400000E+06

0.1270E+03

2.4299E+03

Te-127m 0.1800E+00

Te-127 0.8200E+00

none 0.0000E+00

Nuclide 026:

Sb-129

4

0.1555200000E+05

0.1290E+03

8.7888E+03

Te-129m 0.2200E+00

Te-129 0.7700E+00

none 0.0000E+00

Nuclide 027:

Te-127

4

0.3366000000E+05

0.1270E+03

2.4664E+03

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 028:

Te-127m

4

0.9417600000E+07

0.1270E+03

4.6272E+02

Te-127 0.9800E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 029:

Te-129

4

0.4176000000E+04

0.1290E+03

8.4012E+03

I-129 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 030:

Te-129m

4

0.2903040000E+07

0.1290E+03

1.8872E+03

Te-129 0.6500E+00

I-129 0.3500E+00

none 0.0000E+00

Nuclide 031:

Te-131m

4

0.1080000000E+06

0.1310E+03

5.0686E+03

Te-131 0.2200E+00

I-131 0.7800E+00

none 0.0000E+00

Nuclide 032:

Te-132

4

0.2815200000E+06

0.1320E+03

3.8391E+04

I-132 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 033:

I-131

2

0.6946560000E+06

0.1310E+03

2.7562E+04

Xe-131m 0.1100E-01

none 0.0000E+00

none 0.0000E+00

Nuclide 034:

I-132

2

0.8280000000E+04

0.1320E+03

3.9464E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 035:

I-133

2

0.7488000000E+05

0.1330E+03

5.5715E+04

Xe-133m 0.2900E-01

Xe-133 0.9700E+00

none 0.0000E+00

Nuclide 036:

I-134

2

0.3156000000E+04

0.1340E+03

6.2858E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 037:

I-135

2

0.2379600000E+05

0.1350E+03

5.2964E+04

Xe-135m 0.1500E+00

Xe-135 0.8500E+00

none 0.0000E+00

Nuclide 038:

Xe-133

1

0.4531680000E+06

0.1330E+03

5.5707E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 039:

Xe-135

1

0.3272400000E+05

0.1350E+03

1.7708E+04

Cs-135 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 040:

Cs-134

3

0.6507177120E+08

0.1340E+03

7.1917E+03

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 041:

Cs-136

3

0.1131840000E+07

0.1360E+03

1.7111E+03

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 042:

Cs-137

3

0.9467280000E+09

0.1370E+03

4.7857E+03

Ba-137m 0.9500E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 043:

Ba-139

6

0.4962000000E+04

0.1390E+03

5.1001E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 044:

Ba-140

6

0.1100736000E+07

0.1400E+03

5.2928E+04

La-140 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 045:

La-140

9

0.1449792000E+06

0.1400E+03

5.4255E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 046:

La-141

9

0.1414800000E+05

0.1410E+03

4.6433E+04

Ce-141 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 047:

La-142

9

0.5550000000E+04

0.1420E+03

4.4898E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 048:

Ce-141

8

0.2808086400E+07

0.1410E+03

5.1883E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 049:

Ce-143

8

0.1188000000E+06

0.1430E+03

4.4327E+04

Pr-143 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 050:

Ce-144

8

0.2456352000E+08

0.1440E+03

4.2317E+04

Pr-144m 0.1800E-01

Pr-144 0.9800E+00

none 0.0000E+00

Nuclide 051:

Pr-143

9

0.1171584000E+07

0.1430E+03

4.6904E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

Nuclide 052:

Nd-147

9

0.9486720000E+06

0.1470E+03

1.9151E+04

Pm-147 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 053:

Np-239

8

0.2034720000E+06

0.2390E+03

5.5833E+05

Pu-239 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 054:

Pu-238

8

0.2768863824E+10

0.2380E+03

1.7259E+02

U-234 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 055:

Pu-239

8

0.7594336440E+12

0.2390E+03

1.1469E+01

U-235 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 056:

Pu-240

8

0.2062920312E+12

0.2400E+03

2.0026E+01

U-236 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 057:

Pu-241

8

0.4544294400E+09

0.2410E+03

4.9593E+03

U-237 0.2400E-04

Am-241 0.1000E+01

none 0.0000E+00

Nuclide 058:

Am-241

9

0.1363919472E+11

0.2410E+03

7.3183E+00

Np-237 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 059:

Cm-242

9

0.1406592000E+08

0.2420E+03

2.0078E+03

Pu-238 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 060:

Cm-244

9

0.571508136E+9

0.2440E+03

3.1650E+02

Pu-240 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 061:

Xe-133m

1

1.8922000000E+05

0.1330E+03

1.7354E+03

Xe-133 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 062:

Xe-135m

1

9.1800000000E+02

0.1350E+03

1.1635E+04

Xe-135 0.1000E+01

none 0.0000E+00

none 0.0000E+00

Nuclide 063:

Xe-138

1

8.4600000000E+02

0.1380E+03

4.9330E+04

none 0.0000E+00

none 0.0000E+00

none 0.0000E+00

End of Nuclear Inventory File



ATTACHMENT H  
RELEASE FRACTION AND TIMING FILE CEAFFI.RFT

Release Fraction and Timing Name:

PWR, RG 1.183, Table 2 Section 3.2

Duration (h): Design Basis Accident

0.0001E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Noble Gases:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Iodine:

0.0420E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cesium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Tellurium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Strontium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Barium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Ruthenium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cerium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Lanthanum:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Non-Radioactive Aerosols (kg):

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

End of Release File

ATTACHMENT I  
RELEASE FRACTION AND TIMING FILE CEAFN.RFT

Release Fraction and Timing Name:

PWR, RG 1.183, Table 2 Section 3.2

Duration (h): Design Basis Accident

0.0001E+00 0.0000E+00 0.0000E+00 0.0000E+00

Noble Gases:

0.0820E+00 0.0000E+00 0.0000E+00 0.0000E+00

Iodine:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Cesium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Tellurium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Strontium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Barium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Ruthenium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Cerium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Lanthanum:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Non-Radioactive Aerosols (kg):

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

End of Release File

ATTACHMENT J  
RELEASE FRACTION AND TIMING FILE CEAPRI.RFT

Release Fraction and Timing Name:

PWR, RG 1.183, Table 2 Section 3.2

Duration (h): Design Basis Accident

0.0001E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Noble Gases:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Iodine:

1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cesium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Tellurium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Strontium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Barium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Ruthenium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cerium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Lanthanum:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Non-Radioactive Aerosols (kg):

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

End of Release File

ATTACHMENT K  
RELEASE FRACTION AND TIMING FILE CEAPRN.RFT

Release Fraction and Timing Name:

PWR, RG 1.183, Table 2 Section 3.2

Duration (h): Design Basis Accident

0.0001E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Noble Gases:

1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Iodine:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cesium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Tellurium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Strontium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Barium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Ruthenium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cerium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Lanthanum:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Non-Radioactive Aerosols (kg):

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

End of Release File

ATTACHMENT L  
RELEASE FRACTION AND TIMING FILE CEASEC.RFT

Release Fraction and Timing Name:

PWR, RG 1.183, Table 2 Section 3.2

Duration (h): Design Basis Accident

0.0001E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Noble Gases:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Iodine:

1.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cesium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Tellurium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Strontium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Barium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Ruthenium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Cerium:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Lanthanum:

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

Non-Radioactive Aerosols (kg):

0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
------------	------------	------------	------------

End of Release File

ATTACHMENT M  
RELEASE FRACTION AND TIMING FILE CEACTIONT.RFT

Release Fraction and Timing Name:

PWR, RG 1.183, Table 2 Section 3.2

Duration (h): Design Basis Accident

0.0001E+00 0.0000E+00 0.0000E+00 0.0000E+00

Noble Gases:

0.0820E+00 0.0000E+00 0.0000E+00 0.0000E+00

Iodine:

0.0220E+00 0.0000E+00 0.0000E+00 0.0000E+00

Cesium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Tellurium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Strontium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Barium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Ruthenium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Cerium:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Lanthanum:

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

Non-Radioactive Aerosols (kg):

0.0000E+00 0.0000E+00 0.0000E+00 0.0000E+00

End of Release File

ATTACHMENT N  
CONVERSION FACTORS FILE FGR63.INP

FGRDCF 10/24/95 03:24:50 beta-test version 1.10, minor FORTRAN fixes 5/4/95

Implicit daughter half-lives (m) less than 90 and less than 0.100 of parent

9 ORGANS DEFINED IN THIS FILE:

GONADS  
BREAST  
LUNGS  
RED MARR  
BONE SUR  
THYROID  
REMAINDER  
EFFECTIVE  
SKIN(FGR)

63 NUCLIDES DEFINED IN THIS FILE:

Co-58	Y	
Co-60	Y	
Kr-85		
Kr-85m		
Kr-87		
Kr-88		
Rb-86	D	
Sr-89	Y	
Sr-90	Y	
Sr-91	Y	Including:Y-91m
Sr-92	Y	
Y-90	Y	
Y-91	Y	
Y-92	Y	
Y-93	Y	
Zr-95	D	
Zr-97	Y	Including:Nb-97m , Including:Nb-97
Nb-95	Y	
Mo-99	Y	
Tc-99m	D	
Ru-103	Y	Including:Rh-103m
Ru-105	Y	
Ru-106	Y	Including:Rh-106
Rh-105	Y	
Sb-127	W	
Sb-129	W	
Te-127	W	
Te-127m	W	
Te-129	W	
Te-129m	W	Including:Te-129
Te-131m	W	Including:Te-131
Te-132	W	
I-131	D	
I-132	D	
I-133	D	
I-134	D	
I-135	D	Including:Xe-135m

Xe-133  
Xe-135  
Cs-134 D  
Cs-136 D  
Cs-137 D Including:Ba-137m  
Ba-139 D  
Ba-140 D  
La-140 W  
La-141 D  
La-142 D  
Ce-141 Y  
Ce-143 Y  
Ce-144 Y Including:Pr-144m, Including:Pr-144  
Pr-143 Y  
Nd-147 Y  
Np-239 W  
Pu-238 Y  
Pu-239 Y  
Pu-240 Y  
Pu-241 Y  
Am-241 W  
Cm-242 W  
Cm-244 W  
Xe-133m  
Xe-135m  
Xe-138

	CLOUDSHINE	GROUND SHINE 8HR	GROUND SHINE 7DAY	GROUND SHINE RATE	INHALED ACUTE	INHALED CHRONIC	INGESTION
Co-58							
GONADS	4.660E-14	2.867E-11	5.828E-10	9.970E-16	-1.000E+00	6.170E-10	1.040E-09
BREAST	5.300E-14	2.737E-11	5.565E-10	9.520E-16	-1.000E+00	9.370E-10	1.790E-10
LUNGS	4.640E-14	2.617E-11	5.319E-10	9.100E-16	-1.000E+00	1.600E-08	8.530E-11
RED MARR	4.530E-14	2.671E-11	5.430E-10	9.290E-16	-1.000E+00	9.230E-10	2.600E-10
BONE SUR	7.410E-14	3.795E-11	7.716E-10	1.320E-15	-1.000E+00	6.930E-10	1.250E-10
THYROID	4.770E-14	2.720E-11	5.530E-10	9.460E-16	-1.000E+00	8.720E-10	6.310E-11
REMAINDER	4.440E-14	2.585E-11	5.255E-10	8.990E-16	-1.000E+00	1.890E-09	1.580E-09
EFFECTIVE	4.760E-14	2.732E-11	5.553E-10	9.500E-16	-1.000E+00	2.940E-09	8.090E-10
SKIN(FGR)	5.580E-14	3.278E-11	6.664E-10	1.140E-15	-1.000E+00	0.000E+00	0.000E+00
Co-60							
GONADS	1.230E-13	7.056E-11	1.480E-09	2.450E-15	-1.000E+00	4.760E-09	3.190E-09
BREAST	1.390E-13	6.739E-11	1.413E-09	2.340E-15	-1.000E+00	1.840E-08	1.100E-09
LUNGS	1.240E-13	6.537E-11	1.371E-09	2.270E-15	-1.000E+00	3.450E-07	8.770E-10
RED MARR	1.230E-13	6.710E-11	1.407E-09	2.330E-15	-1.000E+00	1.720E-08	1.320E-09
BONE SUR	1.780E-13	8.956E-11	1.879E-09	3.110E-15	-1.000E+00	1.350E-08	9.390E-10
THYROID	1.270E-13	6.480E-11	1.359E-09	2.250E-15	-1.000E+00	1.620E-08	7.880E-10
REMAINDER	1.200E-13	6.508E-11	1.365E-09	2.260E-15	-1.000E+00	3.600E-08	4.970E-09
EFFECTIVE	1.260E-13	6.768E-11	1.419E-09	2.350E-15	-1.000E+00	5.910E-08	2.770E-09
SKIN(FGR)	1.450E-13	7.948E-11	1.667E-09	2.760E-15	-1.000E+00	0.000E+00	0.000E+00
Kr-85							
GONADS	1.170E-16	8.121E-14	1.704E-12	2.820E-18	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.340E-16	7.891E-14	1.656E-12	2.740E-18	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.140E-16	7.056E-14	1.481E-12	2.450E-18	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.090E-16	6.998E-14	1.469E-12	2.430E-18	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	2.200E-16	1.287E-13	2.702E-12	4.470E-18	-1.000E+00	0.000E+00	0.000E+00



THYROID	1.180E-16	7.459E-14	1.565E-12	2.590E-18	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.090E-16	6.941E-14	1.457E-12	2.410E-18	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.190E-16	7.603E-14	1.596E-12	2.640E-18	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.320E-14	2.304E-11	4.835E-10	8.000E-16	-1.000E+00	0.000E+00	0.000E+00
Kr-85m							
GONADS	7.310E-15	2.594E-12	3.653E-12	1.570E-16	-1.000E+00	0.000E+00	0.000E+00
BREAST	8.410E-15	2.527E-12	3.560E-12	1.530E-16	-1.000E+00	0.000E+00	0.000E+00
LUNGS	7.040E-15	2.379E-12	3.351E-12	1.440E-16	-1.000E+00	0.000E+00	0.000E+00
RED MARR	6.430E-15	2.346E-12	3.304E-12	1.420E-16	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	1.880E-14	5.286E-12	7.446E-12	3.200E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	7.330E-15	2.395E-12	3.374E-12	1.450E-16	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	6.640E-15	2.313E-12	3.257E-12	1.400E-16	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	7.480E-15	2.511E-12	3.537E-12	1.520E-16	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	2.240E-14	2.247E-11	3.164E-11	1.360E-15	-1.000E+00	0.000E+00	0.000E+00
Kr-87							
GONADS	4.000E-14	4.962E-12	5.026E-12	7.610E-16	-1.000E+00	0.000E+00	0.000E+00
BREAST	4.500E-14	4.740E-12	4.802E-12	7.270E-16	-1.000E+00	0.000E+00	0.000E+00
LUNGS	4.040E-14	4.603E-12	4.663E-12	7.060E-16	-1.000E+00	0.000E+00	0.000E+00
RED MARR	4.000E-14	4.708E-12	4.769E-12	7.220E-16	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	6.020E-14	6.514E-12	6.598E-12	9.990E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	4.130E-14	4.473E-12	4.531E-12	6.860E-16	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	3.910E-14	4.590E-12	4.650E-12	7.040E-16	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	4.120E-14	4.773E-12	4.835E-12	7.320E-16	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.370E-13	8.802E-11	8.916E-11	1.350E-14	-1.000E+00	0.000E+00	0.000E+00
Kr-88							
GONADS	9.900E-14	2.278E-11	2.655E-11	1.800E-15	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.110E-13	2.177E-11	2.537E-11	1.720E-15	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.010E-13	2.139E-11	2.493E-11	1.690E-15	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.000E-13	2.190E-11	2.552E-11	1.730E-15	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	1.390E-13	2.886E-11	3.363E-11	2.280E-15	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.030E-13	2.012E-11	2.345E-11	1.590E-15	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	9.790E-14	2.139E-11	2.493E-11	1.690E-15	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.020E-13	2.202E-11	2.567E-11	1.740E-15	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.350E-13	5.607E-11	6.534E-11	4.430E-15	-1.000E+00	0.000E+00	0.000E+00
Rb-86							
GONADS	4.710E-15	2.788E-12	5.187E-11	9.740E-17	-1.000E+00	1.340E-09	2.150E-09
BREAST	5.340E-15	2.662E-12	4.953E-11	9.300E-17	-1.000E+00	1.330E-09	2.140E-09
LUNGS	4.710E-15	2.553E-12	4.750E-11	8.920E-17	-1.000E+00	3.300E-09	2.140E-09
RED MARR	4.640E-15	2.619E-12	4.873E-11	9.150E-17	-1.000E+00	2.320E-09	3.720E-09
BONE SUR	7.050E-15	3.635E-12	6.764E-11	1.270E-16	-1.000E+00	4.270E-09	6.860E-09
THYROID	4.840E-15	2.599E-12	4.836E-11	9.080E-17	-1.000E+00	1.330E-09	2.140E-09
REMAINDER	4.520E-15	2.542E-12	4.729E-11	8.880E-17	-1.000E+00	1.380E-09	2.330E-09
EFFECTIVE	4.810E-15	2.665E-12	4.958E-11	9.310E-17	-1.000E+00	1.790E-09	2.530E-09
SKIN(FGR)	4.850E-14	2.210E-10	4.111E-09	7.720E-15	-1.000E+00	0.000E+00	0.000E+00
Sr-89							
GONADS	7.730E-17	7.155E-14	1.436E-12	2.490E-18	-1.000E+00	7.950E-12	8.050E-12
BREAST	9.080E-17	7.212E-14	1.447E-12	2.510E-18	-1.000E+00	7.960E-12	7.980E-12
LUNGS	7.080E-17	5.689E-14	1.142E-12	1.980E-18	-1.000E+00	8.350E-08	7.970E-12
RED MARR	6.390E-17	5.345E-14	1.073E-12	1.860E-18	-1.000E+00	1.070E-10	1.080E-10
BONE SUR	1.940E-16	1.560E-13	3.131E-12	5.430E-18	-1.000E+00	1.590E-10	1.610E-10
THYROID	7.600E-17	6.063E-14	1.217E-12	2.110E-18	-1.000E+00	7.960E-12	7.970E-12
REMAINDER	6.710E-17	5.603E-14	1.124E-12	1.950E-18	-1.000E+00	3.970E-09	8.250E-09
EFFECTIVE	7.730E-17	6.523E-14	1.309E-12	2.270E-18	-1.000E+00	1.120E-08	2.500E-09
SKIN(FGR)	3.690E-14	1.914E-10	3.841E-09	6.660E-15	-1.000E+00	0.000E+00	0.000E+00

Sr-90

GONADS	7.780E-18	9.590E-15	2.014E-13	3.330E-19	-1.000E+00	2.690E-10	5.040E-11
BREAST	9.490E-18	1.008E-14	2.116E-13	3.500E-19	-1.000E+00	2.690E-10	5.040E-11
LUNGS	6.440E-18	6.307E-15	1.324E-13	2.190E-19	-1.000E+00	2.860E-06	5.040E-11
RED MARR	5.440E-18	5.558E-15	1.167E-13	1.930E-19	-1.000E+00	3.280E-08	6.450E-09
BONE SUR	2.280E-17	2.393E-14	5.025E-13	8.310E-19	-1.000E+00	7.090E-08	1.390E-08
THYROID	7.330E-18	7.171E-15	1.506E-13	2.490E-19	-1.000E+00	2.690E-10	5.040E-11
REMAINDER	6.110E-18	6.422E-15	1.348E-13	2.230E-19	-1.000E+00	5.730E-09	6.700E-09
EFFECTIVE	7.530E-18	8.179E-15	1.717E-13	2.840E-19	-1.000E+00	3.510E-07	3.230E-09
SKIN(FGR)	9.200E-15	4.032E-12	8.465E-11	1.400E-16	-1.000E+00	0.000E+00	0.000E+00

Sr-91

GONADS	4.819E-14	2.155E-11	5.062E-11	1.026E-15	-1.000E+00	5.669E-11	2.520E-10
BREAST	5.477E-14	2.059E-11	4.838E-11	9.806E-16	-1.000E+00	1.775E-11	3.676E-11
LUNGS	4.803E-14	1.970E-11	4.626E-11	9.376E-16	-1.000E+00	2.170E-09	1.055E-11
RED MARR	4.691E-14	2.011E-11	4.722E-11	9.570E-16	-1.000E+00	2.275E-11	5.659E-11
BONE SUR	7.674E-14	2.852E-11	6.709E-11	1.360E-15	-1.000E+00	1.306E-11	2.070E-11
THYROID	4.938E-14	2.035E-11	4.782E-11	9.693E-16	-1.000E+00	9.930E-12	1.968E-12
REMAINDER	4.610E-14	1.948E-11	4.573E-11	9.268E-16	-1.000E+00	5.802E-10	2.557E-09
EFFECTIVE	4.924E-14	2.057E-11	4.832E-11	9.793E-16	-1.000E+00	4.547E-10	8.455E-10
SKIN(FGR)	9.938E-14	1.748E-10	3.987E-10	8.080E-15	-1.000E+00	0.000E+00	0.000E+00

Sr-92

GONADS	6.610E-14	1.593E-11	1.830E-11	1.300E-15	-1.000E+00	1.020E-11	8.180E-11
BREAST	7.480E-14	1.520E-11	1.745E-11	1.240E-15	-1.000E+00	6.490E-12	1.700E-11
LUNGS	6.670E-14	1.483E-11	1.703E-11	1.210E-15	-1.000E+00	1.050E-09	7.220E-12
RED MARR	6.620E-14	1.520E-11	1.745E-11	1.240E-15	-1.000E+00	6.980E-12	2.290E-11
BONE SUR	9.490E-14	2.010E-11	2.308E-11	1.640E-15	-1.000E+00	4.360E-12	8.490E-12
THYROID	6.820E-14	1.446E-11	1.661E-11	1.180E-15	-1.000E+00	3.920E-12	1.300E-12
REMAINDER	6.450E-14	1.471E-11	1.689E-11	1.200E-15	-1.000E+00	2.900E-10	1.720E-09
EFFECTIVE	6.790E-14	1.532E-11	1.759E-11	1.250E-15	-1.000E+00	2.180E-10	5.430E-10
SKIN(FGR)	8.560E-14	2.280E-11	2.618E-11	1.860E-15	-1.000E+00	0.000E+00	0.000E+00

Y-90

GONADS	1.890E-16	1.586E-13	1.601E-12	5.750E-18	-1.000E+00	5.170E-13	1.430E-14
BREAST	2.200E-16	1.578E-13	1.593E-12	5.720E-18	-1.000E+00	5.170E-13	1.270E-14
LUNGS	1.770E-16	1.313E-13	1.326E-12	4.760E-18	-1.000E+00	9.310E-09	1.260E-14
RED MARR	1.620E-16	1.261E-13	1.273E-12	4.570E-18	-1.000E+00	1.520E-11	3.700E-13
BONE SUR	4.440E-16	3.228E-13	3.259E-12	1.170E-17	-1.000E+00	1.510E-11	3.670E-13
THYROID	1.870E-16	1.385E-13	1.398E-12	5.020E-18	-1.000E+00	5.170E-13	1.260E-14
REMAINDER	1.680E-16	1.291E-13	1.303E-12	4.680E-18	-1.000E+00	3.870E-09	9.680E-09
EFFECTIVE	1.900E-16	1.468E-13	1.482E-12	5.320E-18	-1.000E+00	2.280E-09	2.910E-09
SKIN(FGR)	6.240E-14	2.897E-10	2.924E-09	1.050E-14	-1.000E+00	0.000E+00	0.000E+00

Y-91

GONADS	2.560E-16	1.756E-13	3.546E-12	6.110E-18	-1.000E+00	8.200E-12	3.540E-12
BREAST	2.930E-16	1.713E-13	3.459E-12	5.960E-18	-1.000E+00	8.920E-12	5.540E-13
LUNGS	2.500E-16	1.526E-13	3.082E-12	5.310E-18	-1.000E+00	9.870E-08	2.020E-13
RED MARR	2.410E-16	1.521E-13	3.070E-12	5.290E-18	-1.000E+00	3.190E-10	6.590E-12
BONE SUR	4.560E-16	2.903E-13	5.862E-12	1.010E-17	-1.000E+00	3.180E-10	6.130E-12
THYROID	2.600E-16	1.564E-13	3.157E-12	5.440E-18	-1.000E+00	8.500E-12	1.290E-13
REMAINDER	2.390E-16	1.509E-13	3.047E-12	5.250E-18	-1.000E+00	4.200E-09	8.570E-09
EFFECTIVE	2.600E-16	1.650E-13	3.332E-12	5.740E-18	-1.000E+00	1.320E-08	2.570E-09
SKIN(FGR)	3.850E-14	1.989E-10	4.016E-09	6.920E-15	-1.000E+00	0.000E+00	0.000E+00

Y-92

GONADS	1.270E-14	3.855E-12	4.872E-12	2.650E-16	-1.000E+00	2.610E-12	1.960E-11
BREAST	1.440E-14	3.680E-12	4.652E-12	2.530E-16	-1.000E+00	1.500E-12	3.550E-12
LUNGS	1.270E-14	3.535E-12	4.468E-12	2.430E-16	-1.000E+00	1.240E-09	1.390E-12

RED MARR	1.250E-14	3.608E-12	4.560E-12	2.480E-16	-1.000E+00	2.070E-12	4.910E-12
BONE SUR	1.950E-14	5.091E-12	6.435E-12	3.500E-16	-1.000E+00	1.510E-12	1.750E-12
THYROID	1.300E-14	3.579E-12	4.523E-12	2.460E-16	-1.000E+00	1.050E-12	1.770E-13
REMAINDER	1.220E-14	3.506E-12	4.431E-12	2.410E-16	-1.000E+00	2.030E-10	1.700E-09
EFFECTIVE	1.300E-14	3.680E-12	4.652E-12	2.530E-16	-1.000E+00	2.110E-10	5.150E-10
SKIN(FGR)	1.140E-13	2.022E-10	2.556E-10	1.390E-14	-1.000E+00	0.000E+00	0.000E+00
Y-93							
GONADS	4.670E-15	2.108E-12	4.989E-12	9.510E-17	-1.000E+00	5.310E-12	2.200E-11
BREAST	5.300E-15	2.026E-12	4.794E-12	9.140E-17	-1.000E+00	1.740E-12	3.130E-12
LUNGS	4.680E-15	1.937E-12	4.585E-12	8.740E-17	-1.000E+00	2.520E-09	8.670E-13
RED MARR	4.580E-15	1.972E-12	4.669E-12	8.900E-17	-1.000E+00	4.040E-12	4.930E-12
BONE SUR	7.580E-15	2.948E-12	6.977E-12	1.330E-16	-1.000E+00	3.140E-12	1.730E-12
THYROID	4.790E-15	1.908E-12	4.516E-12	8.610E-17	-1.000E+00	9.260E-13	1.260E-13
REMAINDER	4.510E-15	1.919E-12	4.543E-12	8.660E-17	-1.000E+00	9.250E-10	4.090E-09
EFFECTIVE	4.800E-15	2.021E-12	4.784E-12	9.120E-17	-1.000E+00	5.820E-10	1.230E-09
SKIN(FGR)	8.500E-14	2.726E-10	6.452E-10	1.230E-14	-1.000E+00	0.000E+00	0.000E+00
Zr-95							
GONADS	3.530E-14	2.182E-11	4.421E-10	7.590E-16	-1.000E+00	1.880E-09	8.160E-10
BREAST	4.010E-14	2.084E-11	4.223E-10	7.250E-16	-1.000E+00	1.910E-09	1.050E-10
LUNGS	3.510E-14	1.989E-11	4.030E-10	6.920E-16	-1.000E+00	2.170E-09	2.340E-11
RED MARR	3.430E-14	2.030E-11	4.112E-10	7.060E-16	-1.000E+00	1.300E-08	2.140E-10
BONE SUR	5.620E-14	2.875E-11	5.824E-10	1.000E-15	-1.000E+00	1.030E-07	4.860E-10
THYROID	3.610E-14	2.076E-11	4.205E-10	7.220E-16	-1.000E+00	1.440E-09	8.270E-12
REMAINDER	3.360E-14	1.963E-11	3.978E-10	6.830E-16	-1.000E+00	2.280E-09	2.530E-09
EFFECTIVE	3.600E-14	2.078E-11	4.211E-10	7.230E-16	-1.000E+00	6.390E-09	1.020E-09
SKIN(FGR)	4.500E-14	2.561E-11	5.190E-10	8.910E-16	-1.000E+00	0.000E+00	0.000E+00
Zr-97							
GONADS	4.331E-14	2.179E-11	7.799E-11	9.253E-16	-1.000E+00	1.840E-10	6.228E-10
BREAST	4.928E-14	2.083E-11	7.455E-11	8.846E-16	-1.000E+00	4.706E-11	8.137E-11
LUNGS	4.322E-14	1.992E-11	7.127E-11	8.456E-16	-1.000E+00	4.108E-09	1.770E-11
RED MARR	4.224E-14	2.034E-11	7.279E-11	8.634E-16	-1.000E+00	6.376E-11	1.302E-10
BONE SUR	6.897E-14	2.881E-11	1.031E-10	1.224E-15	-1.000E+00	3.504E-11	4.558E-11
THYROID	4.443E-14	2.061E-11	7.377E-11	8.755E-16	-1.000E+00	2.315E-11	2.671E-12
REMAINDER	4.139E-14	1.966E-11	7.035E-11	8.345E-16	-1.000E+00	2.041E-09	6.990E-09
EFFECTIVE	4.432E-14	2.078E-11	7.438E-11	8.824E-16	-1.000E+00	1.171E-09	2.283E-09
SKIN(FGR)	9.835E-14	2.281E-10	8.148E-10	9.587E-15	-1.000E+00	0.000E+00	0.000E+00
Nb-95							
GONADS	3.660E-14	2.253E-11	4.435E-10	7.850E-16	-1.000E+00	4.320E-10	8.050E-10
BREAST	4.160E-14	2.150E-11	4.231E-10	7.490E-16	-1.000E+00	4.070E-10	1.070E-10
LUNGS	3.650E-14	2.055E-11	4.045E-10	7.160E-16	-1.000E+00	8.320E-09	2.740E-11
RED MARR	3.560E-14	2.101E-11	4.135E-10	7.320E-16	-1.000E+00	4.420E-10	1.990E-10
BONE SUR	5.790E-14	2.957E-11	5.819E-10	1.030E-15	-1.000E+00	5.130E-10	2.940E-10
THYROID	3.750E-14	2.144E-11	4.220E-10	7.470E-16	-1.000E+00	3.580E-10	1.180E-11
REMAINDER	3.490E-14	2.032E-11	4.000E-10	7.080E-16	-1.000E+00	1.070E-09	1.470E-09
EFFECTIVE	3.740E-14	2.147E-11	4.226E-10	7.480E-16	-1.000E+00	1.570E-09	6.950E-10
SKIN(FGR)	4.300E-14	2.598E-11	5.112E-10	9.050E-16	-1.000E+00	0.000E+00	0.000E+00
Mo-99							
GONADS	7.130E-15	4.282E-12	4.403E-11	1.550E-16	-1.000E+00	9.510E-11	2.180E-10
BREAST	8.130E-15	4.116E-12	4.233E-11	1.490E-16	-1.000E+00	2.750E-11	3.430E-11
LUNGS	7.060E-15	3.867E-12	3.977E-11	1.400E-16	-1.000E+00	4.290E-09	1.510E-11
RED MARR	6.820E-15	3.923E-12	4.034E-11	1.420E-16	-1.000E+00	5.240E-11	8.320E-11
BONE SUR	1.240E-14	6.105E-12	6.278E-11	2.210E-16	-1.000E+00	4.130E-11	6.320E-11
THYROID	7.270E-15	4.033E-12	4.147E-11	1.460E-16	-1.000E+00	1.520E-11	1.030E-11
REMAINDER	6.740E-15	3.812E-12	3.920E-11	1.380E-16	-1.000E+00	1.740E-09	4.280E-09

EFFECTIVE	7.280E-15	4.061E-12	4.176E-11	1.470E-16	-1.000E+00	1.070E-09	1.360E-09
SKIN(FGR)	3.140E-14	1.039E-10	1.068E-09	3.760E-15	-1.000E+00	0.000E+00	0.000E+00
Tc-99m							
GONADS	5.750E-15	2.334E-12	3.877E-12	1.240E-16	-1.000E+00	2.770E-12	9.750E-12
BREAST	6.650E-15	2.258E-12	3.752E-12	1.200E-16	-1.000E+00	2.150E-12	3.570E-12
LUNGS	5.490E-15	2.127E-12	3.533E-12	1.130E-16	-1.000E+00	2.280E-11	3.140E-12
RED MARR	4.910E-15	2.070E-12	3.439E-12	1.100E-16	-1.000E+00	3.360E-12	6.290E-12
BONE SUR	1.630E-14	5.383E-12	8.942E-12	2.860E-16	-1.000E+00	2.620E-12	4.060E-12
THYROID	5.750E-15	2.145E-12	3.564E-12	1.140E-16	-1.000E+00	5.010E-11	8.460E-11
REMAINDER	5.150E-15	2.070E-12	3.439E-12	1.100E-16	-1.000E+00	1.020E-11	3.340E-11
EFFECTIVE	5.890E-15	2.277E-12	3.783E-12	1.210E-16	-1.000E+00	8.800E-12	1.680E-11
SKIN(FGR)	7.140E-15	2.710E-12	4.502E-12	1.440E-16	-1.000E+00	0.000E+00	0.000E+00
Ru-103							
GONADS	2.191E-14	1.404E-11	2.783E-10	4.892E-16	-1.000E+00	3.070E-10	5.720E-10
BREAST	2.512E-14	1.350E-11	2.677E-10	4.705E-16	-1.000E+00	3.110E-10	1.200E-10
LUNGS	2.180E-14	1.273E-11	2.522E-10	4.432E-16	-1.000E+00	1.561E-08	7.310E-11
RED MARR	2.100E-14	1.287E-11	2.551E-10	4.483E-16	-1.000E+00	3.190E-10	1.660E-10
BONE SUR	3.892E-14	1.958E-11	3.882E-10	6.823E-16	-1.000E+00	2.370E-10	9.631E-11
THYROID	2.241E-14	1.331E-11	2.639E-10	4.638E-16	-1.000E+00	2.570E-10	6.250E-11
REMAINDER	2.080E-14	1.248E-11	2.472E-10	4.346E-16	-1.000E+00	1.250E-09	2.110E-09
EFFECTIVE	2.251E-14	1.332E-11	2.641E-10	4.642E-16	-1.000E+00	2.421E-09	8.271E-10
SKIN(FGR)	2.774E-14	1.785E-11	3.543E-10	6.229E-16	-1.000E+00	0.000E+00	0.000E+00
Ru-105							
GONADS	3.720E-14	1.327E-11	1.861E-11	8.070E-16	-1.000E+00	1.590E-11	9.670E-11
BREAST	4.240E-14	1.271E-11	1.783E-11	7.730E-16	-1.000E+00	6.610E-12	1.590E-11
LUNGS	3.700E-14	1.210E-11	1.697E-11	7.360E-16	-1.000E+00	5.730E-10	6.210E-12
RED MARR	3.590E-14	1.230E-11	1.725E-11	7.480E-16	-1.000E+00	7.700E-12	2.350E-11
BONE SUR	6.280E-14	1.809E-11	2.537E-11	1.100E-15	-1.000E+00	4.620E-12	8.890E-12
THYROID	3.800E-14	1.260E-11	1.766E-11	7.660E-16	-1.000E+00	4.150E-12	1.820E-12
REMAINDER	3.540E-14	1.189E-11	1.667E-11	7.230E-16	-1.000E+00	1.610E-10	8.540E-10
EFFECTIVE	3.810E-14	1.265E-11	1.773E-11	7.690E-16	-1.000E+00	1.230E-10	2.870E-10
SKIN(FGR)	6.730E-14	7.368E-11	1.033E-10	4.480E-15	-1.000E+00	0.000E+00	0.000E+00
Ru-106							
GONADS	1.010E-14	6.411E-12	1.340E-10	2.230E-16	-1.000E+00	1.300E-09	1.640E-09
BREAST	1.160E-14	6.152E-12	1.286E-10	2.140E-16	-1.000E+00	1.780E-09	1.440E-09
LUNGS	1.010E-14	5.836E-12	1.220E-10	2.030E-16	-1.000E+00	1.040E-06	1.420E-09
RED MARR	9.750E-15	5.893E-12	1.232E-10	2.050E-16	-1.000E+00	1.760E-09	1.460E-09
BONE SUR	1.720E-14	8.883E-12	1.856E-10	3.090E-16	-1.000E+00	1.610E-09	1.430E-09
THYROID	1.030E-14	6.066E-12	1.268E-10	2.110E-16	-1.000E+00	1.720E-09	1.410E-09
REMAINDER	9.630E-15	5.721E-12	1.196E-10	1.990E-16	-1.000E+00	1.200E-08	2.110E-08
EFFECTIVE	1.040E-14	6.095E-12	1.274E-10	2.120E-16	-1.000E+00	1.290E-07	7.400E-09
SKIN(FGR)	1.090E-13	4.082E-10	8.531E-09	1.420E-14	-1.000E+00	0.000E+00	0.000E+00
Rh-105							
GONADS	3.640E-15	2.127E-12	1.411E-11	7.980E-17	-1.000E+00	2.110E-11	5.800E-11
BREAST	4.160E-15	2.063E-12	1.369E-11	7.740E-17	-1.000E+00	5.610E-12	8.970E-12
LUNGS	3.570E-15	1.935E-12	1.284E-11	7.260E-17	-1.000E+00	9.580E-10	3.860E-12
RED MARR	3.380E-15	1.946E-12	1.291E-11	7.300E-17	-1.000E+00	7.770E-12	1.470E-11
BONE SUR	7.530E-15	3.332E-12	2.210E-11	1.250E-16	-1.000E+00	4.460E-12	6.750E-12
THYROID	3.680E-15	1.983E-12	1.316E-11	7.440E-17	-1.000E+00	2.880E-12	2.910E-12
REMAINDER	3.390E-15	1.885E-12	1.250E-11	7.070E-17	-1.000E+00	4.530E-10	1.270E-09
EFFECTIVE	3.720E-15	2.031E-12	1.347E-11	7.620E-17	-1.000E+00	2.580E-10	3.990E-10
SKIN(FGR)	1.070E-14	4.691E-12	3.112E-11	1.760E-16	-1.000E+00	0.000E+00	0.000E+00
Sb-127							
GONADS	3.260E-14	1.985E-11	2.441E-10	7.100E-16	-1.000E+00	2.520E-10	6.140E-10

BREAST	3.720E-14	1.904E-11	2.341E-10	6.810E-16	-1.000E+00	9.120E-11	7.600E-11
LUNGS	3.240E-14	1.809E-11	2.224E-10	6.470E-16	-1.000E+00	6.940E-09	1.570E-11
RED MARR	3.140E-14	1.834E-11	2.255E-10	6.560E-16	-1.000E+00	1.610E-10	1.330E-10
BONE SUR	5.520E-14	2.720E-11	3.345E-10	9.730E-16	-1.000E+00	1.340E-10	5.240E-11
THYROID	3.330E-14	1.884E-11	2.317E-10	6.740E-16	-1.000E+00	6.150E-11	4.640E-12
REMAINDER	3.090E-14	1.775E-11	2.183E-10	6.350E-16	-1.000E+00	2.330E-09	5.870E-09
EFFECTIVE	3.330E-14	1.890E-11	2.324E-10	6.760E-16	-1.000E+00	1.630E-09	1.950E-09
SKIN (FGR)	5.580E-14	7.967E-11	9.799E-10	2.850E-15	-1.000E+00	0.000E+00	0.000E+00
Sb-129							
GONADS	6.970E-14	2.336E-11	3.231E-11	1.440E-15	-1.000E+00	2.150E-11	1.510E-10
BREAST	7.910E-14	2.222E-11	3.074E-11	1.370E-15	-1.000E+00	1.280E-11	2.560E-11
LUNGS	6.980E-14	2.141E-11	2.962E-11	1.320E-15	-1.000E+00	8.980E-10	9.390E-12
RED MARR	6.860E-14	2.190E-11	3.029E-11	1.350E-15	-1.000E+00	1.700E-11	3.670E-11
BONE SUR	1.070E-13	3.033E-11	4.196E-11	1.870E-15	-1.000E+00	1.460E-11	1.340E-11
THYROID	7.160E-14	2.174E-11	3.007E-11	1.340E-15	-1.000E+00	9.720E-12	1.470E-12
REMAINDER	6.710E-14	2.125E-11	2.939E-11	1.310E-15	-1.000E+00	1.870E-10	1.450E-09
EFFECTIVE	7.140E-14	2.238E-11	3.096E-11	1.380E-15	-1.000E+00	1.740E-10	4.840E-10
SKIN (FGR)	1.050E-13	8.273E-11	1.144E-10	5.100E-15	-1.000E+00	0.000E+00	0.000E+00
Te-127							
GONADS	2.370E-16	1.191E-13	2.661E-13	5.480E-18	-1.000E+00	2.020E-12	4.020E-12
BREAST	2.730E-16	1.158E-13	2.588E-13	5.330E-18	-1.000E+00	1.880E-12	3.000E-12
LUNGS	2.320E-16	1.060E-13	2.370E-13	4.880E-18	-1.000E+00	4.270E-10	2.890E-12
RED MARR	2.210E-16	1.058E-13	2.365E-13	4.870E-18	-1.000E+00	4.090E-12	6.570E-12
BONE SUR	4.650E-16	1.862E-13	4.162E-13	8.570E-18	-1.000E+00	4.090E-12	6.460E-12
THYROID	2.400E-16	1.106E-13	2.472E-13	5.090E-18	-1.000E+00	1.840E-12	2.860E-12
REMAINDER	2.210E-16	1.036E-13	2.316E-13	4.770E-18	-1.000E+00	1.110E-10	6.130E-10
EFFECTIVE	2.420E-16	1.125E-13	2.515E-13	5.180E-18	-1.000E+00	8.600E-11	1.870E-10
SKIN (FGR)	1.140E-14	1.173E-11	2.622E-11	5.400E-16	-1.000E+00	0.000E+00	0.000E+00
Te-127m							
GONADS	1.900E-16	4.689E-13	9.642E-12	1.630E-17	-1.000E+00	1.100E-10	1.250E-10
BREAST	2.690E-16	5.150E-13	1.059E-11	1.790E-17	-1.000E+00	1.100E-10	9.740E-11
LUNGS	7.620E-17	1.602E-13	3.295E-12	5.570E-18	-1.000E+00	3.340E-08	9.620E-11
RED MARR	6.430E-17	1.249E-13	2.567E-12	4.340E-18	-1.000E+00	5.360E-09	5.430E-09
BONE SUR	3.940E-16	9.005E-13	1.852E-11	3.130E-17	-1.000E+00	2.040E-08	2.070E-08
THYROID	1.500E-16	2.779E-13	5.714E-12	9.660E-18	-1.000E+00	9.660E-11	9.430E-11
REMAINDER	8.640E-17	1.999E-13	4.111E-12	6.950E-18	-1.000E+00	1.660E-09	2.980E-09
EFFECTIVE	1.470E-16	3.251E-13	6.684E-12	1.130E-17	-1.000E+00	5.810E-09	2.230E-09
SKIN (FGR)	8.490E-16	1.496E-12	3.076E-11	5.200E-17	-1.000E+00	0.000E+00	0.000E+00
Te-129							
GONADS	2.710E-15	3.889E-13	3.922E-13	6.510E-17	-1.000E+00	5.050E-13	1.590E-12
BREAST	3.120E-15	3.800E-13	3.832E-13	6.360E-17	-1.000E+00	5.390E-13	6.050E-13
LUNGS	2.640E-15	3.298E-13	3.326E-13	5.520E-17	-1.000E+00	1.530E-10	4.910E-13
RED MARR	2.540E-15	3.298E-13	3.326E-13	5.520E-17	-1.000E+00	6.190E-13	7.640E-13
BONE SUR	4.880E-15	5.753E-13	5.802E-13	9.630E-17	-1.000E+00	6.220E-13	5.400E-13
THYROID	2.740E-15	3.525E-13	3.555E-13	5.900E-17	-1.000E+00	5.090E-13	3.360E-13
REMAINDER	2.520E-15	3.262E-13	3.289E-13	5.460E-17	-1.000E+00	7.280E-12	1.790E-10
EFFECTIVE	2.750E-15	3.590E-13	3.621E-13	6.010E-17	-1.000E+00	2.090E-11	5.450E-11
SKIN (FGR)	3.570E-14	3.429E-11	3.458E-11	5.740E-15	-1.000E+00	0.000E+00	0.000E+00
Te-129m							
GONADS	3.321E-15	2.206E-12	4.799E-11	8.561E-17	-1.000E+00	1.783E-10	2.420E-10
BREAST	3.838E-15	2.181E-12	4.739E-11	8.454E-17	-1.000E+00	1.694E-10	1.664E-10
LUNGS	3.176E-15	1.741E-12	3.815E-11	6.808E-17	-1.000E+00	4.040E-08	1.593E-10
RED MARR	3.071E-15	1.729E-12	3.793E-11	6.768E-17	-1.000E+00	3.100E-09	3.500E-09
BONE SUR	5.772E-15	3.287E-12	7.147E-11	1.275E-16	-1.000E+00	7.050E-09	7.990E-09

THYROID	3.341E-15	1.923E-12	4.201E-11	7.495E-17	-1.000E+00	1.563E-10	1.572E-10
REMAINDER	3.048E-15	1.746E-12	3.822E-11	6.819E-17	-1.000E+00	3.275E-09	7.196E-09
EFFECTIVE	3.337E-15	1.974E-12	4.308E-11	7.686E-17	-1.000E+00	6.484E-09	2.925E-09
SKIN(FGR)	3.811E-14	1.501E-10	3.360E-09	6.001E-15	-1.000E+00	0.000E+00	0.000E+00
Te-131m							
GONADS	7.292E-14	4.020E-11	2.343E-10	1.535E-15	-1.000E+00	2.345E-10	7.415E-10
BREAST	8.286E-14	3.853E-11	2.246E-10	1.472E-15	-1.000E+00	9.309E-11	1.361E-10
LUNGS	7.265E-14	3.657E-11	2.131E-10	1.397E-15	-1.000E+00	2.296E-09	6.335E-11
RED MARR	7.097E-14	3.736E-11	2.178E-10	1.427E-15	-1.000E+00	1.417E-10	2.435E-10
BONE SUR	1.174E-13	5.467E-11	3.189E-10	2.090E-15	-1.000E+00	2.276E-10	3.248E-10
THYROID	7.471E-14	3.741E-11	2.181E-10	1.429E-15	-1.000E+00	3.669E-08	4.383E-08
REMAINDER	6.965E-14	3.626E-11	2.113E-10	1.385E-15	-1.000E+00	9.509E-10	3.153E-09
EFFECTIVE	7.463E-14	3.825E-11	2.229E-10	1.461E-15	-1.000E+00	1.758E-09	2.514E-09
SKIN(FGR)	1.038E-13	1.033E-10	6.188E-10	4.056E-15	-1.000E+00	0.000E+00	0.000E+00
Te-132							
GONADS	1.020E-14	6.812E-12	7.706E-11	2.450E-16	-1.000E+00	4.150E-10	5.410E-10
BREAST	1.180E-14	6.756E-12	7.643E-11	2.430E-16	-1.000E+00	3.630E-10	3.500E-10
LUNGS	9.650E-15	5.727E-12	6.479E-11	2.060E-16	-1.000E+00	1.670E-09	3.300E-10
RED MARR	8.950E-15	5.588E-12	6.322E-11	2.010E-16	-1.000E+00	4.270E-10	4.440E-10
BONE SUR	2.420E-14	1.273E-11	1.441E-10	4.580E-16	-1.000E+00	7.120E-10	8.300E-10
THYROID	1.020E-14	5.978E-12	6.762E-11	2.150E-16	-1.000E+00	6.280E-08	5.950E-08
REMAINDER	9.160E-15	5.644E-12	6.385E-11	2.030E-16	-1.000E+00	7.890E-10	1.490E-09
EFFECTIVE	1.030E-14	6.339E-12	7.171E-11	2.280E-16	-1.000E+00	2.550E-09	2.540E-09
SKIN(FGR)	1.390E-14	8.313E-12	9.405E-11	2.990E-16	-1.000E+00	0.000E+00	0.000E+00
I-131							
GONADS	1.780E-14	1.119E-11	1.789E-10	3.940E-16	-1.000E+00	2.530E-11	4.070E-11
BREAST	2.040E-14	1.082E-11	1.730E-10	3.810E-16	-1.000E+00	7.880E-11	1.210E-10
LUNGS	1.760E-14	1.016E-11	1.626E-10	3.580E-16	-1.000E+00	6.570E-10	1.020E-10
RED MARR	1.680E-14	1.022E-11	1.635E-10	3.600E-16	-1.000E+00	6.260E-11	9.440E-11
BONE SUR	3.450E-14	1.675E-11	2.679E-10	5.900E-16	-1.000E+00	5.730E-11	8.720E-11
THYROID	1.810E-14	1.053E-11	1.685E-10	3.710E-16	-1.000E+00	2.920E-07	4.760E-07
REMAINDER	1.670E-14	9.908E-12	1.585E-10	3.490E-16	-1.000E+00	8.030E-11	1.570E-10
EFFECTIVE	1.820E-14	1.067E-11	1.707E-10	3.760E-16	-1.000E+00	8.890E-09	1.440E-08
SKIN(FGR)	2.980E-14	1.825E-11	2.920E-10	6.430E-16	-1.000E+00	0.000E+00	0.000E+00
I-132							
GONADS	1.090E-13	2.523E-11	2.771E-11	2.320E-15	-1.000E+00	9.950E-12	2.330E-11
BREAST	1.240E-13	2.414E-11	2.652E-11	2.220E-15	-1.000E+00	1.410E-11	2.520E-11
LUNGS	1.090E-13	2.305E-11	2.532E-11	2.120E-15	-1.000E+00	2.710E-10	2.640E-11
RED MARR	1.070E-13	2.360E-11	2.592E-11	2.170E-15	-1.000E+00	1.400E-11	2.460E-11
BONE SUR	1.730E-13	3.327E-11	3.655E-11	3.060E-15	-1.000E+00	1.240E-11	2.190E-11
THYROID	1.120E-13	2.381E-11	2.616E-11	2.190E-15	-1.000E+00	1.740E-09	3.870E-09
REMAINDER	1.050E-13	2.283E-11	2.509E-11	2.100E-15	-1.000E+00	3.780E-11	1.650E-10
EFFECTIVE	1.120E-13	2.403E-11	2.640E-11	2.210E-15	-1.000E+00	1.030E-10	1.820E-10
SKIN(FGR)	1.580E-13	8.199E-11	9.007E-11	7.540E-15	-1.000E+00	0.000E+00	0.000E+00
I-133							
GONADS	2.870E-14	1.585E-11	6.748E-11	6.270E-16	-1.000E+00	1.950E-11	3.630E-11
BREAST	3.280E-14	1.519E-11	6.468E-11	6.010E-16	-1.000E+00	2.940E-11	4.680E-11
LUNGS	2.860E-14	1.446E-11	6.156E-11	5.720E-16	-1.000E+00	8.200E-10	4.530E-11
RED MARR	2.770E-14	1.466E-11	6.242E-11	5.800E-16	-1.000E+00	2.720E-11	4.300E-11
BONE SUR	4.870E-14	2.161E-11	9.202E-11	8.550E-16	-1.000E+00	2.520E-11	4.070E-11
THYROID	2.930E-14	1.502E-11	6.393E-11	5.940E-16	-1.000E+00	4.860E-08	9.100E-08
REMAINDER	2.730E-14	1.418E-11	6.038E-11	5.610E-16	-1.000E+00	5.000E-11	1.550E-10
EFFECTIVE	2.940E-14	1.509E-11	6.425E-11	5.970E-16	-1.000E+00	1.580E-09	2.800E-09
SKIN(FGR)	5.830E-14	1.150E-10	4.897E-10	4.550E-15	-1.000E+00	0.000E+00	0.000E+00

I-134

GONADS	1.270E-13	1.200E-11	1.202E-11	2.640E-15	-1.000E+00	4.250E-12	1.100E-11
BREAST	1.440E-13	1.145E-11	1.147E-11	2.520E-15	-1.000E+00	6.170E-12	1.170E-11
LUNGS	1.270E-13	1.100E-11	1.102E-11	2.420E-15	-1.000E+00	1.430E-10	1.260E-11
RED MARR	1.250E-13	1.127E-11	1.129E-11	2.480E-15	-1.000E+00	6.080E-12	1.090E-11
BONE SUR	1.960E-13	1.568E-11	1.571E-11	3.450E-15	-1.000E+00	5.310E-12	9.320E-12
THYROID	1.300E-13	1.127E-11	1.129E-11	2.480E-15	-1.000E+00	2.880E-10	6.210E-10
REMAINDER	1.220E-13	1.091E-11	1.093E-11	2.400E-15	-1.000E+00	2.270E-11	1.340E-10
EFFECTIVE	1.300E-13	1.150E-11	1.152E-11	2.530E-15	-1.000E+00	3.550E-11	6.660E-11
SKIN(FGR)	1.870E-13	4.477E-11	4.485E-11	9.850E-15	-1.000E+00	0.000E+00	0.000E+00

I-135

GONADS	8.078E-14	3.113E-11	5.489E-11	1.599E-15	-1.000E+00	1.700E-11	3.610E-11
BREAST	9.143E-14	2.971E-11	5.240E-11	1.526E-15	-1.000E+00	2.340E-11	3.850E-11
LUNGS	8.145E-14	2.886E-11	5.089E-11	1.482E-15	-1.000E+00	4.410E-10	3.750E-11
RED MARR	8.054E-14	2.965E-11	5.228E-11	1.523E-15	-1.000E+00	2.240E-11	3.650E-11
BONE SUR	1.184E-13	3.983E-11	7.024E-11	2.046E-15	-1.000E+00	2.010E-11	3.360E-11
THYROID	8.324E-14	2.852E-11	5.030E-11	1.465E-15	-1.000E+00	8.460E-09	1.790E-08
REMAINDER	7.861E-14	2.883E-11	5.084E-11	1.481E-15	-1.000E+00	4.700E-11	1.540E-10
EFFECTIVE	8.294E-14	2.989E-11	5.271E-11	1.535E-15	-1.000E+00	3.320E-10	6.080E-10
SKIN(FGR)	1.156E-13	9.826E-11	1.733E-10	5.047E-15	-1.000E+00	0.000E+00	0.000E+00

Xe-133

GONADS	1.610E-15	1.465E-12	2.052E-11	5.200E-17	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.960E-15	1.505E-12	2.107E-11	5.340E-17	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.320E-15	1.045E-12	1.464E-11	3.710E-17	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.070E-15	8.791E-13	1.231E-11	3.120E-17	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	5.130E-15	4.254E-12	5.958E-11	1.510E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.510E-15	1.181E-12	1.653E-11	4.190E-17	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.240E-15	1.042E-12	1.460E-11	3.700E-17	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.560E-15	1.299E-12	1.819E-11	4.610E-17	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	4.970E-15	1.953E-12	2.734E-11	6.930E-17	-1.000E+00	0.000E+00	0.000E+00

Xe-135

GONADS	1.170E-14	5.455E-12	1.194E-11	2.530E-16	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.330E-14	5.325E-12	1.166E-11	2.470E-16	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.130E-14	4.959E-12	1.086E-11	2.300E-16	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.070E-14	4.959E-12	1.086E-11	2.300E-16	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	2.570E-14	9.120E-12	1.997E-11	4.230E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.180E-14	5.023E-12	1.100E-11	2.330E-16	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.080E-14	4.829E-12	1.058E-11	2.240E-16	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.190E-14	5.217E-12	1.142E-11	2.420E-16	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	3.120E-14	4.506E-11	9.867E-11	2.090E-15	-1.000E+00	0.000E+00	0.000E+00

Cs-134

GONADS	7.400E-14	4.607E-11	9.646E-10	1.600E-15	-1.000E+00	1.300E-08	2.060E-08
BREAST	8.430E-14	4.406E-11	9.224E-10	1.530E-15	-1.000E+00	1.080E-08	1.720E-08
LUNGS	7.370E-14	4.204E-11	8.802E-10	1.460E-15	-1.000E+00	1.180E-08	1.760E-08
RED MARR	7.190E-14	4.262E-11	8.922E-10	1.480E-15	-1.000E+00	1.180E-08	1.870E-08
BONE SUR	1.200E-13	6.105E-11	1.278E-09	2.120E-15	-1.000E+00	1.100E-08	1.740E-08
THYROID	7.570E-14	4.377E-11	9.163E-10	1.520E-15	-1.000E+00	1.110E-08	1.760E-08
REMAINDER	7.060E-14	4.147E-11	8.681E-10	1.440E-15	-1.000E+00	1.390E-08	2.210E-08
EFFECTIVE	7.570E-14	4.377E-11	9.163E-10	1.520E-15	-1.000E+00	1.250E-08	1.980E-08
SKIN(FGR)	9.450E-14	6.249E-11	1.308E-09	2.170E-15	-1.000E+00	0.000E+00	0.000E+00

Cs-136

GONADS	1.040E-13	6.223E-11	1.102E-09	2.180E-15	-1.000E+00	1.880E-09	3.040E-09
BREAST	1.180E-13	5.966E-11	1.056E-09	2.090E-15	-1.000E+00	1.670E-09	2.650E-09
LUNGS	1.040E-13	5.710E-11	1.011E-09	2.000E-15	-1.000E+00	2.320E-09	2.620E-09

RED MARR	1.010E-13	5.824E-11	1.031E-09	2.040E-15	-1.000E+00	1.860E-09	2.950E-09
BONE SUR	1.660E-13	8.422E-11	1.491E-09	2.950E-15	-1.000E+00	1.700E-09	2.710E-09
THYROID	1.070E-13	5.852E-11	1.036E-09	2.050E-15	-1.000E+00	1.730E-09	2.740E-09
REMAINDER	9.950E-14	5.652E-11	1.001E-09	1.980E-15	-1.000E+00	2.190E-09	3.520E-09
EFFECTIVE	1.060E-13	5.966E-11	1.056E-09	2.090E-15	-1.000E+00	1.980E-09	3.040E-09
SKIN(FGR)	1.250E-13	7.251E-11	1.284E-09	2.540E-15	-1.000E+00	0.000E+00	0.000E+00
Cs-137							
GONADS	2.669E-14	1.669E-11	3.530E-10	5.840E-16	-1.000E+00	8.760E-09	1.390E-08
BREAST	3.047E-14	1.596E-11	3.376E-10	5.585E-16	-1.000E+00	7.840E-09	1.240E-08
LUNGS	2.649E-14	1.517E-11	3.209E-10	5.309E-16	-1.000E+00	8.820E-09	1.270E-08
RED MARR	2.583E-14	1.542E-11	3.260E-10	5.394E-16	-1.000E+00	8.300E-09	1.320E-08
BONE SUR	4.382E-14	2.238E-11	4.734E-10	7.832E-16	-1.000E+00	7.940E-09	1.260E-08
THYROID	2.725E-14	1.588E-11	3.358E-10	5.556E-16	-1.000E+00	7.930E-09	1.260E-08
REMAINDER	2.536E-14	1.490E-11	3.152E-10	5.215E-16	-1.000E+00	9.120E-09	1.450E-08
EFFECTIVE	2.725E-14	1.585E-11	3.353E-10	5.546E-16	-1.000E+00	8.630E-09	1.350E-08
SKIN(FGR)	4.392E-14	5.253E-11	1.110E-09	1.836E-15	-1.000E+00	0.000E+00	0.000E+00
Ba-139							
GONADS	2.130E-15	3.368E-13	3.429E-13	4.790E-17	-1.000E+00	2.560E-12	1.560E-12
BREAST	2.450E-15	3.297E-13	3.357E-13	4.690E-17	-1.000E+00	2.460E-12	5.170E-13
LUNGS	2.030E-15	3.002E-13	3.057E-13	4.270E-17	-1.000E+00	2.530E-10	3.890E-13
RED MARR	1.870E-15	2.932E-13	2.985E-13	4.170E-17	-1.000E+00	3.410E-12	8.590E-13
BONE SUR	5.290E-15	6.841E-13	6.965E-13	9.730E-17	-1.000E+00	2.490E-12	4.380E-13
THYROID	2.130E-15	3.044E-13	3.100E-13	4.330E-17	-1.000E+00	2.400E-12	2.660E-13
REMAINDER	1.920E-15	2.932E-13	2.985E-13	4.170E-17	-1.000E+00	4.820E-11	3.570E-10
EFFECTIVE	2.170E-15	3.227E-13	3.286E-13	4.590E-17	-1.000E+00	4.640E-11	1.080E-10
SKIN(FGR)	6.160E-14	7.241E-11	7.373E-11	1.030E-14	-1.000E+00	0.000E+00	0.000E+00
Ba-140							
GONADS	8.410E-15	5.451E-12	9.607E-11	1.910E-16	-1.000E+00	4.300E-10	9.960E-10
BREAST	9.640E-15	5.280E-12	9.305E-11	1.850E-16	-1.000E+00	2.870E-10	1.590E-10
LUNGS	8.270E-15	4.852E-12	8.550E-11	1.700E-16	-1.000E+00	1.660E-09	6.630E-11
RED MARR	7.930E-15	4.880E-12	8.601E-11	1.710E-16	-1.000E+00	1.290E-09	4.390E-10
BONE SUR	1.550E-14	8.020E-12	1.413E-10	2.810E-16	-1.000E+00	2.410E-09	5.530E-10
THYROID	8.530E-15	5.109E-12	9.003E-11	1.790E-16	-1.000E+00	2.560E-10	5.250E-11
REMAINDER	7.890E-15	4.766E-12	8.399E-11	1.670E-16	-1.000E+00	1.410E-09	7.370E-09
EFFECTIVE	8.580E-15	5.137E-12	9.053E-11	1.800E-16	-1.000E+00	1.010E-09	2.560E-09
SKIN(FGR)	2.520E-14	5.565E-11	9.808E-10	1.950E-15	-1.000E+00	0.000E+00	0.000E+00
La-140							
GONADS	1.140E-13	6.027E-11	4.425E-10	2.240E-15	-1.000E+00	4.540E-10	1.340E-09
BREAST	1.290E-13	5.758E-11	4.228E-10	2.140E-15	-1.000E+00	1.450E-10	1.800E-10
LUNGS	1.150E-13	5.596E-11	4.109E-10	2.080E-15	-1.000E+00	4.210E-09	4.010E-11
RED MARR	1.140E-13	5.731E-11	4.208E-10	2.130E-15	-1.000E+00	2.140E-10	2.810E-10
BONE SUR	1.690E-13	7.776E-11	5.709E-10	2.890E-15	-1.000E+00	1.410E-10	9.770E-11
THYROID	1.180E-13	5.462E-11	4.010E-10	2.030E-15	-1.000E+00	6.870E-11	6.400E-12
REMAINDER	1.110E-13	5.569E-11	4.089E-10	2.070E-15	-1.000E+00	2.120E-09	6.260E-09
EFFECTIVE	1.170E-13	5.812E-11	4.267E-10	2.160E-15	-1.000E+00	1.310E-09	2.280E-09
SKIN(FGR)	1.660E-13	2.217E-10	1.628E-09	8.240E-15	-1.000E+00	0.000E+00	0.000E+00
La-141							
GONADS	2.330E-15	7.315E-13	9.675E-13	4.740E-17	-1.000E+00	1.010E-11	3.770E-12
BREAST	2.640E-15	7.007E-13	9.267E-13	4.540E-17	-1.000E+00	9.840E-12	7.070E-13
LUNGS	2.340E-15	6.713E-13	8.879E-13	4.350E-17	-1.000E+00	6.460E-10	2.720E-13
RED MARR	2.310E-15	6.852E-13	9.063E-13	4.440E-17	-1.000E+00	2.930E-11	1.070E-12
BONE SUR	3.490E-15	9.923E-13	1.312E-12	6.430E-17	-1.000E+00	1.200E-10	6.060E-13
THYROID	2.390E-15	6.590E-13	8.716E-13	4.270E-17	-1.000E+00	9.400E-12	5.290E-14
REMAINDER	2.260E-15	6.682E-13	8.838E-13	4.330E-17	-1.000E+00	2.280E-10	1.240E-09



EFFECTIVE	2.390E-15	7.007E-13	9.267E-13	4.540E-17	-1.000E+00	1.570E-10	3.740E-10
SKIN(FGR)	6.580E-14	1.667E-10	2.204E-10	1.080E-14	-1.000E+00	0.000E+00	0.000E+00
La-142							
GONADS	1.400E-13	1.978E-11	2.034E-11	2.540E-15	-1.000E+00	1.660E-11	6.990E-11
BREAST	1.570E-13	1.885E-11	1.938E-11	2.420E-15	-1.000E+00	1.130E-11	1.540E-11
LUNGS	1.420E-13	1.846E-11	1.898E-11	2.370E-15	-1.000E+00	3.010E-10	8.400E-12
RED MARR	1.420E-13	1.900E-11	1.954E-11	2.440E-15	-1.000E+00	1.360E-11	1.930E-11
BONE SUR	1.950E-13	2.484E-11	2.554E-11	3.190E-15	-1.000E+00	1.110E-11	7.400E-12
THYROID	1.450E-13	1.768E-11	1.818E-11	2.270E-15	-1.000E+00	8.740E-12	1.160E-12
REMAINDER	1.380E-13	1.853E-11	1.906E-11	2.380E-15	-1.000E+00	8.070E-11	5.200E-10
EFFECTIVE	1.440E-13	1.916E-11	1.970E-11	2.460E-15	-1.000E+00	6.840E-11	1.790E-10
SKIN(FGR)	2.160E-13	9.111E-11	9.368E-11	1.170E-14	-1.000E+00	0.000E+00	0.000E+00
Ce-141							
GONADS	3.380E-15	2.213E-12	4.332E-11	7.710E-17	-1.000E+00	5.540E-11	1.080E-10
BREAST	3.930E-15	2.170E-12	4.247E-11	7.560E-17	-1.000E+00	4.460E-11	1.110E-11
LUNGS	3.170E-15	1.951E-12	3.820E-11	6.800E-17	-1.000E+00	1.670E-08	1.430E-12
RED MARR	2.830E-15	1.860E-12	3.641E-11	6.480E-17	-1.000E+00	8.960E-11	3.390E-11
BONE SUR	9.410E-15	5.166E-12	1.011E-10	1.800E-16	-1.000E+00	2.540E-10	2.300E-11
THYROID	3.350E-15	2.003E-12	3.922E-11	6.980E-17	-1.000E+00	2.550E-11	1.800E-13
REMAINDER	2.980E-15	1.894E-12	3.708E-11	6.600E-17	-1.000E+00	1.260E-09	2.500E-09
EFFECTIVE	3.430E-15	2.118E-12	4.146E-11	7.380E-17	-1.000E+00	2.420E-09	7.830E-10
SKIN(FGR)	1.020E-14	3.788E-12	7.416E-11	1.320E-16	-1.000E+00	0.000E+00	0.000E+00
Ce-143							
GONADS	1.280E-14	7.900E-12	4.958E-11	2.980E-16	-1.000E+00	7.530E-11	2.120E-10
BREAST	1.470E-14	7.688E-12	4.825E-11	2.900E-16	-1.000E+00	1.660E-11	2.320E-11
LUNGS	1.230E-14	6.893E-12	4.325E-11	2.600E-16	-1.000E+00	3.880E-09	3.820E-12
RED MARR	1.170E-14	6.787E-12	4.259E-11	2.560E-16	-1.000E+00	2.960E-11	5.070E-11
BONE SUR	2.520E-14	1.323E-11	8.302E-11	4.990E-16	-1.000E+00	1.640E-11	1.610E-11
THYROID	1.280E-14	7.211E-12	4.525E-11	2.720E-16	-1.000E+00	6.230E-12	4.350E-13
REMAINDER	1.170E-14	6.734E-12	4.226E-11	2.540E-16	-1.000E+00	1.420E-09	3.890E-09
EFFECTIVE	1.290E-14	7.396E-12	4.642E-11	2.790E-16	-1.000E+00	9.160E-10	1.230E-09
SKIN(FGR)	3.960E-14	1.058E-10	6.638E-10	3.990E-15	-1.000E+00	0.000E+00	0.000E+00
Ce-144							
GONADS	2.725E-15	6.328E-13	1.319E-11	6.088E-17	-1.000E+00	2.390E-10	6.987E-11
BREAST	3.129E-15	6.274E-13	1.307E-11	5.922E-17	-1.000E+00	3.480E-10	1.223E-11
LUNGS	2.639E-15	5.228E-13	1.089E-11	5.362E-17	-1.000E+00	7.911E-07	6.551E-12
RED MARR	2.507E-15	4.755E-13	9.907E-12	5.247E-17	-1.000E+00	2.880E-09	8.923E-11
BONE SUR	5.441E-15	1.646E-12	3.429E-11	1.127E-16	-1.000E+00	4.720E-09	1.280E-10
THYROID	2.753E-15	5.529E-13	1.152E-11	5.418E-17	-1.000E+00	2.920E-10	5.154E-12
REMAINDER	2.534E-15	5.086E-13	1.060E-11	5.283E-17	-1.000E+00	1.910E-08	1.890E-08
EFFECTIVE	2.773E-15	5.909E-13	1.231E-11	5.766E-17	-1.000E+00	1.010E-07	5.711E-09
SKIN(FGR)	8.574E-14	7.648E-13	1.594E-11	1.250E-14	-1.000E+00	0.000E+00	0.000E+00
Pr-143							
GONADS	2.130E-17	2.264E-14	4.032E-13	7.930E-19	-1.000E+00	4.370E-18	8.990E-18
BREAST	2.550E-17	2.330E-14	4.149E-13	8.160E-19	-1.000E+00	2.220E-18	1.090E-18
LUNGS	1.860E-17	1.642E-14	2.923E-13	5.750E-19	-1.000E+00	1.330E-08	1.910E-19
RED MARR	1.620E-17	1.493E-14	2.659E-13	5.230E-19	-1.000E+00	1.480E-11	1.030E-12
BONE SUR	5.930E-17	5.454E-14	9.711E-13	1.910E-18	-1.000E+00	1.490E-11	1.030E-12
THYROID	2.050E-17	1.802E-14	3.208E-13	6.310E-19	-1.000E+00	1.680E-18	2.660E-20
REMAINDER	1.760E-17	1.642E-14	2.923E-13	5.750E-19	-1.000E+00	1.970E-09	4.220E-09
EFFECTIVE	2.100E-17	2.002E-14	3.564E-13	7.010E-19	-1.000E+00	2.190E-09	1.270E-09
SKIN(FGR)	1.760E-14	5.711E-11	1.017E-09	2.000E-15	-1.000E+00	0.000E+00	0.000E+00
Nd-147							
GONADS	6.130E-15	4.218E-12	7.235E-11	1.480E-16	-1.000E+00	8.410E-11	1.790E-10

BREAST	7.120E-15	4.132E-12	7.088E-11	1.450E-16	-1.000E+00	3.450E-11	1.870E-11
LUNGS	5.820E-15	3.648E-12	6.257E-11	1.280E-16	-1.000E+00	1.060E-08	2.440E-12
RED MARR	5.400E-15	3.505E-12	6.013E-11	1.230E-16	-1.000E+00	9.190E-11	5.050E-11
BONE SUR	1.320E-14	8.265E-12	1.418E-10	2.900E-16	-1.000E+00	3.260E-10	2.220E-11
THYROID	6.120E-15	3.876E-12	6.648E-11	1.360E-16	-1.000E+00	1.820E-11	2.640E-13
REMAINDER	5.530E-15	3.562E-12	6.111E-11	1.250E-16	-1.000E+00	1.760E-09	3.760E-09
EFFECTIVE	6.190E-15	3.961E-12	6.795E-11	1.390E-16	-1.000E+00	1.850E-09	1.180E-09
SKIN(FGR)	1.950E-14	3.135E-11	5.377E-10	1.100E-15	-1.000E+00	0.000E+00	0.000E+00
Np-239							
GONADS	7.530E-15	4.691E-12	4.380E-11	1.710E-16	-1.000E+00	7.450E-11	1.620E-10
BREAST	8.730E-15	4.636E-12	4.329E-11	1.690E-16	-1.000E+00	1.630E-11	1.720E-11
LUNGS	7.180E-15	4.115E-12	3.842E-11	1.500E-16	-1.000E+00	2.360E-09	2.400E-12
RED MARR	6.500E-15	4.005E-12	3.740E-11	1.460E-16	-1.000E+00	2.080E-10	4.660E-11
BONE SUR	2.000E-14	1.001E-11	9.349E-11	3.650E-16	-1.000E+00	2.030E-09	3.590E-11
THYROID	7.520E-15	4.197E-12	3.919E-11	1.530E-16	-1.000E+00	7.620E-12	2.070E-13
REMAINDER	6.760E-15	4.005E-12	3.740E-11	1.460E-16	-1.000E+00	9.590E-10	2.770E-09
EFFECTIVE	7.690E-15	4.471E-12	4.175E-11	1.630E-16	-1.000E+00	6.780E-10	8.820E-10
SKIN(FGR)	1.600E-14	7.215E-12	6.737E-11	2.630E-16	-1.000E+00	0.000E+00	0.000E+00
Pu-238							
GONADS	6.560E-18	4.291E-14	9.011E-13	1.490E-18	-1.000E+00	1.040E-05	2.330E-09
BREAST	1.270E-17	5.558E-14	1.167E-12	1.930E-18	-1.000E+00	4.400E-10	1.800E-13
LUNGS	1.060E-18	2.267E-15	4.759E-14	7.870E-20	-1.000E+00	3.200E-04	8.640E-14
RED MARR	1.680E-18	5.587E-15	1.173E-13	1.940E-19	-1.000E+00	5.800E-05	1.270E-08
BONE SUR	9.300E-18	3.514E-14	7.378E-13	1.220E-18	-1.000E+00	7.250E-04	1.580E-07
THYROID	4.010E-18	9.792E-15	2.056E-13	3.400E-19	-1.000E+00	3.860E-10	7.990E-14
REMAINDER	1.990E-18	9.216E-15	1.935E-13	3.200E-19	-1.000E+00	2.740E-05	2.180E-08
EFFECTIVE	4.880E-18	2.413E-14	5.068E-13	8.380E-19	-1.000E+00	7.790E-05	1.340E-08
SKIN(FGR)	4.090E-17	2.776E-13	5.830E-12	9.640E-18	-1.000E+00	0.000E+00	0.000E+00
Pu-239							
GONADS	4.840E-18	1.768E-14	3.713E-13	6.140E-19	-1.000E+00	1.200E-05	2.640E-09
BREAST	7.550E-18	2.238E-14	4.699E-13	7.770E-19	-1.000E+00	3.990E-10	1.210E-13
LUNGS	2.650E-18	2.267E-15	4.760E-14	7.870E-20	-1.000E+00	3.230E-04	7.890E-14
RED MARR	2.670E-18	3.456E-15	7.258E-14	1.200E-19	-1.000E+00	6.570E-05	1.410E-08
BONE SUR	9.470E-18	1.673E-14	3.514E-13	5.810E-19	-1.000E+00	8.210E-04	1.760E-07
THYROID	3.880E-18	5.126E-15	1.077E-13	1.780E-19	-1.000E+00	3.750E-10	7.500E-14
REMAINDER	2.860E-18	4.838E-15	1.016E-13	1.680E-19	-1.000E+00	3.020E-05	2.120E-08
EFFECTIVE	4.240E-18	1.057E-14	2.220E-13	3.670E-19	-1.000E+00	8.330E-05	1.400E-08
SKIN(FGR)	1.860E-17	1.057E-13	2.220E-12	3.670E-18	-1.000E+00	0.000E+00	0.000E+00
Pu-240							
GONADS	6.360E-18	4.118E-14	8.649E-13	1.430E-18	-1.000E+00	1.200E-05	2.640E-09
BREAST	1.230E-17	5.328E-14	1.119E-12	1.850E-18	-1.000E+00	4.330E-10	1.730E-13
LUNGS	1.090E-18	2.249E-15	4.723E-14	7.810E-20	-1.000E+00	3.230E-04	8.220E-14
RED MARR	1.650E-18	5.386E-15	1.131E-13	1.870E-19	-1.000E+00	6.570E-05	1.410E-08
BONE SUR	9.260E-18	3.398E-14	7.137E-13	1.180E-18	-1.000E+00	8.210E-04	1.760E-07
THYROID	3.920E-18	9.446E-15	1.984E-13	3.280E-19	-1.000E+00	3.760E-10	7.510E-14
REMAINDER	1.960E-18	8.870E-15	1.863E-13	3.080E-19	-1.000E+00	3.020E-05	2.130E-08
EFFECTIVE	4.750E-18	2.313E-14	4.857E-13	8.030E-19	-1.000E+00	8.330E-05	1.400E-08
SKIN(FGR)	3.920E-17	2.644E-13	5.552E-12	9.180E-18	-1.000E+00	0.000E+00	0.000E+00
Pu-241							
GONADS	7.190E-20	6.653E-17	1.396E-15	2.310E-21	-1.000E+00	2.760E-07	5.660E-11
BREAST	8.670E-20	7.229E-17	1.517E-15	2.510E-21	-1.000E+00	2.140E-11	2.790E-15
LUNGS	6.480E-20	4.090E-17	8.584E-16	1.420E-21	-1.000E+00	3.180E-06	4.480E-15
RED MARR	5.630E-20	4.003E-17	8.403E-16	1.390E-21	-1.000E+00	1.430E-06	2.780E-10
BONE SUR	2.190E-19	1.385E-16	2.908E-15	4.810E-21	-1.000E+00	1.780E-05	3.480E-09

THYROID	6.980E-20	4.522E-17	9.491E-16	1.570E-21	-1.000E+00	9.150E-12	1.010E-15
REMAINDER	6.090E-20	4.291E-17	9.007E-16	1.490E-21	-1.000E+00	6.020E-07	1.850E-10
EFFECTIVE	7.250E-20	5.558E-17	1.167E-15	1.930E-21	-1.000E+00	1.340E-06	2.070E-10
SKIN(FGR)	1.170E-19	2.033E-16	4.268E-15	7.060E-21	-1.000E+00	0.000E+00	0.000E+00
Am-241							
GONADS	8.580E-16	9.360E-13	1.966E-11	3.250E-17	-1.000E+00	3.250E-05	2.700E-07
BREAST	1.070E-15	1.014E-12	2.129E-11	3.520E-17	-1.000E+00	2.670E-09	2.620E-11
LUNGS	6.740E-16	5.789E-13	1.216E-11	2.010E-17	-1.000E+00	1.840E-05	3.360E-11
RED MARR	5.210E-16	4.838E-13	1.016E-11	1.680E-17	-1.000E+00	1.740E-04	1.450E-06
BONE SUR	2.870E-15	2.678E-12	5.625E-11	9.300E-17	-1.000E+00	2.170E-03	1.810E-05
THYROID	7.830E-16	6.365E-13	1.337E-11	2.210E-17	-1.000E+00	1.600E-09	1.320E-11
REMAINDER	6.340E-16	5.933E-13	1.246E-11	2.060E-17	-1.000E+00	7.820E-05	6.660E-07
EFFECTIVE	8.180E-16	7.920E-13	1.663E-11	2.750E-17	-1.000E+00	1.200E-04	9.840E-07
SKIN(FGR)	1.280E-15	2.396E-12	5.032E-11	8.320E-17	-1.000E+00	0.000E+00	0.000E+00
Cm-242							
GONADS	7.830E-18	4.893E-14	1.013E-12	1.700E-18	-1.000E+00	5.700E-07	5.200E-09
BREAST	1.480E-17	6.159E-14	1.275E-12	2.140E-18	-1.000E+00	9.440E-10	8.950E-12
LUNGS	1.130E-18	3.022E-15	6.257E-14	1.050E-19	-1.000E+00	1.550E-05	8.840E-12
RED MARR	1.890E-18	6.562E-15	1.359E-13	2.280E-19	-1.000E+00	3.900E-06	3.570E-08
BONE SUR	1.060E-17	4.231E-14	8.759E-13	1.470E-18	-1.000E+00	4.870E-05	4.460E-07
THYROID	4.910E-18	1.261E-14	2.610E-13	4.380E-19	-1.000E+00	9.410E-10	8.820E-12
REMAINDER	2.270E-18	1.079E-14	2.235E-13	3.750E-19	-1.000E+00	2.450E-06	4.020E-08
EFFECTIVE	5.690E-18	2.751E-14	5.697E-13	9.560E-19	-1.000E+00	4.670E-06	3.100E-08
SKIN(FGR)	4.290E-17	2.700E-13	5.589E-12	9.380E-18	-1.000E+00	0.000E+00	0.000E+00
Cm-244							
GONADS	6.900E-18	4.522E-14	9.492E-13	1.570E-18	-1.000E+00	1.590E-05	1.330E-07
BREAST	1.330E-17	5.702E-14	1.197E-12	1.980E-18	-1.000E+00	1.040E-09	8.820E-12
LUNGS	7.080E-19	2.592E-15	5.441E-14	9.000E-20	-1.000E+00	1.930E-05	8.810E-12
RED MARR	1.460E-18	5.875E-15	1.233E-13	2.040E-19	-1.000E+00	9.380E-05	7.820E-07
BONE SUR	8.820E-18	3.859E-14	8.101E-13	1.340E-18	-1.000E+00	1.170E-03	9.770E-06
THYROID	4.190E-18	1.146E-14	2.406E-13	3.980E-19	-1.000E+00	1.010E-09	8.440E-12
REMAINDER	1.810E-18	9.821E-15	2.062E-13	3.410E-19	-1.000E+00	4.780E-05	4.150E-07
EFFECTIVE	4.910E-18	2.529E-14	5.308E-13	8.780E-19	-1.000E+00	6.700E-05	5.450E-07
SKIN(FGR)	3.910E-17	2.506E-13	5.260E-12	8.700E-18	-1.000E+00	0.000E+00	0.000E+00
Xe-133m							
GONADS	1.420E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.700E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.190E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.100E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	3.230E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.360E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.150E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.370E-15	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.040E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
Xe-135m							
GONADS	2.000E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BREAST	2.290E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.980E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.910E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	3.500E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
THYROID	2.040E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.890E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	2.040E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	2.970E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00

Xe-138

GONADS	5.590E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BREAST	6.320E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
LUNGS	5.660E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
RED MARR	5.600E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	8.460E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
THYROID	5.770E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	5.490E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	5.770E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
SKIN (FGR)	1.070E-13	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00

# ATTACHMENT O CONVERSION FACTORS FILE FGR14.INP

FGRDCF 10/24/95 03:24:50 beta-test version 1.10, minor FORTRAN fixes 5/4/95  
Implicit daughter half-lives (m) less than 90 and less than 0.100 of parent  
9 ORGANS DEFINED IN THIS FILE:

GONADS  
BREAST  
LUNGS  
RED MARR  
BONE SUR  
THYROID  
REMAINDER  
EFFECTIVE  
SKIN(FGR)

14 NUCLIDES DEFINED IN THIS FILE:

Kr-85  
Kr-85m  
Kr-87  
Kr-88  
I-131 D  
I-132 D  
I-133 D  
I-134 D  
I-135 D Including: Xe-135m  
Xe-133  
Xe-135  
Xe-133m  
Xe-135m  
Xe-138

	CLOUDSHINE	GROUND SHINE 8HR	GROUND SHINE 7DAY	GROUND SHINE RATE	INHALED ACUTE	INHALED CHRONIC	INGESTION
Kr-85							
GONADS	1.170E-16	8.121E-14	1.704E-12	2.820E-18	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.340E-16	7.891E-14	1.656E-12	2.740E-18	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.140E-16	7.056E-14	1.481E-12	2.450E-18	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.090E-16	6.998E-14	1.469E-12	2.430E-18	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	2.200E-16	1.287E-13	2.702E-12	4.470E-18	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.180E-16	7.459E-14	1.565E-12	2.590E-18	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	1.090E-16	6.941E-14	1.457E-12	2.410E-18	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.190E-16	7.603E-14	1.596E-12	2.640E-18	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.320E-14	2.304E-11	4.835E-10	8.000E-16	-1.000E+00	0.000E+00	0.000E+00
Kr-85m							
GONADS	7.310E-15	2.594E-12	3.653E-12	1.570E-16	-1.000E+00	0.000E+00	0.000E+00
BREAST	8.410E-15	2.527E-12	3.560E-12	1.530E-16	-1.000E+00	0.000E+00	0.000E+00
LUNGS	7.040E-15	2.379E-12	3.351E-12	1.440E-16	-1.000E+00	0.000E+00	0.000E+00
RED MARR	6.430E-15	2.346E-12	3.304E-12	1.420E-16	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	1.880E-14	5.286E-12	7.446E-12	3.200E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	7.330E-15	2.395E-12	3.374E-12	1.450E-16	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	6.640E-15	2.313E-12	3.257E-12	1.400E-16	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	7.480E-15	2.511E-12	3.537E-12	1.520E-16	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	2.240E-14	2.247E-11	3.164E-11	1.360E-15	-1.000E+00	0.000E+00	0.000E+00
Kr-87							

GONADS	4.000E-14	4.962E-12	5.026E-12	7.610E-16	-1.000E+00	0.000E+00	0.000E+00
BREAST	4.500E-14	4.740E-12	4.802E-12	7.270E-16	-1.000E+00	0.000E+00	0.000E+00
LUNGS	4.040E-14	4.603E-12	4.663E-12	7.060E-16	-1.000E+00	0.000E+00	0.000E+00
RED MARR	4.000E-14	4.708E-12	4.769E-12	7.220E-16	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	6.020E-14	6.514E-12	6.598E-12	9.990E-16	-1.000E+00	0.000E+00	0.000E+00
THYROID	4.130E-14	4.473E-12	4.531E-12	6.860E-16	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	3.910E-14	4.590E-12	4.650E-12	7.040E-16	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	4.120E-14	4.773E-12	4.835E-12	7.320E-16	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.370E-13	8.802E-11	8.916E-11	1.350E-14	-1.000E+00	0.000E+00	0.000E+00
Kr-88							
GONADS	9.900E-14	2.278E-11	2.655E-11	1.800E-15	-1.000E+00	0.000E+00	0.000E+00
BREAST	1.110E-13	2.177E-11	2.537E-11	1.720E-15	-1.000E+00	0.000E+00	0.000E+00
LUNGS	1.010E-13	2.139E-11	2.493E-11	1.690E-15	-1.000E+00	0.000E+00	0.000E+00
RED MARR	1.000E-13	2.190E-11	2.552E-11	1.730E-15	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	1.390E-13	2.886E-11	3.363E-11	2.280E-15	-1.000E+00	0.000E+00	0.000E+00
THYROID	1.030E-13	2.012E-11	2.345E-11	1.590E-15	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	9.790E-14	2.139E-11	2.493E-11	1.690E-15	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	1.020E-13	2.202E-11	2.567E-11	1.740E-15	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.350E-13	5.607E-11	6.534E-11	4.430E-15	-1.000E+00	0.000E+00	0.000E+00
I-131							
GONADS	1.780E-14	1.119E-11	1.789E-10	3.940E-16	-1.000E+00	2.530E-11	4.070E-11
BREAST	2.040E-14	1.082E-11	1.730E-10	3.810E-16	-1.000E+00	7.880E-11	1.210E-10
LUNGS	1.760E-14	1.016E-11	1.626E-10	3.580E-16	-1.000E+00	6.570E-10	1.020E-10
RED MARR	1.680E-14	1.022E-11	1.635E-10	3.600E-16	-1.000E+00	6.260E-11	9.440E-11
BONE SUR	3.450E-14	1.675E-11	2.679E-10	5.900E-16	-1.000E+00	5.730E-11	8.720E-11
THYROID	1.810E-14	1.053E-11	1.685E-10	3.710E-16	-1.000E+00	2.920E-07	4.760E-07
REMAINDER	1.670E-14	9.908E-12	1.585E-10	3.490E-16	-1.000E+00	8.030E-11	1.570E-10
EFFECTIVE	1.820E-14	1.067E-11	1.707E-10	3.760E-16	-1.000E+00	8.890E-09	1.440E-08
SKIN(FGR)	2.980E-14	1.825E-11	2.920E-10	6.430E-16	-1.000E+00	0.000E+00	0.000E+00
I-132							
GONADS	1.090E-13	2.523E-11	2.771E-11	2.320E-15	-1.000E+00	9.950E-12	2.330E-11
BREAST	1.240E-13	2.414E-11	2.652E-11	2.220E-15	-1.000E+00	1.410E-11	2.520E-11
LUNGS	1.090E-13	2.305E-11	2.532E-11	2.120E-15	-1.000E+00	2.710E-10	2.640E-11
RED MARR	1.070E-13	2.360E-11	2.592E-11	2.170E-15	-1.000E+00	1.400E-11	2.460E-11
BONE SUR	1.730E-13	3.327E-11	3.655E-11	3.060E-15	-1.000E+00	1.240E-11	2.190E-11
THYROID	1.120E-13	2.381E-11	2.616E-11	2.190E-15	-1.000E+00	1.740E-09	3.870E-09
REMAINDER	1.050E-13	2.283E-11	2.509E-11	2.100E-15	-1.000E+00	3.780E-11	1.650E-10
EFFECTIVE	1.120E-13	2.403E-11	2.640E-11	2.210E-15	-1.000E+00	1.030E-10	1.820E-10
SKIN(FGR)	1.580E-13	8.199E-11	9.007E-11	7.540E-15	-1.000E+00	0.000E+00	0.000E+00
I-133							
GONADS	2.870E-14	1.585E-11	6.748E-11	6.270E-16	-1.000E+00	1.950E-11	3.630E-11
BREAST	3.280E-14	1.519E-11	6.468E-11	6.010E-16	-1.000E+00	2.940E-11	4.680E-11
LUNGS	2.860E-14	1.446E-11	6.156E-11	5.720E-16	-1.000E+00	8.200E-10	4.530E-11
RED MARR	2.770E-14	1.466E-11	6.242E-11	5.800E-16	-1.000E+00	2.720E-11	4.300E-11
BONE SUR	4.870E-14	2.161E-11	9.202E-11	8.550E-16	-1.000E+00	2.520E-11	4.070E-11
THYROID	2.930E-14	1.502E-11	6.393E-11	5.940E-16	-1.000E+00	4.860E-08	9.100E-08
REMAINDER	2.730E-14	1.418E-11	6.038E-11	5.610E-16	-1.000E+00	5.000E-11	1.550E-10
EFFECTIVE	2.940E-14	1.509E-11	6.425E-11	5.970E-16	-1.000E+00	1.580E-09	2.800E-09
SKIN(FGR)	5.830E-14	1.150E-10	4.897E-10	4.550E-15	-1.000E+00	0.000E+00	0.000E+00
I-134							
GONADS	1.270E-13	1.200E-11	1.202E-11	2.640E-15	-1.000E+00	4.250E-12	1.100E-11
BREAST	1.440E-13	1.145E-11	1.147E-11	2.520E-15	-1.000E+00	6.170E-12	1.170E-11
LUNGS	1.270E-13	1.100E-11	1.102E-11	2.420E-15	-1.000E+00	1.430E-10	1.260E-11
RED MARR	1.250E-13	1.127E-11	1.129E-11	2.480E-15	-1.000E+00	6.080E-12	1.090E-11

BONE SUR 1.960E-13 1.568E-11 1.571E-11 3.450E-15 -1.000E+00 5.310E-12 9.320E-12  
BUNDOSE 1.960E-13 1.568E-11 1.571E-11 3.450E-15 -1.000E+00 5.310E-12 9.320E-12

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SKIN(FGR)	2.970E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
Xe-138							
GONADS	5.590E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BREAST	6.320E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
LUNGS	5.660E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
RED MARR	5.600E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
BONE SUR	8.460E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
THYROID	5.770E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
REMAINDER	5.490E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
EFFECTIVE	5.770E-14	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00
SKIN(FGR)	1.070E-13	0.000E+00	0.000E+00	0.000E+00	-1.000E+00	0.000E+00	0.000E+00



# ATTACHMENT P CONVERSION FACTORS FILE FGR05.INP

FGRDCF 10/24/95 03:24:50 beta-test version 1.10, minor FORTRAN fixes 5/4/95  
Implicit daughter half-lives (m) less than 90 and less than 0.100 of parent  
9 ORGANS DEFINED IN THIS FILE:

GONADS  
BREAST  
LUNGS  
RED MARR  
BONE SUR  
THYROID  
REMAINDER  
EFFECTIVE  
SKIN(FGR)

05 NUCLIDES DEFINED IN THIS FILE:

I-131 D  
I-132 D  
I-133 D  
I-134 D  
I-135 D Including: Xe-135m

	CLOUDSHINE	GROUND	GROUND	GROUND	INHALED	INHALED	INGESTION
	SHINE 8HR	SHINE 7DAY	SHINE RATE	ACUTE	CHRONIC		

I-131							
GONADS	1.780E-14	1.119E-11	1.789E-10	3.940E-16	-1.000E+00	2.530E-11	4.070E-11
BREAST	2.040E-14	1.082E-11	1.730E-10	3.810E-16	-1.000E+00	7.880E-11	1.210E-10
LUNGS	1.760E-14	1.016E-11	1.626E-10	3.580E-16	-1.000E+00	6.570E-10	1.020E-10
RED MARR	1.680E-14	1.022E-11	1.635E-10	3.600E-16	-1.000E+00	6.260E-11	9.440E-11
BONE SUR	3.450E-14	1.675E-11	2.679E-10	5.900E-16	-1.000E+00	5.730E-11	8.720E-11
THYROID	1.810E-14	1.053E-11	1.685E-10	3.710E-16	-1.000E+00	2.920E-07	4.760E-07
REMAINDER	1.670E-14	9.908E-12	1.585E-10	3.490E-16	-1.000E+00	8.030E-11	1.570E-10
EFFECTIVE	1.820E-14	1.067E-11	1.707E-10	3.760E-16	-1.000E+00	8.890E-09	1.440E-08
SKIN(FGR)	2.980E-14	1.825E-11	2.920E-10	6.430E-16	-1.000E+00	0.000E+00	0.000E+00
I-132							
GONADS	1.090E-13	2.523E-11	2.771E-11	2.320E-15	-1.000E+00	9.950E-12	2.330E-11
BREAST	1.240E-13	2.414E-11	2.652E-11	2.220E-15	-1.000E+00	1.410E-11	2.520E-11
LUNGS	1.090E-13	2.305E-11	2.532E-11	2.120E-15	-1.000E+00	2.710E-10	2.640E-11
RED MARR	1.070E-13	2.360E-11	2.592E-11	2.170E-15	-1.000E+00	1.400E-11	2.460E-11
BONE SUR	1.730E-13	3.327E-11	3.655E-11	3.060E-15	-1.000E+00	1.240E-11	2.190E-11
THYROID	1.120E-13	2.381E-11	2.616E-11	2.190E-15	-1.000E+00	1.740E-09	3.870E-09
REMAINDER	1.050E-13	2.283E-11	2.509E-11	2.100E-15	-1.000E+00	3.780E-11	1.650E-10
EFFECTIVE	1.120E-13	2.403E-11	2.640E-11	2.210E-15	-1.000E+00	1.030E-10	1.820E-10
SKIN(FGR)	1.580E-13	8.199E-11	9.007E-11	7.540E-15	-1.000E+00	0.000E+00	0.000E+00
I-133							
GONADS	2.870E-14	1.585E-11	6.748E-11	6.270E-16	-1.000E+00	1.950E-11	3.630E-11
BREAST	3.280E-14	1.519E-11	6.468E-11	6.010E-16	-1.000E+00	2.940E-11	4.680E-11
LUNGS	2.860E-14	1.446E-11	6.156E-11	5.720E-16	-1.000E+00	8.200E-10	4.530E-11
RED MARR	2.770E-14	1.466E-11	6.242E-11	5.800E-16	-1.000E+00	2.720E-11	4.300E-11
BONE SUR	4.870E-14	2.161E-11	9.202E-11	8.550E-16	-1.000E+00	2.520E-11	4.070E-11
THYROID	2.930E-14	1.502E-11	6.393E-11	5.940E-16	-1.000E+00	4.860E-08	9.100E-08
REMAINDER	2.730E-14	1.418E-11	6.038E-11	5.610E-16	-1.000E+00	5.000E-11	1.550E-10
EFFECTIVE	2.940E-14	1.509E-11	6.425E-11	5.970E-16	-1.000E+00	1.580E-09	2.800E-09
SKIN(FGR)	5.830E-14	1.150E-10	4.897E-10	4.550E-15	-1.000E+00	0.000E+00	0.000E+00

I-134

GONADS	1.270E-13	1.200E-11	1.202E-11	2.640E-15	-1.000E+00	4.250E-12	1.100E-11
BREAST	1.440E-13	1.145E-11	1.147E-11	2.520E-15	-1.000E+00	6.170E-12	1.170E-11
LUNGS	1.270E-13	1.100E-11	1.102E-11	2.420E-15	-1.000E+00	1.430E-10	1.260E-11
RED MARR	1.250E-13	1.127E-11	1.129E-11	2.480E-15	-1.000E+00	6.080E-12	1.090E-11
BONE SUR	1.960E-13	1.568E-11	1.571E-11	3.450E-15	-1.000E+00	5.310E-12	9.320E-12
THYROID	1.300E-13	1.127E-11	1.129E-11	2.480E-15	-1.000E+00	2.880E-10	6.210E-10
REMAINDER	1.220E-13	1.091E-11	1.093E-11	2.400E-15	-1.000E+00	2.270E-11	1.340E-10
EFFECTIVE	1.300E-13	1.150E-11	1.152E-11	2.530E-15	-1.000E+00	3.550E-11	6.660E-11
SKIN(FGR)	1.870E-13	4.477E-11	4.485E-11	9.850E-15	-1.000E+00	0.000E+00	0.000E+00

I-135

GONADS	8.078E-14	3.113E-11	5.489E-11	1.599E-15	-1.000E+00	1.700E-11	3.610E-11
BREAST	9.143E-14	2.971E-11	5.240E-11	1.526E-15	-1.000E+00	2.340E-11	3.850E-11
LUNGS	8.145E-14	2.886E-11	5.089E-11	1.482E-15	-1.000E+00	4.410E-10	3.750E-11
RED MARR	8.054E-14	2.965E-11	5.228E-11	1.523E-15	-1.000E+00	2.240E-11	3.650E-11
BONE SUR	1.184E-13	3.983E-11	7.024E-11	2.046E-15	-1.000E+00	2.010E-11	3.360E-11
THYROID	8.324E-14	2.852E-11	5.030E-11	1.465E-15	-1.000E+00	8.460E-09	1.790E-08
REMAINDER	7.861E-14	2.883E-11	5.084E-11	1.481E-15	-1.000E+00	4.700E-11	1.540E-10
EFFECTIVE	8.294E-14	2.989E-11	5.271E-11	1.535E-15	-1.000E+00	3.320E-10	6.080E-10
SKIN(FGR)	1.156E-13	9.826E-11	1.733E-10	5.047E-15	-1.000E+00	0.000E+00	0.000E+00

# ATTACHMENT Q CEAFFI OUTPUT FILE

#####  
Cumulative Dose Summary  
#####

	eab		lpz		cr	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.250	1.6065E+00	5.8302E-02	3.7820E-01	1.3725E-02	3.6197E+00	1.1535E-01
0.333	1.6797E+00	6.0934E-02	3.9543E-01	1.4345E-02	5.9654E+00	1.9001E-01
0.500	1.8449E+00	6.6841E-02	4.3433E-01	1.5736E-02	1.0045E+01	3.1973E-01
0.800	2.1107E+00	7.6244E-02	4.9688E-01	1.7949E-02	1.5210E+01	4.8368E-01
1.100	2.4120E+00	8.6783E-02	5.6782E-01	2.0430E-02	1.8883E+01	6.0002E-01
1.400	2.7486E+00	9.8438E-02	6.4706E-01	2.3174E-02	2.1980E+01	6.9798E-01
1.700	3.1200E+00	1.1119E-01	7.3449E-01	2.6176E-02	2.4945E+01	7.9157E-01
2.000	3.5258E+00	1.2503E-01	8.3004E-01	2.9433E-02	2.7987E+01	8.8750E-01
2.300	3.5258E+00	1.2503E-01	8.3676E-01	2.9661E-02	3.1058E+01	9.8422E-01
2.600	3.5258E+00	1.2503E-01	8.4400E-01	2.9905E-02	3.4147E+01	1.0814E+00
2.900	3.5258E+00	1.2503E-01	8.5175E-01	3.0165E-02	3.7363E+01	1.1825E+00
3.200	3.5258E+00	1.2503E-01	8.6000E-01	3.0440E-02	4.0755E+01	1.2890E+00
3.500	3.5258E+00	1.2503E-01	8.6876E-01	3.0732E-02	4.4349E+01	1.4017E+00
3.800	3.5258E+00	1.2503E-01	8.7801E-01	3.1038E-02	4.8153E+01	1.5210E+00
4.100	3.5258E+00	1.2503E-01	8.8775E-01	3.1360E-02	5.2173E+01	1.6470E+00
4.400	3.5258E+00	1.2503E-01	8.9797E-01	3.1697E-02	5.6408E+01	1.7796E+00
4.700	3.5258E+00	1.2503E-01	9.0868E-01	3.2049E-02	6.0859E+01	1.9188E+00
5.000	3.5258E+00	1.2503E-01	9.1986E-01	3.2416E-02	6.5523E+01	2.0647E+00
5.300	3.5258E+00	1.2503E-01	9.3152E-01	3.2798E-02	7.0399E+01	2.2171E+00
5.600	3.5258E+00	1.2503E-01	9.4364E-01	3.3194E-02	7.5485E+01	2.3761E+00
5.900	3.5258E+00	1.2503E-01	9.5623E-01	3.3605E-02	8.0780E+01	2.5414E+00
6.200	3.5258E+00	1.2503E-01	9.6927E-01	3.4030E-02	8.6281E+01	2.7131E+00
6.500	3.5258E+00	1.2503E-01	9.8277E-01	3.4469E-02	9.1987E+01	2.8912E+00
6.800	3.5258E+00	1.2503E-01	9.9672E-01	3.4922E-02	9.7895E+01	3.0755E+00
7.100	3.5258E+00	1.2503E-01	1.0111E+00	3.5389E-02	1.0400E+02	3.2659E+00
7.400	3.5258E+00	1.2503E-01	1.0260E+00	3.5869E-02	1.1031E+02	3.4625E+00
7.700	3.5258E+00	1.2503E-01	1.0412E+00	3.6364E-02	1.1682E+02	3.6652E+00
8.000	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.2352E+02	3.8739E+00
8.300	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.2838E+02	4.0252E+00
8.600	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3073E+02	4.0984E+00
8.900	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3187E+02	4.1338E+00
9.200	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3242E+02	4.1510E+00
9.500	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3269E+02	4.1593E+00
9.800	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3282E+02	4.1633E+00
10.100	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3288E+02	4.1653E+00
10.400	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3291E+02	4.1663E+00
24.000	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3294E+02	4.1672E+00
96.000	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3294E+02	4.1672E+00
720.000	3.5258E+00	1.2503E-01	1.0570E+00	3.6871E-02	1.3294E+02	4.1672E+00

#####  
Worst Two-Hour Doses

#####

eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	1.3920E-02	3.5258E+00	1.2503E-01

ATTACHMENT R  
CEAFFN OUTPUT FILE

#####  
Cumulative Dose Summary  
#####

	eab		lpz		cr	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.333	0.0000E+00	5.7185E-02	0.0000E+00	1.3462E-02	0.0000E+00	9.4344E-03
0.500	0.0000E+00	7.8304E-02	0.0000E+00	1.8434E-02	0.0000E+00	1.8143E-02
0.800	0.0000E+00	1.0995E-01	0.0000E+00	2.5885E-02	0.0000E+00	3.6895E-02
1.100	0.0000E+00	1.3653E-01	0.0000E+00	3.2143E-02	0.0000E+00	5.7856E-02
1.400	0.0000E+00	1.6000E-01	0.0000E+00	3.7666E-02	0.0000E+00	8.0048E-02
1.700	0.0000E+00	1.8124E-01	0.0000E+00	4.2667E-02	0.0000E+00	1.0283E-01
2.000	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.2570E-01
2.300	0.0000E+00	2.0073E-01	0.0000E+00	4.7530E-02	0.0000E+00	1.4786E-01
2.600	0.0000E+00	2.0073E-01	0.0000E+00	4.7785E-02	0.0000E+00	1.6878E-01
2.900	0.0000E+00	2.0073E-01	0.0000E+00	4.8022E-02	0.0000E+00	1.8851E-01
3.200	0.0000E+00	2.0073E-01	0.0000E+00	4.8242E-02	0.0000E+00	2.0710E-01
3.500	0.0000E+00	2.0073E-01	0.0000E+00	4.8448E-02	0.0000E+00	2.2459E-01
3.800	0.0000E+00	2.0073E-01	0.0000E+00	4.8640E-02	0.0000E+00	2.4104E-01
4.100	0.0000E+00	2.0073E-01	0.0000E+00	4.8819E-02	0.0000E+00	2.5650E-01
4.400	0.0000E+00	2.0073E-01	0.0000E+00	4.8987E-02	0.0000E+00	2.7104E-01
4.700	0.0000E+00	2.0073E-01	0.0000E+00	4.9144E-02	0.0000E+00	2.8472E-01
5.000	0.0000E+00	2.0073E-01	0.0000E+00	4.9292E-02	0.0000E+00	2.9758E-01
5.300	0.0000E+00	2.0073E-01	0.0000E+00	4.9430E-02	0.0000E+00	3.0970E-01
5.600	0.0000E+00	2.0073E-01	0.0000E+00	4.9560E-02	0.0000E+00	3.2110E-01
5.900	0.0000E+00	2.0073E-01	0.0000E+00	4.9683E-02	0.0000E+00	3.3185E-01
6.200	0.0000E+00	2.0073E-01	0.0000E+00	4.9798E-02	0.0000E+00	3.4200E-01
6.500	0.0000E+00	2.0073E-01	0.0000E+00	4.9907E-02	0.0000E+00	3.5157E-01
6.800	0.0000E+00	2.0073E-01	0.0000E+00	5.0010E-02	0.0000E+00	3.6061E-01
7.100	0.0000E+00	2.0073E-01	0.0000E+00	5.0107E-02	0.0000E+00	3.6917E-01
7.400	0.0000E+00	2.0073E-01	0.0000E+00	5.0199E-02	0.0000E+00	3.7726E-01
7.700	0.0000E+00	2.0073E-01	0.0000E+00	5.0286E-02	0.0000E+00	3.8493E-01
8.000	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	3.9221E-01
8.300	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	3.9842E-01
8.600	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.0316E-01
8.900	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.0679E-01
9.200	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.0957E-01
9.500	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.1170E-01
9.800	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.1333E-01
10.100	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.1459E-01
10.400	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.1555E-01
24.000	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.1885E-01
96.000	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.1885E-01
720.000	0.0000E+00	2.0073E-01	0.0000E+00	5.0368E-02	0.0000E+00	4.1885E-01

#####  
Worst Two-Hour Doses  
#####

eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	2.0073E-01	0.0000E+00	2.0073E-01

ATTACHMENT S  
CEAPRI OUTPUT FILE

#####  
Cumulative Dose Summary  
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	eab		lpz		cr	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.250	2.1387E-05	6.9436E-07	5.0349E-06	1.6346E-07	4.8199E-05	1.5002E-06
0.333	2.2362E-05	7.2597E-07	5.2645E-06	1.7091E-07	7.9459E-05	2.4729E-06
0.500	2.4566E-05	7.9735E-07	5.7833E-06	1.8771E-07	1.3387E-04	4.1655E-06
0.800	2.8114E-05	9.1207E-07	6.6186E-06	2.1472E-07	2.0283E-04	6.3101E-06
1.100	3.2145E-05	1.0421E-06	7.5674E-06	2.4533E-07	2.5195E-04	7.8371E-06
1.400	3.6653E-05	1.1873E-06	8.6288E-06	2.7951E-07	2.9345E-04	9.1264E-06
1.700	4.1636E-05	1.3475E-06	9.8018E-06	3.1722E-07	3.3321E-04	1.0361E-05
2.000	4.7089E-05	1.5225E-06	1.1085E-05	3.5842E-07	3.7409E-04	1.1630E-05
2.300	4.7089E-05	1.5225E-06	1.1176E-05	3.6131E-07	4.1540E-04	1.2912E-05
2.600	4.7089E-05	1.5225E-06	1.1273E-05	3.6443E-07	4.5701E-04	1.4203E-05
2.900	4.7089E-05	1.5225E-06	1.1378E-05	3.6778E-07	5.0038E-04	1.5548E-05
3.200	4.7089E-05	1.5225E-06	1.1489E-05	3.7133E-07	5.4619E-04	1.6969E-05
3.500	4.7089E-05	1.5225E-06	1.1608E-05	3.7511E-07	5.9477E-04	1.8474E-05
3.800	4.7089E-05	1.5225E-06	1.1733E-05	3.7910E-07	6.4626E-04	2.0070E-05
4.100	4.7089E-05	1.5225E-06	1.1865E-05	3.8330E-07	7.0073E-04	2.1757E-05
4.400	4.7089E-05	1.5225E-06	1.2004E-05	3.8771E-07	7.5818E-04	2.3536E-05
4.700	4.7089E-05	1.5225E-06	1.2149E-05	3.9233E-07	8.1861E-04	2.5407E-05
5.000	4.7089E-05	1.5225E-06	1.2301E-05	3.9716E-07	8.8201E-04	2.7370E-05
5.300	4.7089E-05	1.5225E-06	1.2460E-05	4.0220E-07	9.4836E-04	2.9423E-05
5.600	4.7089E-05	1.5225E-06	1.2625E-05	4.0743E-07	1.0176E-03	3.1567E-05
5.900	4.7089E-05	1.5225E-06	1.2796E-05	4.1287E-07	1.0898E-03	3.3800E-05
6.200	4.7089E-05	1.5225E-06	1.2974E-05	4.1851E-07	1.1649E-03	3.6121E-05
6.500	4.7089E-05	1.5225E-06	1.3159E-05	4.2435E-07	1.2428E-03	3.8531E-05
6.800	4.7089E-05	1.5225E-06	1.3349E-05	4.3038E-07	1.3236E-03	4.1028E-05
7.100	4.7089E-05	1.5225E-06	1.3546E-05	4.3661E-07	1.4072E-03	4.3612E-05
7.400	4.7089E-05	1.5225E-06	1.3750E-05	4.4303E-07	1.4936E-03	4.6282E-05
7.700	4.7089E-05	1.5225E-06	1.3959E-05	4.4965E-07	1.5828E-03	4.9037E-05
8.000	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.6747E-03	5.1877E-05
8.300	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.7414E-03	5.3938E-05
8.600	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.7737E-03	5.4936E-05
8.900	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.7894E-03	5.5419E-05
9.200	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.7970E-03	5.5653E-05
9.500	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.8006E-03	5.5767E-05
9.800	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.8024E-03	5.5822E-05
10.100	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.8033E-03	5.5849E-05
10.400	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.8037E-03	5.5862E-05
24.000	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.8041E-03	5.5874E-05
96.000	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.8041E-03	5.5874E-05
720.000	4.7089E-05	1.5225E-06	1.4175E-05	4.5645E-07	1.8041E-03	5.5874E-05

#####  
Worst Two-Hour Doses

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eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	6.1845E-08	4.7089E-05	1.5225E-06



ATTACHMENT T  
CEAPRN OUTPUT FILE

#####  
Cumulative Dose Summary  
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	eab		lpz		cr	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.333	0.0000E+00	6.8281E-06	0.0000E+00	1.6075E-06	0.0000E+00	1.1967E-06
0.500	0.0000E+00	1.0087E-05	0.0000E+00	2.3746E-06	0.0000E+00	2.5448E-06
0.800	0.0000E+00	1.5768E-05	0.0000E+00	3.7121E-06	0.0000E+00	5.9264E-06
1.100	0.0000E+00	2.1253E-05	0.0000E+00	5.0033E-06	0.0000E+00	1.0260E-05
1.400	0.0000E+00	2.6574E-05	0.0000E+00	6.2559E-06	0.0000E+00	1.5297E-05
1.700	0.0000E+00	3.1750E-05	0.0000E+00	7.4744E-06	0.0000E+00	2.0849E-05
2.000	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	2.6772E-05
2.300	0.0000E+00	3.6795E-05	0.0000E+00	8.7373E-06	0.0000E+00	3.2836E-05
2.600	0.0000E+00	3.6795E-05	0.0000E+00	8.8109E-06	0.0000E+00	3.8875E-05
2.900	0.0000E+00	3.6795E-05	0.0000E+00	8.8829E-06	0.0000E+00	4.4873E-05
3.200	0.0000E+00	3.6795E-05	0.0000E+00	8.9534E-06	0.0000E+00	5.0818E-05
3.500	0.0000E+00	3.6795E-05	0.0000E+00	9.0225E-06	0.0000E+00	5.6703E-05
3.800	0.0000E+00	3.6795E-05	0.0000E+00	9.0904E-06	0.0000E+00	6.2524E-05
4.100	0.0000E+00	3.6795E-05	0.0000E+00	9.1571E-06	0.0000E+00	6.8276E-05
4.400	0.0000E+00	3.6795E-05	0.0000E+00	9.2227E-06	0.0000E+00	7.3960E-05
4.700	0.0000E+00	3.6795E-05	0.0000E+00	9.2873E-06	0.0000E+00	7.9575E-05
5.000	0.0000E+00	3.6795E-05	0.0000E+00	9.3509E-06	0.0000E+00	8.5122E-05
5.300	0.0000E+00	3.6795E-05	0.0000E+00	9.4135E-06	0.0000E+00	9.0603E-05
5.600	0.0000E+00	3.6795E-05	0.0000E+00	9.4754E-06	0.0000E+00	9.6020E-05
5.900	0.0000E+00	3.6795E-05	0.0000E+00	9.5364E-06	0.0000E+00	1.0137E-04
6.200	0.0000E+00	3.6795E-05	0.0000E+00	9.5966E-06	0.0000E+00	1.0667E-04
6.500	0.0000E+00	3.6795E-05	0.0000E+00	9.6561E-06	0.0000E+00	1.1190E-04
6.800	0.0000E+00	3.6795E-05	0.0000E+00	9.7150E-06	0.0000E+00	1.1708E-04
7.100	0.0000E+00	3.6795E-05	0.0000E+00	9.7732E-06	0.0000E+00	1.2221E-04
7.400	0.0000E+00	3.6795E-05	0.0000E+00	9.8308E-06	0.0000E+00	1.2729E-04
7.700	0.0000E+00	3.6795E-05	0.0000E+00	9.8878E-06	0.0000E+00	1.3232E-04
8.000	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.3730E-04
8.300	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.4174E-04
8.600	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.4528E-04
8.900	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.4810E-04
9.200	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5035E-04
9.500	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5215E-04
9.800	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5359E-04
10.100	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5473E-04
10.400	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5565E-04
24.000	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5932E-04
96.000	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5932E-04
720.000	0.0000E+00	3.6795E-05	0.0000E+00	9.9443E-06	0.0000E+00	1.5932E-04

#####  
Worst Two-Hour Doses  
#####

eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	3.6795E-05	0.0000E+00	3.6795E-05

ATTACHMENT U  
CEASEC OUTPUT FILE

#####  
Cumulative Dose Summary  
#####

	eab		lpz		cr	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.333	3.3296E-03	1.0371E-04	7.8385E-04	2.4416E-05	9.8724E-03	3.0318E-04
0.500	4.9862E-03	1.5530E-04	1.1738E-03	3.6560E-05	2.0033E-02	6.1517E-04
0.800	6.3261E-03	1.9701E-04	1.4893E-03	4.6380E-05	3.6923E-02	1.1338E-03
1.100	7.6607E-03	2.3855E-04	1.8035E-03	5.6158E-05	5.0624E-02	1.5544E-03
1.400	8.9899E-03	2.7990E-04	2.1164E-03	6.5894E-05	6.2755E-02	1.9268E-03
1.700	1.0314E-02	3.2108E-04	2.4280E-03	7.5587E-05	7.4105E-02	2.2752E-03
2.000	1.1632E-02	3.6208E-04	2.7384E-03	8.5240E-05	8.5053E-02	2.6112E-03
2.300	1.1632E-02	3.6208E-04	2.7585E-03	8.5864E-05	9.5331E-02	2.9267E-03
2.600	1.1632E-02	3.6208E-04	2.7785E-03	8.6485E-05	1.0490E-01	3.2202E-03
2.900	1.1632E-02	3.6208E-04	2.7984E-03	8.7103E-05	1.1410E-01	3.5027E-03
3.200	1.1632E-02	3.6208E-04	2.8182E-03	8.7719E-05	1.2311E-01	3.7791E-03
3.500	1.1632E-02	3.6208E-04	2.8380E-03	8.8332E-05	1.3201E-01	4.0521E-03
3.800	1.1632E-02	3.6208E-04	2.8576E-03	8.8943E-05	1.4084E-01	4.3229E-03
4.100	1.1632E-02	3.6208E-04	2.8772E-03	8.9551E-05	1.4961E-01	4.5920E-03
4.400	1.1632E-02	3.6208E-04	2.8967E-03	9.0157E-05	1.5834E-01	4.8598E-03
4.700	1.1632E-02	3.6208E-04	2.9162E-03	9.0760E-05	1.6703E-01	5.1263E-03
5.000	1.1632E-02	3.6208E-04	2.9355E-03	9.1361E-05	1.7569E-01	5.3918E-03
5.300	1.1632E-02	3.6208E-04	2.9548E-03	9.1959E-05	1.8431E-01	5.6561E-03
5.600	1.1632E-02	3.6208E-04	2.9740E-03	9.2555E-05	1.9290E-01	5.9194E-03
5.900	1.1632E-02	3.6208E-04	2.9932E-03	9.3149E-05	2.0145E-01	6.1817E-03
6.200	1.1632E-02	3.6208E-04	3.0122E-03	9.3740E-05	2.0997E-01	6.4429E-03
6.500	1.1632E-02	3.6208E-04	3.0312E-03	9.4328E-05	2.1846E-01	6.7030E-03
6.800	1.1632E-02	3.6208E-04	3.0501E-03	9.4914E-05	2.2691E-01	6.9622E-03
7.100	1.1632E-02	3.6208E-04	3.0690E-03	9.5498E-05	2.3534E-01	7.2203E-03
7.400	1.1632E-02	3.6208E-04	3.0877E-03	9.6080E-05	2.4372E-01	7.4774E-03
7.700	1.1632E-02	3.6208E-04	3.1064E-03	9.6659E-05	2.5208E-01	7.7335E-03
8.000	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.6041E-01	7.9886E-03
8.300	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.6635E-01	8.1707E-03
8.600	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.6923E-01	8.2590E-03
8.900	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7063E-01	8.3018E-03
9.200	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7130E-01	8.3225E-03
9.500	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7163E-01	8.3326E-03
9.800	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7179E-01	8.3375E-03
10.100	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7187E-01	8.3398E-03
10.400	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7191E-01	8.3410E-03
24.000	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7194E-01	8.3421E-03
96.000	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7194E-01	8.3421E-03
720.000	1.1632E-02	3.6208E-04	3.1251E-03	9.7236E-05	2.7194E-01	8.3421E-03

#####  
Worst Two-Hour Doses  
#####

eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	5.2494E-06	1.1632E-02	3.6208E-04

ATTACHMENT V  
CEAFFI2 OUTPUT FILE

#####

Cumulative Dose Summary

#####

	eab		lpz		cr	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.250	1.6061E+00	5.8286E-02	3.7809E-01	1.3721E-02	3.6189E+00	1.1532E-01
0.333	1.6789E+00	6.0905E-02	3.9524E-01	1.4338E-02	5.9637E+00	1.8995E-01
0.500	1.8431E+00	6.6774E-02	4.3389E-01	1.5720E-02	1.0040E+01	3.1957E-01
0.800	2.2002E+00	7.9410E-02	5.1796E-01	1.8694E-02	1.5395E+01	4.8955E-01
1.100	2.6355E+00	9.4634E-02	6.2044E-01	2.2278E-02	1.9634E+01	6.2385E-01
1.400	3.1479E+00	1.1238E-01	7.4107E-01	2.6456E-02	2.3655E+01	7.5097E-01
1.700	3.7364E+00	1.3259E-01	8.7962E-01	3.1213E-02	2.7884E+01	8.8452E-01
2.000	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.2527E+01	1.0309E+00
2.300	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.6016E+01	1.1408E+00
2.600	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.7703E+01	1.1939E+00
2.900	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.8519E+01	1.2195E+00
3.200	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.8914E+01	1.2319E+00
3.500	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9105E+01	1.2379E+00
3.800	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9197E+01	1.2408E+00
4.100	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9242E+01	1.2422E+00
4.400	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9263E+01	1.2429E+00
4.700	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9274E+01	1.2432E+00
5.000	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9279E+01	1.2434E+00
5.300	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9281E+01	1.2435E+00
5.600	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9282E+01	1.2435E+00
5.900	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
6.200	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
6.500	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
6.800	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
7.100	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
7.400	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
7.700	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
8.000	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
8.300	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
8.600	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
8.900	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
9.200	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
9.500	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
9.800	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
10.100	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
10.400	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
24.000	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
96.000	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00
720.000	4.4000E+00	1.5521E-01	1.0358E+00	3.6538E-02	3.9283E+01	1.2435E+00

#####

Worst Two-Hour Doses

#####

eab

Time	Whole Body	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)
0.0	1.6638E-02	4.4000E+00	1.5521E-01

ATTACHMENT W  
CEAFFN2 OUTPUT FILE

#####  
Cumulative Dose Summary  
#####

	eab		lpz		cr	
Time (hr)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)	Thyroid (rem)	TEDE (rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.333	0.0000E+00	5.7185E-02	0.0000E+00	1.3462E-02	0.0000E+00	9.4344E-03
0.500	0.0000E+00	7.8304E-02	0.0000E+00	1.8434E-02	0.0000E+00	1.8143E-02
0.800	0.0000E+00	1.0995E-01	0.0000E+00	2.5885E-02	0.0000E+00	3.6895E-02
1.100	0.0000E+00	1.3653E-01	0.0000E+00	3.2143E-02	0.0000E+00	5.7856E-02
1.400	0.0000E+00	1.6000E-01	0.0000E+00	3.7666E-02	0.0000E+00	8.0048E-02
1.700	0.0000E+00	1.8124E-01	0.0000E+00	4.2667E-02	0.0000E+00	1.0283E-01
2.000	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.2570E-01
2.300	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.4543E-01
2.600	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.6014E-01
2.900	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.7113E-01
3.200	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.7936E-01
3.500	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.8553E-01
3.800	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.9017E-01
4.100	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.9365E-01
4.400	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.9627E-01
4.700	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.9825E-01
5.000	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	1.9974E-01
5.300	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0086E-01
5.600	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0171E-01
5.900	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0236E-01
6.200	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0285E-01
6.500	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0322E-01
6.800	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0350E-01
7.100	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0371E-01
7.400	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0387E-01
7.700	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0400E-01
8.000	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0409E-01
8.300	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0416E-01
8.600	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0422E-01
8.900	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0426E-01
9.200	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0429E-01
9.500	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0432E-01
9.800	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0434E-01
10.100	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0435E-01
10.400	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0436E-01
24.000	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0440E-01
96.000	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0440E-01
720.000	0.0000E+00	2.0073E-01	0.0000E+00	4.7255E-02	0.0000E+00	2.0440E-01

#####  
Worst Two-Hour Doses  
#####

eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	2.0073E-01	0.0000E+00	2.0073E-01



# ATTACHMENT X CEAPRI2 OUTPUT FILE

#####  
Cumulative Dose Summary  
#####

	eab		lpz		cr	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.250	2.1381E-05	6.9416E-07	5.0335E-06	1.6342E-07	4.8189E-05	1.4999E-06
0.333	2.2351E-05	7.2562E-07	5.2619E-06	1.7082E-07	7.9437E-05	2.4722E-06
0.500	2.4541E-05	7.9654E-07	5.7774E-06	1.8752E-07	1.3380E-04	4.1634E-06
0.800	2.9309E-05	9.5070E-07	6.8999E-06	2.2381E-07	2.0530E-04	6.3870E-06
1.100	3.5131E-05	1.1385E-06	8.2705E-06	2.6803E-07	2.6200E-04	8.1494E-06
1.400	4.1995E-05	1.3596E-06	9.8863E-06	3.2006E-07	3.1585E-04	9.8225E-06
1.700	4.9889E-05	1.6133E-06	1.1745E-05	3.7980E-07	3.7259E-04	1.1585E-05
2.000	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	4.3495E-04	1.3521E-05
2.300	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	4.8187E-04	1.4977E-05
2.600	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.0459E-04	1.5682E-05
2.900	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.1560E-04	1.6023E-05
3.200	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2093E-04	1.6188E-05
3.500	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2351E-04	1.6268E-05
3.800	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2476E-04	1.6307E-05
4.100	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2536E-04	1.6326E-05
4.400	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2565E-04	1.6335E-05
4.700	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2580E-04	1.6339E-05
5.000	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2587E-04	1.6342E-05
5.300	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2590E-04	1.6343E-05
5.600	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2592E-04	1.6343E-05
5.900	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2592E-04	1.6343E-05
6.200	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6343E-05
6.500	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6343E-05
6.800	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
7.100	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
7.400	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
7.700	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
8.000	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
8.300	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
8.600	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
8.900	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
9.200	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
9.500	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
9.800	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
10.100	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
10.400	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
24.000	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
96.000	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05
720.000	5.8803E-05	1.8994E-06	1.3843E-05	4.4715E-07	5.2593E-04	1.6344E-05

#####  
Worst Two-Hour Doses

#####

eab

Time	Whole Body	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)
0.0	7.5742E-08	5.8803E-05	1.8994E-06

# ATTACHMENT Y CEAPRN2 OUTPUT FILE

#####  
Cumulative Dose Summary  
#####

	eab		lpz		cr	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.333	0.0000E+00	6.8281E-06	0.0000E+00	1.6075E-06	0.0000E+00	1.1967E-06
0.500	0.0000E+00	1.0087E-05	0.0000E+00	2.3746E-06	0.0000E+00	2.5448E-06
0.800	0.0000E+00	1.5768E-05	0.0000E+00	3.7121E-06	0.0000E+00	5.9264E-06
1.100	0.0000E+00	2.1253E-05	0.0000E+00	5.0033E-06	0.0000E+00	1.0260E-05
1.400	0.0000E+00	2.6574E-05	0.0000E+00	6.2559E-06	0.0000E+00	1.5297E-05
1.700	0.0000E+00	3.1750E-05	0.0000E+00	7.4744E-06	0.0000E+00	2.0849E-05
2.000	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	2.6772E-05
2.300	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	3.2167E-05
2.600	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	3.6408E-05
2.900	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	3.9747E-05
3.200	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	4.2377E-05
3.500	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	4.4452E-05
3.800	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	4.6090E-05
4.100	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	4.7385E-05
4.400	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	4.8409E-05
4.700	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	4.9219E-05
5.000	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	4.9861E-05
5.300	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.0370E-05
5.600	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.0774E-05
5.900	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.1094E-05
6.200	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.1349E-05
6.500	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.1551E-05
6.800	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.1712E-05
7.100	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.1840E-05
7.400	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.1942E-05
7.700	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2023E-05
8.000	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2087E-05
8.300	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2139E-05
8.600	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2180E-05
8.900	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2213E-05
9.200	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2239E-05
9.500	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2259E-05
9.800	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2276E-05
10.100	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2289E-05
10.400	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2300E-05
24.000	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2343E-05
96.000	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2343E-05
720.000	0.0000E+00	3.6795E-05	0.0000E+00	8.6621E-06	0.0000E+00	5.2343E-05

#####  
Worst Two-Hour Doses  
#####

eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	3.6795E-05	0.0000E+00	3.6795E-05

ATTACHMENT Z  
CEASEC2 OUTPUT FILE

#####

Cumulative Dose Summary

#####

	eab		lpz		cr	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.333	3.2712E-03	1.0189E-04	7.7010E-04	2.3988E-05	9.6991E-03	2.9786E-04
0.500	4.8988E-03	1.5258E-04	1.1533E-03	3.5919E-05	1.9681E-02	6.0438E-04
0.800	7.8134E-03	2.4331E-04	1.8394E-03	5.7280E-05	3.9925E-02	1.2259E-03
1.100	1.0709E-02	3.3344E-04	2.5212E-03	7.8498E-05	6.1712E-02	1.8948E-03
1.400	1.3587E-02	4.2297E-04	3.1986E-03	9.9574E-05	8.4171E-02	2.5843E-03
1.700	1.6446E-02	5.1190E-04	3.8717E-03	1.2051E-04	1.0688E-01	3.2814E-03
2.000	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.2964E-01	3.9798E-03
2.300	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.4590E-01	4.4789E-03
2.600	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.5378E-01	4.7208E-03
2.900	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.5760E-01	4.8380E-03
3.200	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.5946E-01	4.8949E-03
3.500	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6035E-01	4.9225E-03
3.800	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6079E-01	4.9358E-03
4.100	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6100E-01	4.9423E-03
4.400	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6110E-01	4.9454E-03
4.700	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6115E-01	4.9470E-03
5.000	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6118E-01	4.9477E-03
5.300	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6119E-01	4.9481E-03
5.600	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6119E-01	4.9482E-03
5.900	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9483E-03
6.200	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
6.500	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
6.800	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
7.100	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
7.400	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
7.700	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
8.000	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
8.300	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
8.600	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
8.900	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
9.200	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
9.500	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
9.800	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
10.100	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
10.400	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
24.000	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
96.000	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03
720.000	1.9287E-02	6.0024E-04	4.5405E-03	1.4131E-04	1.6120E-01	4.9484E-03

#####

Worst Two-Hour Doses

#####

eab

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	8.6279E-06	1.9287E-02	6.0024E-04

# ATTACHMENT AA CEACTMT OUTPUT FILE

#####  
Cumulative Dose Summary  
#####

	EAB		LPZ		cr	
Time	Thyroid	TEDE	Thyroid	TEDE	Thyroid	TEDE
(hr)	(rem)	(rem)	(rem)	(rem)	(rem)	(rem)
0.000	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
0.092	1.1984E+00	5.0944E-02	3.0420E-01	1.2932E-02	3.3051E-01	1.0664E-02
0.333	4.3174E+00	1.7880E-01	1.0959E+00	4.5387E-02	4.1116E+00	1.3215E-01
0.733	7.8710E+00	3.2365E-01	1.9980E+00	8.2157E-02	1.3550E+01	4.3494E-01
1.033	9.1919E+00	3.8086E-01	2.3333E+00	9.6680E-02	1.9039E+01	6.1148E-01
1.333	9.9233E+00	4.1577E-01	2.5190E+00	1.0554E-01	2.2815E+01	7.3374E-01
1.633	1.0328E+01	4.3830E-01	2.6218E+00	1.1126E-01	2.5247E+01	8.1343E-01
1.933	1.0553E+01	4.5383E-01	2.6788E+00	1.1520E-01	2.6751E+01	8.6378E-01
2.000	1.0587E+01	4.5664E-01	2.6875E+00	1.1592E-01	2.6995E+01	8.7208E-01
2.300	1.0587E+01	4.5664E-01	2.6893E+00	1.1610E-01	2.7772E+01	8.9932E-01
2.600	1.0587E+01	4.5664E-01	2.6904E+00	1.1625E-01	2.8198E+01	9.1520E-01
2.900	1.0587E+01	4.5664E-01	2.6909E+00	1.1637E-01	2.8432E+01	9.2481E-01
3.200	1.0587E+01	4.5664E-01	2.6912E+00	1.1648E-01	2.8561E+01	9.3091E-01
3.500	1.0587E+01	4.5664E-01	2.6914E+00	1.1657E-01	2.8632E+01	9.3504E-01
3.800	1.0587E+01	4.5664E-01	2.6915E+00	1.1666E-01	2.8672E+01	9.3803E-01
4.100	1.0587E+01	4.5664E-01	2.6916E+00	1.1674E-01	2.8694E+01	9.4034E-01
4.400	1.0587E+01	4.5664E-01	2.6916E+00	1.1681E-01	2.8706E+01	9.4224E-01
4.700	1.0587E+01	4.5664E-01	2.6916E+00	1.1688E-01	2.8713E+01	9.4386E-01
5.000	1.0587E+01	4.5664E-01	2.6916E+00	1.1695E-01	2.8717E+01	9.4530E-01
5.300	1.0587E+01	4.5664E-01	2.6916E+00	1.1701E-01	2.8720E+01	9.4660E-01
5.600	1.0587E+01	4.5664E-01	2.6917E+00	1.1707E-01	2.8721E+01	9.4780E-01
5.900	1.0587E+01	4.5664E-01	2.6917E+00	1.1712E-01	2.8722E+01	9.4891E-01
6.200	1.0587E+01	4.5664E-01	2.6917E+00	1.1717E-01	2.8723E+01	9.4994E-01
6.500	1.0587E+01	4.5664E-01	2.6917E+00	1.1722E-01	2.8723E+01	9.5091E-01
6.800	1.0587E+01	4.5664E-01	2.6917E+00	1.1727E-01	2.8723E+01	9.5182E-01
7.100	1.0587E+01	4.5664E-01	2.6917E+00	1.1731E-01	2.8724E+01	9.5267E-01
7.400	1.0587E+01	4.5664E-01	2.6917E+00	1.1735E-01	2.8724E+01	9.5348E-01
7.700	1.0587E+01	4.5664E-01	2.6917E+00	1.1739E-01	2.8724E+01	9.5425E-01
8.000	1.0587E+01	4.5664E-01	2.6917E+00	1.1742E-01	2.8724E+01	9.5497E-01
8.300	1.0587E+01	4.5664E-01	2.6917E+00	1.1746E-01	2.8724E+01	9.5562E-01
8.600	1.0587E+01	4.5664E-01	2.6917E+00	1.1749E-01	2.8724E+01	9.5617E-01
8.900	1.0587E+01	4.5664E-01	2.6917E+00	1.1752E-01	2.8724E+01	9.5665E-01
9.200	1.0587E+01	4.5664E-01	2.6917E+00	1.1755E-01	2.8724E+01	9.5706E-01
9.500	1.0587E+01	4.5664E-01	2.6917E+00	1.1758E-01	2.8724E+01	9.5742E-01
9.800	1.0587E+01	4.5664E-01	2.6917E+00	1.1761E-01	2.8724E+01	9.5775E-01
10.100	1.0587E+01	4.5664E-01	2.6917E+00	1.1763E-01	2.8724E+01	9.5804E-01
10.400	1.0587E+01	4.5664E-01	2.6917E+00	1.1766E-01	2.8724E+01	9.5831E-01
24.000	1.0587E+01	4.5664E-01	2.6917E+00	1.1825E-01	2.8724E+01	9.6363E-01
96.000	1.0587E+01	4.5664E-01	2.6917E+00	1.1838E-01	2.8724E+01	9.6582E-01
720.000	1.0587E+01	4.5664E-01	2.6917E+00	1.1862E-01	2.8724E+01	9.6789E-01

#####  
Worst Two-Hour Doses

#####

EAB

Time (hr)	Whole Body (rem)	Thyroid (rem)	TEDE (rem)
0.0	1.2280E-01	1.0587E+01	4.5664E-01



ATTACHMENT AB  
ETP-97-064R CONTROL ROOM INLEAKAGE RESULTS

CONTROLLED  
COPY

CAO 6454 Rev.0  
Page 105

CALVERT CLIFFS NUCLEAR POWER PLANT

TECHNICAL PROCEDURE

ENGINEERING TEST PROCEDURE

UNIT 0

ETP 97-064R

CONTROL ROOM HVAC SYSTEM INLEAKAGE TEST

REVISION 0

Effective Date

11/11/1997

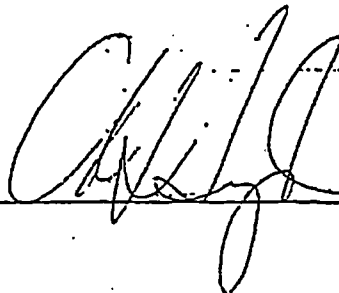
Safety Related X

Non-Safety Related           

Writer: D. T. McElheny

Sponsor: V. P. Spunar

Approved



11/11/97  
Date

CONTROLLED  
COPY

FT-86 (Rev. 1 10/97)

- ACU#11



NUCON International, Inc.

## Decay Test Data

Estimated duration of test: 2 hours  
 Beginning concentration (C<sub>1</sub>): 19.0 ppb  
 Ending concentration (C<sub>0</sub>): 2.7 ppb  
 Time at start of test: Time "zero" for decay test was at 01:15 hours on 18 Nov 97.  
 Time at end of test: 03:12 hours on 19 Nov 97  
 Sample time intervals: 15 minute, except for last sample

## Time / Sample Concentration

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
01:15 / 19.0	/	/	/
01:30 / 14.8	/	/	/
01:45 / 12.1	/	/	/
02:00 / 8.3	/	/	/
02:15 / 6.7	/	/	/
02:30 / 5.1	/	/	/
03:12 / 2.7	/	/	/

(A) Air Change Rate (1/min)

0.0170

(Q) Inleakage Flow Rate (CFM)

4300

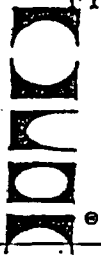
95% Confidence Limit

95% Confidence Interval

(A) = 0.0170 ± 0.00124000 < Q < 4600

Comments: Decay samples taken at a sample port on the discharge of #11 return fan. All sample concentrations in the ppb range.

Watt O. Wilf      W. Peter Sullivan  
 Test personnel signature(s) and date: NUCON International Inc.



## Decay Test Data

Estimated duration of test: 1.4 hours  
Beginning concentration (C<sub>i</sub>): 40.5 ppb  
Ending concentration (C<sub>o</sub>): 14.2 ppb  
Time at start of test: Time "zero" for decay test was at 23:16 hours on 19 Nov 97.  
Time at end of test: 00:46 hours on 20 Nov 97  
Sample time intervals: 15 minute

## Time / Sample Concentration

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
23:16 / 40.5	/	/	/
23:31 / 35.2	/	/	/
23:46 / 21.2	/	/	/
00:01 / 26.7	/	/	/
00:16 / 20.3	/	/	/
00:31 / 16.7	/	/	/
00:46 / 14.2	/	/	/

(A) Air Change Rate (1/min)

0.0118

(Q) Inleakage Flow Rate (CFM)

3000

95% Confidence Limit

(A) = 0.0118 ± 0.0012

95% Confidence Interval

2900 &lt; Q &lt; 3300

Comments: Decay samples taken at a sample port on the discharge of #12 return fan. These samples were taken in conjunction with samples taken in CAS and on both CSR return ducts. The decay sample taken at 23:46 hours was disregarded due to a faulty gas sample bag.

Walt O. Wiloff M. Peter Therman  
Test personnel signature(s) and date: NUCON International Inc.

CALVERT CLIFFS NUCLEAR POWER PLANT  
TECHNICAL PROCEDURE  
ENGINEERING TEST PROCEDURE

---

UNIT 0  
ETP 97-064R  
CONTROL ROOM HVAC SYSTEM INLEAKAGE TEST  
REVISION 0

3rd  
Run of  
ETP

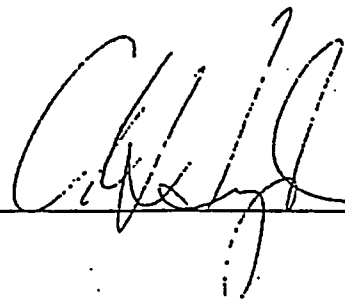
Effective Date 11/11/1997

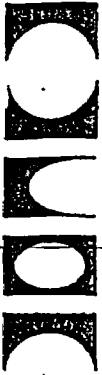
Safety Related X  
Non-Safety Related           

**CONTROLLED  
COPY**

Writer: D. T. McElheny

Sponsor: V. P. Spunar

Approved  11/11/97  
Date



*Art. 1 Chron Log*  
*Page 3 of 7*  
**NUCON International, Inc.**

P.O. BOX 29151 7000 HUNTLEY ROAD  
COLUMBUS, OHIO 43229 U.S.A.

*CA06454 Rev 0*  
*Page 109*

TELEPHONE: (614) 846-5710  
OUTSIDE OHIO: 1-800-992-5192  
FAX: (614) 431-0858

## **Control Room Inleakage Test Report**

**performed for:**

**Baltimore Gas and Electric Company  
Calvert Cliffs Nuclear Power Station  
1850 Calvert Cliffs Pkwy.  
Lusby, Maryland  
20657**

**P.O. No. 16582**

**20 April 1998**

### **Distribution:**

**BG&E:**

**Dale McElheny (1)**

**NUCON:**

**12BG847 MF (1)**

**Field Test (1)**

**QA (1)**

**Marketing (1)**

**NUCON 12BG847 /02**

### Decay Test Data

Estimated duration of test: 120 minutes  
 Beginning concentration (Ct): 25.0 ppb  
 Ending concentration (C(O)): 4.1 ppb  
 Time at start of test: Time "zero" for decay test was at 22:03 hrs. on 10 Feb 98  
 Time at end of test: 00:03 hrs. on 11 Feb 98  
 Sample time intervals: 20 minutes apart

#### Time / Sample Concentration

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
22:03 / 25.0	/	/	/
22:23 / 17.9	/	/	/
22:43 / 11.9	/	/	/
23:03 / 9.7	/	/	/
23:23 / 9.0	/	/	/
23:43 / 5.7	/	/	/
00:03 / 4.1	/	/	/

(A) Air Change Rate (1/min)

0.0143

(Q) Inleakage Flow Rate (CFM)

3,600

95% Confidence Limit

95% Confidence Interval

(A) = 0.0143 ± 0.0025

$$3000 < Q < 4300$$

10 ftm  
\* 4200

Comments: Decay samples taken at a sample port on the discharge of #11 return fan. All sample concentrations in the ppb range.

\* per conversation w/ Pete Freeman 5/27/98. DTM

Test personnel signature(s) and date: NUCON International Inc.

**Decay Test Data**

Estimated duration of test: 120 minutes  
 Beginning concentration (Ct): 47 ppb  
 Ending concentration (C(O)): 12.6 ppb  
 Time at start of test: Time "zero" for decay test was at 02:05 hrs. on 11 Feb 98  
 Time at end of test: 04:05 hrs. on 11 Feb 98  
 Sample time intervals: 20 minutes apart

**Time / Sample Concentration**

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
<u>02:05 / 47.0</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>02:25 / 33.2</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>02:45 / 27.4</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>03:05 / 24.8</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>03:25 / 21.4</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>03:45 / 16.1</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>04:05 / 12.6</u>	<u>/</u>	<u>/</u>	<u>/</u>

**(A) Air Change Rate ( 1/min)**0.0101**(Q) Inleakage Flow Rate (CFM)**2550**95% Confidence Limit**(A) = 0.0101  $\pm$  0.0018**95% Confidence Interval**2100 < Q < 3000

Comments: Decay samples taken at a sample port on the discharge of #12 return fan. All sample concentrations in the ppb range.

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Test personnel signature(s) and date: NUCON International Inc.



CALVERT CLIFFS NUCLEAR POWER PLANT  
TECHNICAL PROCEDURE  
ENGINEERING TEST PROCEDURE  
UNIT 0  
ETP 97-064R  
CONTROL ROOM HVAC SYSTEM INLEAKAGE TEST  
REVISION 0

4th  
Run of  
ETP

Effective Date 11/11/1997

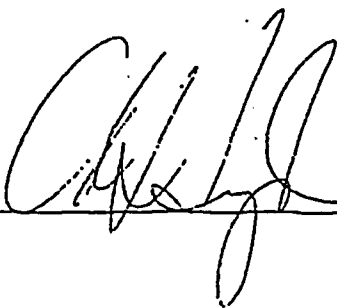
Safety Related X  
Non-Safety Related           

**CONTROLLED  
COPY**

Writer: D. T. McElheny

Sponsor: V. P. Spunar

Approved



11/11/97  
Date



NUCON International, Inc.

P.O. BOX 29151 7000 HUNTLEY ROAD  
COLUMBUS, OHIO 43229 U.S.A.

Att. 1. Chron. Log

Page 3 of 11

CA06454 Rev.0  
Page 113

TELEPHONE: (614) 846-5710  
OUTSIDE OHIO: 1-800-992-5192  
FAX: (614) 431-0858

## Control Room Inleakage Test Report

performed for:

Baltimore Gas and Electric Company  
Calvert Cliffs Nuclear Power Station  
1850 Calvert Cliffs Pkwy.  
Lusby, Maryland  
20657

P.O. No. 16582

20 April 1998

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### Distribution:

BG&E:

Dale McElheny (1)

NUCON:

12BG847 MF (1)

Field Test (1)

QA (1)

Marketing (1)

NUCON 12BG847 /02

**Decay Test Data**

Estimated duration of test: 120 minutes  
 Beginning concentration (C<sub>i</sub>): 37.5 ppb  
 Ending concentration (C<sub>0</sub>): 9.2 ppb  
 Time at start of test: Time "zero" for decay test was at 01:15 hrs on 12 Feb 98  
 Time at end of test: 03:15 hrs on 12 Feb 98  
 Sample time intervals: 20 minutes apart

**Time / Sample Concentration**

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
<u>1:15 / 37.5</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>1:35 / 28.1</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>1:55 / 24.7</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>2:15 / 19.3</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>2:35 / 15.7</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>2:55 / 11.7</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>3:15 / 9.2</u>	<u>/</u>	<u>/</u>	<u>/</u>

**(A) Air Change Rate (min<sup>-1</sup>)**0.0115**(Q) Inleakage Flow Rate (CFM)**2,900**95% Confidence Limit**(A) = 0.0115 ± .0010**95% Confidence Interval**2650 < Q < 3150

Comments: Decay samples taken at a sample port on the discharge of #11 return fan. All sample concentrations in the ppb range.

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Test personnel signature(s) and date: NUCON International Inc.

## Decay Test Data

Estimated duration of test: 120 minutes  
 Beginning concentration (Ct): 37.5 ppb  
 Ending concentration (C(O)): 9.2 ppb  
 Time at start of test: Time "zero" for decay test was at 21:25 hrs. on 11 Feb 98  
 Time at end of test: 23:25 hrs. on 11 Feb 98  
 Sample time intervals: 20 minutes apart

### Time / Sample Concentration

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
<u>21:25 / 37.6</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>21:45 / 30.2</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>22:05 / 25.2</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>22:25 / 22.7</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>22:45 / 15.5</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>23:05 / 13.4</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>23:25 / 10.5</u>	<u>/</u>	<u>/</u>	<u>/</u>

(A) Air Change Rate (1/min)

0.0109

(Q) Inleakage Flow Rate (CFM)

2.750

95% Confidence Limit

(A) = 0.0109 ± .0015

95% Confidence Interval

2370 < Q < 3130

Comments: Decay samples taken at a sample port on the discharge of #12 return fan. All sample concentrations in the ppb range.

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Test personnel signature(s) and date: NUCON International Inc.

CALVERT CLIFFS NUCLEAR POWER PLANT  
TECHNICAL PROCEDURE  
ENGINEERING TEST PROCEDURE  
UNIT 0  
ETP 97-064R  
CONTROL ROOM HVAC SYSTEM INLEAKAGE TEST  
REVISION 1

File 88-185  
Rev'n 8/17/44

5901 - Al.

Effective Date 1/18/00

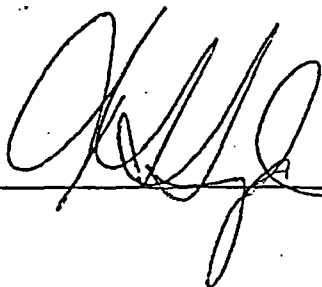
Safety Related X  
Non-Safety Related       

CONTROLLED COPY

Writer: D. T. McElheny

Sponsor: T. R. Lupold

Approved



1/18/00  
Date

Attachment 1

Page 2 of 14

**NUCON International, Inc.**

P.O. BOX 29151 7000 HUNTLEY ROAD  
COLUMBUS, OHIO 43229 U.S.A.

TELEPHONE: (614) 846-5710

TOLL FREE: 1-800-992-5192

FAX: (614) 431-0858

WEB SITE: [www.nucon-int.com](http://www.nucon-int.com)

**Control Room Inleakage Test Report**

performed for:

**Baltimore Gas and Electric Company**

**Calvert Cliffs Nuclear Power Station**

**1850 Calvert Cliffs Pkwy.**

**Lusby, Maryland**

**20657**

**P.O. No. 16582**

**3 March 2000**

**Distribution:**

**BG&E:**

**Dale McElheny (1)**

**NUCON:**

**12BG658 MF (1)**

**Field Test (1)**

**QA (1)**

**Marketing (1)**

**NUCON 12BG658 /01**

## Decay Test Data

Estimated duration of test: 180 minutes  
 Beginning concentration (C<sub>i</sub>): 51.4 ppb  
 Ending concentration (C<sub>0</sub>): 13.2 ppb  
 Time at start of test: Time "zero" for decay test was at 01:05 hrs. on 26 Jan 00  
 Time at end of test: 04:05 hrs. on 26 Jan 00  
 Sample time intervals: 15 minutes apart

## Time / Sample Concentration

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
/	120/23.8	/	/
30/ 51.4	135/21.0	/	/
45/ 47.6	150/17.8	/	/
60/ 41.9	165/16.4	/	/
75/ 33.0	180/13.2	/	/
90/ 30.7	/	/	/
105/ 29.3	/	/	/

(A) Air Change Rate (1/min)

0.00896

(Q) Inleakage Flow Rate (CFM)

2600

95% Confidence Limit

(A) = 0.00896 ± 0.00065

95 % Confidence Interval

2400 < Q < 2800

Comments: Decay samples taken at a sample port on the discharge of #12 return fan. All sample concentrations in the ppb range.

W. Peter Freeman Eric M Banks 3 March 00  
 Test personnel signature(s) and date: NUCON International Inc.

### Decay Test Data

Estimated duration of test: 180 minutes  
 Beginning concentration (Ct): 59.2 ppb @ 15 minutes into test  
 Ending concentration (C(O)): 8.8 ppb @ 195 minutes into test  
 Time at start of test: Time "zero" for decay test was at 23:35 hrs. on 26 Jan 00  
 Time at end of test: 03:00 hrs. on 27 Jan 00  
 Sample time intervals: 15 minutes apart to 105 minutes then @ 140, 165, and 195 minutes

#### Time / Sample Concentration

Time/Conc.	Time/Conc.	Time/Conc.	Time/Conc.
<u>15/59.2</u>	<u>165/13.8</u>	<u>/</u>	<u>/</u>
<u>30/52.5</u>	<u>195/8.8</u>	<u>/</u>	<u>/</u>
<u>45/42.8</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>60/40.2</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>75/36.1</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>105/26.2</u>	<u>/</u>	<u>/</u>	<u>/</u>
<u>140/17.4</u>	<u>/</u>	<u>/</u>	<u>/</u>

(A) Air Change Rate (1/min)

0.0103

(Q) Inleakage Flow Rate (CFM)

3000

95% Confidence Limit

(A) = 0.0103 ± 0.00085

95 % Confidence Interval

2750 < Q < 3250

Comments: Decay samples taken at a sample port on the discharge of #11 return fan. All sample concentrations in the ppb range.

W. Peter Freeman Eric M Banks 37 March 00  
 Test personnel signature(s) and date: NUCON International Inc.



ATTACHMENT AC  
ETP 01-035R PERFLUOROCARBON TRACER GAS TESTING

## CALVERT CLIFFS NUCLEAR POWER PLANT

## TECHNICAL PROCEDURE

## ENGINEERING TEST PROCEDURE

## UNIT 0

ETP 01-035R

PERFLUOROCARBON TRACER GAS TESTING

REVISION 0

**CONTROLLED  
COPY**Effective Date 5/1/02Safety Related X  
Non-Safety Related       

Writer: D. T. McElheny

Sponsor: M. A. Junge

Approved

Richard L. Speltz1 5-1-02

Date

CA06454 Rev.0

Page 122

TRACER TECHNOLOGY CENTER  
BROOKHAVEN NATIONAL LABORATORY

FACSIMILE

DATE: July 29, 2002

TO: John E. Wynn Jr.  
Aux Systems Engr Unit  
Calvert Cliffs Nuclear Power Plant  
Lusby, MD 20657

FAX NO: (410) 495 - 4727

## MESSAGE:

John,

I'm on vacation this week but wanted to send you the final results but without my final assessment. Remarkably, total inleakage was  $2930 \pm 185$  cfm. Other flows, in cfm, were:

Zone	From/To	CR Inleakage	% of total	CR Outleakage	% of total
0	Outside	$275 \pm 185$	9	$1866 \pm 470$	64
2	AB	$436 \pm 157$	15	$366 \pm 248$	13
3	TB	$466 \pm 172$	16	$599 \pm 415$	20
4	MSIVs	$272 \pm 134$	9	$44 \pm 33$	2
5	AC11	$274 \pm 33$	9	$19 \pm 3$	1
6	AC13	$387 \pm 38$	13	$11 \pm 8$	0
7	SWGRs	$818 \pm 114$	28	$21 \pm 10$	1

More next week. I'll put a copy in the mail also.



Total no. of pages including this cover page: 4

From: Russell N. Dietz - Head  
Tracer Technology Center  
Atmospheric Sciences Division  
Brookhaven National Laboratory  
Bldg 815E  
Upton, NY 11973-5000

Telephone: (631) 344-3059  
Fax: (631) 344-2887  
Confirmation: (631) 344-3275  
Email: dietz@bnl.gov  
Secretary: Barbara J. Roland  
Secretary's email: roland@bnl.gov

## BNL-AIMS

12:36:28 07-26-2002

PROJECT: CALVERT CLIFFS  
HOUSE: CALVERT CLIFFSSTART: 09:00 (08-08-1902)  
STOP: 10:00 (06-18-1902)BNL CODE: CAL1A0  
ANALYZED: 06-27-1902

\*\*\*\*\* RATES \*\*\*\*\*  
 OVERALL INFILTRATION RATE = %515878.1  $q$  85992.1 ( $m^3/h$ )  
 OVERALL AIR EXCHANGE RATE = 1.461  $q$  0.251 (1/h)

ZONE	LOCATION	SOURCE	RATE	EXFILTRATION	INFILTRATION	ACH	SD
CR		@25C QTY	@T	RATE	RATE		
		(nL/m)	(nL/h)	( $m^3/h$ )	( $m^3/h$ )	(/h)	
1	CR	%663.0	1	41812	3170.4	787.9	464.8
2	AB	%3858.0	4	973219	30896.3	11048.8	32707.5
3	TB	%3870.0	12	%3399361	411130.1	88819.1	419373.8
4	MSIVs	%458.0	4	189594	22087.4	10568.3	5694.9
5	No.11 AC	%2150.0	1	132691	30819.8	3244.6	32226.2
6	No.13 AC	6.4	30	12620	14492.4	1194.7	8912.2
7	SWGRs	9.2	10	6435	3381.7	10458.4	16598.8
							1527.7
							2.460
							0.541
							2.348
							0.246

ZONE-ZONE	RATE	$q$	SD ( $m^3/h$ )	ZONE-ZONE	RATE	$q$	SD ( $m^3/h$ )
1-1	622.2	421.7		2-1	741.3	267.9	
1-2	1018.1	704.6		2-2	792.5	292.2	
1-3	74.3	56.7		2-3	462.9	227.1	
1-4	32.3	5.2		2-4	464.9	55.6	
1-5	19.4	13.7		2-5	657.3	64.4	
1-6	36.3	16.9		2-6	1389.7	193.3	
1-7	2870.3	1460.4		2-7	145.4	46.5	
2-1	31.1	69.4		2-8	378.6	44.8	
2-2	12.0	6.0		2-9	334.8	25.8	
2-3	11.1	21.7		2-10	314.4	24.3	
2-4	552.1	220.7		2-11	611.4	55.6	
2-5	17034.4	%11524.3		2-12	164.4	133.2	
2-6	163.4	115.6		2-13	807.0	235.2	
2-7	8416.2	1965.2		2-14	1002.9	424.6	
2-8	215.4	133.1		2-15	12671.2	%11138.9	
2-9	60.1	35.6		2-16	138.1	86.7	
2-10	12.7	6.5		2-17	755.3	506.8	
2-11	30.9	19.1		2-18	541.5	547.4	
2-12	60.8	11.3		2-19	125.9	120.7	
2-13	22.3	7.0		2-20	27.6	62.7	
2-14	91.1	20.9		2-21	7.0	214.7	

ZONE	RATE	$q$	SD ( $m^3/h$ )	ACH	$q$	SD (/h)	ZONE	RATE	$q$	SD ( $m^3/h$ )	ACH	$q$	SD (/h)
1	4973.4	310.5		0.586	0.047		2	35114.3	%12483.9		0.730	0.262	
3	%437897.5	%93722.6		1.547	0.340		4	23186.9	%11083.4		18.966	9	
5	32647.6	3389.9	19.291	2.223			6	17439.5	1095.1	4.814	0.386		
7	17547.1	1595.5	2.480	0.257									

\*\*\*\*\* ANALYSIS \*\*\*\*\*

Total Infiltration = 2930 ± 185  $cm^3/h$

VOL SOURCE	TYPE	AVG. TRACER	CONC.	SD	SD	SD	SD	SD	SD	SD	SD	SD	SD
		ptPDCH	PMCP	PDCE	1-PICH	PMCH	ocPDCH	ippCH					
8490	ptPDCH	3.447 $q$ 0.403	4.466 $q$ 0.173	2.352 $q$ 0.111	0.786 $q$ 0.076	0.396 $q$ 0.014	0.101 $q$ 0.005	0.106 $q$ 0					
48110	PMCP	0.151 $q$ 0.088	27.815 $q$ 9.791	0.174 $q$ 0.085	0.103 $q$ 0.090	0.046 $q$ 0.026	0.009 $q$ 0.004	0.008 $q$ 0					
283000	PDCE	0.021 $q$ 0.013	0.219 $q$ 0.049	7.784 $q$ 1.632	0.006 $q$ 0.001	0.009 $q$ 0.001	0.002 $q$ 0.001	0.011 $q$ 0					
1223	1-PICH	0.043 $q$ 0.011	0.196 $q$ 0.026	5.846 $q$ 2.452	8.164 $q$ 3.895	0.033 $q$ 0.009	0.025 $q$ 0.011	0.000 $q$ 0					
1692	PMCH	0.009 $q$ 0.001	0.017 $q$ 0.003	0.067 $q$ 0.021	0.016 $q$ 0.005	4.065 $q$ 0.389	0.003 $q$ 0.003	0.000 $q$ 0					
3622	ocPDCH	0.020 $q$ 0.001	0.129 $q$ 0.010	3.764 $q$ 0.299	0.010 $q$ 0.001	0.019 $q$ 0.002	0.725 $q$ 0.035	0.006 $q$ 0					
75	ippCH	0.023 $q$ 0.007	0.888 $q$ 0.143	0.136 $q$ 0.054	0.019 $q$ 0.005	0.008 $q$ 0.001	0.004 $q$ 0.001	0.367 $q$ 0					

CATS	ptPDCH	PMCP	PDCE	T-PTCH	PMCH	ocPDCH	IPPDCH	otPDCH	stPDCH	MPDCH	2-PTCH
4277	7.147	3.899	2.686	0.637	0.375	0.096	0.083	0.000	8.279	7.315	0.191 DELETED
580	7.742	4.630	2.584	1.290	0.335	0.080	0.115	0.000	9.085	8.045	0.400 DELETED
8149	8.107	4.402	2.249	0.733	0.399	0.087	0.096	0.000	9.463	8.384	0.223
12400	9.277	4.610	2.428	0.808	0.415	0.109	0.107	0.000	10.964	9.738	0.244
12321	8.890	4.691	2.325	0.794	0.391	0.106	0.109	0.000	10.546	9.361	0.238
12055	8.689	4.290	2.432	0.804	0.393	0.104	0.122	0.000	10.329	9.185	0.241
12631	8.324	4.340	2.500	0.777	0.379	0.101	0.123	0.000	9.886	8.765	0.252
10181	8.362	4.382	2.327	0.758	0.425	0.107	0.103	0.000	9.774	8.664	0.232
12057	8.446	4.598	2.370	0.978	0.388	0.101	0.105	0.000	10.017	8.883	0.304
11079	7.998	4.410	2.484	0.712	0.384	0.096	0.096	0.000	9.357	8.289	0.218
1328	8.082	4.327	2.169	0.721	0.383	0.093	0.100	0.000	9.420	8.346	0.221
936	8.415	4.409	2.298	0.777	0.382	0.100	0.105	0.000	9.924	8.800	0.237
520	7.126	3.865	2.295	0.657	0.804	0.101	0.089	0.000	8.413	7.441	0.198 DELETED
2268	6.923	4.160	2.469	0.644	0.526	0.110	0.087	0.000	8.174	7.227	0.194 DELETED
2188	7.555	4.335	2.589	0.698	0.553	0.118	0.096	0.000	8.920	7.896	0.211 DELETED
3644	8.586	2.498	3.554	0.326	0.184	0.145	0.052	0.000	4.003	3.510	0.094 DELETED
12390	0.204	0.418	15.834	0.020	0.015	0.002	0.007	0.000	0.187	0.164	0.006 DELETED
12036	5.449	3.128	7.235	0.502	0.276	0.067	0.065	0.000	6.274	5.527	0.149 DELETED
12302	5.119	2.808	5.224	0.475	0.275	0.140	0.062	0.000	5.907	5.200	0.139 DELETED
12083	1.035	0.619	3.481	0.090	0.876	0.310	0.018	0.000	1.259	1.098	0.025 DELETED
4779	0.031	0.098	2.728	0.014	1.353	0.490	0.005	0.000	0.459	0.400	0.005 DELETED
4627	3.552	2.287	1.977	0.323	1.448	0.122	0.043	0.000	3.944	3.458	0.082 DELETED
12497	2.791	1.837	1.829	0.249	1.879	0.106	0.034	0.000	3.014	2.637	0.070 DELETED
12189	0.030	11.417	0.020	0.002	0.009	0.001	0.003	0.000	0.000	0.000	0.000 DELETED
12063	0.028	10.242	0.141	0.001	0.014	0.002	0.007	0.000	0.000	0.000	0.000 DELETED
12393	0.028	1.611	1.886	0.088	1.488	0.338	0.005	0.000	0.330	0.289	0.028 DELETED
12009	0.072	16.480	0.089	0.076	0.035	0.011	0.014	0.000	0.000	0.000	0.021 DELETED
12264	0.143	35.832	0.214	0.202	0.057	0.013	0.008	0.000	0.000	0.000	0.056 DELETED
12376	0.167	43.634	0.244	0.257	0.030	0.006	0.008	0.000	0.000	0.000	0.072 DELETED
12297	0.523	14.879	1.321	0.682	0.536	0.119	0.009	0.000	0.641	0.560	0.201 DELETED
12191	0.169	16.484	1.166	0.638	0.538	0.118	0.008	0.000	0.308	0.269	0.188 DELETED
12379	0.935	30.172	0.222	0.061	0.088	0.012	0.005	0.000	0.408	0.357	0.017 DELETED
12012	1.489	20.586	0.519	0.175	0.295	0.030	0.018	0.000	1.561	1.362	0.049 DELETED
12244	0.112	25.193	0.138	0.061	0.069	0.003	0.003	0.000	0.182	0.160	0.017 DELETED
12155	0.107	26.430	0.094	0.044	0.031	0.003	0.003	0.000	0.181	0.159	0.012 DELETED
12384	0.507	0.312	4.404	0.044	0.923	0.253	0.011	0.000	0.686	0.600	0.012 DELETED
12118	4.134	2.583	1.088	0.367	0.203	0.049	0.067	0.000	4.586	4.026	0.107 DELETED
561	0.053	3.165	0.464	0.092	0.219	0.070	0.008	0.000	0.124	0.109	0.025 DELETED
2018	0.122	16.960	0.214	0.018	0.014	0.012	0.016	0.000	0.177	0.155	0.006 DELETED
11151	0.013	9.204	5.908	0.005	0.010	0.002	0.026	0.000	0.020	0.018	0.002
9590	0.019	0.197	7.035	0.005	0.009	0.002	0.008	0.000	0.025	0.022	0.002
12402	0.020	0.176	7.297	0.006	0.010	0.002	0.009	0.000	0.026	0.023	0.002
12337	0.014	0.156	6.492	0.004	0.009	0.002	0.004	0.000	0.020	0.018	0.002
12417	0.017	0.235	9.217	0.007	0.009	0.003	0.008	0.000	0.024	0.022	0.002
12425	0.030	0.205	8.388	0.008	0.010	0.003	0.005	0.000	0.038	0.034	0.003
12488	0.062	0.381	15.438	0.009	0.009	0.004	0.008	0.000	0.064	0.057	0.003 DELETED
12383	0.015	0.195	6.342	0.005	0.007	0.001	0.011	0.000	0.021	0.019	0.002
12203	0.055	0.320	10.741	0.008	0.009	0.003	0.004	0.000	0.056	0.050	0.003
12176	0.013	0.279	9.691	0.006	0.009	0.001	0.005	0.000	0.019	0.017	0.002
12286	0.091	0.382	12.712	0.013	0.008	0.002	0.011	0.000	0.035	0.031	0.004 DELETED
12269	0.018	0.221	6.731	0.006	0.007	0.002	0.029	0.000	0.025	0.022	0.002
12022	0.051	0.215	7.580	0.026	0.018	0.000	0.000	0.000	0.000	0.000	1.799
12156	0.036	0.177	4.112	0.038	0.039	0.033	0.000	0.000	0.000	0.000	3.610
1818	0.009	0.019	0.081	0.020	4.340	0.005	0.001	0.000	0.019	0.017	0.006
8706	0.008	0.015	0.052	0.012	3.780	0.001	0.000	0.000	0.014	0.012	0.004
1319	0.020	0.139	3.849	0.011	0.018	0.751	0.006	0.000	0.877	0.591	0.004
707	0.020	0.128	4.011	0.009	0.021	0.685	0.006	0.000	0.612	0.534	0.004
1281	0.019	0.120	3.432	0.009	0.017	0.739	0.005	0.000	0.687	0.582	0.004
12340	0.013	0.970	0.178	0.023	0.016	0.004	0.325	0.000	0.027	0.025	0.006
12502	0.016	1.129	0.203	0.027	0.009	0.005	0.378	0.000	0.034	0.031	0.008
12307	0.024	0.751	0.080	0.015	0.007	0.004	0.399	0.000	0.040	0.035	0.005
12300	0.031	0.880	0.095	0.019	0.008	0.004	0.385	0.000	0.046	0.041	0.006
2158	0.019	0.963	0.182	0.022	0.007	0.005	0.382	0.000	0.038	0.034	0.007
6706	0.017	0.942	0.173	0.022	0.008	0.005	0.389	0.000	0.037	0.033	0.007
7750	0.029	0.728	0.084	0.013	0.007	0.003	0.333	0.000	0.044	0.039	0.004
10831	0.031	0.732	0.085	0.015	0.006	0.003	0.338	0.000	0.043	0.038	0.005

F.: PDCE PMCP PMCH ocPDCH ptPDCH MPDCH PTCH  
0.74 0.74 0.82 0.62 0.65 0.88 0.71

COEFFICIENTS FILE  
60177

\*\*\*\*\* NOTES \*\*\*\*\*

All gas volumes are reported at 21.5 C. and 1 atm.  
The standard deviation in the source strength has been set at 4 %.  
The standard deviation in the volume measurement has been set at 5 %.  
Overall normalized condition number (K(C)/N<sup>1.5</sup>) = 0.429

((DC)/N = 1.136

Local condition numbers are:

Condition Number	1	2	3	4	5	6
1.044	1.083	1.017	1.379	1.248	1.005	1.134

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## FLOW-RATIOS STD.DEV.

## FILTEN/EXFILTEN

FE 1	0.147	0.1142
FE 2	1.059	0.0455
FE 3	1.020	0.0363
FE 4	0.258	0.3540
FE 5	1.046	0.0108
FE 6	0.615	0.1209
FE 7	4.908	15.1200

## PERZONAL

2/ 2- 1	0.839	0.4551
3/ 3- 1	1.285	0.9277
4/ 4- 1	0.161	0.0969
5/ 5- 1	0.069	0.0093
6/ 6- 1	0.029	0.0209
7/ 7- 1	0.026	0.0122
3/ 3- 2	19.743	62.9947
4/ 4- 2	0.082	0.1957
5/ 5- 2	0.036	0.0273
6/ 6- 2	0.036	0.0723
7/ 7- 2	0.903	0.7688
4/ 4- 3	110.353	89.6471
5/ 5- 3	0.203	0.1401
6/ 6- 3	8.392	3.1448
7/ 7- 3	0.017	0.0174
- 4	0.435	0.2269
6/ 6- 4	0.017	0.0085
7/ 7- 4	-0.057	0.0552
6/ 6- 5	0.483	0.4655
7/ 7- 5	0.809	1.8474
7/ 7- 6	12.975	396.7011

ANDARD DEVIATION OF ptpdch IN ZONE 2 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ptpdch IN ZONE 3 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ptpdch IN ZONE 4 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ptpdch IN ZONE 7 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF pmcp IN ZONE 2 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ppcb IN ZONE 2 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ppcb IN ZONE 4 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ppcb IN ZONE 5 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ppcb IN ZONE 7 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF t-ptch IN ZONE 2 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF t-ptch IN ZONE 4 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF t-ptch IN ZONE 5 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF pmch IN ZONE 2 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF pmch IN ZONE 4 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ocpdch IN ZONE 2 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ocpdch IN ZONE 3 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ocpdch IN ZONE 4 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ocpdch IN ZONE 5 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ippch IN ZONE 2 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ippch IN ZONE 3 IS GREATER THAN 25 %  
 ANDARD DEVIATION OF ippch IN ZONE 5 IS GREATER THAN 25 %