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RADIOLOGICAL ACCIDENT EVALUATION — THE CONAC03 CODE

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ABSTRACT

Current NRC regulatory requirements and regulatory guides define methods and dose limits acceptable to the NRC relative to design basis accidents. To simplify radiological calculations required to fulfill these guides as well as to provide accurate results, a computer program, CONAC03, has been developed by GE. The purpose of this report is to describe the models, assumptions, and conditions applicable to this program as well as to provide a sample problem and input requirements.

1. INTRODUCTION

The purpose of this report is to describe the transport pathways, fission product source terms, and analytical models which are used to evaluate the radiological consequences of the nine accidents identified in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.70 which result in the release of radioactivity to the environment. These models have been incorporated into a computer program called CONAC03 (CONservative ACcident Calculation). The modeling and assumptions identified herein represent the conditions set forth in either the Regulatory Guides (RG) or Standard Review Plans (SRP) which describe each of the nine accidents.

One exception, which is in the source term definition, has taken the RG/SRP approach. For all accidents involving core fission product inventory, the RADC01[1] computer program is used to calculate actual fuel rod inventory in place of the values stated in some of the NRC documents. The justification for that deviation is that the NRC values are in general many years old and do not necessarily reflect current nuclear data.

Each of the accidents evaluated by the CONAC03 computer program are described in subsequent sections of this report.

It should be noted that fission product removal credit by the suppression pool has not been assumed in the models presented in this report. However, the General Electric Company is currently involved in an experimental program which will demonstrate the inherent removal features of the suppression pool. Upon completion of this program and subsequent review and acceptance of the results by the NRC this document will be ammended to reflect the suppression pool removal capabilities.

2. LOSS-OF-COOLANT ACCIDENT

Regulatory Guide 1.3[2] establishes the assumptions for the analysis of the loss-of-coolant accident (LOCA) in the Boiling Water Reactor. Contained within RG 1.3 is the assumption of an instantaneous break of the recirculation line resulting in rapid coolant loss and depressurization of the reactor vessel. RG 1.3 also assumes total fuel damage which causes 100% of the noble gas activity and 25% of the iodine activity to be immediately airborne in the containment. For the Mark III containment this activity leaks to the shield building, auxiliary and fuel storage buildings, and then to the environment via the standby gas treatment system (SGTS). Depending on specific plant design features, a small fraction of the activity in the containment may be allowed to bypass the shield building and SGTS and enter the environs directly. Atmospheric dispersion and dose evaluation follow the assumptions of Regulatory Guide 1.3.[2] Figure 2-1 shows the factors involved in the LOCA evaluation.

2.1 SOURCE

The reactor is assumed to operate continuously for 3 years at 102% of rated power. There is no delay assumed between the end of the 3-year irradiation and the appearance of the iodines and noble gases in the containment. The source calculation is:

$$S_i = (P) * (SA_i) * (FHL \text{ or } FNL) \qquad (2\text{-}1)$$

where

S_i = the source activity airborne in the containment for the isotope i, curies;

P = the licensing basis power (includes 102% factor), MWt;

SA_i = the specific activity of isotope i after 3 years of irradiation with no decay, curies/MWt;

FHL = the fraction of the core iodine activity airborne in the containment; and

FNL = the fraction of the core noble gas activity airborne in the containment.

Consider, for example, the I-131 source. The specific activity is 2.51×10^4 curies/MWt (see Appendix A) and FHL is 0.25. For a power of 3,758 MWt, the source is:

$$S_{131} = (3758) * (2.51 \times 10^4) * (0.25) = 2.36 \times 10^7 \text{ curies.}$$

Table 2-1 shows the source activity for each isotope in the LOCA.

Table 2-1
LOCA CONTAINMENT ACTIVITY, CURIES/MWt[a]

Isotope	0 minutes
I-131	2.63 + 4[b]
I-132	3.85 + 4
I-133	5.50 + 4
I-134	6.06 + 4
I-135	5.20 + 4
Kr-83m	3.14 + 3
Kr-85m	6.73 + 3
Kr-85	3.02 + 2
Kr-87	1.29 + 4
Kr-88	1.83 + 4
Kr-89	2.28 + 4
Xe-131m	1.58 + 2
Xe-133m	2.31 + 3
Xe-133	5.53 + 4
Xe-135m	1.04 + 4
Xe-135	7.15 + 3
Xe-137	4.85 + 4
Xe-138	4.61 + 4

[a] Assuming 1 MWt for 3 years, 100% iodine and 100% noble gas release.
[b] 2.63 + 4 is read 2.63×10^4.

2.2 RELEASE

The activity airborne in the containment is assumed to be released to the environment, via the Standby Gas Treatment System (SGTS). The capability also exists in this code to evaluate an unfiltered or bypass pathway. Figure 1 shows both the filtered and bypass pathways.

For purposes of simplification daughter growth is ignored, therefore the governing differential equations are:

$$\frac{dA_1}{dt} = -(\lambda + L_1 + L_b)\,A_1, \tag{2-2}$$

$$\frac{dA_2}{dt} = -(\lambda + L_2)\,A_2 + L_1 A_1, \text{ and} \tag{2-3}$$

$$\frac{dQ}{dt} = (1 - f)\,L_2 A_2 + L_b A_1 \quad . \tag{2-4}$$

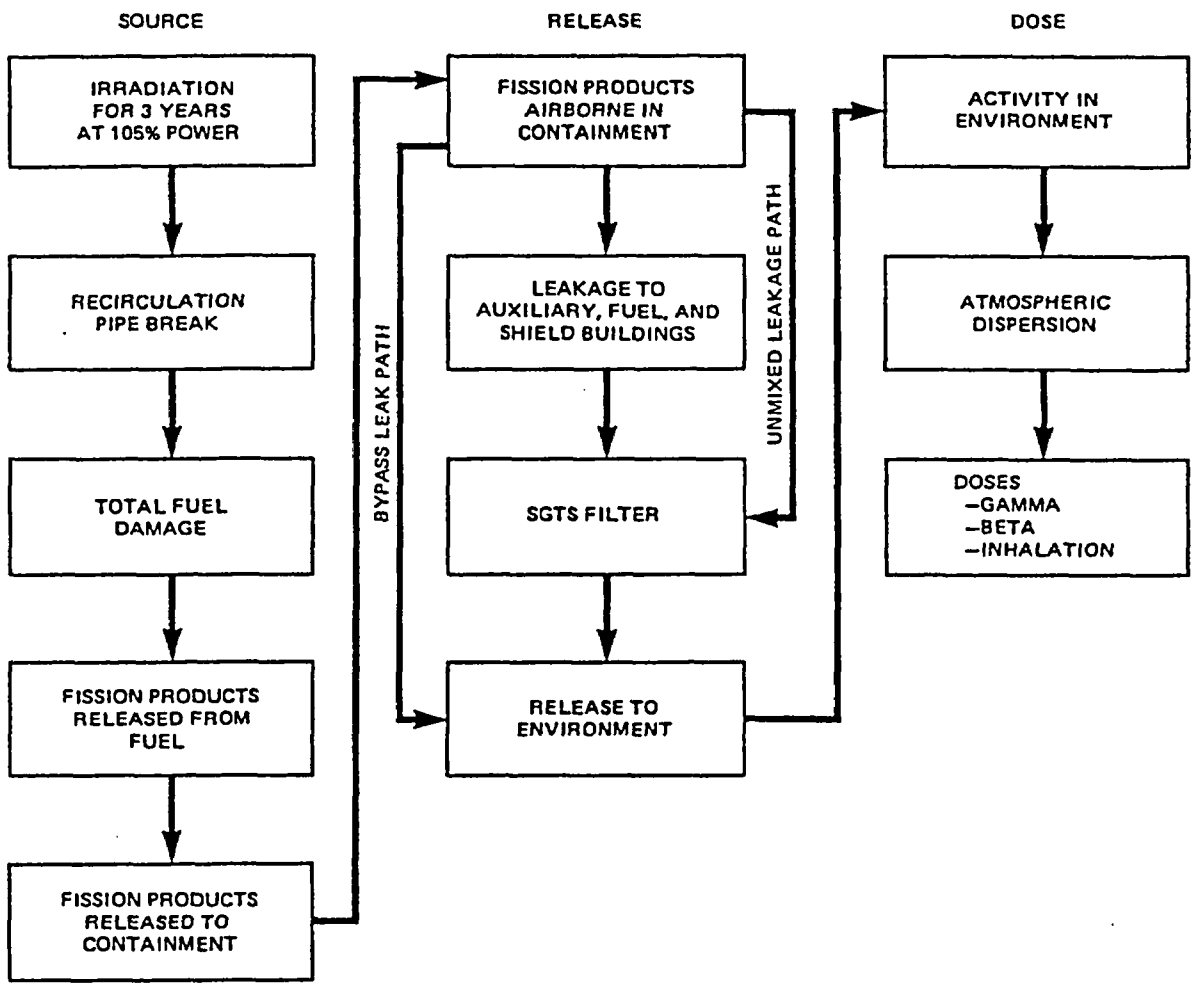

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Figure 2-1. Loss-of-Coolant Accident

Subject to the initial conditions

$$A_1(0) = S \tag{2-5}$$

$$A_2(0) = 0 \tag{2-6}$$

$$Q(0) = 0 \tag{2-6}$$

where

A_1 = activity airborne in containment, Ci;

t = time, sec;

λ = the decay constant, sec^{-1};

L_1 = the leak rate from the containment to the shield building, auxiliary building or fuel building, sec^{-1};

L_b = the bypass rate, sec^{-1};

L_2 = the leak rate from the shield building, auxiliary building or fuel building to the environment, sec^{-1};

A_2 = the activity in the shield building, fuel building, or auxiliary building, Ci;

Q = the activity released to the environment, Ci; and

f = the SGTS filter efficiency, fraction.

The solution of these equations is:

$$A_1 = S \exp[-(\lambda + L_1 + L_b)\, t] \tag{2-8}$$

$$A_2 = \frac{S L_1}{L_2 - L_1 - L_b} \left\{ \exp[-(\lambda + L_1 + L_b)\, t] - \exp[-(\lambda + L_2)\, t] \right\} \tag{2-9}$$

$$Q = \frac{L_b S}{\lambda + L_1 + L_b} \left\{ 1 - \exp[-(\lambda + L_1 + L_b)\, t] \right\} + \frac{(1-f)\, L_2 L_1 S}{L_2 - L_1 - L_b} \left\{ \frac{1 - \exp[-(\lambda + L_1 + L_b)\, t]}{\lambda + L_1 + L_b} - \frac{1 - [\exp - (\lambda + L_2)\, t]}{\lambda + L_2} \right\} \tag{2-10}$$

It should be noted that inherent in Equations (2-8) to (2-10) is the assumption of uniform mixing within those compartments which present a physical barrier to the release of fission products. If such credit is not allowed by the NRC, Equations (2-8) to (2-10) can be modified to reflect this condition by assuming that L_1 or L_2 is equal to (Leak Rate)/(f) (vol.) where (Leak Rate) is the actual leak rate from one compartment to the next, (f) is the fraction of the compartment in which credit for mixing is allowed, and (vol.) is the free volume of the compartment. If no credit for mixing is allowed, then L_1 or L_2, depending on where no credit is allowed, is set equal to zero with resulting change in equations (2-8) to (2-10). The CONAC03 code (Appendix A) allows one to specify up to five different compartments with leak, purge, and recirculation values. Recirculation is applicable if filters are installed in the recirculation path.

2.3 DOSE

The dose is the final result of a radiological evaluation. Doses computed from a design basis accident analysis must be less than the appropriate RG limits to obtain a construction permit or an operating license. There are three distinct doses calculated: an inhalation dose to the thyroid; a gamma dose to the whole body; and a beta dose to the skin. All three are the product of the activity released, atmospheric dispersion factor, and dose conversion factor:

$$D_i = (Q) \cdot (\chi/Q) \cdot (DCF_i) \tag{2-11}$$

where

D_i = the dose from the ith isotope, Rem;
Q_i = the activity released, Ci;
χ/Q = the atmospheric dispersion factor, sec/m³; and
DCF_i = the dose conversion factor, Rem/(curie-sec/m³).

Appendix B explains the calculation of χ/Q and Appendix C describes the dose conversion factor calculation in some detail.

Each dose must be evaluated for 2 hours at the exclusion area and for 30 days at the low population zone. At both points the doses must be less than the limits.

2.3.1 Inhalation Dose

The inhalation dose results primarily from breathing radioiodine which travels from the lungs to the thyroid gland.[2] Each iodine isotope has a different dose effect per curie inhaled due to differences in energy and half life. The dose conversion factor for the inhalation dose is the product of the breathing rate and the Rem/Ci inhaled.[6]

$$DCF_i = (BRATE_i) * (RPCI_i) \qquad (2\text{-}12)$$

where

DCF_i = the inhalation dose conversion factor, Rem/(curie-sec/m³);
$BRATE_i$ = the breathing rate, m³/sec; and
$RPCI_i$ = the ratio of dose to inhaled activity, Rem/curie-inhaled.

2.3.2 Gamma Dose

2.3.2.1 Semi-Infinite Cloud

The gamma dose results from external exposure of an individual in the vicinity of the cloud of airborne radioactivity. All isotopes which emit gamma rays when disintegrating contribute to the gamma dose, both iodines and noble gases. For the conservative evaluation of this dose, the hypothetical individual is assumed to be immersed in a semi-infinite cloud; that is, a cloud of infinite height and width. Depending upon the release height, meteorological conditions and distance to the dose receptor this assumption can overestimate the dose by a factor of 1 to ~100.[3] Each isotope has a distinct gamma dose conversion factor which is proportional to its average gamma energy.

$$(DCF_g)_S = (0.25) * (E_g) \qquad (2\text{-}13)$$

where

$(DCF_g)_S$ = the gamma dose conversion factor, Rem/(Ci-sec/m³); and

E_g = the average gamma energy per disintegration, MeV/dis.

For example, Xe-133 has an E_g of 0.0461 MeV/dis, so its dose conversion factor is 0.25 × 0.0461 or 0.0115 Rem/(Ci-sec/m³).

2.3.2.2 Finite Cloud

For a realistic evaluation, the function subprogram ADOSC04[4] is called to return a finite-cloud gamma dose conversion factor.

$$(DCFg)_F = GDOSC\ (NUM, SPEC, HT, IS, DD, A, IOPT, U)$$

Each of the above arguments must be given a value prior to the call. The arguments are defined in Reference 4.

3. STEAM LINE BREAK ACCIDENT

Regulatory Guide 1.5 provides the basis for the analysis of the steam line break accident (SLBA) in the Boiling Water Reactor.[5]

The assumption of an instantaneous complete severance of one of the main steam lines is the design basis accident for pipe breaks outside the primary containment. Mass flow occurs from both ends of the break until closure of the isolation valves. No fuel is damaged in the SLBA, so the only activity released is that contained in the discharged coolant. Conservatism is assured by assuming that the NRC technical specification value of 0.2 μCi/g dose equivalent (DE) I-131 is used and that the noble gas leakage is three times the design basis. It is assumed that all the activity released from the break escapes (i.e., 100% flashing and carryover) from the turbine building at rooftop level within a short time period. Figure 3-1 shows the factors involved in computing the effects of the SLBA.

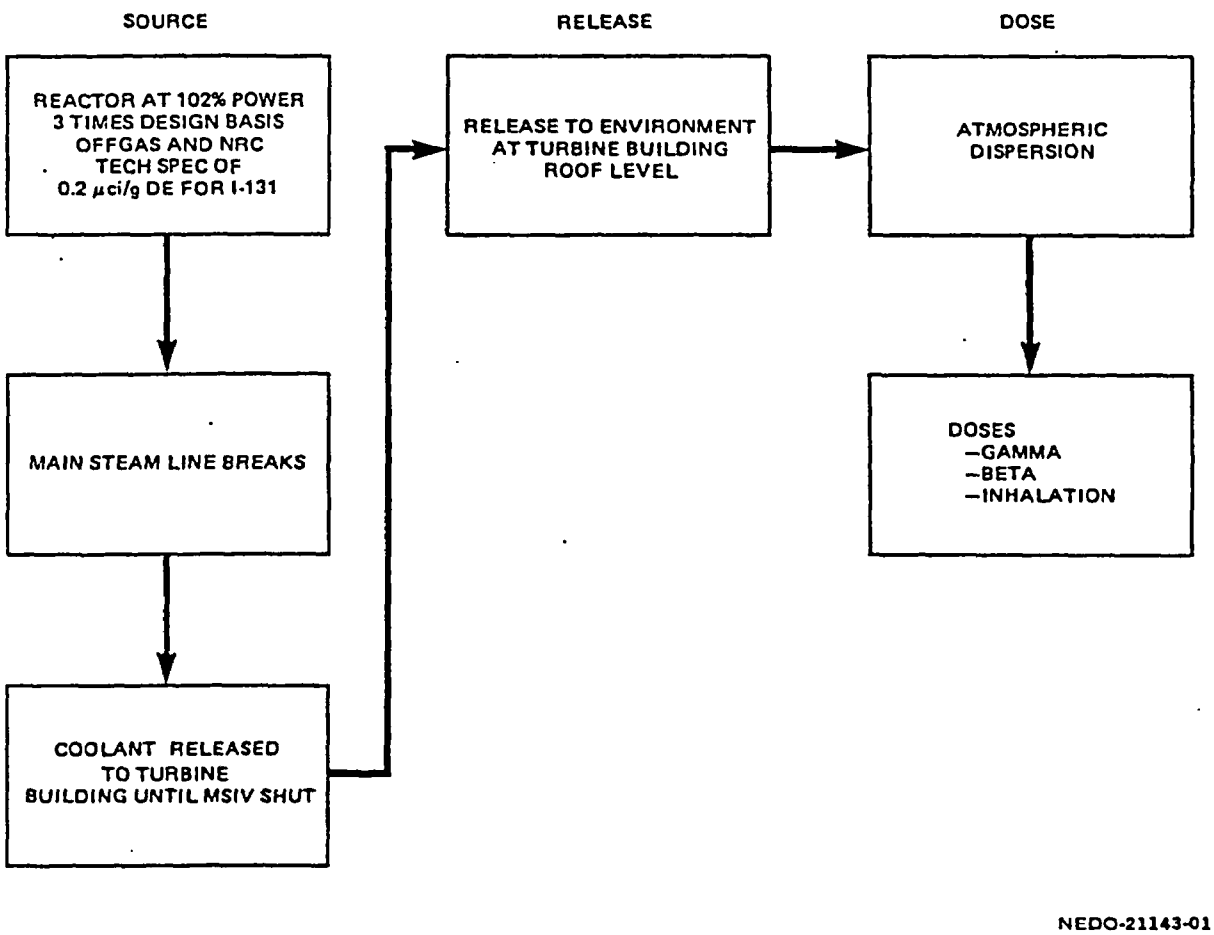

Figure 3-1. Steam Line Break Accident

3.1 SOURCE

Fission products in the reactor vessel provide the source of activity for the SLBA. For the iodine isotopes the activity released is the product of the coolant concentration and the mass of coolant released. The coolant concentration is taken to be the NRC standard technical specification coolant value of 0.2 μCi/g DE I-131. The mass of coolant released is the sum of the initial liquid released, the steam released due to liquid coolant flashing to steam, and the "carryover equivalent" of the initial steam dome volume. This total equivalent liquid release is assumed to become airborne in the turbine building to form the SLBA source term.

The iodine source term is calculated as follows.

$$S = (CONC) * (TELR) * (4.54 \times 10^{-4}) \quad (3\text{-}1)$$

$$TELR = RELIQ + FLASH + CARRY \quad (3\text{-}2)$$

$$FLASH = RESTM - (SVI/SPV) \quad (3\text{-}3)$$

$$CARRY = (SCF) * (SVI/SPV) \quad (3\text{-}4)$$

where

S = the iodine source, Ci;

CONC = the design basis concentration, μCi/gm;

TELR = the total equivalent liquid released, lb;

4.54×10^{-4} = the conversion factor (Ci/# – μCi/g)

RELIQ = the liquid released, lb;

FLASH = the steam release which comes from liquid flashing during the blowdown, lb;

CARRY = the carryover equivalent, i.e., the steam released which existed as steam in the RPV steam dome volume prior to the blowdown, lb;

RESTM = the total steam release, lb;

SVI = the initial steam or steam dome volume, ft^3;

SPV = the specific volume of steam, ft^3/lb, nominally 0.42; and

SCF = the steam carryover fraction for iodine, nominally 0.02.

The noble gas source term is somewhat simpler to calculate. At the break, it is conservatively assumed that the noble gas isotopes are released at three times the design basis, that is three times the 30-minute rate of 0.1 Ci/sec ratioed back to an equivalent 2-minute mixture. The product of the release rate and the valve closure time gives the noble gas release during the SLBA.

$$S = (TSHUT) * (AECF) * (OGR) * (PNG) \quad (3\text{-}5)$$

where

S = the noble gas release, Ci;

VTIM = the main steam isolation valve closure time, (typically 5.5 sec);

AECF = the ratio of NRC-assumed to design basis noble release rate, nominally 3;

OGR = the offgas rate at the break, Ci/sec, nominally 0.45 Ci/sec, i.e., a 2-minute-old diffusion mixture which, if extrapolated to 30 minutes, would yield a design basis offgas release rate of 0.1 Ci/sec. The mixture is 7 seconds old at the time of the break but the 2-minute-old mixture is used to allow for decay in flight; and

PNG = the fraction of release due to each isotope, Table 3-1.

Consider, for example, Xe-133. The fraction of the total due to Xe-133 is 0.0219. Thus the source of Xe-133 is:

$$S = (5.5) * (3) * (0.45) * (0.0219) = 0.163 \text{ Ci.}$$

Table 3-1 shows the reactor water iodine concentration and noble gas release fractions.

Table 3-1
SLBA SOURCE ACTIVITIES

Isotope	Halogen Coolant Concentration (μCi/g)[a]
I-131	7.30 – 2[b]
I-132	7.10 – 1
I-133	5.00 – 1
I-134	1.40 – 0
I-135	7.30 – 1
	Fraction of Release for Noble Gas
Kr-83m	9.36 – 3
Kr-85m	1.64 – 2
Kr-85	6.40 – 5
Kr-87	5.11 – 2
Kr-88	5.24 – 2
Kr-89	2.18 – 1
Xe-131m	5.23 – 5
Xe-133m	7.82 – 4
Xe-133	2.19 – 2
Xe-135m	6.41 – 2
Xe-135	5.92 – 2
Xe-137	2.88 – 1
Xe-138	2.18 – 1

[a] See Appendix A for reference.
[b] 7.30 – 2 is read 7.3×10^{-2}.

3.2 RELEASE

In the SLBA all of the source activity calculated above is assumed to be immediately released to the environment with no holdup, plateout, or filtration. This release, as constrained by Regulatory Guide 1.5, is limited to the height of the turbine building despite the enormous buoyancy of the steam cloud due to its high temperature.

3.3 DOSE

The methods of dose evaluation are the same as those presented in Subsection 2.3 and Appendix C. In the case of the SLBA, however, a somewhat different evaluation of (χ/Q) is assumed.

Instead of the conventional centerline or sector average calculation, a condition called fumigation is assumed to persist over the short duration of the SLBA release. Fumigation conditions happen during the breakup of an inversion layer where complete vertical mixing occurs up to the inversion lid which traps all of the released activity below it.[3] The air concentration and thus χ/Q are inversely proportional to the lid height which is conservatively assumed to be the turbine building rooftop. Appendix B discusses fumigation in more detail.

4. FUEL HANDLING ACCIDENT

Regulatory Guide 1.25 establishes the guidelines for evaluating the fuel handling accident (FUHA) in the Boiling Water Reactor.[7]

For the BWR/6 the fuel handling accident is assumed to occur as a consequence of dropping a fuel bundle onto the spent fuel in the fuel storage pool. The activity released from the fuel pool is assumed to be released to the environment within a 2-hour period. The iodine and noble gas isotopes are released to the environs via the standby gas treatment system. Figure 4-1 shows the factors involved in evaluating the FUHA.

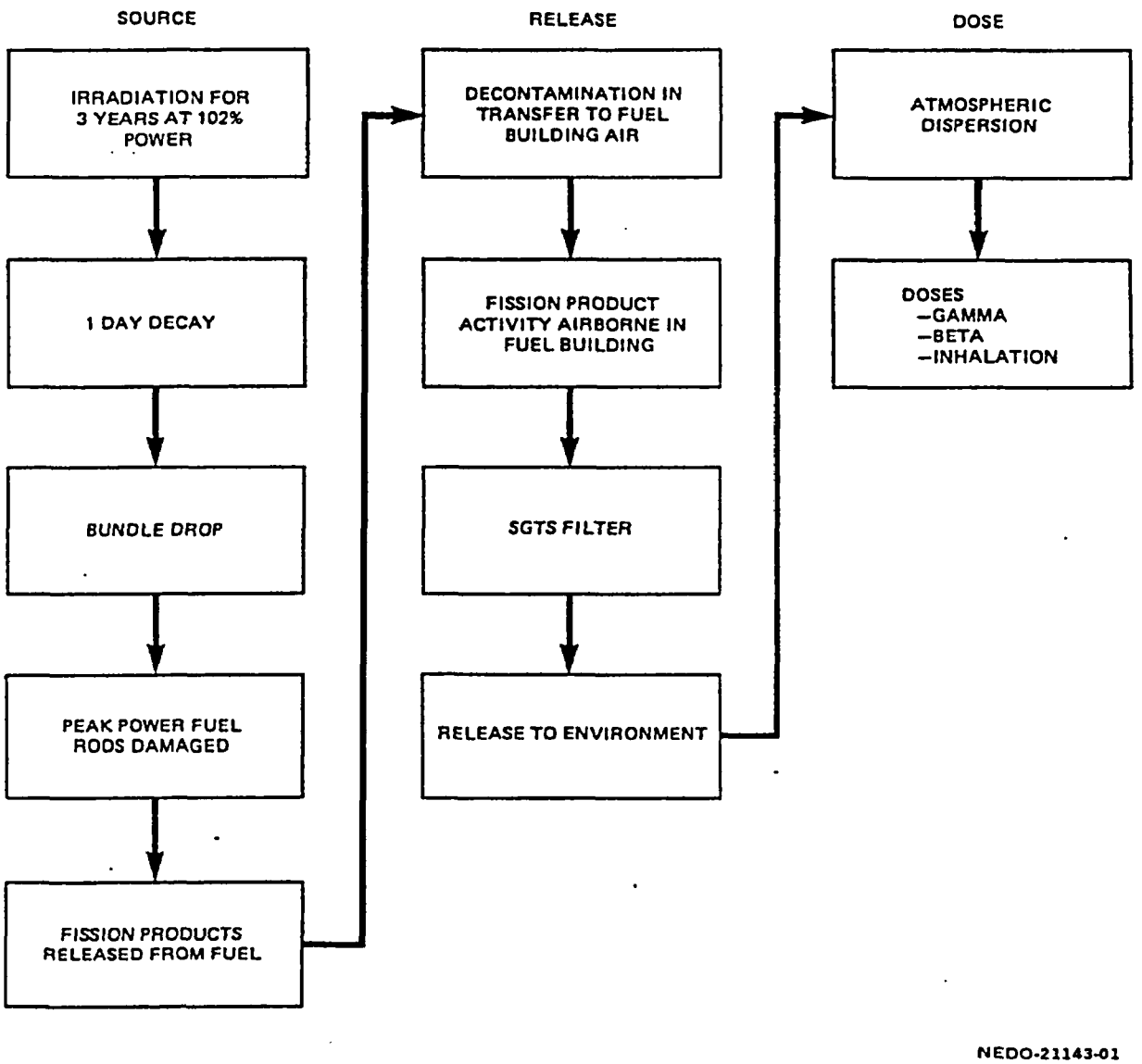

Figure 4-1. Fuel Handling Accident

4.1 SOURCE

Fission products in the damaged fuel rods provide the activity initially available for release. The fuel is assumed to be continuously irradiated for 3 years at licensing-basis power and then allowed to decay for 1 day, which is the minimum time for removing fuel bundles from the core.

Those rods which experience failure are assumed to have been operating at 50% above the core average power so each rod has 1.5 times the fission product inventory of an average rod. Regulatory Guide 1.25 specifies 10% release from the fuel to the pool for all isotopes except Kr-85 which has a 30% release. The fuel pool water retains 99% of the iodine activity with the remaining iodine and the noble isotopes becoming airborne.

The source term is:

$$S = (P) \cdot (SA) \cdot \left(\frac{FDR \times RPF}{RPB \times BUND}\right) \cdot \left\{\begin{array}{l} FAR \times HDF \text{ (for iodine) or} \\ FAR \text{ (for noble gases except Kr-85) and} \\ FARK85 \text{ (for Kr-85)} \end{array}\right\} \quad (4\text{-}1)$$

where

S = the FUHA source airborne in the fuel handling area, Ci;

P = the licensing basis power, MWt;

SA = the specific activity after 1-day decay, Ci/MWt;

FDR = the number of rods damaged in the FUHA, nominally 101;

RPF = the radial peaking factor, nominally 1.5;

RPB = the number of fuel rods per bundle, nominally 62;

BUND = the number of bundles in the core;

FAR = the fractional activity released from each damaged rod, nominally 0.10;

FARK85 = the fraction of Kr-85 activity released, nominally 0.30; and

HDF = the iodine decontamination factor, nominally 0.01.

The first two factors P × SA evaluate the total core inventory of a particular isotope. The next group (FDR × RPF/RPB × BUND) adjusts the total inventory to the inventory in the damaged rods. The remaining factors express the amount of activity which leaves each rod and becomes airborne. Table 4-1 presents the source activity for an average fuel rod (Ci/MWt).

Table 4-1
FUHA — AVERAGE FUEL ROD ACTIVITY (Ci/MWt)[a]

Isotope	
I-131	2.45 + 4[b]
I-132	3.16 + 4
I-133	2.53 + 4
I-134	1.38 − 3
I-135	4.15 + 3
Kr-83m	1.31 + 1
Kr-85m	1.66 + 2
Kr-85	3.02 + 2
Kr-87	2.58 − 2
Kr-88	4.82 + 1
Kr-89	0.63 − 9
Xe-131m	1.58 + 2
Xe-133m	2.09 + 3
Xe-133	5.33 + 4
Xe-135m	6.36 + 2
Xe-135	1.22 + 4
Xe-137	1.35 − 9
Xe-138	1.28 − 9

[a] Assuming 1 MWt for 3 years, 1 day decay.
[b] 2.45 + 4 is read 2.45×10^4.

4.2 RELEASE

High radiation levels in the fuel handling area and ventilation ducts will isolate the area and start the standby gas treatment system (SGTS) before any activity is released to the environment. This ensures that the airborne fission products will pass through the SGTS prior to their release to the environment.

The governing equations are:

$$\frac{dA}{dt} = -(\lambda + L)\,A \tag{4-2}$$

$$\frac{dQ}{dt} = (1 - f)\,LA \tag{4-3}$$

with initial conditions

$$A(0) = S \tag{4-4}$$

$$Q(0) = 0 \tag{4-5}$$

where

A = the activity airborne in the fuel handling area, Ci;
t = time, sec;
λ = the radiological decay constant, sec^{-1};
L = the SGTS fractional flow rate from the fuel handling area, sec^{-1};
Q = the activity released to the environment, Ci; and
f = the SGTS filter efficiency.

The solution to Equations (21) and (22) is:

$$A = S \exp[-(\lambda + L)t] \tag{4-6}$$

$$Q = \frac{(1-f)(LS)}{(\lambda + L)} \{1 - \exp[-(\lambda + L)t]\} \tag{4-7}$$

4.3 DOSE

The dose and diffusion assumptions for the FUHA are the same as those described in Subsection 2.3 for the LOCA.

As noted earlier, the assumption is made that all of the activity which will be released to the environment is released during a 2-hour period. Therefore both the site boundary and low population zone doses are based on the meteorology associated with this time period. Either the standard meteorology of Regulatory Guide 1.3 or site specific meteorology is used to evaluate the atmospheric dispersion factor, (χ/Q). Appendix B describes accident meteorology in more detail.

5. CONTROL ROD DROP ACCIDENT

While there is no Regulatory Guide applicable to a Control Rod Drop Accident (CRDA) Standard Review Plan 15.4.9[8] does exist, therefore the CRDA analysis is done consistent with the assumptions therein.

In the CRDA, the highest worth control rod is assumed to drop out of the reactor core in a period of time sufficient to cause rapid reactivity insertion. The consequent local power peak may be enough to damage some fuel rods which release part of their inventory of fission products. A fraction of this activity will be transported to the condenser where it leaks to the environment via the turbine building. Figure 5-1 presents the fission product pathway while Table 5-1 gives the activity in the core at the time of the CRDA.

Table 5-1
CRDA — ACTIVITY IN THE CORE, CURIES/MWt

Isotope	No Decay (Ci/MWt)
I-131	2.63 + 4[a]
I-132	3.85 + 4
I-133	5.50 + 4
I-134	6.06 + 4
I-135	5.20 + 4
Kr-83m	3.14 + 3
Kr-85m	6.73 + 3
Kr-85	3.02 + 2
Kr-87	1.29 + 4
Kr-88	1.83 + 4
Kr-89	2.28 + 4
Xe-131m	1.58 + 2
Xe-133m	2.31 + 3
Xe-133	5.53 + 4
Xe-135m	1.04 + 4
Xe-135	7.15 + 3
Xe-137	4.85 + 4
Xe-138	4.61 + 4

[a] 2.63 + 4 is read 2.63×10^4.

5.1 SOURCE

Fission products in the damaged fuel rods provide the initial activity available for release. The fuel is assumed to be at 102% power continuously for 3 years before the accident to conservatively estimate the fission product inventory. The core activity in Table 5-1 has no decay prior to accident initiation.

In accordance with the requirements of the Standard Review Plan, it is assumed that for that mass of fuel involved in the event which is below 2842°C (fuel melting point), 10% of the noble gases and 10% of the iodine activity is released to the primary coolant. For that fuel above 2842°C, the release is assumed to be 100% of the noble gases and 50% of the iodine activity.

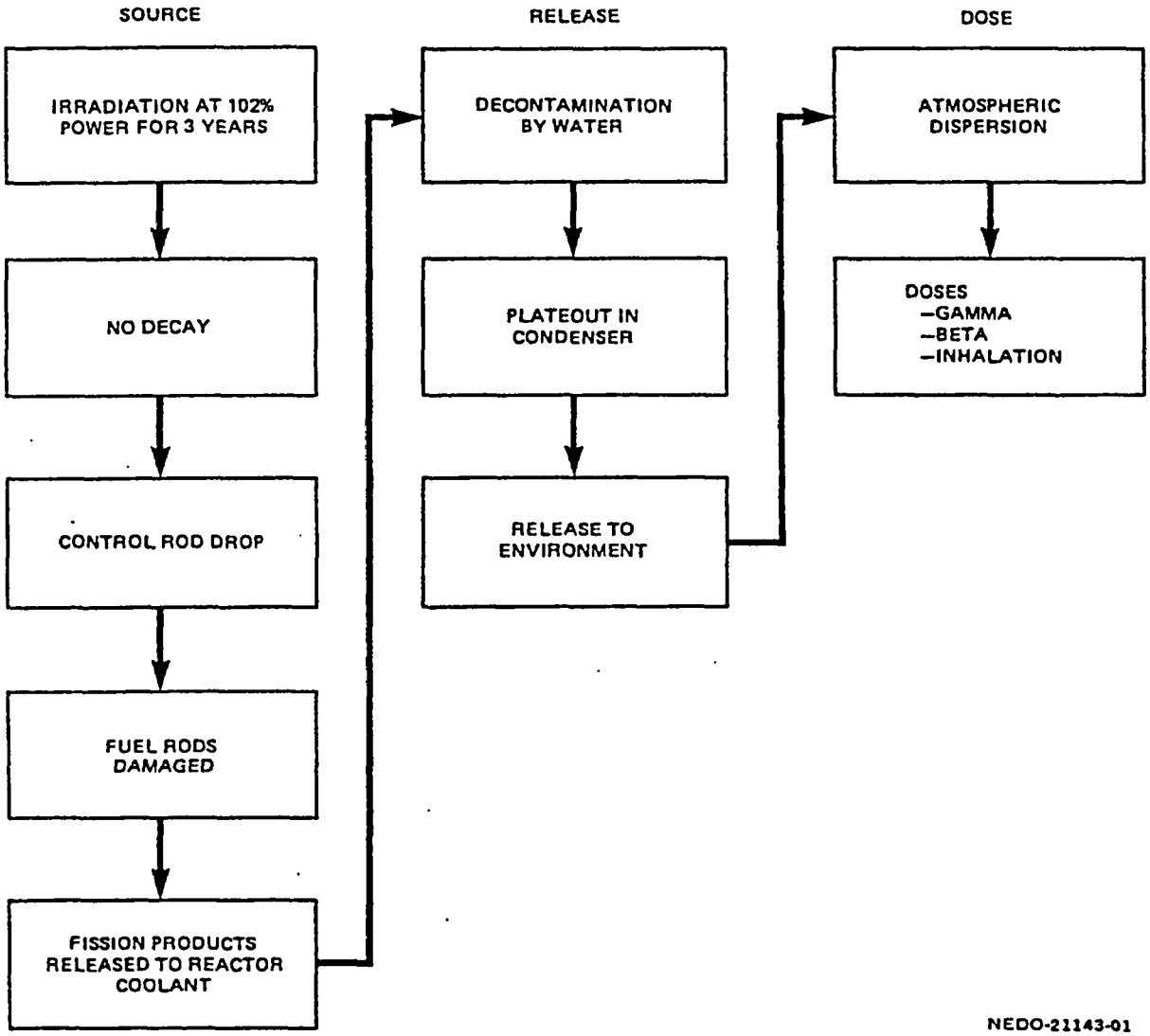

Figure 5-1. Control Rod Drop Accident

All the noble gases and 10% of the halogens released to the primary coolent are assumed to be transported to the condenser before the steam lines isolate. Once the activity is in the condenser it is assumed that the quantity of airborne iodine available for leakage is reduced by a factor of 10 by partitioning and plateout. All the noble gas activity becomes airborne in the condenser. The activity airborne in the condenser constitutes the source term for the control rod drop accident.

This discussion may be condensed into two equations for computing the source activity.

For the iodine:

$$S = (P) \cdot (SA) \cdot \left(\frac{CDR}{RPB \cdot BUND}\right) \cdot (FHC) \cdot (FHW) \cdot (1 - CWASH). \qquad (5\text{-}1)$$

For the noble gases:

$$S = (P) \cdot (SA) \cdot \left(\frac{CDR}{RPB \cdot BUND}\right) \cdot (FNC) \qquad (5\text{-}2)$$

where

S = the source airborne in the condenser, Ci;
P = the full core power, MWt;
SA = the specific activity after 0 minutes decay, Ci/MWt; (Table 5-1)
CDR = the number of failed rods;
RPB = the number of rods per bundle;
BUND = the number of bundles in the core;
FHC = the fractional iodine release from each failed fuel rod;
FHW = the fractional iodine released from the reactor water;
CWASH = the fractional iodine washed and plated out in the condenser; and
FNC = the fractional noble gas activity released from failed fuel.

In these equations the factor (P × SA) gives the total fuel activity for a particular isotope. The next factor (CDR)/(RPB × BUND) is the fraction of the total core fission product inventory in the damaged fuel rods. The factors FNC and FHC give the amount of noble gas and iodine released from the failed rods. The two remaining terms in the iodine equation express the retention of iodine by reactor water and iodine washout and plateout in the condenser.

5.2 RELEASE

The activity in the condenser leaks to the environment at a nominal rate of 1.0% per day.[8] In reality, leakage will not start until the condenser loses vacuum and rises to ambient pressure — a process which may take several hours. Even after the vacuum breaks, there is no driving force other than a concentration gradient to cause fission product leakage. Thus the 1.0% per day is an arbitrary value presumably higher than the expected leak rate.

No credit is taken for holdup or plateout in the turbine building; the activity in the condenser is assumed to leak directly to the environment at ground level. The release calculation for the CRDA is similar to that for the FUHA.

5.3 DOSE

The methods of diffusion and dose evaluation for the CRDA are the same as those used for the LOCA and the FUHA. Appendices B and C discuss the calculation of atmospheric dispersion and dose evaluation.

6. FAILURE OF THE AIR EJECTOR LINE

Standard Review Plan 15.7.1[9] for waste gas system failure does not specifically address this particular failure of the air ejector line (FAEL), however, this accident will be analyzed in a conservative manner.

The line leading from the steam jet ejector to the offgas treatment system is postulated to fail. This results in activity normally processed by the offgas treatment system being discharged directly to the turbine building and subsequently to the environment via the roof vents. Operator action is assumed to occur within 10 minutes after the accident resulting in an uncontrolled release of activity to the environment for 10 minutes.

6.1 SOURCE

It is assumed that the reactor is operating at design steam flow conditions. The iodine activity per pound of steam is assumed to be 2% of the iodine activity per pound of reactor coolant. No credit is taken for plateout in the building prior to release.

The iodine source term is calculated as follows:

$$S = (CONC) \cdot (SR) \cdot (SCF) \cdot (CONDF) \cdot (TFAEL) \cdot (4.54) \cdot (10^{-6}/60) \qquad (6\text{-}1)$$

where

S	=	the iodine source, Ci;
CONC	=	design basis concentration, μCi/g (see Section 3);
SR	=	steam flow rate, lb/hr;
SCF	=	fraction of steam carryover for iodine, nominally 0.02;
CONDF	=	condenser decontamination factor, nominally 0.0072;
TFAEL	=	release period, min, nominally 10 minutes; and
4.54×10^{-6}	=	conversion factor (Ci/# – μCi/g).

At the break, it is conservatively assumed that the noble gas isotopes are released at three times the design basis. The product of the release rate and the release duration gives the noble gas release as follows:

$$S = (TFAEL) \cdot (AECF) \cdot (OGR) \cdot (PNG) \qquad (6\text{-}2)$$

where

S	=	the noble gas release, Ci;
TFAEL	=	duration of release, sec, nominally 600 seconds; conservative multiplier of design basis noble gas activity level; nominally 3;
AECF	=	nominally 3;
OGR	=	the offgas rate at the break, Ci/sec, nominally 0.45 Ci/sec, i.e., a 2-minute-old diffusion mixture which, if extrapolated to 30 minutes, would yield a design basis offgas release rate of 0.1 Ci/sec. The mixture is 7 seconds old at the time of the break but the 2-minute-old mixture is assumed to allow for decay in flight; and
PNG	=	the fraction of release due to each isotope.

Consider, for example, Xe-133. The fraction of the total due to Xe-133 is 0.0219. Thus the source of Xe-133 is:

$$S = 600 * 3 * 0.45 * 0.0219 = 17.74 .$$

Table 6-1 shows the reactor water iodine concentration and noble gas release fractions.

Table 6-1
FAEL SOURCE ACTIVITY

Halogen Coolant Concentration (μCi/g)[a]	
Isotope	
I-131	7.3 − 2[b]
I-132	7.1 − 1
I-133	5.0 − 1
I-134	1.4 − 0
I-135	7.3 − 1
Noble Gas Release Fraction	
Kr-83m	9.36 − 3
Kr-85m	1.64 − 2
Kr-85	6.40 − 5
Kr-87	5.11 − 2
Kr-88	5.24 − 2
Kr-89	2.18 − 1
Xe-131m	5.23 − 5
Xe-133m	7.82 − 4
Xe-133	2.19 − 2
Xe-135m	6.41 − 2
Xe-135	5.92 − 2
Xe-137	2.88 − 1
Xe-138	2.18 − 1

[a] See Reference 6.
[b] 7.3 − 2 = 7.3 × 10⁻².

6.2 RELEASE

In the FAEL all the activity listed in Table 6-1 is assumed to be immediately released to the environment with no holdup, plateout, or filtration. This release, as constrained by SRP 15.7.1[9], is a ground-level release.

6.3 DOSE

The methods of dose evaluation are the same as those presented in Subsection 2.3 and Appendix C. In the case of FAEL, however, the doses calculated are total for the distances considered.

7. FEEDWATER LINE BREAK ACCIDENT

While there is no Regulatory Guide or Standard Review Plan applicable to this event for a BWR the radiological evaluation presented in this report assumed the feedwater line break accident (FLBA) occurred downstream of the condensate demineralizer and outside the containment. The reactor pressure vessel is isolated due to the flow check valves in the feedwater piping thereby preventing backflow. However, much of the feedwater condensate is released from the break.

The reactor is operating at design feedwater flow when a feedwater line is assumed to circumferentially break downstream of the high pressure heater. Although the feedwater check valves operate immediately to isolate the break from the reactor pressure vessel, the entire mass of water in the feedwater piping heater drain, and condensate booster system is assumed to leave the break and flash to steam. High differential pressure across the condensate demineralizers automatically opens the bypass line. This allows a portion of the condensate flow to bypass the demineralizer. A schematic of the FLBA can be found in Figure 7-1.

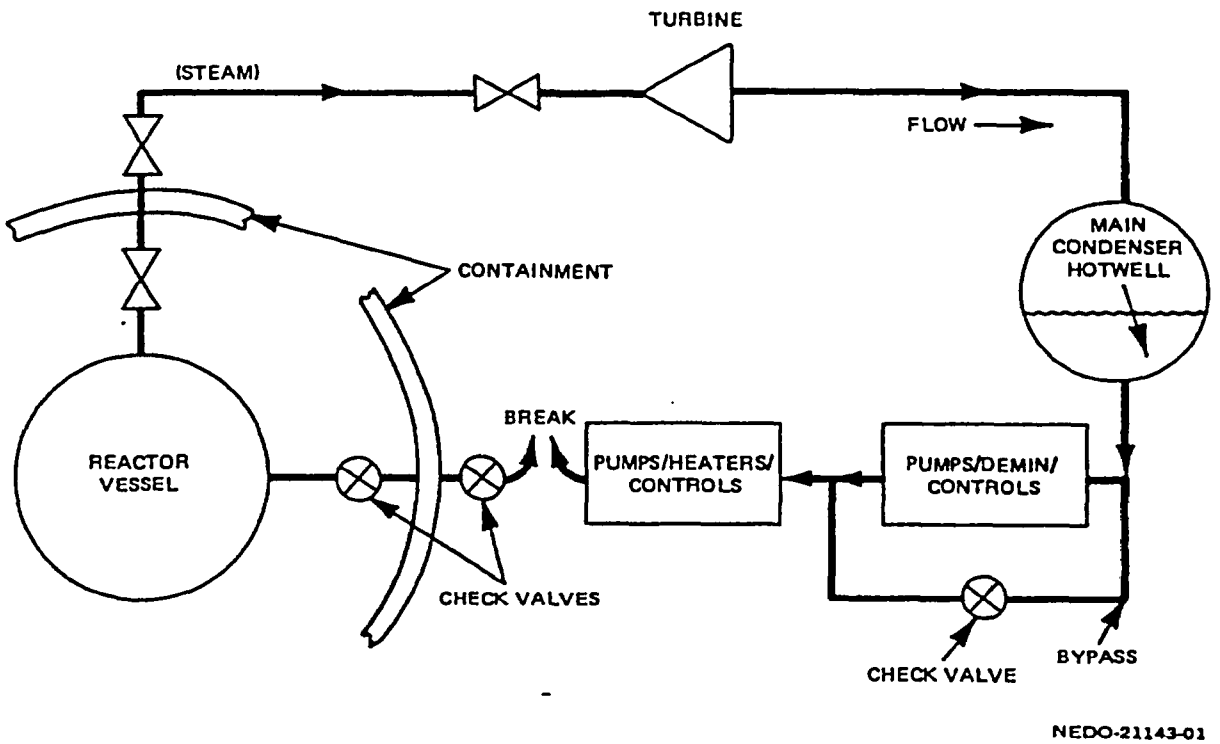

Figure 7-1. Schematic of Feedwater Line Break Accident

7.1 SOURCE

Since the feedwater line is downstream of the main condenser, the only significant release from the break is iodine activity. The activity released is a function of the coolant activity and mass of coolant released. Taking into consideration the carryover fraction and the demineralizer efficiency, the iodine activity released to the environment is determined as follows:

$$S = (CONC) \cdot (SMASS) \cdot (SCF) \cdot (1 - PO) \cdot (1 - F1 \cdot DEMIN) \cdot [F2 + F3\,(1 - F2)] \cdot (4.54 \times 10^{-4}) \quad (7\text{-}1)$$

S = iodine source, Ci;
SMASS = mass of coolant released, lb;
PO = iodine plateout fraction;
DEMIN = demineralizer efficiency, fraction;
F1 = fraction of total coolant filtered;
F2 = fraction of non-flashed liquid; and
F3 = fraction of liquid flashed to steam.

Other parameters are defined in Section 6.

7.2 DOSE

The methods of dose evaluation are the same as those presented in Subsection 2.3 and Appendix C.

8. INSTRUMENT LINE BREAK ACCIDENT

Standard Review Plan 15.6.2[10] is used as a basis for evaluating the radiological consequences of these accidents for Mark I and Mark III containments. For the Standard 238 Nuclear Island design, there are no instrument or sample lines connected to the reactor coolant pressure boundary which penetrate the primary containment. However, for a special BWR/6 Mark III, where the instrument line penetrated the containment, the accident will be analyzed.

8.1 SOURCE

A circumferential rupture of an instrument line which is connected to the primary coolant system is postulated to occur outside the primary containment. Operator action is assumed to occur at 10 minutes. Therefore, for 10 minutes, primary coolant flows into the containment at the maximum rate. At 10 minutes the containment is isolated, SGTS initiated and the reactor is taken through a normal shutdown over a 5.4-hour period. Since the instrument lines normally contain a 1/4-inch flow restricting orifice, Figure 8-1 shows the maximum fluid flow rate out of the instrument line with a 1/4-inch orifice. Figure 8-2 shows the pressure in the vessel for the duration of the shutdown. It is assumed that saturated water flows into the instrument line therein resulting in the maximum iodine release to the containment. If the water is subcooled, then there will be less flashing and if the line connects to partially vaporized coolant the activity level in the fluid will be less than in the saturated liquid due to steam carryover considerations.

8.1.1 Coolant Flashing to Steam

A mass and energy balance gives the mass of released coolant which flashes to steam:

$$\text{Mass} \quad - \quad \dot{M}_t = \dot{M}_s + \dot{M}_f \tag{8-1}$$

$$\text{Energy} \quad - \quad \dot{M}_t \cdot h_t = \dot{M}_s \cdot h_s + \dot{M}_f \cdot h_f \tag{8-2}$$

where

$\dot{M}$ = mass flow rate (lb/sec)
h = enthalpy (Btu/lb)

Subscript

t means total
s means steam
f means liquid

Therefore, the amount of coolant which flashes to steam is

$$\dot{M}_s = \dot{M}_t \left(\frac{h_t - h_f}{h_s - h_f} \right) \tag{8-3}$$

where

$\dot{M}_t$ = from Figure 8-1 (lb/sec);
h_t = obtained from steam tables based on the assumption of saturated liquid at the pressure conditions shown in Figure 8-2;
h_s = 1150.4 Btu/lb at 1 atmosphere; and
h_f = 180.1 Btu/lb at 1 atmosphere.

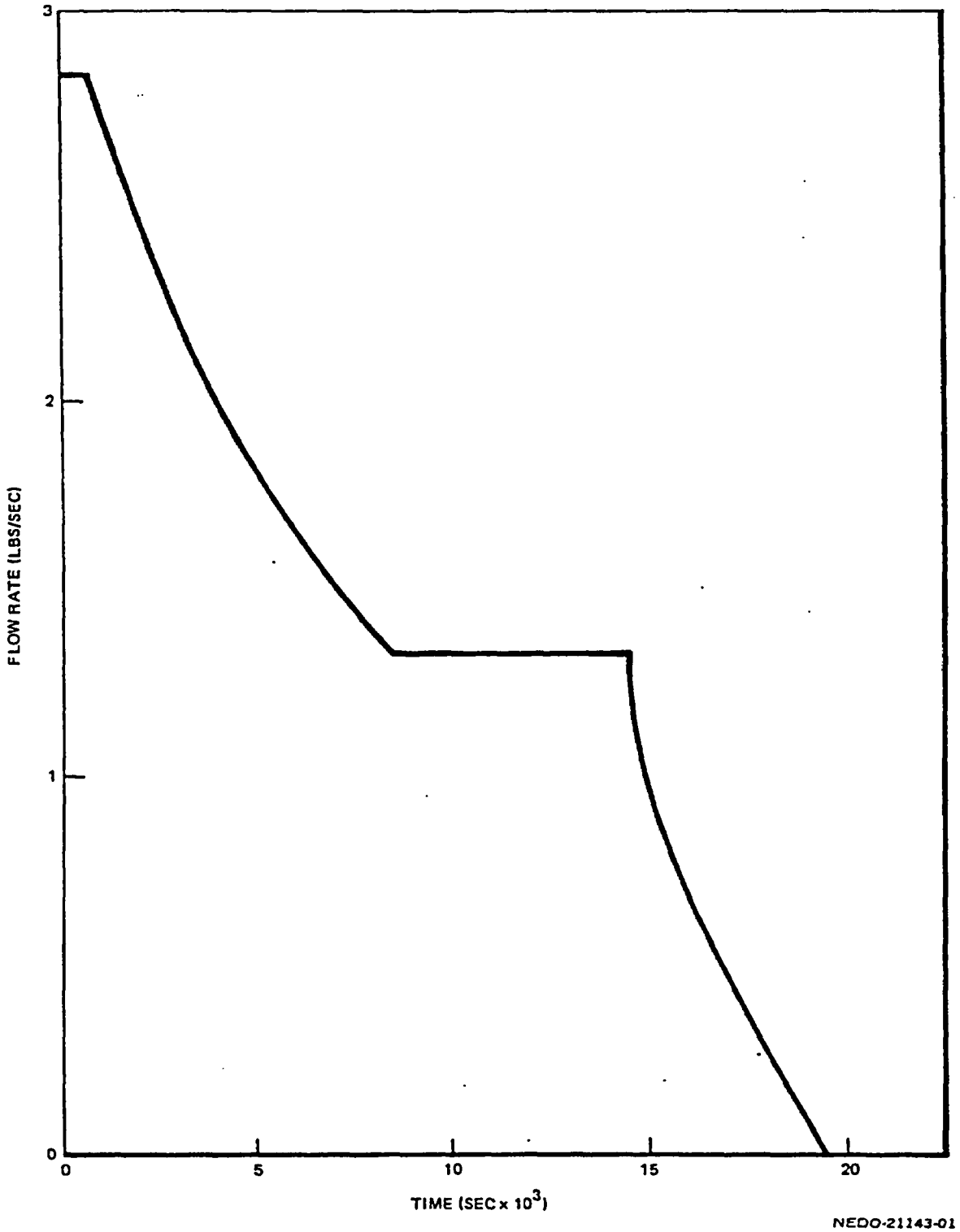

Figure 8-1. Total Mass Flow Rate from Instrument Line Break — 1/4 in. Orifice

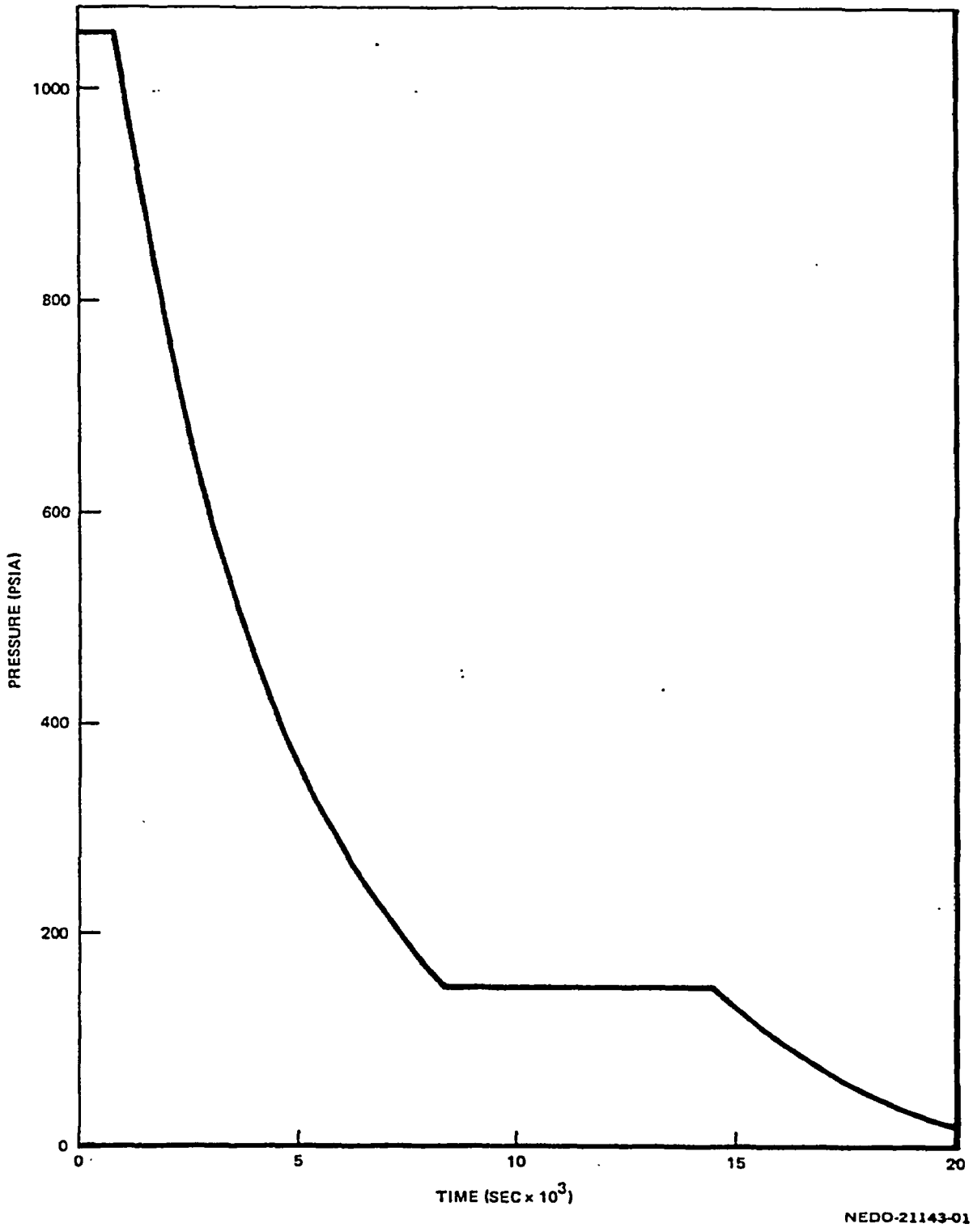

Figure 8-2. Reactor Pressure During Normal Shutdown

8.1.2 Iodine Source

8.1.2.1 Prior to Reactor Pressure Vessel (RPV) Scram

Prior to scram and normal depressurization the iodine activity in the primary coolant is that associated with normal operation. For conservatism it is assumed that the normal coolant is at the allowable technical specification limit.

8.1.2.2 After Reactor Pressure Vessel Scram

The coolant activity level following reactor vessel scram and vessel depressurization is based on plant operating data for 7×7 fuel.[11] This data has been conservatively extrapolated to predict 8×8 fuel behavior and has resulted in the following analytical expression for iodine "spiking" as a consequence of reactor scram and reactor pressure vessel depressurization:

$$I_T = (0.15 \cdot S + 0.85 \sum_{1}^{J} I_J) \cdot N_B \qquad (8\text{-}4)$$

where

I_T = total isotopic activity released to RPV for pressure reduction of $(P_{J-1} - P_J)$, Ci

S = isotopic activity released to RPV for complete depressurization (Ci/fuel bundle):

I-131	2.1
I-132	3.2
I-133	5.0
I-134	5.4
I-135	4.8

0.15 = 15% of the total isotopic activity is released to the RPV at time of scram;

N_B = number of fuel bundles in the core;

I_J = isotopic source term released to the RPV which is a function of the reactor pressure differential and amount of activity remaining to be released, Ci. I_J is mathematically defined as

$$I_J = (S - \sum_{1}^{J} I_{J-1}) \cdot (P_{J-1} - P_J)/P_{J-1} \,. \qquad (8\text{-}5)$$

Where

P_{J-1} = RPV pressure at the end of previous point in time, psia; and

P_J = final RPV pressure for point in time being considered, psia.

I_J is determined as follows:

when

$$J = 1$$
$$I_1 = (S - \Sigma\ I_0) * (P_0 - P_1)/P_0 .$$

However, for

$$J = 1,\ \Sigma\ I_{J-1} = 0 ;$$

therefore,

$$I_1 = (S) * (P_0 - P_1)/P_0$$

when

$$J = 2$$
$$I_2 = (S - I_1) * (P_1 - P_2)/P_1$$

when

$$J = 3$$
$$I_3 = [S - (I_1 + I_2)] * (P_2 - P_3)/P_2$$

when

$$J = 4$$
$$I_4 = [S - (I_1 + I_2 + I_3)] * (P_3 - P_4)/P_3$$

or in general as shown in Equation (8-5):

$$I_J = (S - \sum_{1}^{J} I_{J-1}) * (P_{J-1} - P_J)/P_{J-1} .$$

8.1.3 Airborne Activity

The activity airborne in the containment is a product of the blowdown rate, depressurization rate which controls the amount of iodine spiking and hence coolant activity levels, the flashing factor and natural removal factors. Each of these factors, except the natural removal factor, has been covered in a previous section. Natural removal is assumed to account for a reduction factor of two for any iodine activity which becomes airborne.

Figure 8-3 illustrates the leakage path of fission products.

8.2 DOSE

The method of diffusion and dose evaluation for the ILBA are the same as those used for CRDA, FUHA, and LOCA. Appendices B and C discuss the calculation of atmosphere dispersion and dose evaluation.

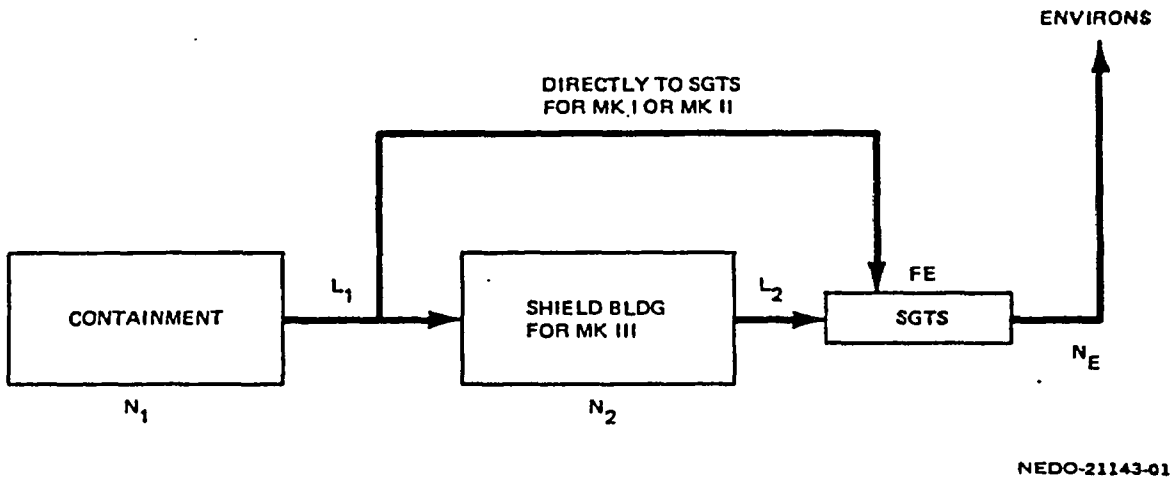

Figure 8-3. Leakage Path for Instrument Line Break

9. LIQUID RADWASTE TANK ACCIDENT

Standard Review Plan 15.7.3[12] for liquid containing tank failures does not specifically address the airborne pathway of the Liquid Radwaste Tank Accident (LRTA). However, this accident will be analyzed in a conservative manner.

Failure of the liquid radwaste tank results in the release of the contents of the tank with the maximum activity to the radwaste building. Ten percent of the total iodine inventory postulated to be released from the tank becomes airborne and is released to the environs over a 2-hour period.

The concentrated waste tank of the 238 Standard BWR/6 plant with the highest iodine activity[13] is located in an area of 20 × 25 feet in the radwaste building. Based upon an analytical model developed for the U.S. Atomic Energy Commission at Idaho[14] for radioiodine evolution from open waste storage pools, the percentage of iodine released as a function of pool area are presented in Figure 9-1. For the conditions of the above concentrate waste tank, the release of iodine is about 0.5% for a 2-hour period.

While not directly applicable to the evolution rate from a large open waste pool, operating data from BWR radwaste buildings provides an indication of the conservatism of a 10% release value assumed for this accident. Data[15,16] from operating BWRs show *annual* releases of elemental I-131 to the environment of 0.0013 to 0.046 curies. Assuming that all of this activity came from only one radwaste tank, which had an average concentration of 26 curies,[13] the fractional release from this tank would be 0.005% to 0.2%. The assumption of 10% release of the activity in a 2-hour period is therefore believed to be quite conservative.

9.1 SOURCE

The iodine activity contained in the tank is based on the activity levels specified in Reference 13. The iodine source term is calculated as follows:

$$S = (SA) \cdot (HFRACT) \qquad (9\text{-}1)$$

where

S = the iodine source, in Ci;
SA = iodine concentration in the worse tank,[13] Ci; and
HFRACT = fraction of iodine release, nominally 0.1.

9.2 RELEASE

In the LRTA 10% of the activity calculated above is assumed to be immediately released to the environment with no holdup, plateout, or filtration. This release as constrained in SRP 15.7.3 is at the radwaste building floor, i.e., ground level.

9.3 DOSE

The methods of dose evaluation are the same as those for FAEL and FWLB.

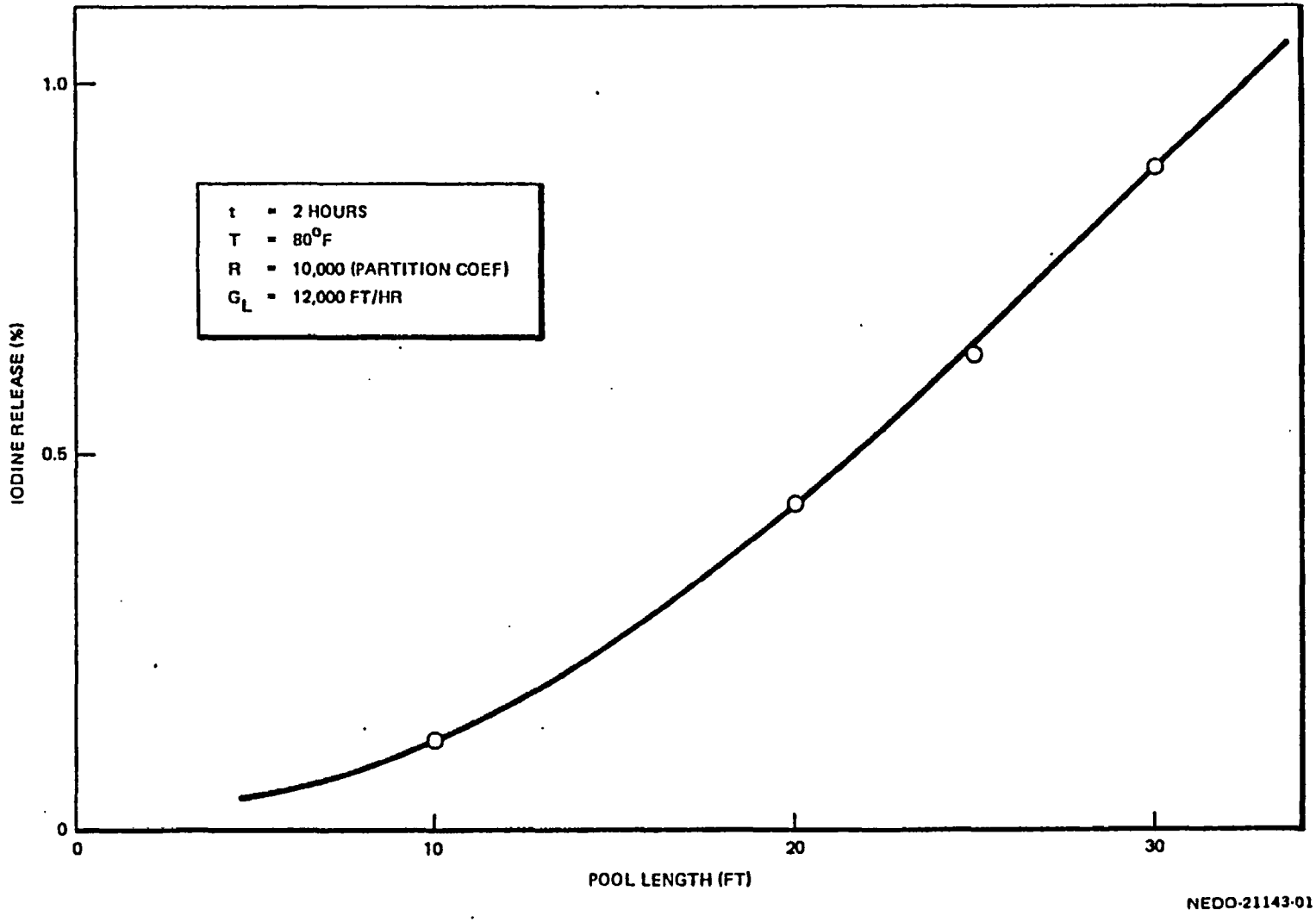

Figure 9-1. Iodine Release from Open Pool

10. OFFGAS SYSTEM ACCIDENT

Regulatory Guide 1.98[17] and Standard Review Plan 15.7.1[9] establish the assumptions for the analysis of the Offgas System Accident (OGSA). Regulatory Guide 1.98 assumes release of 100% of the noble gas inventory stored in the system and a fractional release of the particulate matter on the filter. The schematic diagrams of the N-62, N-64 and N-66 offgas systems are presented in Figures 10-1 and 10-2.

The release fractions assumed for the various components of the system are presented in Table 10-1. It should be noted that it is not required to assume that all components fail but only that one which maximizes the offsite consequences.

Table 10-1
EQUIPMENT FAILURE RELEASE ASSUMPTIONS
RELEASE FRACTIONS ASSUMED FOR DESIGN BASIS

Equipment Piece	Noble Gases	Solid Daughters	Radioiodine
Preheater	1.00	1.00	N/A
Catalytic Recombiner	1.00	1.00	N/A
Offgas Condenser	1.00	1.00	N/A
Water Separator	1.00	1.00	N/A
Holdup Pipe	1.00	1.00	N/A
Cooler Condenser	1.00	1.00	N/A
Moisture Separator	1.00	1.00	N/A
Dessicant Dryer	1.00	0.01	N/A
Prefilter	1.00	0.01	N/A
Charcoal Adsorbers	0.10	0.01	0.01
Afterfilter	1.00	0.01	N/A

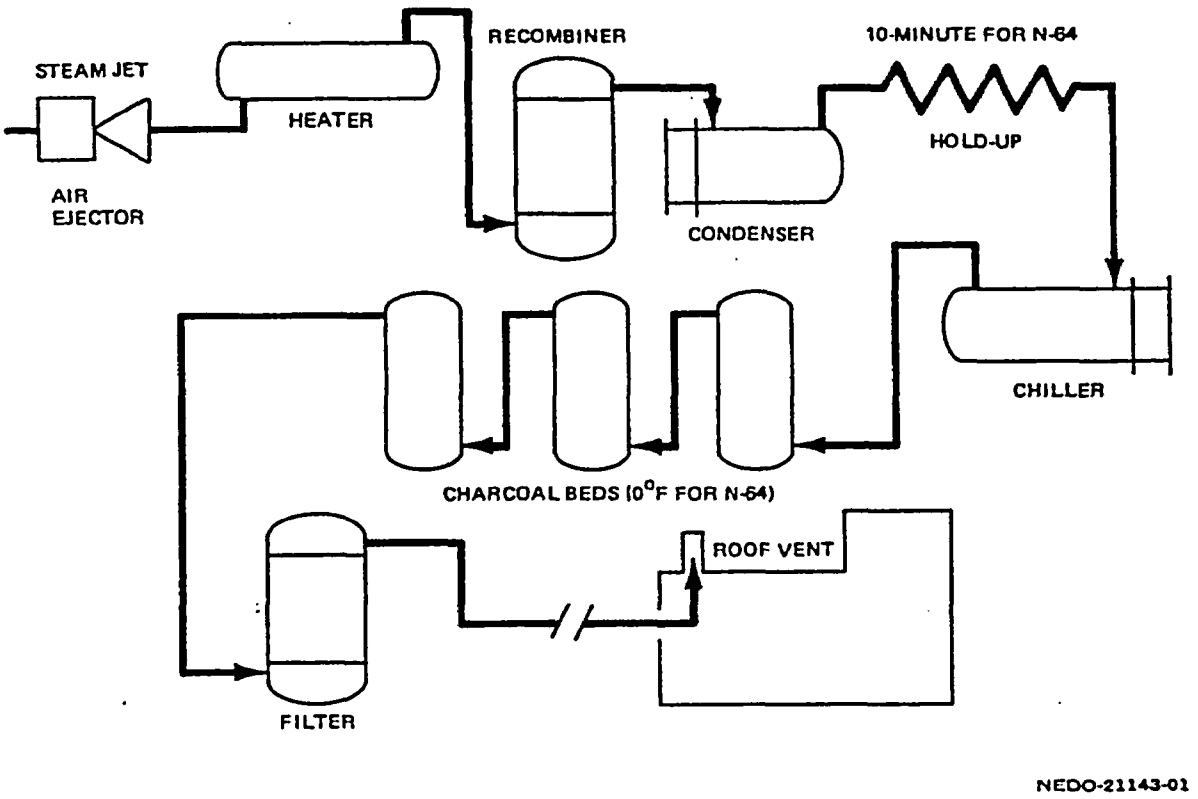

Figure 10-1. N-64 Offgas System

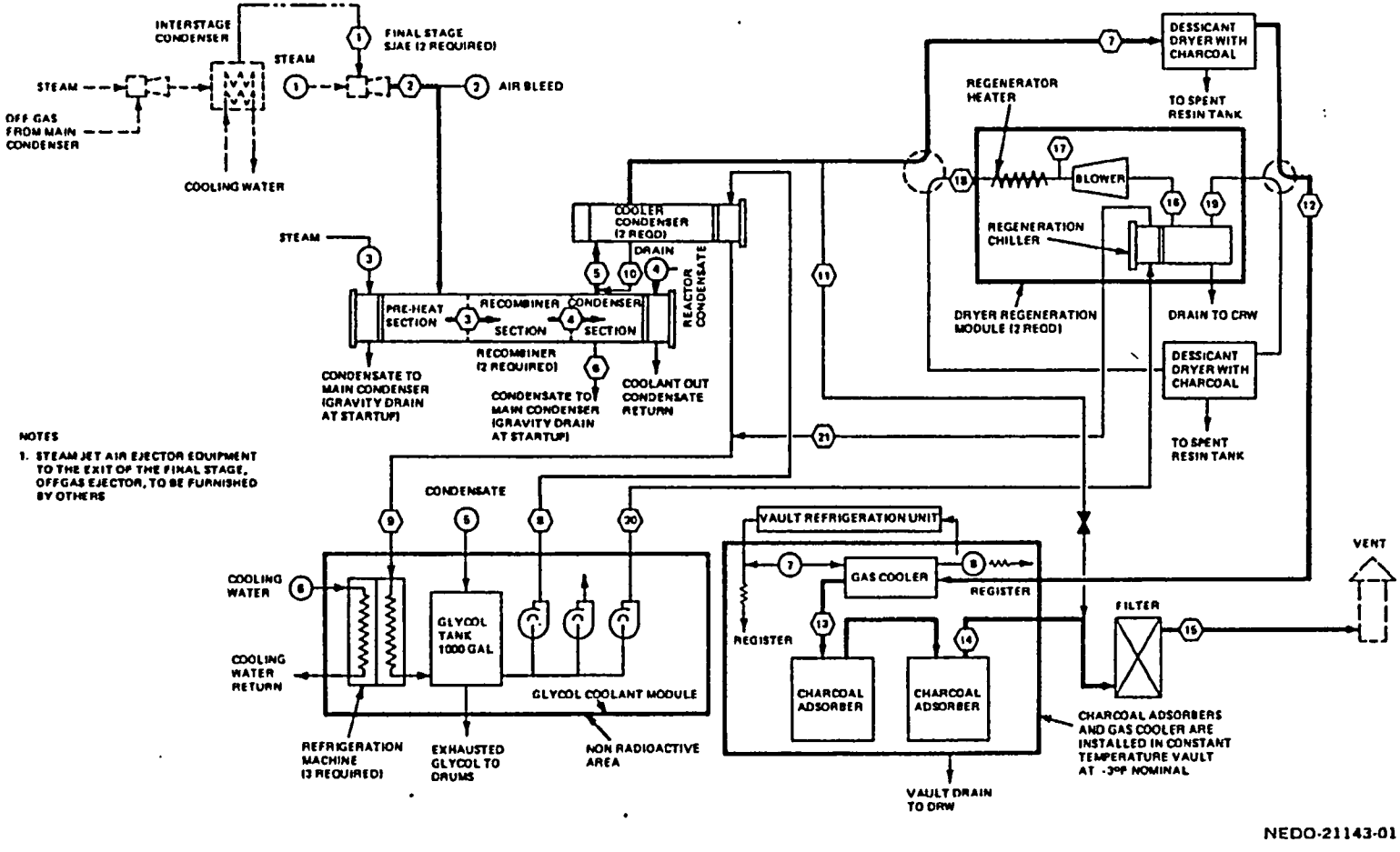

Figure 10-2. Process Diagram for N-66 Offgas System

10.1 SOURCE

The activity released to the environment for the N-64 and N-66 offgas systems is determined as follows:

$$S_i = \left[(s_{1_i}) \cdot (TOGSA) \cdot (6E\text{-}5) \right] + \left[(S_{2_i}) \cdot F_i \right] \qquad (10\text{-}1)$$

where

S_i = isotopic activity released to the environment, Ci;

S_{1_i} = isotopic release rate at the Steam Jet Air Ejectors (SJAE), μCi/sec;

TOGSA = duration of the break in the delay line just downstream of the SJAE, min;

6E-5 = conversion factor (C-sec/μCi-min);

S_{2_i} = isotopic activity released from charcoal bed, Ci; and

F_i = isotopic release fraction from Table 10-1.

10.2 RELEASE

For both the N-64 and N-66 offgas systems the SJAE is assumed to operate for a period of 1/2 hour after the accident unless a positive means (automatic isolation) is provided to limit this release from this source. One hundred percent of the activity released from the SJAE is assumed to be at ground level, with no delay assumed from the SJAE to the break in the delay line. In addition, a fraction of the activity in the delay line for the N-64 system and a fraction of the activity of the charcoal for the N-66 system is also assumed to be released to the environment. Tables 10-2 and 10-3 present the isotopic releases to the environment for N-64 and N-66 offgas systems respectively. Other data for the offgas systems can be found in Appendix D.

10.3 DOSE

The methods of thyroid and whole body gamma dose evaluation are the same as those presented in Subsection 2.3 and Appendix C. In the case of OGSA, however, decay in flight and finite cloud model are optional. In addition, the OGSA also considers the dose to bone, liver, kidney, lung, and GI-LLI as specified in RG 1.109.[18]

Table 10-2
GASEOUS RADWASTE SYSTEM FAILURE (N-64 SYSTEM)
FISSION PRODUCT RELEASE TO ENVIRONMENT

DESIGN BASIS ANALYSIS

ISOTOPE	CURIES
BR-83	4.66E-03
BR-84	1.01E-02
BR-85	9.87E-03
I -131	3.39E-03
I -132	4.33E-02
I -133	2.49E-02
I -134	7.91E-02
I -135	3.99E-02
KR-83M	7.25E 01
KR-85M	1.28E 02
KR-85	9.73E-02
KR-87	3.29E 02
KR-88	4.00E 02
KR-89	6.00E 02
XE131M	7.27E-01
XE133M	7.43E 00
XE-133	1.81E 02
XE135M	2.26E 02
XE-135	5.34E 02
XE-137	7.65E 02
XE-138	7.23E 02
XE-139	1.20E 03
XE-140	1.06E 03
H -3	2.09E-03
C -14	4.64E-04
NA-24	4.13E-06
P -32	4.12E-08
CR-51	1.05E-06
MN-54	8.22E-08
MN-56	1.06E-04
FE-55	0.
FE-59	1.68E-07
CO-58	1.05E-05
CO-60	9.92E-07
NI-63	0.
NI-65	6.34E-07
CU-64	0.
ZN-65	4.07E-09
ZN-69	0.
RB-86	0.
RB-88	1.42E 02
RB-89	6.80E 01

Table 10-2 (Continued)
GASEOUS RADWASTE SYSTEM FAILURE (N-64 SYSTEM)
FISSION PRODUCT RELEASE TO ENVIRONMENT

DESIGN BASIS ANALYSIS

ISOTOPE	CURIES
SR-89	2.96E-02
SR-90	4.35E-05
SR-91	8.09E-02
SR-92	5.02E-04
Y -90	3.51E-07
Y -91M	1.61E-02
Y -91	1.74E-05
Y -92	1.86E-06
Y -93	1.16E-06
ZR-95	7.35E-08
ZR-97	5.77E-07
NB-95	7.27E-08
MO-99	5.67E-07
TC-99M	3.03E-04
TC-101	3.81E-04
RU-103	4.00E-08
RU-105	3.59E-07
RU-106	2.84E-09
AG110M	1.24E-07
TE125M	0.
TE127M	0.
TE-127	0.
TE129M	1.08E-08
TE-129	1.41E-06
TE131M	4.54E-08
TE-131	9.53E-06
TE-132	3.62E-07
CS-134	0.
CS-136	0.
CS-137	4.88E-04
CS-138	1.72E 02
BA-139	6.29E 00
BA-140	8.41E-03
BA-141	8.46E-04
BA-142	1.40E-03
LA-140	1.08E-04
LA-142	6.64E-06
CE-141	7.36E-08
CE-143	3.29E-07
CE-144	4.35E-08
PR-143	9.32E-08
PR-144	0.
ND-147	3.88E-08
W -187	6.34E-06
NP-239	4.39E-04

Table 10-3
GASEOUS RADWASTE SYSTEM FAILURE (N-66 SYSTEM)
FISSION PRODUCT RELEASE TO ENVIRONMENT

DESIGN BASIS ANALYSIS

ISOTOPE	CURIES
BR-83	4.67E-03
BR-84	1.01E-02
BR-85	9.86E-03
I -131	3.36E-03
I -132	4.27E-02
I -133	2.49E-02
I -134	7.91E-02
I -135	3.99E-02
KR-83M	1.41E 01
KR-85M	4.68E 01
KR-85	8.11E-01
KR-87	6.05E 01
KR-88	1.04E 02
KR-89	4.35E 02
XE131M	1.40E 01
XE133M	2.36E 01
XE-133	1.52E 03
XE135M	6.45E 01
XE-135	1.63E 02
XE-137	5.16E 02
XE-138	2.53E 02
XE-139	1.09E 03
XE-140	1.03E 03
H -3	5.10E-04
C -14	4.14E-05
NA-24	4.18E-06
P -32	4.06E-08
CR-51	9.71E-07
MN-54	4.70E-08
MN-56	1.06E-04
FE-55	0.
FE-59	1.47E-07
CO-58	8.19E-06
CO-60	3.76E-07
NI-63	0.
NI-65	6.34E-07
CU-64	0.
ZN-65	2.75E-09
ZN-69	0.
RB-86	0.
RB-88	6.44E 00
RB-89	6.81E-03

Table 10-3 (Continued)
GASEOUS RADWASTE SYSTEM FAILURE (N-66 SYSTEM)
FISSION PRODUCT RELEASE TO ENVIRONMENT

DESIGN BASIS ANALYSIS

ISOTOPE	CURIES
SR-89	2.19E-03
SR-90	2.08E-06
SR-91	1.45E-04
SR-92	5.03E-04
Y -90	2.03E-06
Y -91M	2.88E-06
Y -91	1.82E-07
Y -92	1.72E-06
Y -93	1.16E-06
ZR-95	6.09E-08
ZR-97	5.77E-07
NB-95	5.33E-08
MO-99	5.63E-07
TC-99M	3.02E-04
TC-101	3.81E-04
RU-103	3.57E-08
RU-105	3.60E-07
RU-106	1.55E-09
AG110M	7.52E-08
TE125M	0.
TE127M	0.
TE-127	0.
TE129M	9.22E-09
TE-129	1.31E-06
TE131M	4.53E-08
TE-131	9.53E-06
TE-132	3.59E-07
CS-134	0.
CS-136	0.
CS-137	5.94E-05
CS-138	5.12E-03
BA-139	3.33E-04
BA-140	1.70E-05
BA-141	8.46E-04
BA-142	1.40E-03
LA-140	2.90E-06
LA-142	6.64E-06
CE-141	6.67E-08
CE-143	3.29E-07
CE-144	2.56E-08
PR-143	8.95E-08
PR-144	0.
ND-147	3.77E-08
W -187	6.34E-06
NP-239	4.44E-04

11. REFERENCES

1. H. A. Careway, *Calculation of Fission Product Inventory and Spectra-RADCI01 Program*, October 1980 (NEDO-25176).

2. U.S. NRC, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors*, Regulatory Guide 1.3, Rev. 2, June 1974.

3. D. H. Slade, Editor, *Meteorology and Atomic Energy 1968*, U.S. Atomic Energy Commission, Division of Technical Information, Oak Ridge, Tenn., July 1968.

4. H. A. Careway, et al., *Atmospheric Gamma Dose Conversion Factors — ADOSC/GDOSC Functions*, January 1981 (NEDO-21202B).

5. U.S. NRC, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors*, Regulatory Guide 1.5, March 1971.

6. U.S. NRC, *Standard Technical Specifications for General Electric Boiling Water Reactors*, Revision of April 1, 1978 (NUREG-0123).

7. U.S. NRC, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors*, Regulatory Guide 1.25, March 1972.

8. U.S. NRC, Spectrum of Rod Drop Accidents (BWR), Standard Review Plan 15.4.9, November 1975.

9. U.S. NRC, Standard Review Plan, Section 15.7.1 (NUREG-75/087).

10. U.S. NRC, Standard Review Plan, Section 15.6.2 (NUREG-75/087).

11. F. J. Brutchy, C. R. Hill, N. R. Horton, A. J. Levine, "Behavior of Iodine in Reactor Water During Plant Shutdown and Startup," (NEDO-10585).

12. U.S. NRC, Standard Review Plan, Section 15.7.3 (NUREG-75/087).

13. R. A. Head, *BWR Radioactive Waste Treatment System, BWRSD*, San Jose, Calif., 1976 (NEDO-21059).

14. W. A. Yuill, et al., "Release of Radioiodine from Open Pools," 1970 (IN-1449).

15. T. R. Marrero, "Airborne Released from BWRs for Environmental Impact Evaluations," 1978 (NEDO-21159).

16. U.S. NRC, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Boiling Water Reactors," Regulatory Guide 1.112, Washington, D.C., 1976.

17. U.S. NRC, *Assumptions Used for Evaluating the Potential Radiological Consequence of a Radioactive Offgas System Failure in a Boiling Water Reactor*, Regulatory Guide 1.98, March 1976.

18. U.S. NRC, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I*, Regulatory Guide 1.109, October 1977.

APPENDIX A
THE CONAC03 COMPUTER CODE

This appendix describes how to use the CONAC03 computer code to evaluate the radiological consequences of design basis accidents. CONAC03 may be run either with card input or through the CARDIN Time Sharing System. The output is designed to be inserted into a Safety Analysis Report.

A.1 A STANDARD EVALUATION

Figure A-1 shows the deck setup to analyze the nine design basis accidents for a BWR/6 plant. Each analysis starts with a case card followed by free-format (DTA) input which describes the assumptions for that accident. Note that an input variable (for example, DIST) which has the same value from case to case need not be repeated. The user consequently must be careful to avoid carrying over unwanted input from prior cases.

Only four control cards are necessary: IDENT, USERID, SELECT, and ENDJOB. Any valid charge number and USERID may be used to run the CONAC03 program. The first case set defines the first accident, the control rod drop accident. The source is automatically computed using standard data when the variables P for power and IACT for accident type are set. In the CRDA there is only one compartment (NCOMP=1), the condenser, which is assumed to leak at 0.5% per day (RPURGE=0.5%). These variables suffice to establish the release calculation. The meteorology and dose assumptions of Regulatory Guide 1.3 are used by specifying the release height, the building cross section, and the distances at which the dose evaluations are to be computed. The next two accidents require the user to describe the particular release pathways. For example, the LOCA uses a three-compartment model in which the last compartment may be used to give the unfiltered bypass leakage as much holdup as the leakage which passes through the standby gas treatment system. The fuel handling accident uses one compartment, the fuel handling area, to define the release. In the steam line break accident no release model need be specified because the release is assumed to be instantaneous. The release height is changed from ground level to 30 meters and the cross section is set to 0 in accordance with Regulatory Guide 1.5 which suggests a release at the turbine building rooftop level and assumes fumigation condition.

Note that the input is entered in columns 1 to 80 with the variable name on the left followed by the input value or values. Comments may be made after a single dollar sign, $, and the input for a case is terminated by a double dollar sign.

Table A-1 defines the most commonly used input variables in the CONAC03 code. The thermal power, P, and the accident type, IACT, determine the activity initially available for release, that is, the source term. The pathway from the point of initial activity to the environment is expressed in terms of flow rates and filter efficiencies. The total number of compartments or separate enclosures is established by NCOMP.

Table A-1
USUAL INPUT VARIABLES FOR THE CONAC03 CODE[a]

BCS	—	building cross section, m^2
CHIQ(ITIM,IDIS)	—	values of the atmospheric dispersion factor, χ/Q, at time period ITIM[b] and distance IDIS, sec/m^3
DIST(IDIS)	—	distances (up to 10),m
FLEAK(ICMP)	—	leakage filter efficiency in compartment ICMP (up to 5), %
FPURGE(ICMP)	—	purge filter efficiency,%
FRECIR(ICMP)	—	recirculation filter efficiency,%
HITE	—	release height, m
IACT	—	accident type: 1-control rod drop, 2-loss of coolant, 3-fuel handling, 4-steam line break, etc.,
NCOMP	—	number of compartments, 1 to 5
P	—	power, MWt (2000, 2952, 3651, 3876 or 4146 for standard plants); any value can be used, however
RECIRC(ICMP)	—	recirculation rate in compartment ICMP, % per day
RLEAK(ICMP)	—	leak rate to next compartment, % per day
RPURGE(ICMP)	—	purge rate to environment, % per day
TITLE	—	title

[a] A complete input list is in Table A-3.
[b] Time periods built in CONAC are: 1 min, 10 min, 30 min, 1 hr, 2 hr, 4 hr, 8 hr, 1 day, 4 days, 30 days. However, these values can be overlaid.

CONAC03, through the use of the FORTRAN subroutine RELES02, calculates the activity of a single isotope in a series of compartments. Each of up to five compartments may have: an initial activity; leakage to the next compartment, RLEAK; leakage directly to the environment, RPURGE; and internal recirculation, RECIRC. Figure A-2 identifies a five-compartment model and the release paths. The rate of activity change equals the gain rate minus the loss rate minus radioactive decay.

$$\frac{dN_i}{dt} = \text{Incoming Rate} - \text{Loss Rate} - \text{Radioactive Decay}$$

Incoming: from source, S_i;
from previous compartment, $(1 - FL_{i-1})\, L_{i-1}N_{i-1}$;
from recirculation, $(1 - FR_i)\, R_iN_i$.

Loss: to environment, P_iN_i;
to next compartment, L_iN_i;
to recirculation, R_iN_i.

Decay: λN_i.

Therefore the governing equation is:

$$\frac{dN_i}{dt} = (1 - FL_{i-1})\, L_{i-1}N_{i-1} + (1 - FR_i)\, R_iN_i + S_i - P_iN_i - L_iN_i - R_iN_i - \lambda N_i \text{ Ci/sec}$$

```
$       IDENT    J072,DAT-TTT17,EXPRESS ** CONAC03 **
$       SELECT   CONAC03
$       PRMFL  21, R, R, FSXXXX/RDMLIB
$       DATA     I*
)CRDA
 TITLE 60H** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **
 IACT 1  P 2952  NCOMP 1  RPURGE 1  $
 NBOOK 1 $ TESTING FOR DATA BOOK WRITEUP
 DIST 800 4000   $ DIST. FOR EA & LPZ IN METERS
 CHIQ(1,1) 2.0-4 *10  $  X/Q FOR EA
 CHIQ(1,2) 4.0-5 *3 3.0-5 1.3-5 *2 8.0-6 *2 3.0-6 1.5-6 $$ LPZ X/Q
(LOCA
 TITLE 60H** TEST CASE * 2952 MWT * DBA LOCA * 30-IV-1981 **
 IACT 2  RPURGE 1  FPURGE 99  $$
(FUHA
 TITLE 60H** TEST CASE * 2952 MWT * DBA FUHA * 30-IV-1981 **
 IACT 3  RPURGE 3600  FPURGE 99  $$
(SLBA
 TITLE 60H** TEST CASE * 2952 MWT * DBA SLBA * 30-IV-1981 **
 IACT 4  RPURGE 0  FPURGE 0  $$
(FAEL
 TITLE 60H** TEST CASE FOR FAEL * 2952 MWT * SRP FAEL * 30-IV-1981 *
 IACT 5  $$
(FLBA
 TITLE 60H** TEST CASE FOR FLBA * 2952 MWT * SRP FLBA * 30-IV-1981 *
 IACT 6  SMASS 500000 $$ TOTAL WATER RELEASED , LBS
(ILBA
 TITLE 60H** TEST CASE FOR ILBA * 2952 MWT * SRP ILBA * 30-IV-1981 *
 IACT 7  RPURGE 100  FPURGE 99  NCOMP 1  $$
(LRTA
 TITLE 60H** TEST CASE FOR LRTA * 2952 MWT * SRP LRTA * 30-IV-1981 *
 SA(1,8) 2.6 6.2-3 0.15 1.0-6 7.3-3 $ BWR-6 GESSAR II VALUES (238)
 IACT 8  NT 1  NTANK  7HCON. WT $$ REALISTIC CASE
(OGSA N-66
 TITLE 60H** TEST CASE FOR OGSA * N-66 OFF-GAS * 30-IV-1981 **
 IACT 9  NSYS  2  1  $$ N-66 OFFGAS & ADULT DCF
(OGSA N-64
 TITLE 60H** TEST CASE FOR OGSA * N-64 OFF-GAS * 30-IV-1981 **
 IACT 9  NSYS 1  1  $ N-64 OFFGAS & ADULT DCF
 IFC 1  WSPD 2 *10  PERSIS 1 *10 $$ FINITE CLOUD & PASQUILL F
)LAST
$       ENDJOB
```

Figure A-1. CONAC Input for a BWR/6 Plant

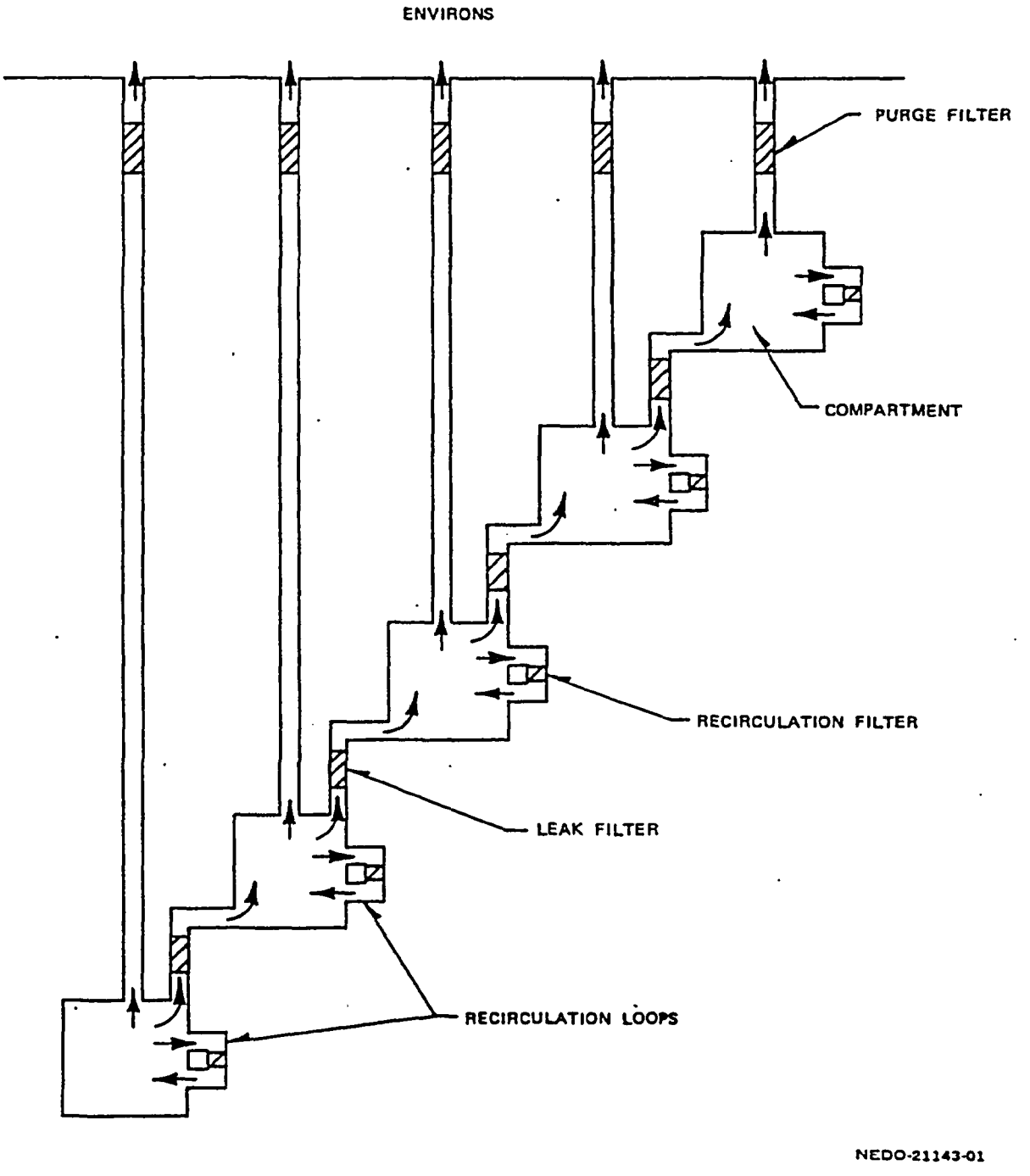

Figure A-2. Release Path for a Five-Compartment Model

where

N_i = the activity in compartment i, Ci;
t = time, sec;
FL_i = leak filter efficiency in i, fraction;
L_i = leak rate from i, sec^{-1};
FR_i = recirculation filter efficiency in i, fraction;
R_i = recirculation rate in i, sec^{-1};
S_i = the source rate in i, Ci/sec;
P_i = the purge rate from i, sec^{-1}; and
λ = the decay constant, sec^{-1}.

An equation of this form applies to each compartment in the series. These equations are solved with Laplace transforms.

The rates are expressed in vol % per day where the percent is computed in terms of the compartment from which the stream leaves. For example, a primary containment leak rate of 1% per day is equivalent to an 8 ft^3/minute leak rate out of a volume of 1.15×10^6 ft^3. CONAC03 computes the activity in each compartment and the release to the environment at various time periods up to 30 days through the use of the exact solution. The meteorology can be either the standard accident meteorology of Regulatory Guide 1.3 (which requires one to specify the distances, the release height, and the building cross section) or site-specific meteorology (which requires the distances and time-dependent values of the atmospheric dispersion factor, χ/Q, at each distance). If site-specific χ/Q values are used one should ensure that they have been evaluated at the proper height and distance. Appendix B describes a method for calculating these χ/Q values. If the values are supplied by the customer one can check them for internal consistency by noting that χ/Q for ground-level releases should in general decrease with distance and time. That is, χ/Q will be lower at 3 km than it is at 1 km and lower in the 4- to 30-day time period than it is in the 0- to 8-hour time period. The standard meterology is evaluated according to the rules of Regulatory Guide 1.3 with the CHIQU02 subroutine.[A-1]

Table A-2 illustrates the results of the first case in Figure A-1, the CRDA. Each accident evaluated has a similar set of tables which are formatted to be directly inserted into the Safety Analysis Report without retyping. The last several pages of the output from a CONAC03 run repeat the relevant tables for each accident so that the user can retain a copy of the input variables and the results for verification.

A.2 NONSTANDARD EVALUATIONS

The previous section showed how to use CONAC03 for standard BWR/6 design basis accident evaluations. This section explains the application of CONAC03 to nonstandard situations. Two of the most frequent departures from the standard are the evaluation of the design basis accidents for other product lines and the evaluation of a time-dependent, multiple-pathway, loss-of-coolant accident. It should be noted that if one time-dependent variable is overlaid with new data, all other corresponding time-dependent variables must be adjusted likewise (see Table A-3, Note 2). The CONAC03 code can be used to compute the radiological consequences of these deviations as well as many others by prudent input changes. The user is cautioned, however, to be careful when attempting nonstandard evaluations. The authors have found that discussion of the problem with other experienced users and examinations of the source listing are helpful in avoiding errors.

Figure A-3 shows the input used to analyze the design basis accidents for a BWR/4 plant. In addition to the usual input (IACT, P, DIST, etc.) some additional data are required. These variables are arrowed in Figure A-3. Since the power is not one of the standard values, the built-in variable POWER must be set. For the CRDA and the FUHA the number of bundles in the core, BUND, must also be input to enable CONAC03 to compute the fraction of the core inventory which is in the damaged fuel rods. In the fuel handling accident, the number of damaged rods for 7X7 fuel configuration is 125. Thus the built-in value of 101 rods, used for BWR/6 analyses must be changed to 125 for the variable FDR. The steam line break accident requires the user to input the initial steam volume, SVI, the steam released, RESTM, and the liquid released, RELIQ. In addition, the iodine coolant concentration, CONC, must be changed to the design basis for the plant being evaluated.

Table A-2
CONAC01 OUTPUT FOR THE CONTROL ROD DROP ACCIDENT

	Inhalation Dose (Rem) Distance (meters)		Whole Body Dose[a] (Rem) Distance (meters)		Skin dose[b] (Rem) Distance (meters)	
	850	3219	850	3219	850	3219
1 minute	5.42 − 2[c]	9.69 − 3	1.81 − 3	3.24 − 4	3.26 − 3	5.83 − 4
30 minutes	1.60	2.87 − 1	3.36 − 2	6.01 − 3	5.46 − 2	9.76 − 3
1 hour	3.17	5.68 − 1	5.60 − 2	1.00 − 2	8.96 − 2	1.60 − 2
2 hours	6.22	1.11	9.07 − 2	1.62 − 2	1.44 − 1	2.58 − 2
4 hours	1.20 + 1	2.15	1.39 − 1	2.49 − 2	2.22 − 1	3.98 − 2
8 hours	2.29E + 1	4.09	1.96 − 1	3.50 − 2	3.19 − 1	5.71 − 2
12 hours	2.46E + 1	4.30	2.07 − 1	3.63 − 2	3.41 − 1	5.96 − 2
1 day	2.94E + 1	4.84	2.25 − 1	3.84 − 2	3.80 − 1	6.41 − 2
4 days	3.88E + 1	5.92	2.37 − 1	3.98 − 2	4.15 − 1	6.82 − 2
30 days	4.39E + 1	6.49	2.41 − 1	4.03 − 2	4.28 − 1	6.96 − 1

[a] Whole Body dose is gamma dose only.
[b] Skin dose is the sum of gamma and beta doses.
[c] 5.42 − 2 is read 5.42×10^{-2}.

From time to time variations on the standard loss-of-coolant accident are required because the LOCA is usually the accident which comes closest to the licensing dose limits and consequently the LOCA is subject to the most scrutiny. The example used here is a combination of two BWR/6 LOCA evaluations. Figure A-4 shows a schematic diagram of the loss-of-coolant accident which has a 60-second drawdown time in the shield building and three paths for the initial activity in the primary containment to the environment: through the shield building and standby gas treatment system; through the auxiliary building and immediately to the standby gas system without holdup or mixing; and directly to the environment via open-ended penetrations in the containment. This does not represent a particular evaluation but rather is an example chosen to illustrate the capability of the CONAC03 program to calculate the consequences of nonstandard situations.

INDEX VARIABLES
ITIME 1 to 10 time
IDIS 1 to 10 Distance.

Table A-3
CONAC01 INPUT VARIABLES

Variable	Accident	Definition	Units
AECF	SLBA	Ratio of NRC to GE offgas rate. Built-in value 3.0 for noble gases.	none
BCS	All	Building cross section for use with ground-level release χ/Q calculation. Built-in value 0.	m^2
BEN(ISOT)	All	Average beta energy for isotope ISOT. Built-in values — see Note 1.	MeV/dis
BRATE(ITIM)	All	Breathing rate at time ITIM. Built-in values — see Note 1.	m^3/sec
BUND(IPOW)	FUHA, CRDA	Number of bundles for power IPOW. Built-in values — see Note 2.	none
CDR	CRDA	Number of rods damaged in CRDA. Built-in value 770.	none
(10,10) CHIQ(ITIM,IDIS)	All	Atmospheric dispersion factor for time ITIM and distance IDIS. Built-in value 0.	sec/m^3
CONC(ISOT)	SLBA,FLBA, ILBA	Design basis iodine coolant concentration for isotope ISOT. Built-in values — see Table 3-1.	μCi/g
CONDF	FAEL	Condenser decontamination factor	none
CWASH	CRDA	Fractional iodine washout and plateout in condenser. Built-in value 0.9.	none
DEMIN	FLBA	Demineralizer efficiency (0.5)	none
DIST(IDIS)	All	Distance for offsite dose calculation. Built-in value 0.	m
DLAM(ISOT)	LOCA, FUHA, CRDA, ILBA	Decay constant for isotope ISOT. Built-in values — see Note 1.	$(sec)^{-1}$
FAR	FUHA	Fractional isotopic release from damaged rods in FUHA except Kr-875. Built-in value 0.1.	none
F1	FLBA	Fraction of steam filtered (1.0)	none
F2	FLBA	Fraction of iodine evolved off non-flashed liquid (0.8)	none
~~F2~~ FS	FLBA	Fraction of liquid flashed to steam (0.2)	none
FARK85	FUHA	Fractional Kr-85 release from damaged rods in FUHA. Built-in value 0.30.	none

Table A-3
CONAC03 INPUT VARIABLES (Continued)

Variable	Accident	Definition	Units
FDR	FUHA	Number of damaged fuel rods in FUHA. Built-in value 101.	none
FHC	CRDA	Fractional iodine release from damaged rods in CRDA. Built-in value 0.105.	none
FHL	LOCA	Fraction of iodine airborne in containment in LOCA. Built-in value 0.25.	none
FHW	CRDA	Fraction of iodine released from reactor water in CRDA. Built-in value 0.10.	none
FLEAK(IC,IT)	LOCA, CRDA, FUHA, ILBA	Leak filter efficiency from compartment IC and at time IT to the next compartment. Built-in value 0.	%
FNC	CRDA	Fraction of noble gas released from damaged fuel in CRDA. Built-in value 0.11.	none
FNL	LOCA	Fraction of noble gas released in LOCA. Built-in value 1.00.	none
FPURGE(IC,IT)	LOCA, CRDA, FUHA, ILBA	Purge filter efficiency from compartment IC and at time IT to the environment. Built-in value 0.	%
FRECIR(~~ICMP~~ IC, IT)	LOCA, ILBA	Recirculation loop filter efficiency in compartment ICMP. Built-in value 0.	%
FUME	All	Long fumigation signal. For elevated releases near (3 km) a large body of water, set FUME to 1. This causes fumigation meteorology to persist for 4 hours. Built-in value 0 (30-min fumigation only).	none
GEN(ISOT)	All	Average gamma energy for isotope ISOT. Built-in values — see Note 1.	MeV/dis
HDF	FUHA	Halogen decontamination factor in FUHA. Built-in value 0.01.	$\frac{\text{Ci in air}}{\text{Ci in water}}$
HITE	All	Effective release height. Built-in value 0.	m
IACT	All	Accident number. 1=CRDA, 2=LOCA, 3=FUHA, 4=SLBA, 5=FAEL, 6=FLBA, 7=ILBA, 8=LRTA, 9=OGSA	none
IFC	All	Option for whole body finite cloud. Built-in value 0.	none

Table A-3
CONAC03 INPUT VARIABLES (Continued)

Variable	Accident	Definition	Units
ILAST	LOCA	Sum signal. When ILAST is 1 the activities and doses of prior LOCA cases are added and printed. Built-in value 0 (do not sum).	none
ING	LOCA, FUHA, CRDA, ILBA	Specific option: Noble gases with filter. Built-in value 0.	none
INDEX (6)	All	Meteorology option as in CHIQU02	none
IP	OGSA	Pasquill type index. Built-in IP=6 for type F.	none
LOOK	All	Print signal. When LOOK is 1 the entire list of input to CONAC is printed. Built-in value 0 (do not print).	none
NAM(IT,IACC)		Table headings. Word IW (IW=1 to 10) of Table IT (IT=1 to 6) for accident IACC (IACC=1 to 4) Compartments 1-5 environment 6	none
NAME(ISOT)	All	Isotope names	none
NAMT(IT)	LOCA, FUHA, CRDA, ILBA	Time period names. Built-in values — see Note 1.	none
NBOOK	All	Option for date book. Built-in value 0.	none
NCOMP	LOCA, FUHA, CRDA, ILBA	Number of compartments. Built-in value 0. Maximum value is 5.	none
NT	LRTA	Number of Tank	none
NTANK	LRTA	Name of Tank	none
NTCHAN = 1	LOCA, FUHA, CRDA, ILBA	Number of time intervals	
NTI	All	Option for no integrated dose with time. Built-in value 0.	none
NSYS(IS,IA)	OGSA	Offgas system number IS (1=N-64, 2=N-66) and age group IA (1=ADULT, 2=TEEN, 3=CHILD, 4=INFANT)	none
NTIME	LOCA, FUHA, CRDA, ILBA	Number of time periods. Built-in value 10.	none
OGR	SLBA	Offgas rate at the steam line break. Built-in value 0.45.	Ci/sec

Table A-3
CONAC03 INPUT VARIABLES (Continued)

Variable	Accident	Definition	Units
P	All	Licensing basis power. Built-in value 0.	MWt
PERSIS (ITIM)	OGSA	Wind persistency. Built-in value 1.	none
not in namelist starts at PERSIS (12) → PNG(ISOT)	SLBA	Percent of SLBA offgas rate from noble gas isotope ISOT.	%
PO	FLBA	Iodine plateout fraction (0.5)	
POWER(POW)	All	Standard BWR/6 licensing power levels. Built-in values — see Note 2.	MWt
RECIRC (IC,IT)	LOCA, FUHA, CRDA, ILBA	Recirculation rate in compartment IC and at time IT expressed in terms of the volume of the compartment. Built-in value 0.	% per day
RELIQ(IPOW)	SLBA	Liquid released in the SLBA for power IPOW. Built-in values — see Note 2.	lb
RESTM(IPOW)	SLBA	Steam released in the SLBA for power IPOW. Built-in values — see Note 2.	lb
RLEAK(IC,IT)	LOCA, FUHA	Leak rate from compartment IC and at time IT to the next compartment. Built-in value 0.	% per day
RPB	FUHA, CRDA	Number of rods per bundle. Built-in value 62.	none
RPCI(ISOT)	All	Iodine dose factors	Rem/Ci inhaled
RPF	FUHA	Ratio of damaged rod power to average rod power. Built-in value 1.5.	none
RPURGE(IC,IT)	LOCA, FUHA, CRDA, ILBA	Purge rate from compartment IC and time IT to the environment. Built-in value 0.	% per day
SA(ISOT,IACC)	LOCA, FUHA, CRDA	Specific core fission product activity after 3 years of continuous irradiation for isotope ISOT and accident IACC.	Ci/MWt
SCF	SLBA	Steam carryover fraction for iodine. Built-in value 0.02.	$\frac{\text{Ci/gm stm}}{\text{Ci/gm liq}}$
SFL	FAEL	Steam flow rate	lb/hr
SMASS	FLBA	~~To~~ Total test mass release	lb
SPEC	OGSA	Γ– and β–spectrum built in	none
SPV	SLBA	Specific volume of steam in the SLBA. Built-in value 0.4222.	ft^3/lb

Table A-3
CONAC03 INPUT VARIABLES (Continued)

Variable	Accident	Definition	Units
SVI(IPOW)	SLBA	Initial steam (dome) volume in the SLBA for power IPOW. Built-in values — see Note 2.	ft^3
TCHAN(IT)	LOCA, FUHA, CRDA, ILBA	Time of beginning interval IT, the first interval must be zero.	sec
TFAEL	FAEL	Isolation time. Built-in value 10.	min
TIMES(IT)	LOCA, FUHA, CRDA, ILBA	Time period values. Built-in values — see Note 1.	sec
TITLE(IW)	All	Case title (IW=1 to 12). Built-in "blank."	none
TOGSA	OGSA	Duration of release. Built-in value 30.	min
VTIM	SLBA	Valve closure time in SLBA. Built-in value 5.5	sec
WREL (IPOW)	ILBA	Water inventory	lb
WSPD (ITIM)	OGSA	Wind speed. Built-in value 1.	m/sec

NOTES

1. **TIME DEPENDENT DATA**

ITIM	NAMT	Time (sec)	BRATE (m^3/sec)
1	1 minute	6.00 + 1	3.47 − 4
2	10 minutes	6.00 + 2	3.47 − 4
3	~~30 minutes~~ 1hr	1.80 + 3	3.47 − 4
4	~~1 hour~~ 2hr	3.60 + 3	3.47 − 4
5	~~2 hours~~ 4hr	7.20 + 3	3.47 − 4
6	~~4 hours~~ 8hr	1.44 + 4	3.47 − 4
7	~~8 hours~~ 12hr	2.88 + 4	~~3.47 − 4~~ 1.75E-4
8	1 day	8.64 + 4	1.75 − 4
9	4 days	3.46 + 5	2.32 − 4
10	30 days	2.59 + 6	2.32 − 4

2. **SIZE-DEPENDENT DATA**

IPOW	Power (MWt)	BUND	SVI (ft^3)	RELIQ (lb)	RESTM (lb)
1	2000	484	4.23 + 3	5.30 + 4	1.50 + 4
2	2952	624	5.22 + 3	7.65 + 4	1.94 + 4
3	3651	748	6.30 + 3	9.30 + 4	2.30 + 4
4	3876	784	7.57 + 3	1.076 + 5	2.66 + 4
5	4146	848	7.60 + 3	1.076 + 5	2.66 + 4

```
$       IDENT
$       USERID  FS' 000$PASSWORD
$       SELECT  CO AC01
)CRDA
  TITLE(1)  42.00.../4 CHAPTER 15 ACCIDENT ANALYSIS
►POWER     1364     $105% OF RATED THERMAL POWER, MWT
►BUND       408     $NUMBER OF BUNDLES
  IACT        1     $CONTROL ROD DROP ACCIDENT
  P        1364     $THERMAL POWER, MWT
  NCOMP       1     $NUMBER OF COMPARTMENTS  (CONDENSER)
  RPURGE    0.5     $PURGE RATE TO THE ENVIRONMENT, %/DAY
  FPURGE     99     $PURGE FILTER EFFICIENCY, %
  DIST  800  5000   $EXCLUSION AREA & LOW POPULATION ZONE, METERS
  $CHI/Q VALUES FOR THE EA AND LPZ
  CHIQ(1,1)  5.0-4 *6  2.1-4 *2  7.5-5  1.8-5 $ 800 METERS
  CHIQ(1,2)  6.0-5 *6  1.2-5 *2  4.0-6  6.6-7 $ 5000 METERS
  $$
)LOCA
  IACT        2     $LOSS OF COOLANT ACCIDENT
  $$
)FUHA
  IACT        3     $FUEL HANDLING ACCIDENT
►FDR        125     $NUMBER OF DAMAGED RODS
  RPURGE   3600     $PURGE RATE TO THE ENVIRONMENT, %/DAY
  $$
)SLBA
  IACT        4     $STEAM LINE BREAK ACCIDENT
►SV1       2723     $INITIAL STEAM VOLUME, CU. FT.
►CONC  6.8-2 3.0-1 4.0-1 5.4-1 5.2-1 $ HALOGEN CONCENTRATION, UCI/GM
►RELIQ    54000     $LIQUID RELEASED FROM THE BREAK, LBS
►RESTM    15000     $STEAM RELEASED FROM THE BREAK, LBS
  $$.
)LAST
$       ENDJOB
```

Figure A-3. CONAC03 Sample Input

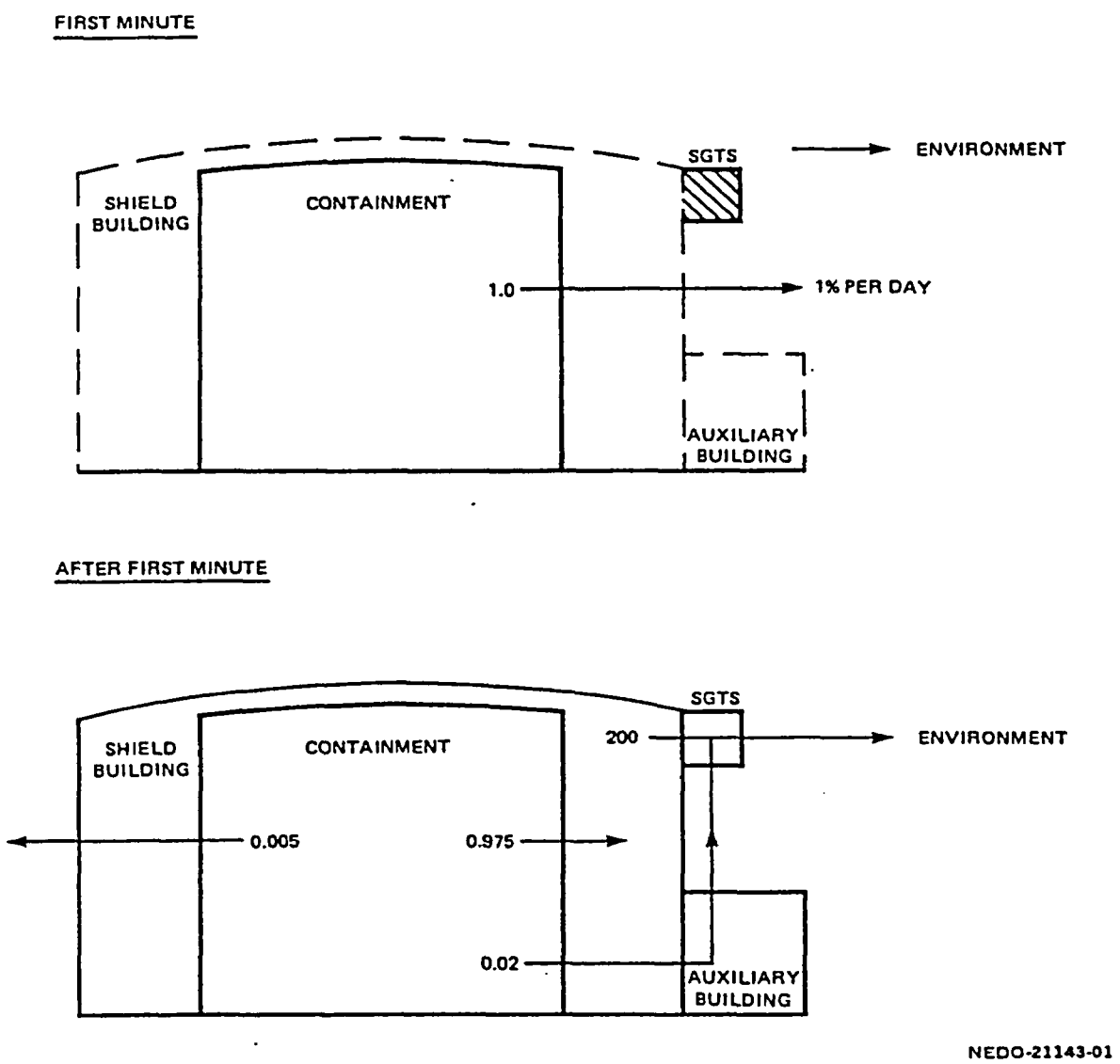

Figure A-4. Nonstandard-LOCA Schematic Diagram

Figure A-5 shows the input which will evaluate this LOCA. The first case computes the effect of the first 60 seconds when there is effectively no filtration of the release to the environment. Only one compartment (NCOMP) is necessary because the leakage is directly from the containment to the environment. Both the shield building-SGTS and the penetration-bypass paths are evaluated in the second case except that there is no holdup assumed for the penetration purge. The third case calculates the effect of leakage to the auxiliary building and then to the environment via the SGTS with no delay assumed. Note that the variable ILAST is set to 1 in the third case. This sums the activity in each compartment, the activity released, and the doses for all three cases. Thus the output can be directly inserted into the Safety Analysis Report without retyping.

Table A-3 defines all the variables which can be input to CONAC01. The built-in values are also summarized here. The user should be able to evaluate any sort of accident according to NRC methods by the use of this input list together with the equations in the body of this report.

The release model in CONAC01 is designed to handle only a single series of compartments. For situations with multiple parallel pathways, conservative results for compartment activities and off-site releases can be obtained by summing the results of a sequence of separate cases. Each case in the sequence will represent a single pathway. Figure A-5 shows the input which will evaluate this LOCA. The first case computes the effect of the first 60 seconds when there is effectively no filtration of the release to the environment. Only one compartment (NCOMP) is necessary because the leakage is directly from the containment to the environment. Both the shield building-SGTS and the penetration-bypass paths are evaluated in the second case except that there is no holdup assumed for the penetration purge. The third case calculates the effect of leakage to the auxiliary building and then to the environment via the SGTS with no delay assumed. Note that the variable ILAST is set to 1 in the third case. This sums the activity in each compartment, the activity released, and the doses for all three cases. Thus the output can be directly inserted into the Safety Analysis Report without retyping.

A.3 REFERENCES

A-1. S. M. Grove, *Atmospheric Dispersion — CHIQU02 Function*, February 1977 (NEDO-20809B).

```
$       IDENT
$       USERID  FS.000$PASSWORD
$       SELECT  COL.ACU1
)LCA1
  TITLE(1)  42HBWR/6 LOCA 60 SEC DRAWDOWN WITH BYPASS
  IACT        2      $LOSS OF COOLANT ACCIDENT
  P        .3758     $105% OF RATED THERMAL POWER, MWT
  NCOMP       1      $NUMBER OF COMPARTMENTS
  RPURGE    1.0      $PURGE RATE TO THE ENVIRONMENT, %/DAY
  FPURGE      0      $NO PURGE FILTER EFFICIENCY
  NTIME       1      $EVALUATE FOR FIRST TIME PERIOD ONLY (60 SECONDS)
  DIST  850  3219    $EXCLUSION AREA & LOW POPULATION ZONE, METERS
  CHIQ(1,1)  3.94-4$EXCLUSION AREA (850 METERS)
  CHIQ(1,2)  8.50-5$LOW POPULATION ZONE (3219 METERS)
  $$
)LCA2
  TITLE(2)  42HNO HOLDUP FOR PENETRATION PURGE
  NCOMP       2      $NUMBER OF COMPARTMENTS
  RPURGE  0.005 200$PURGE RATE TO THE ENVIRONMENT, %/DAY
  RLEAK    .975   0 $PURGE FILTER EFFICIENCY, %
  $CHI/Q VALUES PER REG. GUIDE 1.3 (EXCEPT FOR FIRST 60 SECONDS)
  CHIQ(1,1)  1.0-12  3.94-4 *5  1.92-4 *2  6.89-5  1.53-5 $EXCLUSION AREA
  CHIQ(1,2)  1.0-12  8.50-5 *5  2.22-5 *2  7.87-6  1.70-6 $LOW POPULATION ZONE
  $$
(LCA3
  TITLE(3)  42HAUX. BLDG. TO SGTS TO ENVIRONS - NO DELAY
  NCOMP       1      $NUMBER OF COMPARTMENTS
  RPURGE   0.02      $PURGE RATE TO THE ENVIRONMENT, %/DAY
  RLEAK       0      $NO LEAKAGE TO THE NEXT COMPARTMENT
  FPURGE     99      $PURGE FILTER EFFICIENCY, %
  ILAST       1      $SUM OF TABLES
  $$
)LAST
$       ENDJOB
```

Figure A-5. CONOC03 Input for the Nonstandard LOCA

APPENDIX B
METEOROLOGY

This appendix describes the methods used to compute the atmospheric dispersion factor, χ/Q, for design basis accidents according to assumptions acceptable to the Nuclear Regulatory Commission. Both standard meteorology as defined in Regulatory Guide 1.3 and site-specific meteorology are discussed. The goal of the dispersion calculations is to arrive at a value for χ/Q appropriate to a given time and distance. When the atmospheric dispersion factor, χ/Q, is multiplied by the released activity, Q, the result is the time-integrated air concentration, χ, which is then used to evaluate doses.

B.1 DISPERSION CHRONOLOGY

The basic philosophy underlying atmospheric dispersion calculations is to assume that the postulated accident starts during the most unfavorable weather conditions and then slowly the meteorology improves.

Table B-1 defines the meterological assumptions made over the 30-day duration of the accident. For the first 8 hours a centerline diffusion equation is used. This implies that the postulated receptor stands in the center of the cloud of airborne activity released; that is, the point of maximum air concentration. The basic equation for atmospheric dispersion at the centerline from an elevated release is[B-1]

$$\chi/Q = (\pi u \sigma_y \sigma_z)^{-1} \exp(-h^2/2\sigma_z^2) \qquad \text{(B-1)}$$

where

χ/Q = the atmospheric dispersion factor, sec/m³;
u = the wind speed, m/sec;
σ_y = the horizontal standard deviation of the plume, m;
σ_z = the vertical standard deviation of the plume, m; and
h = the effective height of release, m.

For ground-level releases, credit should be taken for the effect of further dispersion in the building wake by increasing σ_y and σ_z so long as the overall reduction in χ/Q is not more than a factor of 3. For elevated releases a fumigation condition is assumed to persist for at least 30 minutes following the accident and, for sites less than 2 miles from large bodies of water (e.g., oceans, large lakes), the fumigation is assumed to exist for 4 hours. Fumigation implies the complete vertical mixing of the plume, and the equation for χ/Q is [B-1]

$$\chi/Q = [(2\pi)^{1/2} u h \sigma_y]^{-1}.^{*} \qquad \text{(B-2)}$$

* Note: for fumigation condition as described by Equation B-2, the only valid values for σ_z are those for type F or type G stability.

Table B-1
METEOROLOGICAL TIMETABLE

Time After Accident	Seaside Site (h>0)[a]	Inland Site (h>0)[a]	Any Site (h=0)[b]
30 minutes	Fumigation	Fumigation	Centerline and Wake
1/2-4 hours	Fumigation	Centerline with No Wake	Centerline and Wake
4-8 hours	Centerline with No Wake		Centerline and Wake
8-24 hours	Sector Average		
1-4 days	Sector Average		
4-30 days	Sector Average		

[a] h>0 — release height is ~ 2-1/2 times greater than the height of the nearest structure.
[b] h=0 — release height is less than 2-1/2 times the height of the nearest structure; a ground-level release is assumed.

After 8 hours the released activity is assumed to meander uniformly across a 22.5-degree sector. For the period from 8 hours to 30 days a sector average calculation of χ/Q is used[B-1]

$$\chi/Q = \left(\frac{8}{\pi}\sqrt{\frac{2}{\pi}}\right)(ux\sigma_z)^{-1} \exp\left(-h^2/2\sigma_z^2\right) \qquad \text{(B-3)}$$

where

x = downwind distance, m.

Figure B-1 shows the variation of χ/Q with time based on the meteorology of Regulatory Guide 1.3 with a 2,250 m² building cross section. These χ/Q values were used throughout the text to illustrate the radiological consequences of the design basis accidents. Note that fumigation and centerline χ/Q value are similar and that both are greater than the sector average values. The sector average values decrease over the 30-day period because the standard wind speed is assumed to increase and the atmosphere approaches a more normal stability distribution; that is, σ_z increases.

The formulas given for χ/Q in this appendix neglect the in-flight decay of isotopes and the deposition of iodine on the ground, i.e., fallout. Both decay and deposition will reduce the value of χ/Q; thus the approximation is conservative. For example, deposition of iodine will reduce the ground-level concentration at the exclusion area by a factor of about 7 and at the low population zone by a factor of almost 25.[B-1] In-flight decay depends on the particular isotope's half-life and the wind speed. The decay, for example, of Xe-137 at the exclusion area would reduce χ/Q by a factor of 12 and at the low population zone by a factor of almost 14,000. However, for most isotopes of radiological significance, decay for distances of concern is relatively minor.

B.2 STANDARD METEOROLOGY

The atmospheric dispersion factors (χ/Q) which conform to the Regulatory Guide 1.3 meteorology are generated by the subroutine CHIQU02[B-1] according to Equations B-1, B-2, and B-3 presented in Appendix B. The models for a ground-level and an elevated release are based on the Pasquill diffusion categories, wind speeds, and wind directions presented in Tables B-2 and B-3 per Regulatory Guide 1.3.[B-2]

The standard meteorological model is used when adequate site data is not available. The site meteorological data, in some cases, may prove to be a more restrictive model because of the inclusion of topographical, geographical, and meteorological particulars of the specific site. The consideration of these particulars will ensure conservatism in the calculation of χ/Q and the estimate of potential off-site exposures.

Table B-2
ATMOSPHERIC DIFFUSION PARAMETERS FOR A GROUND-LEVEL RELEASE[a]

Time Following Accident	Stability (%)	Stability (Type)	Wind Speed (m/sec)	Direction
0-8 hours	100	Pasquill F	1	Closest site boundary centerline
8-24 hours	100	Pasquill F	1	Variable in 22.5° sector
1-4 days	40	Pasquill D	3	Variable in 22.5° sector
	60	Pasquill F	2	
4-30 days	33.3	Pasquill C	3	33.3% frequency in 22.5° sector
	33.3	Pasquill D	3	
	33.3	Pasquill F	2	

[a] Refer to Table B-1 for the meteorological equation assumption (fumigation, centerline, or sector average) used in conjunction with the above table.

Table B-3
ATMOSPHERIC DIFFUSION PARAMETERS FOR AN ELEVATED RELEASE

Time Following Accident[a]	Stability (%)	Stability (Type)	Wind Speed (m/sec)	Direction
0-8 hours	100	Pasquill Worst[b]	1	Closest site boundary centerline
8-24 hours	100	Pasquill Worst[b]	1	Variable in 22.5° sector
1-4 days		Pasquill Worst[c]	2 for Types A, B, E and F 3 for Types C and D	Variable in 22.5° sector
4-30 days		Pasquill Worst[c]	2 for Types A, B, E and F	33.3% frequency in 22.5° sector

[a] Refer to Table B-1 for the meteorological equation assumption (fumigation, centerline, or sector average) used in conjunction with the above table.
[b] "Worst" refers to the diffusion category that produces the highest χ/Q for a given release height and distance.
[c] Refers to the diffusion category based on the following relationships that produces the maximum χ/Q as a function of distance.

Case 1 40% Pasquill A, 50% Pasquill C
Case 2 50% Pasquill C, 50% Pasquill D
Case 3 33.3% Pasquill C, 33.3% Pasquill D, 33.3% Pasquill E
Case 4 33.3% Pasquill D, 33.3% Pasquill E, 33.3% Pasquill F
Case 5 50% Pasquill D, 50% Pasquill F

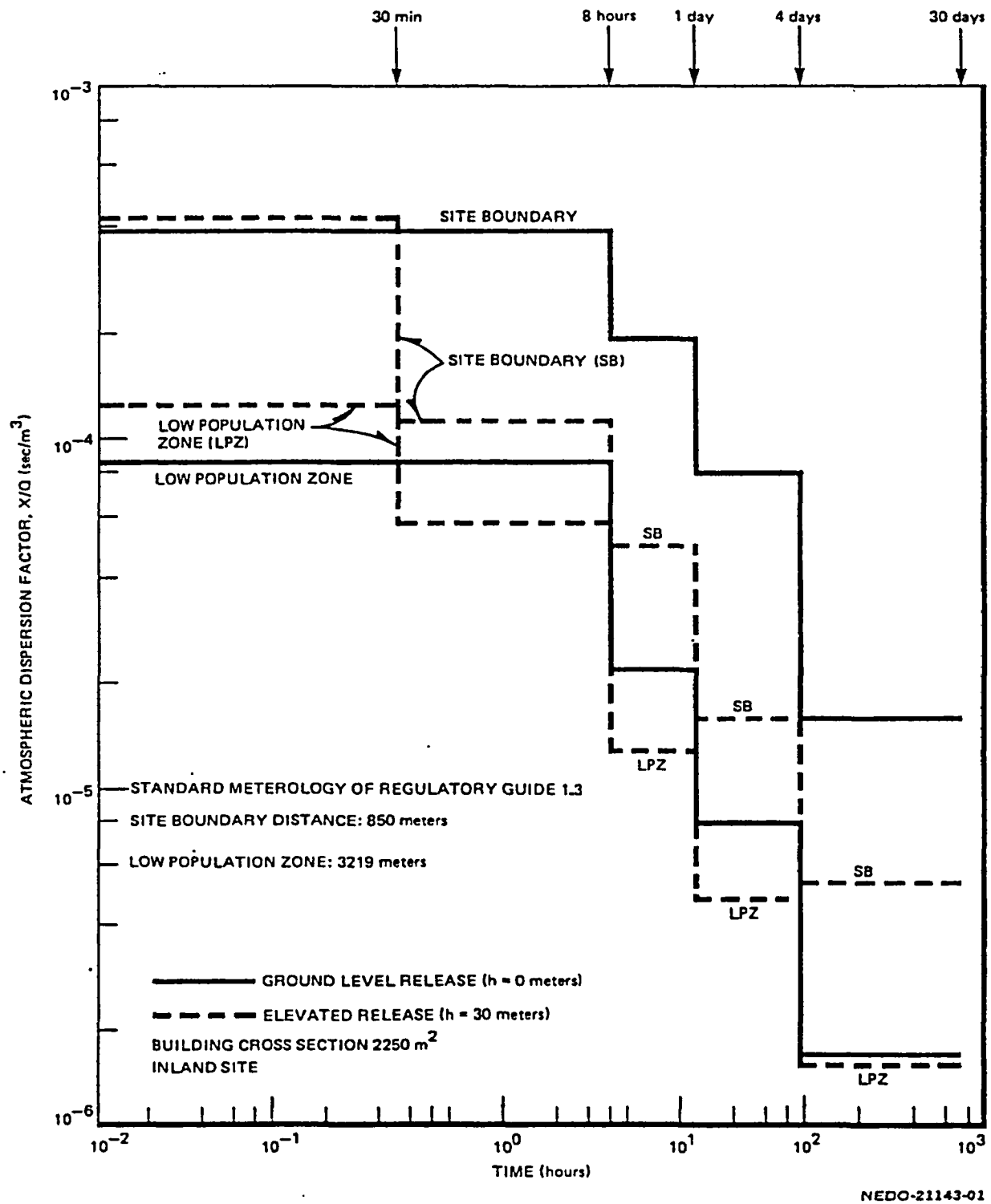

Figure B-1. Atmospheric Dispersion Factor, χ/Q, versus Time

B.3 PROBABLE 5th PERCENTILE χ/Q

The probable 5th percentile χ/Qs when available from the customer, are directly input into CONAC03. These values reflect actual site meteorological conditions for a period of a least 1 year.

Since these values are provided by the customer, there is no assurance of precisely the same calculational method from one customer to another. In general, it is believed that each follows the method employed by the Nuclear Regulatory Commission. Unfortunately, the NRC's method is not documented and thereby invites variations in interpretation.

The method of calculating the 5th percentile χ/Qs used by the NRC, as interpreted by these authors, is based on hourly meteorology data. An atmospheric dispersion factor, χ/Q, is calculated based on the minimum exclusion area, wind speed and stability for each hour of the year (8760 data points). The results are ranked from the highest value to the lowest value, for example 10^{-2} to 10^{-6}, and the χ/Q which corresponds to the 5th percentile is designated *the 5th percentile χ/Q for a 0- to 1-hour period.*

Hourly χ/Q values become somewhat cumbersome to handle when evaluating exposures for a 30-day period. Time envelopes for 0 to 2, 2 to 8, 8 to 24 hours, 1 to 4 and 4 to 30 days are evaluated and a probable 5th percentile atmospheric dispersion factor determined for each. For example, in determining an χ/Q for the 2- to 8-hour interval, the first six hourly values (hours 1 to 6) are summed and averaged to obtain one χ/Q. Another six hourly values (hours 2 to 7) are summed and averaged for a second χ/Q. The numerical progression continues through the hourly data and results in 8760 6-hour values which are then ranked. The 5th percentile χ/Q becomes the representative for a 2- to 8-hour χ/Q. The representative χ/Q for the other time envelopes are determined in the same manner.

χ/Q evaluations for ground-level releases taking into account the effects of building wake mixing and plume meander are also available as required by Regulatory Guide 1.145.[B-3]

B.4 REFERENCES

B-1. S. M. Grove, *Atmospheric Dispersion — CHIQU02 Function, February 1979* (NEDO-20904B).

B-2. U.S. NRC, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors*, Regulatory Guide 1.3, Rev. 2, June 1974.

B-3: U.S. NRC, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*, Regulatory Guide 1.145, August 1979.

APPENDIX C
DOSE CONVERSION FACTORS

The dose conversion factor is an expression of the ratio of dose rate to activity exposure. There are methods of dose calculations for internal and external exposures which require distinct dose conversion factors. This appendix describes the applicable dose conversion factors, (DCFs,) for the inhalation dose, external beta dose, and external gamma dose.

C.1 INHALATION DOSE CONVERSION FACTORS

The radioiodine isotopes released to the atmosphere from a design basis accident may be inhaled by persons in the vicinity and result in a dose to the thyroid. Dose conversion factors have been established for converting the air concentrations of these radioiodines into a dose rate.

The equations used for calculating the internal dose factors were based on those generated by the International Commission on Radiological protection.[C-1] They are reported in Regulatory Guide 1.109 with the units of mRem/yr per pCi/m^3 (air).[C-2] The values presented in Table C-1 are the ratio of dose to inhaled activity. These, when multiplied by a breathing rate, constitute the radioiodine dose conversion factors for an inhalation dose.

$$DCF_i = BRATE \times RCPI_i \qquad \text{(C-1)}$$

where

DCF_i = the inhalation dose conversion factor, Rem/(Ci-sec/m^3);
BRATE = breathing rate, m^3/sec; and
$RPCI_i$ = ratio of dose to inhaled activity, Rem/Ci-inhaled.

Table C-1
RATIO OF DOSE TO INHALED ACTIVITY[a]

Isotope	Activity (Rem/Ci-Inhaled)
I-131	1.49 + 6
I-132	5.67 + 4
I-133	3.70 + 5
I-134	2.86 + 4
I-135	1.35 + 5

[a] Organic and inorganic forms of radioiodine are assumed to give the same dose from inhalation.

Consider the inhalation dose conversion factor for I-131. The accident breathing rate for the first 8 hours of an accident is specified in regulatory Guide 1.3 as 10 m^3 or 3.47×10^{-4} m^3/sec and the RPCI is 1.49×10^6 Rem/Ci-inhaled for I-131. Therefore

$$DCF_{I\text{-}131} = (3.47 \times 10^{-4}) \times (1.49 \times 10^6) = 517 \text{ Rem/(Ci-sec/m}^3\text{)}.$$

Since the breathing rate varies during the duration of the accident, the dose conversion factor will also vary accordingly. As stated previously, the breathing rate for 0 to 8 hours is 3.47×10^{-4} m³/sec. From 8 to 24 hours it is 1.75×10^{-4} m³/sec and after that until the end of the accident (30 days) 2.32×10^{-4} m³/sec. The corresponding dose conversion factors for I-131 are:

$$DCF_{I\text{-}131}\ (8 \text{ to } 24 \text{ hours}) = (1.75 \times 10^{-4})\ (1.49 \times 10^{6}) = 261 \text{ Rem/(Ci-sec/m}^3)$$

$$DCF_{I\text{-}131}\ (1 \text{ to } 30 \text{ days}) = (2.32 \times 10^{-4})\ (1.49 \times 10^{6}) = 346 \text{ Rem/(Ci-sec/m}^3).$$

C.2 EXTERNAL BETA DOSE CONVERSION FACTORS

The external beta dose and its associated dose conversion factor are based on an infinite cloud of radioactivity that decays through beta emission. This source of radiation and the subsequent beta dose depend on the concentration of radioactivity contained therein, the energies of the beta emitters, and the wind speeds that carry these emissions.

The cloud itself is assumed to be spherical and the radius at least equal to the distance that the beta particles travel. In this way the receptor at the center would not be exposed to additional beta emitters outside of the cloud's dimension. Therefore the cloud is described as being infinite.[C-3,C-4]

For an infinite uniform cloud containing N curies of beta radiation per cubic meter, the beta dose conversion factor for air is[C-4]

$$DCF_{\beta} = \frac{(1.6 \times 10^{-6})\ (3.7 \times 10^{10})}{(1293)\ (100)}\ \bar{E}_{\beta} \qquad \text{(C-2)}$$

where

1.6×10^{-6} = number of ergs per MeV;
3.7×10^{10} = disintegration rate per Ci, dis/sec-Ci;
1293 = density of air at STP, g/m³;
100 = energy absorbed per gram of absorbing material per Rad, erg/g-Rad; and
$\bar{E}_{\beta}$ = average beta energy per disintegration, MeV/dis.

$$DCF_{\beta} = 0.457\ \bar{E}_{\beta}$$

where

DCF_{β} = beta dose conversion factor, Rem/(Ci-sec/m³).

A receptor immersed in an infinite cloud causes disturbances in the beta radiation field. Due to the fact that the body is made up of materials with different absorbing characteristics and that beta particles have a limited range in tissue, the beta dose to the body is largely from half of the cloud. For this reason the surface body beta dose rate can be approximated at being about one-half that of the full cloud.[C-4]

Therefore, the beta dose conversion factor is:

$$DCF_{\beta} = 0.23\ \bar{E}_{\beta}. \qquad \text{(C-3)}$$

Table C-2 presents the average energy per disintegration[C-5] for the noble gas isotopes that contribute to the beta dose. Using Xe-133 as an example, the dose conversion factor calculation based on an average beta energy per disintegration of 0.135 is

$$\beta DCF_{Xe\text{-}133} = 0.23 \times 0.135 = 0.03105 \text{ Rem/(Ci-sec/m}^3). \qquad \text{(C-4)}$$

Table C-2
AVERAGE ENERGY PER DISINTEGRATION[C-5]

Isotope	$\bar{E}_\gamma$(MeV/dis)	$\bar{E}_\beta$ (MeV/dis)
Kr-83m	0.00258	0.0382
Kr-85m	0.15800	0.2549
Kr-85	0.00223	0.251
Kr-87	0.79300	1.33
Kr-88	1.98	0.35
Kr-89	1.87	1.31
Xe-131m	0.0201	0.142
Xe-133m	0.0415	0.19
Xe-133	0.0461	0.135
Xe-135m	0.431	0.0958
Xe-135	0.248	0.317
Xe-137	0.183	1.78
Xe-138	1.13	0.632

C.3 EXTERNAL GAMMA DOSE CONVERSION FACTOR

As with the beta radiation, if the dimensions of a cloud are large compared to the distance that the gamma rays travel, an equilibrium is established and the rate of energy absorption per unit volume is equal to the energy release per unit volume. The gamma dose rate to air is then proportional to $\bar{E}_\gamma$, the average gamma energy release per disintegration. The dose conversion factor is essentially the same as that for beta radiation, but in addition there is a correction factor of 1.11 for the ratio of electron densities of tissue to those of air. The resulting equation is[C-4]

$$DCF_\gamma = \frac{(1.6 \times 10^{-6})\,(3.7 \times 10^{10})\,(1.11)}{(1293)\,(100)} \times \bar{E}_\gamma \qquad \text{(C-5)}$$

$$DCF_\gamma = 0.507\,\bar{E}_\gamma$$

where

1.6×10^{-6} = number of ergs per MeV;
3.7×10^{10} = disintegration rate per Ci, dis/sec-Ci;
1293 = density of air at STP, g/m³;
100 = energy absorbed per gram of absorbing material per Rad, erg/g-Rad;
E_γ = average gamma energy per disintegration, MeV/dis; and
DCF_γ = gamma dose conversion factor, Rem/(Ci-sec/m³).

If the receptor is at ground level, a correction must be made for the fact that radiation is only received from half of the cloud because of the presence of the ground. Therefore equation C-5 becomes[C-4]

$$DCF_\gamma = 0.25\,E_\gamma. \qquad \text{(C-6)}$$

Table C-2 shows the average gamma energies per disintegration for the noble gas isotopes. Again using Xe-133 as an example, the average gamma energy is 0.0461 MeV/dis and the resulting dose conversion factor is

$$\gamma DCF_{Xe\text{-}133} = 0.25 \times 0.0461 = 0.01152 \text{ Rem/(Ci-sec/m}^3\text{)}. \qquad \text{(C-7)}$$

C.4 REFERENCES

C-1. K. Z. Morgan, W. S. Snyder, and J. A. Auxier, "Report of the ICRP Committee II on Permissible Dose for Internal Radiation (1959)," *Health Physics*, 3, 1960.

C-2. U.S. NRC, *Calculation of Annual Dose to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I*, October 1977.

C-3. U.S. NRC, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors*, Regulatory Guide 1.3, Rev. 2, June 1974.

C-4. D. H. Slade, Editor, *Meteorology and Atomic Energy 1968*, U.S. Atomic Energy Commission, Division of Technical Information, Oak Ridge, Tenn., July 1968.

C-5. ORNL/NUREG/TM-102, *Nuclear Decay Rate for Radionuclides Occurring in Positive Releases from Nuclear Fuel Cycle Facilities*, August 1977.

APPENDIX D
CONAC03 LIBRARY

This appendix describes the CONAC03 random data library and subroutine RDMRD(ISVS,M,IJ,K) which is used to access the library.

The data library is accessed by CONAC03 through file code 21 and is usually described by the following card:

```
$      PRMFL      21,R,R,FS####/LIBRARY
```

The library is set up in blocks of data. Each block of data is referred to by the CONAC system number (ISVS). The association between system numbers and data for CONAC03 is as follows:

Argument		Contents
1)	ISYS	
	1	N-64 System
	2	N-66 System
	3	RG 1.109 Adult DCF
	4	RG 1.109 Teenager DCF
	5	RG 1.109 Child DCF
	6	RG 1.109 Infant DCF
	7	Miscellaneous data
	8	RG 1.109 Adult ingestion factor
	9	RG 1.109 Teenager ingestion factor
	10	RG 1.109 Child ingestion factor
	11	RG 1.109 Infant ingestion factor

Each block of data has 87 records associated with it, one record for each isotope. Each record consists of eight binary words, seven words of data and the eighth word containing the date the record was last updated in fixed format. The random data file is initialized by the call

```
CALL    RANSIZ (21,8,1)
```

The read statement used in RDMRD is:

```
READ(21'(ISYS*87+M)) (XDATA(I),I=1,7)
```

When ISYS is as defined and M is the Mth isotope in the list of isotopes.

The case to function routine RDMRD is

```
X = RDMRD (ISYS,N,IJ,K)
```

where ISYS and M are as defined above. IJ is a BCD character variable (A6) which on return contains the isotope name corresponding to M and K specifies which of the seven values contained on the record is to be returned into X for the N-64 and N-66 systems K corresponds to the folowing

A — ISYS = 1 for N-64 offgas system, where:

K	Content
1	conservative SJAE release rate, μCi/sec
2	conservative delay line release, Ci
3	conservative charcoal release, Ci
5	realistic SJAE release rate, μCi/sec
6	realistic delay line release, Ci
7	realistic charcoal release, Ci

B — ISYS = 2 for N-66 offgas system, where:

1	conservative SJAE release rate, μCi/sec
2	conservative charcoal release, Ci
5	realistic SJAE release rate, μCi/sec
6	realistic charcoal release, Ci

The attached tables are sample values for a CONAC03 library. The isotope names given in these tables correspond to the order required by CONAC03 and should be stored in the first word of each record for ISYS=0.

CONAC SYSTEM # 1

BR-83	2.583E 00	1.366E-05	6.855E-07	1.366E-05	2.583E 00	5.763E-06	2.286E-07
BR-84	5.602E 00	1.399E-05	2.731E-07	1.399E-05	5.602E 00	1.164E-05	9.105E-08
BR-85	5.481E 00	1.007E-06	2.223E-09	1.007E-06	5.481E 00	5.108E-06	7.410E-10
I -131	1.878E 00	1.269E-05	4.155E-05	1.269E-05	1.878E 00	4.276E-06	1.407E-05
I -132	2.399E 01	1.235E-04	5.962E-06	1.235E-04	2.399E 01	5.345E-05	2.016E-06
I -133	1.378E 01	9.183E-05	3.315E-05	9.183E-05	1.378E 01	3.130E-05	1.107E-05
I -134	4.388E 01	1.553E-04	3.895E-06	1.553E-04	4.388E 01	9.461E-05	1.299E-06
I -135	2.207E 01	1.376E-04	1.661E-05	1.376E-04	2.207E 01	4.987E-05	5.539E-06
KR-83M	4.865E 03	6.373E 01	1.197E 02	6.373E 01	4.449E 03	1.937E 00	3.992E 01
KR-85M	7.245E 03	1.150E 02	4.461E 02	1.150E 02	6.625E 03	2.930E 00	1.488E 02
KR-85	1.837E 01	6.423E-02	1.606E 00	6.423E-02	1.680E 01	7.510E-03	2.778E 00
KR-87	2.500E 04	2.837E 02	4.060E 02	2.837E 02	2.287E 04	9.838E 00	1.354E 02
KR-88	2.439E 04	3.563E 02	9.240E 02	3.563E 02	2.231E 04	9.799E 00	3.081E 02
KR-89	2.549E 05	1.415E 02	1.778E 01	1.415E 02	2.356E 05	4.628E 01	5.919E 00
XE131M	3.945E 01	6.555E-01	1.328E 02	6.555E-01	3.481E 01	1.555E-02	4.698E 01
XE133M	3.888E 02	6.727E 00	2.802E 02	6.727E 00	3.430E 02	1.528E-01	9.419E 01
XE-133	9.475E 03	1.640E 02	2.000E 00	1.631E 04	8.360E 03	3.730E 00	5.530E 03
XE135M	4.477E 04	1.452E 02	9.528E 01	1.452E 02	3.965E 04	1.465E 01	3.180E 01
XE-135	2.818E 04	4.828E 02	3.618E 03	4.828E 02	2.486E 04	1.117E 01	1.208E 03
XE-137	3.081E 05	2.107E 02	3.838E 01	2.107E 02	2.755E 05	6.147E 01	1.279E 01
XE-138	1.504E 05	4.518E 02	2.863E 02	4.518E 02	1.332E 05	4.851E 01	9.545E 01
XE-139	6.511E 05	2.398E 01	1.192E-03	2.398E 01	6.076E 05	2.037E 01	3.974E-04
XE-140	5.862E 05	4.977E-01	0.	4.977E-01	5.723E 05	2.401E 00	4.274E-14
H -3	1.157E 00	7.646E-06	2.387E-04	7.646E-06	1.128E 00	8.521E-06	2.754E-04
C -14	2.434E-01	2.607E-05	9.437E-05	2.607E-05	1.037E-01	1.570E-05	6.235E-04
NA-24	2.294E-03	6.721E-17	2.159E-25	6.721E-17	2.294E-03	7.028E-17	2.162E-25
P -32	2.288E-05	6.805E-19	2.353E-27	6.805E-19	2.288E-05	7.030E-19	2.419E-27
CR-51	5.852E-04	1.650E-17	5.716E-26	1.650E-17	5.852E-04	1.799E-17	6.206E-26
MN-54	4.566E-05	7.978E-19	2.768E-27	7.978E-19	4.566E-05	1.404E-18	4.854E-27
MN-56	5.873E-02	1.406E-15	3.285E-24	1.406E-15	5.873E-02	1.771E-15	3.285E-24
FE-55	0.	0.	0.	0.	0.	0.	0.
FE-59	9.343E-05	2.505E-18	8.683E-27	2.505E-18	9.343E-05	2.872E-18	9.918E-27
CO-58	5.822E-03	1.454E-16	5.043E-25	1.454E-16	5.822E-03	1.789E-16	6.184E-25
CO-60	5.511E-04	6.374E-18	2.212E-26	6.374E-18	5.511E-04	1.694E-17	5.859E-26
NI-63	0.	0.	0.	0.	0.	0.	0.
NI-65	3.524E-04	8.388E-18	1.943E-26	8.388E-18	3.524E-04	1.062E-17	1.943E-26
CU-64	0.	0.	0.	0.	0.	0.	0.
ZN-65	2.263E-06	4.612E-20	1.600E-28	4.612E-20	2.263E-06	6.957E-20	2.406E-28
ZN-69	0.	0.	0.	0.	0.	0.	0.
RB-86	0.	0.	0.	0.	0.	0.	0.
RB-88	3.082E-01	1.421E 02	9.313E 02	1.421E 02	2.873E-01	1.006E 00	3.107E 02
RB-89	3.796E 00	6.797E 01	2.761E 01	6.797E 01	3.572E 00	5.450E 00	9.204E 00
SR-89	2.534E-03	2.962E-02	2.846E 01	2.962E-02	2.533E-03	1.560E-04	9.550E 00
SR-90	1.442E-04	4.321E-05	2.741E-05	4.321E-05	1.442E-04	7.076E-07	4.352E-05
SR-91	7.983E-02	8.074E-02	3.674E-11	8.074E-02	7.977E-02	1.272E-03	1.225E-11
SR-92	2.785E-01	1.077E-06	1.727E-16	1.077E-06	2.785E-01	2.176E-08	5.757E-17
Y -90	1.363E-06	3.487E-07	1.378E-05	3.487E-07	1.361E-06	3.830E-10	4.086E-05
Y -91M	1.861E-03	1.607E-02	4.463E-11	1.607E-02	1.855E-03	3.135E-05	1.490E-11
Y -91	2.070E-05	1.741E-05	9.449E-11	1.741E-05	2.067E-05	1.269E-08	3.197E-11
Y -92	9.591E-04	1.358E-07	3.493E-16	1.358E-07	9.591E-04	2.133E-10	1.165E-16
Y -93	6.444E-04	9.132E-11	1.320E-19	9.132E-11	6.444E-04	7.434E-13	4.401E-20
ZR-95	4.084E-05	3.291E-18	5.621E-24	3.291E-18	4.084E-05	1.279E-18	2.255E-24
ZR-97	3.208E-04	2.835E-17	4.952E-25	2.835E-17	3.208E-04	9.832E-18	1.651E-25
NB-95	4.039E-05	2.716E-18	1.009E-23	2.716E-18	4.039E-05	1.241E-18	4.899E-24
MO-99	3.149E-04	3.029E-17	2.029E-24	3.029E-17	3.149E-04	1.017E-17	6.808E-25
TC-99M	1.685E-01	1.371E-14	9.424E-23	1.371E-14	1.685E-01	5.138E-15	3.186E-23
TC-101	2.114E-01	3.429E-15	3.227E-24	3.429E-15	2.114E-01	5.371E-15	1.076E-24
RU-103	2.225E-05	1.960E-18	1.841E-24	1.960E-18	2.225E-05	7.194E-19	6.866E-25
RU-105	1.996E-04	6.278E-17	6.915E-25	6.278E-17	1.996E-04	1.465E-17	2.305E-25
RU-106	1.579E-06	8.066E-20	3.555E-25	8.066E-20	1.579E-06	4.893E-20	4.210E-25
AG110M	6.876E-05	3.829E-18	1.478E-23	3.829E-18	6.876E-05	2.113E-18	1.274E-23
TE125M	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.
TE-127	0.	0.	0.	0.	0.	0.	0.
TE129M	5.988E-06	4.709E-19	3.952E-25	0.	5.988E-06	1.841E-19	1.534E-25

CONAC SYSTEM # 1

TE-129	7.822E-04	4.215E-17	5.562E-25	4.215E-17	7.822E-04	2.316E-17	2.294E-25
TE131M	2.522E-05	2.427E-18	9.001E-26	2.427E-18	2.522E-05	7.868E-19	3.006E-26
TE-131	5.295E-03	1.933E-16	4.385E-25	1.933E-16	5.295E-03	1.561E-16	1.463E-25
TE-132	2.010E-04	1.816E-17	1.437E-24	1.816E-17	2.010E-04	6.176E-18	4.834E-25
CS-134	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.
CS-137	1.497E-04	4.875E-04	1.295E 00	4.875E-04	1.493E-04	8.199E-06	2.059E 00
CS-138	1.062E 00	1.718E 02	3.170E 02	1.718E 02	9.669E-01	2.921E 00	1.057E 02
BA-139	1.083E-01	6.288E 00	1.168E-02	6.288E 00	1.076E-01	9.004E-02	3.895E-03
BA-140	8.682E-03	8.394E-03	2.260E-10	8.394E-03	8.676E-03	1.304E-04	7.532E-11
BA-141	4.697E-01	6.558E-07	2.664E-17	6.558E-07	4.697E-01	3.763E-08	8.946E-18
BA-142	7.785E-01	4.933E-10	2.551E-20	4.933E-10	7.785E-01	7.359E-11	8.505E-21
LA-140	6.371E-05	1.079E-04	3.267E-10	1.079E-04	6.330E-05	1.123E-07	1.142E-10
LA-142	3.687E-03	1.290E-10	8.661E-20	1.290E-10	3.687E-03	1.644E-12	2.221E-20
CE-141	4.086E-05	5.358E-11	9.633E-17	5.358E-11	4.086E-05	1.485E-14	3.214E-17
CE-143	1.830E-04	2.405E-17	1.398E-24	2.405E-17	1.830E-04	6.450E-18	4.661E-25
CE-144	2.418E-05	1.316E-17	6.616E-24	1.316E-17	2.418E-05	8.534E-19	5.781E-24
PR-143	5.178E-05	4.595E-18	3.902E-24	4.595E-18	5.178E-05	1.592E-18	1.327E-24
PR-144	0.	0.	0.	0.	0.	0.	0.
ND-147	2.155E-05	1.922E-18	5.117E-25	1.922E-18	2.155E-05	6.624E-19	1.754E-25
W -187	3.523E-03	3.148E-16	7.751E-24	3.148E-16	3.523E-03	1.081E-16	2.585E-24
NP-239	2.440E-01	2.210E-14	1.268E-21	2.210E-14	2.440E-01	7.494E-15	4.239E-22

CONAC SYSTEM # 2

BR-83	2.592E 00	1.407E-07	0.	0.	2.591E 00	9.898E-07	0.
BR-84	5.609E 00	2.686E-08	0.	0.	5.609E 00	4.387E-07	0.
BR-85	5.475E 00	6.986E-14	0.	0.	5.475E 00	1.456E-08	0.
I -131	1.864E 00	1.172E-05	0.	0.	1.864E 00	5.847E-05	0.
I -132	2.374E 01	1.241E-06	0.	0.	2.373E 01	8.622E-06	0.
I -133	1.385E 01	8.804E-06	0.	0.	1.385E 01	4.673E-05	0.
I -134	4.396E 01	5.479E-07	0.	0.	4.396E 01	5.938E-06	0.
I -135	2.217E 01	4.034E-06	0.	0.	2.217E 01	2.355E-05	0.
KR-83M	4.331E 03	6.297E 01	0.	0.	4.086E 03	3.721E 01	0.
KR-85M	6.942E 03	3.428E 02	0.	0.	6.545E 03	1.439E 02	0.
KR-85	3.371E 00	8.045E 00	0.	0.	3.174E 00	2.655E-01	0.
KR-87	2.388E 04	1.751E 02	0.	0.	2.254E 04	1.363E 02	0.
KR-88	2.336E 04	6.169E 02	0.	0.	2.203E 04	3.065E 02	0.
KR-89	2.419E 05	2.603E-07	0.	0.	2.341E 05	9.272E 00	0.
XE131M	3.553E 01	1.398E 02	0.	0.	3.265E 01	3.387E 01	0.
XE133M	3.674E 02	2.291E 02	0.	0.	3.377E 02	9.144E 01	0.
XE-133	8.912E 03	1.502E 04	0.	0.	8.191E 03	5.065E 03	0.
XE135M	3.581E 04	1.339E-04	0.	0.	3.329E 04	9.614E-01	0.
XE-135	2.627E 04	1.153E 03	0.	0.	2.416E 04	1.067E 03	0.
XE-137	2.869E 05	0.	0.	0.	2.728E 05	2.217E-05	0.
XE-138	1.408E 05	1.253E-16	0.	0.	1.310E 05	2.608E 00	0.
XE-139	6.076E 05	0.	0.	0.	6.046E 05	0.	0.
XE-140	5.713E 05	0.	0.	0.	5.713E 05	0.	0.
H -3	2.832E-01	1.019E-05	0.	0.	2.809E-01	4.453E-05	0.
C -14	1.963E-02	6.094E-04	0.	0.	8.781E-03	6.919E-05	0.
NA-24	2.322E-03	0.	0.	0.	2.322E-03	0.	0.
P -32	2.258E-05	0.	0.	0.	2.258E-05	0.	0.
CR-51	5.395E-04	0.	0.	0.	5.395E-04	0.	0.
MN-54	2.611E-05	0.	0.	0.	2.611E-05	0.	0.
MN-56	5.874E-02	0.	0.	0.	2.874E-02	0.	0.
FE-55	0.	0.	0.	0.	0.	0.	0.
FE-59	8.189E-05	0.	0.	0.	8.189E-05	0.	0.
CO-58	4.549E-03	0.	0.	0.	4.754E-03	0.	0.
CO-60	2.089E-04	0.	0.	0.	2.089E-04	0.	0.
NI-63	0.	0.	0.	0.	0.	0.	0.
NI-65	3.524E-04	0.	0.	0.	3.524E-04	0.	0.
CU-64	0.	0.	0.	0.	0.	0.	0.
ZN-65	1.527E-06	0.	0.	0.	1.527E-06	0.	0.
ZN-69	0.	0.	0.	0.	0.	0.	0.
RB-86	0.	0.	0.	0.	0.	0.	0.
RB-88	2.970E-01	6.437E 02	0.	0.	2.837E-01	3.082E 02	0.
RB-89	3.641E 00	2.537E-02	0.	0.	3.551E 00	1.283E 01	0.
SR-89	2.298E-03	2.182E-01	0.	0.	2.296E-03	1.303E 01	0.
SR-90	2.797E-05	2.031E-04	0.	0.	2.796E-05	1.587E-03	0.
SR-91	8.046E-02	5.797E-06	0.	0.	8.045E-02	5.419E-03	0.
SR-92	2.796E-01	3.772E-13	0.	0.	2.796E-01	7.431E-07	0.
Y -90	3.368E-07	2.032E-04	0.	0.	2.545E-07	1.280E-03	0.
Y -91M	1.564E-03	6.557E-06	0.	0.	1.472E-03	6.189E-03	0.
Y -91	1.533E-05	1.540E-05	0.	0.	1.423E-05	1.281E-02	0.
Y -92	9.579E-04	8.307E-13	0.	0.	9.579E-04	1.489E-06	0.
Y -93	6.446E-04	7.645E-15	0.	0.	6.446E-04	7.469E-09	0.
ZR-95	3.385E-05	0.	0.	0.	3.385E-05	6.165E-19	0.
ZR-97	3.207E-04	0.	0.	0.	3.207E-04	0.	0.
NB-95	2.961E-05	0.	0.	0.	2.961E-05	7.209E-19	0.
MO-99	3.128E-04	0.	0.	0.	3.128E-04	0.	0.
TC-99M	1.680E-01	0.	0.	0.	1.680E-01	0.	0.
TC-101	2.117E-01	0.	0.	0.	2.117E-01	0.	0.
RU-103	1.982E-05	0.	0.	0.	1.982E-05	0.	0.
RU-105	1.998E-04	0.	0.	0.	1.998E-04	0.	0.
RU-106	8.638E-07	0.	0.	0.	8.638E-07	0.	0.
AG110M	4.176E-05	0.	0.	0.	4.176E-05	0.	0.
TE125M	0.	0.	0.	0.	0.	0.	0.
TE127M	0.	0.	0.	0.	0.	0.	0.
TE-127	0.	0.	0.	0.	0.	0.	0.
TE129M	5.120E-06	0.	0.	0.	5.120E-06	0.	0.

CONAC SYSTEM # 2

TE-129	7.283E-04	0.	0.	0.	7.283E-04	0.	0.
TE131M	2.516E-05	0.	0.	0.	2.516E-05	0.	0.
TE-131	5.294E-03	0.	0.	0.	5.294E-03	0.	0.
TE-132	1.993E-04	0.	0.	0.	1.993E-04	0.	0.
CS-134	0.	0.	0.	0.	0.	0.	0.
CS-136	0.	0.	0.	0.	0.	0.	0.
CS-137	3.020E-05	5.932E-03	0.	0.	3.003E-05	3.940E-03	0.
CS-138	1.005E 00	3.315E-01	0.	0.	9.511E-01	3.096E 00	0.
BA-139	1.076E-01	1.396E-02	0.	0.	1.074E-01	9.965E-02	0.
BA-140	8.617E-03	1.477E-04	0.	0.	8.615E-03	1.324E-02	0.
BA-141	4.701E-01	3.816E-14	0.	0.	4.701E-01	2.710E-07	0.
BA-142	7.788E-01	1.835E-16	0.	0.	7.788E-01	1.361E-09	0.
LA-140	6.018E-05	2.787E-04	0.	0.	4.803E-05	2.316E-02	0.
LA-142	3.689E-03	3.249E-15	0.	0.	3.689E-03	3.258E-09	0.
CE-141	3.704E-05	4.915E-13	0.	0.	3.704E-05	9.028E-07	0.
CE-143	1.828E-04	0.	0.	0.	1.828E-04	0.	0.
CE-144	1.422E-05	3.899E-18	0.	0.	1.422E-05	9.261E-13	0.
PR-143	4.970E-05	0.	0.	0.	4.970E-05	0.	0.
PR-144	0.	0.	0.	0.	0.	0.	0.
ND-147	2.097E-05	0.	0.	0.	2.097E-05	0.	0.
W -187	3.521E-03	0.	0.	0.	3.521E-03	0.	0.
NP-239	2.467E-01	0.	0.	0.	2.467E-01	0.	0.

CONAC SYSTEM # 3

BR-83	0.	0.	3.010E-08	0.	0.	0.	2.900E-08
BR-84	0.	0.	3.910E-08	0.	0.	0.	2.050E-13
BR-85	0.	0.	1.600E-09	0.	0.	0.	1.000E-24
I -131	3.150E-06	4.470E-06	2.560E-06	1.490E-03	7.660E-06	0.	7.850E-07
I -132	1.450E-07	4.070E-07	1.450E-07	1.430E-05	6.480E-07	0.	5.080E-08
I -133	1.080E-06	1.050E-06	5.650E-07	2.690E-04	3.230E-06	0.	1.110E-06
I -134	8.050E-08	2.160E-07	7.690E-08	3.730E-06	3.440E-07	0.	1.260E-10
I -135	3.350E-07	8.730E-07	3.210E-07	5.600E-05	1.390E-06	0.	6.560E-07
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	1.580E-07	1.580E-07	1.580E-07	1.580E-07	1.580E-07	1.580E-07
C -14	2.270E-06	4.260E-07	4.260E-07	4.260E-07	4.260E-07	4.260E-07	4.260E-07
NA-24	1.280E-06	1.280E-06	1.280E-06	1.280E-06	1.280E-06	1.280E-06	1.280E-06
P -32	1.650E-04	9.640E-06	6.260E-06	0.	0.	0.	1.080E-05
CR-51	0.	0.	1.250E-08	7.440E-09	2.850E-09	1.800E-06	4.150E-07
MN-54	0.	4.950E-06	7.870E-07	0.	1.230E-06	1.750E-04	9.670E-06
MN-56	0.	1.550E-10	2.290E-11	0.	1.630E-10	1.180E-06	2.530E-06
FE-55	3.070E-06	2.120E-06	4.930E-07	0.	0.	9.010E-06	7.540E-07
FE-59	1.470E-06	3.470E-06	1.320E-06	0.	0.	1.270E-04	2.350E-05
CO-58	0.	1.980E-07	2.590E-07	0.	0.	1.160E-04	1.330E-05
CO-60	0.	1.440E-06	1.850E-06	0.	0.	7.460E-04	3.560E-05
NI-63	5.400E-05	3.930E-06	1.810E-06	0.	0.	2.230E-05	1.670E-06
NI-65	1.920E-10	2.620E-11	1.140E-11	0.	0.	7.000E-07	1.540E-06
CU-64	0.	1.830E-10	7.690E-11	0.	5.780E-10	8.480E-07	6.120E-06
ZN-65	4.050E-06	1.290E-05	5.820E-06	0.	8.620E-06	1.080E-04	6.680E-06
ZN-69	4.230E-12	8.140E-12	5.650E-13	0.	5.270E-12	1.150E-07	2.040E-09
RB-86	0.	1.690E-05	7.370E-06	0.	0.	0.	2.080E-06
RB-88	0.	4.840E-08	2.410E-08	0.	0.	0.	4.180E-19
RB-89	0.	3.200E-08	2.120E-08	0.	0.	0.	1.160E-21
SR-89	3.800E-05	0.	1.090E-06	0.	0.	1.750E-04	4.370E-05
SR-90	1.240E-02	0.	7.620E-04	0.	0.	1.200E-03	9.020E-05
SR-91	7.740E-09	0.	3.130E-10	0.	0.	4.560E-06	2.390E-05
SR-92	8.430E-10	0.	3.640E-11	0.	0.	2.060E-06	5.380E-06
Y -90	2.610E-07	0.	7.010E-09	0.	0.	2.120E-05	6.320E-05
Y -91M	3.260E-11	0.	1.270E-12	0.	0.	2.400E-07	1.660E-10
Y -91	5.780E-05	0.	1.550E-06	0.	0.	2.130E-04	4.810E-05
Y -92	1.290E-09	0.	3.770E-11	0.	0.	1.960E-06	9.190E-06
Y -93	1.180E-08	0.	3.260E-10	0.	0.	6.060E-06	5.270E-05
ZR-95	1.340E-05	4.300E-06	2.910E-06	0.	6.770E-06	2.210E-04	1.880E-05
ZR-97	1.210E-08	2.450E-09	1.130E-09	0.	3.710E-09	9.840E-06	6.540E-05
NB-95	1.760E-06	9.770E-07	5.260E-07	0.	9.670E-07	6.310E-05	1.300E-05
MO-99	0.	1.510E-08	2.870E-09	0.	3.640E-08	1.140E-05	3.100E-05
TC-99M	1.290E-13	3.640E-13	4.630E-12	0.	5.520E-12	9.550E-08	5.200E-07
TC-101	5.220E-15	7.520E-15	7.380E-14	0.	1.350E-13	4.990E-08	1.360E-21
RU-103	1.910E-07	0.	8.230E-08	0.	7.290E-07	6.310E-05	1.380E-05
RU-105	9.880E-11	0.	3.890E-11	0.	1.270E-10	1.370E-06	6.020E-06
RU-106	8.640E-06	0.	1.090E-06	0.	1.670E-05	1.170E-03	1.140E-04
AG110M	1.350E-06	1.250E-06	7.430E-07	0.	2.460E-06	5.790E-04	3.780E-05
TE125M	4.270E-07	1.980E-07	5.840E-08	1.310E-07	1.550E-06	3.920E-05	8.830E-06
TE127M	1.580E-06	7.210E-07	1.960E-07	4.110E-07	5.720E-06	1.200E-04	1.870E-05
TE-127	1.750E-10	8.030E-11	3.870E-11	1.320E-10	6.370E-10	8.140E-07	7.170E-06
TE129M	1.220E-06	5.840E-07	1.980E-07	4.300E-07	4.570E-06	1.450E-04	4.790E-05

CONAC SYSTEM # 3

TE-129	6.220E-12	2.990E-12	1.550E-12	4.870E-12	2.340E-11	2.420E-07	1.960E-08
TE131M	8.740E-09	5.450E-09	3.630E-09	6.880E-09	3.860E-08	1.820E-05	6.950E-05
TE-131	1.390E-12	7.440E-13	4.490E-13	1.170E-12	5.460E-12	1.740E-07	2.300E-09
TE-132	3.250E-08	2.690E-08	2.020E-08	2.370E-08	1.820E-07	3.600E-05	6.370E-05
CS-134	4.660E-05	1.060E-04	9.100E-05	0.	3.590E-05	1.220E-05	1.300E-06
CS-136	4.880E-06	1.830E-05	1.380E-05	0.	1.070E-05	1.500E-06	1.460E-06
CS-137	5.980E-05	7.760E-05	5.350E-05	0.	2.780E-05	9.400E-06	1.050E-06
CS-138	4.140E-08	7.760E-08	4.050E-08	0.	6.000E-08	6.070E-09	2.330E-13
BA-139	1.170E-10	8.320E-14	3.420E-12	0.	7.780E-14	4.700E-07	1.120E-07
BA-140	4.880E-06	6.130E-09	3.210E-07	0.	2.090E-09	1.590E-04	2.730E-05
BA-141	1.250E-11	9.410E-15	4.200E-13	0.	8.750E-15	2.420E-07	1.450E-17
BA-142	3.290E-12	3.380E-15	2.070E-13	0.	2.860E-15	1.490E-07	1.960E-26
LA-140	4.300E-08	2.170E-08	5.730E-09	0.	0.	1.700E-05	5.730E-05
LA-142	8.540E-11	3.880E-11	9.650E-12	0.	0.	7.910E-07	2.640E-07
CE-141	2.490E-06	1.690E-06	1.910E-07	0.	7.830E-07	4.520E-05	1.500E-05
CE-143	2.330E-08	1.720E-08	1.910E-09	0.	7.600E-09	9.970E-06	2.830E-05
CE-144	4.290E-04	1.790E-04	2.300E-05	0.	1.060E-04	9.720E-04	1.020E-04
PR-143	1.170E-06	4.690E-07	5.800E-08	0.	2.700E-07	3.510E-05	2.500E-05
PR-144	3.760E-12	1.560E-12	1.910E-13	0.	8.810E-13	1.270E-07	2.690E-18
ND-147	6.590E-07	7.620E-07	4.560E-08	0.	4.450E-07	2.760E-05	2.160E-05
W -187	1.060E-09	8.850E-10	3.100E-10	0.	0.	3.630E-06	1.940E-05
NP-239	2.870E-08	2.820E-09	1.550E-09	0.	8.750E-09	4.700E-06	1.490E-05

CONAC SYSTEM # 4

BR-83	0.	0.	4.300E-08	0.	0.	0.	1.000E-24
BR-84	0.	0.	5.410E-08	0.	0.	0.	1.000E-24
BR-85	0.	0.	2.290E-09	0.	0.	0.	1.000E-24
I -131	4.430E-06	6.140E-06	3.300E-06	1.830E-03	1.050E-05	0.	8.110E-07
I -132	1.990E-07	5.470E-07	1.970E-07	1.890E-05	8.650E-07	0.	1.590E-07
I -133	1.520E-06	2.560E-06	7.780E-07	3.650E-04	4.490E-06	0.	1.290E-06
I -134	1.110E-07	2.900E-07	1.050E-07	4.940E-06	4.580E-07	0.	2.550E-09
I -135	4.620E-07	1.180E-06	4.360E-07	7.760E-05	1.860E-06	0.	8.690E-07
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	1.590E-07	1.590E-07	1.590E-07	1.590E-07	1.590E-07	1.590E-07
C -14	3.250E-06	6.090E-07	6.090E-07	6.090E-07	6.090E-07	6.090E-07	6.090E-07
NA-24	1.720E-06	1.720E-06	1.720E-06	1.720E-06	1.720E-06	1.720E-06	1.720E-06
P -32	2.360E-04	1.370E-05	8.950E-06	0.	0.	0.	1.160E-05
CR-51	0.	0.	1.690E-08	9.370E-09	3.840E-09	2.620E-06	3.750E-07
MN-54	0.	6.390E-06	1.050E-06	0.	1.590E-06	2.480E-04	8.350E-06
MN-56	0.	2.120E-10	3.150E-11	0.	2.240E-10	1.900E-06	7.180E-06
FE-55	4.180E-06	2.980E-06	6.930E-07	0.	0.	1.550E-05	7.990E-07
FE-59	1.990E-06	4.620E-06	1.790E-06	0.	0.	1.910E-04	2.230E-05
CO-58	0.	2.590E-07	3.470E-07	0.	0.	1.680E-04	1.190E-05
CO-60	0.	1.890E-06	2.480E-06	0.	0.	1.090E-03	3.240E-05
NI-63	7.250E-05	5.430E-06	2.470E-06	0.	0.	3.840E-05	1.770E-06
NI-65	2.730E-10	3.660E-11	1.590E-11	0.	0.	1.170E-06	4.590E-06
CU-64	0.	2.540E-10	1.060E-10	0.	8.010E-10	1.390E-06	7.680E-06
ZN-65	4.820E-06	1.670E-05	7.800E-06	0.	1.080E-05	1.550E-04	5.830E-06
ZN-69	6.040E-12	1.150E-11	8.070E-13	0.	7.530E-12	1.980E-07	3.560E-08
RB-86	0.	2.380E-05	1.050E-05	0.	0.	0.	2.210E-06
RB-88	0.	6.820E-08	3.400E-08	0.	0.	0.	3.650E-15
RB-89	0.	4.400E-08	2.910E-08	0.	0.	0.	4.220E-17
SR-89	5.430E-05	0.	1.560E-06	0.	0.	3.020E-04	4.640E-05
SR-90	1.350E-02	0.	8.350E-04	0.	0.	2.060E-03	9.560E-05
SR-91	1.100E-08	0.	4.390E-10	0.	0.	7.590E-06	3.240E-05
SR-92	1.190E-09	0.	5.080E-11	0.	0.	3.430E-06	1.490E-05
Y -90	3.730E-07	0.	1.000E-08	0.	0.	3.660E-05	6.990E-05
Y -91M	4.630E-11	0.	1.770E-12	0.	0.	4.000E-07	3.770E-09
Y -91	8.260E-05	0.	2.210E-06	0.	0.	3.670E-04	5.110E-05
Y -92	1.840E-09	0.	5.360E-11	0.	0.	3.350E-06	2.060E-05
Y -93	1.690E-08	0.	4.650E-10	0.	0.	1.040E-05	7.240E-05
ZR-95	1.820E-05	5.730E-06	3.940E-06	0.	8.420E-06	3.360E-04	1.860E-05
ZR-97	1.720E-08	3.400E-09	1.570E-09	0.	5.150E-09	1.620E-05	7.880E-05
NB-95	2.320E-06	1.290E-06	7.080E-07	0.	1.250E-06	9.390E-05	1.210E-05
MO-99	0.	2.110E-08	4.030E-09	0.	5.140E-08	1.920E-05	3.360E-05
TC-99M	1.730E-13	4.830E-13	6.240E-12	0.	7.200E-12	1.440E-07	7.660E-07
TC-101	7.400E-15	1.050E-14	1.030E-13	0.	1.900E-13	8.340E-08	1.090E-16
RU-103	2.630E-07	0.	1.120E-07	0.	9.290E-07	9.790E-05	1.360E-05
RU-105	1.400E-10	0.	5.420E-11	0.	1.760E-10	2.270E-06	1.130E-05
RU-106	1.230E-05	0.	1.550E-06	0.	2.380E-05	2.010E-03	1.200E-04
AG110M	1.730E-06	1.640E-06	9.990E-07	0.	3.130E-06	8.440E-04	3.410E-05
TE125M	6.100E-07	2.800E-07	8.340E-08	1.750E-07	0.	6.700E-05	9.380E-06
TE127M	2.250E-06	1.020E-06	2.730E-07	5.480E-07	8.170E-06	2.070E-04	1.990E-05
TE-127	2.510E-10	1.140E-10	5.520E-11	1.770E-10	9.100E-10	1.400E-06	1.010E-05
TE129M	1.740E-06	8.230E-07	2.810E-07	5.720E-07	6.490E-06	2.470E-04	5.060E-05

CONAC SYSTEM # 4

TE-129	8.870E-12	4.220E-12	2.200E-12	6.480E-12	3.320E-11	4.120E-07	2.020E-07
TE131M	1.230E-08	7.510E-09	5.030E-09	9.060E-09	5.490E-08	2.970E-05	7.760E-05
TE-131	1.970E-12	1.040E-12	6.300E-13	1.550E-12	7.720E-12	2.920E-07	1.890E-09
TE-132	4.500E-08	3.630E-08	2.740E-08	3.070E-08	2.440E-07	5.610E-05	5.790E-05
CS-134	6.280E-05	1.410E-04	6.860E-05	0.	4.690E-05	1.830E-05	1.220E-06
CS-136	6.440E-06	2.420E-05	1.710E-05	0.	1.380E-05	2.220E-06	1.360E-06
CS-137	8.380E-05	1.060E-04	3.890E-05	0.	3.800E-05	1.510E-05	1.060E-06
CS-138	5.820E-08	1.070E-07	5.580E-08	0.	8.280E-08	9.840E-09	3.380E-11
BA-139	1.670E-10	1.180E-13	4.870E-12	0.	1.110E-13	8.080E-07	8.060E-07
BA-140	6.840E-06	8.380E-09	4.400E-07	0.	2.850E-09	2.540E-04	2.860E-05
BA-141	1.780E-11	1.320E-14	5.930E-13	0.	1.230E-14	4.110E-07	9.330E-14
BA-142	4.620E-12	4.630E-15	2.840E-13	0.	3.920E-15	2.390E-07	5.990E-20
LA-140	5.990E-08	2.950E-08	7.820E-09	0.	0.	2.680E-05	6.090E-05
LA-142	1.200E-10	5.310E-11	1.320E-11	0.	0.	1.270E-06	1.500E-06
CE-141	3.550E-06	2.370E-06	2.710E-07	0.	1.110E-06	7.670E-05	1.580E-05
CE-143	3.320E-08	2.420E-08	2.700E-09	0.	1.080E-08	1.630E-05	3.190E-05
CE-144	6.110E-04	2.530E-04	3.280E-05	0.	1.510E-04	1.670E-03	1.080E-04
PR-143	1.670E-06	6.640E-07	8.280E-08	0.	3.860E-07	6.040E-05	2.670E-05
PR-144	5.370E-12	2.200E-12	2.720E-13	0.	1.260E-12	2.190E-07	2.940E-14
ND-147	9.830E-07	1.070E-06	6.410E-08	0.	6.280E-07	4.650E-05	2.280E-05
W -187	1.500E-09	1.220E-09	4.290E-10	0.	0.	5.920E-06	2.210E-05
NP-239	4.230E-08	3.990E-09	2.210E-09	0.	1.250E-08	8.110E-06	1.650E-05

CONAC SYSTEM # 5

BR-83	0.	0.	1.280E-07	0.	0.	0.	1.000E-24
BR-84	0.	0.	1.480E-07	0.	0.	0.	1.000E-24
BR-85	0.	0.	6.840E-09	0.	0.	0.	1.000E-24
I -131	1.300E-05	1.300E-05	7.370E-06	4.390E-03	2.130E-05	0.	7.680E-07
I -132	5.720E-07	1.100E-06	5.070E-07	5.230E-05	1.690E-06	0.	8.650E-07
I -133	4.480E-06	5.490E-06	2.080E-06	1.040E-03	9.130E-06	0.	1.480E-06
I -134	3.170E-07	5.840E-07	2.690E-07	1.370E-05	8.920E-07	0.	2.580E-07
I -135	1.330E-06	2.360E-06	1.120E-06	2.140E-04	3.620E-06	0.	1.200E-06
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	3.040E-07	3.040E-07	3.040E-07	3.040E-07	3.040E-07	3.040E-07
C -14	9.700E-06	1.820E-06	1.820E-06	1.820E-06	1.820E-06	1.820E-06	1.820E-06
NA-24	4.350E-06	4.350E-06	4.350E-06	4.350E-06	4.350E-06	4.350E-06	4.350E-06
P -32	7.040E-04	3.090E-05	2.670E-05	0.	0.	0.	1.140E-05
CR-51	0.	0.	4.170E-08	2.310E-08	6.570E-09	4.590E-06	2.930E-07
MN-54	0.	1.160E-05	2.570E-06	0.	2.710E-06	4.260E-04	6.190E-06
MN-56	0.	4.480E-10	8.430E-11	0.	4.520E-10	3.550E-06	3.330E-05
FE-55	1.280E-05	6.800E-06	2.100E-06	0.	0.	3.000E-05	7.750E-07
FE-59	5.590E-06	9.040E-06	4.510E-06	0.	0.	3.430E-04	1.910E-05
CO-58	0.	4.790E-07	8.550E-07	0.	0.	2.990E-04	9.290E-06
CO-60	0.	3.550E-06	6.120E-06	0.	0.	1.910E-03	2.600E-05
NI-63	2.220E-04	1.250E-05	7.560E-06	0.	0.	7.430E-05	1.710E-06
NI-65	8.080E-10	7.990E-11	4.440E-11	0.	0.	2.210E-06	2.270E-05
CU-64	0.	5.390E-10	2.900E-10	0.	1.630E-09	2.590E-06	9.920E-06
ZN-65	1.150E-05	3.060E-05	1.900E-05	0.	1.930E-05	2.690E-04	4.410E-06
ZN-69	1.810E-11	2.610E-11	2.410E-12	0.	1.580E-11	3.840E-07	2.750E-06
RB-86	0.	5.360E-05	3.090E-05	0.	0.	0.	2.160E-06
RB-88	0.	1.520E-07	9.900E-08	0.	0.	0.	4.660E-09
RB-89	0.	9.330E-08	7.830E-08	0.	0.	0.	5.110E-10
SR-89	1.620E-04	0.	4.660E-06	0.	0.	5.830E-04	4.520E-05
SR-90	2.730E-02	0.	1.740E-03	0.	0.	3.990E-03	9.280E-05
SR-91	3.280E-08	0.	1.240E-09	0.	0.	1.440E-05	4.700E-05
SR-92	3.540E-09	0.	1.420E-10	0.	0.	6.490E-06	6.550E-05
Y -90	1.110E-06	0.	2.990E-08	0.	0.	7.070E-05	7.240E-05
Y -91M	1.370E-10	0.	4.980E-12	0.	0.	7.600E-07	4.640E-07
Y -91	2.470E-04	0.	6.590E-06	0.	0.	7.100E-04	4.970E-05
Y -92	5.500E-09	0.	1.570E-10	0.	0.	6.460E-06	6.460E-05
Y -93	5.040E-08	0.	1.380E-09	0.	0.	2.010E-05	1.050E-04
ZR-95	5.130E-05	1.130E-05	1.000E-05	0.	1.610E-05	6.030E-04	1.650E-05
ZR-97	5.070E-08	7.340E-09	4.320E-09	0.	1.050E-08	3.060E-05	9.490E-05
NB-95	6.350E-06	2.480E-06	1.770E-06	0.	2.330E-06	1.660E-04	1.000E-05
MO-99	0.	4.660E-08	1.150E-08	0.	1.060E-07	3.660E-05	3.420E-05
TC-99M	4.810E-13	9.410E-13	1.560E-11	0.	1.370E-11	2.570E-07	1.300E-06
TC-101	2.190E-14	2.300E-14	2.910E-13	0.	3.920E-13	1.580E-07	4.410E-09
RU-103	7.550E-07	0.	2.900E-07	0.	1.900E-06	1.790E-04	1.210E-05
RU-105	4.130E-10	0.	1.500E-10	0.	3.630E-10	4.300E-06	2.690E-05
RU-106	3.680E-05	0.	4.570E-06	0.	4.970E-05	3.870E-03	1.160E-04
AG110M	4.560E-06	3.080E-06	2.470E-06	0.	5.740E-06	1.480E-03	2.710E-05
TE125M	1.820E-06	6.290E-07	2.470E-07	5.200E-07	0.	1.290E-04	9.130E-06
TE127M	6.720E-06	2.310E-06	8.160E-07	1.640E-06	1.720E-05	4.000E-04	1.930E-05
TE-127	7.490E-10	2.570E-10	1.650E-10	5.300E-10	1.910E-09	2.710E-06	1.520E-05
TE129M	5.190E-06	1.850E-06	8.220E-07	1.710E-06	1.360E-05	4.760E-04	4.910E-05

CONAC SYSTEM # 5

TE-129	2.640E-11	9.450E-12	6.440E-12	1.930E-11	6.940E-11	7.930E-07	6.890E-06
TE131M	3.630E-08	1.600E-08	1.370E-08	2.640E-08	1.080E-07	5.560E-05	8.320E-05
TE-131	5.870E-12	2.280E-12	1.780E-12	4.590E-12	1.590E-11	5.550E-07	3.600E-07
TE-132	1.300E-07	7.360E-08	7.120E-08	8.580E-08	4.790E-07	1.020E-04	3.720E-05
CS-134	1.760E-04	2.740E-04	6.070E-05	0.	8.930E-05	3.270E-05	1.040E-06
CS-136	1.760E-05	4.620E-05	3.140E-05	0.	2.580E-05	3.930E-06	1.130E-06
CS-137	2.450E-04	2.230E-04	3.470E-05	0.	7.630E-05	2.810E-05	9.780E-07
CS-138	1.710E-07	2.270E-07	1.500E-07	0.	1.680E-07	1.240E-08	7.290E-08
BA-139	4.980E-10	2.660E-13	1.450E-11	0.	2.330E-13	1.560E-06	1.560E-05
BA-140	2.000E-05	1.750E-08	1.170E-06	0.	5.710E-09	4.710E-04	2.750E-05
BA-141	5.290E-11	2.950E-14	1.720E-12	0.	2.560E-14	7.890E-07	7.440E-08
BA-142	1.350E-11	9.730E-15	7.540E-13	0.	7.870E-15	4.440E-07	7.410E-10
LA-140	1.740E-07	6.080E-08	2.040E-08	0.	0.	4.940E-05	5.100E-05
LA-142	3.500E-10	1.110E-10	3.490E-11	0.	0.	2.350E-06	2.050E-05
CE-141	1.060E-05	5.280E-06	7.830E-07	0.	2.310E-06	1.470E-04	1.530E-05
CE-143	9.890E-08	5.370E-08	7.770E-09	0.	2.260E-08	3.120E-05	3.440E-05
CE-144	1.830E-03	5.720E-04	9.770E-05	0.	3.170E-04	3.230E-03	1.050E-04
PR-143	4.990E-06	1.500E-06	2.470E-07	0.	8.110E-07	1.170E-04	2.630E-05
PR-144	1.610E-11	4.990E-12	8.100E-13	0.	2.640E-12	4.230E-07	5.320E-08
ND-147	2.920E-06	2.360E-06	1.840E-07	0.	1.300E-06	8.870E-05	2.220E-05
W -187	4.410E-09	2.610E-09	1.170E-09	0.	0.	1.110E-05	2.460E-05
NP-239	1.260E-07	9.040E-09	6.350E-09	0.	2.630E-08	1.570E-05	1.730E-05

CONAC SYSTEM # 6

BR-83	0.	0.	2.720E-07	0.	0.	0.	1.000E-24
BR-84	0.	0.	2.850E-07	0.	0.	0.	1.000E-24
BR-85	0.	0.	1.460E-08	0.	0.	0.	1.000E-24
I -131	2.710E-05	3.170E-05	1.400E-05	1.06CE-02	3.700E-05	0.	7.560E-07
I -132	1.210E-06	2.530E-06	8.990E-07	1.210E-04	2.820E-06	0.	1.360E-06
I -133	9.460E-06	1.370E-05	4.000E-06	2.540E-03	1.600E-05	0.	1.540E-06
I -134	6.580E-07	1.340E-06	4.750E-07	3.180E-05	1.490E-06	0.	9.210E-07
I -135	2.760E-06	5.430E-06	1.980E-06	4.970E-04	6.050E-06	0.	1.310E-06
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	4.620E-07	4.620E-07	4.620E-07	4.620E-07	4.620E-07	4.620E-07
C -14	1.890E-05	3.790E-06	3.790E-06	3.790E-06	3.790E-06	3.790E-06	3.790E-06
NA-24	7.540E-06	7.540E-06	7.540E-06	7.540E-06	7.540E-06	7.540E-06	7.540E-06
P -32	1.450E-03	8.030E-05	5.530E-05	0.	0.	0.	1.150E-05
CR-51	0.	0.	6.390E-08	4.110E-08	9.450E-09	9.170E-06	2.550E-07
MN-54	0.	1.810E-05	3.560E-06	0.	3.560E-06	7.140E-04	5.040E-06
MN-56	0.	1.100E-09	1.580E-10	0.	7.860E-10	8.950E-06	5.120E-05
FE-55	1.410E-05	8.390E-06	2.380E-06	0.	0.	6.210E-05	7.820E-07
FE-59	9.690E-06	1.680E-05	6.770E-06	0.	0.	7.250E-04	1.770E-05
CO-58	0.	8.710E-07	1.300E-06	0.	0.	5.550E-04	7.950E-06
CO-60	0.	5.730E-06	8.410E-06	0.	0.	3.220E-03	2.280E-05
NI-63	2.420E-04	1.460E-05	8.290E-06	0.	0.	1.490E-04	1.730E-06
NI-65	1.710E-09	2.030E-10	8.790E-11	0.	0.	5.800E-06	3.580E-05
CU-64	0.	1.340E-09	5.530E-10	0.	2.840E-09	6.640E-06	1.070E-05
ZN-65	1.380E-05	4.470E-05	2.220E-05	0.	2.320E-05	4.620E-04	3.670E-05
ZN-69	3.850E-11	6.910E-11	5.130E-12	0.	2.870E-11	1.050E-06	9.440E-06
RB-86	0.	1.360E-04	6.300E-05	0.	0.	0.	2.170E-06
RB-88	0.	3.980E-07	2.050E-07	0.	0.	0.	2.420E-07
RB-89	0.	2.290E-07	1.470E-07	0.	0.	0.	4.870E-08
SR-89	2.840E-04	0.	8.150E-06	0.	0.	1.450E-03	4.570E-05
SR-90	2.920E-02	0.	1.850E-03	0.	0.	8.030E-03	9.360E-05
SR-91	6.830E-08	0.	2.470E-09	0.	0.	3.760E-05	5.240E-05
SR-92	7.500E-09	0.	2.790E-10	0.	0.	1.700E-05	1.000E-04
Y -90	2.350E-06	0.	6.300E-08	0.	0.	1.920E-04	7.430E-05
Y -91M	2.910E-10	0.	9.900E-12	0.	0.	1.990E-06	1.680E-06
Y -91	4.200E-04	0.	1.120E-05	0.	0.	1.750E-03	5.020E-05
Y -92	1.170E-08	0.	3.290E-10	0.	0.	1.750E-05	9.040E-05
Y -93	1.070E-07	0.	2.910E-09	0.	0.	5.460E-05	1.190E-04
ZR-95	8.240E-05	1.990E-05	1.450E-05	0.	2.220E-05	1.250E-03	1.550E-05
ZR-97	1.070E-07	1.830E-08	8.360E-09	0.	1.850E-08	7.880E-05	1.000E-04
NB-95	1.120E-05	4.590E-06	2.700E-06	0.	3.370E-06	3.420E-04	9.050E-06
MO-99	0.	1.180E-07	2.310E-08	0.	1.890E-07	9.630E-05	3.480E-05
TC-99M	9.980E-13	2.060E-12	2.660E-11	0.	2.220E-11	5.790E-07	1.450E-06
TC-101	4.650E-14	5.880E-14	5.800E-13	0.	6.990E-13	4.170E-07	6.030E-07
RU-103	1.440E-06	0.	4.850E-07	0.	3.030E-06	3.940E-04	1.150E-05
RU-105	8.740E-10	0.	2.930E-10	0.	6.420E-10	1.120E-05	3.460E-05
RU-106	6.200E-05	0.	7.770E-06	0.	7.610E-05	8.260E-03	1.170E-04
AG110M	7.130E-06	5.160E-06	3.570E-06	0.	7.800E-06	2.620E-03	2.360E-05
TE125M	3.400E-06	1.420E-06	4.700E-07	1.160E-06	0.	3.190E-04	9.220E-06
TE127M	1.190E-05	4.930E-06	1.480E-06	3.480E-06	2.680E-05	9.370E-04	1.950E-05
TE-127	1.590E-09	6.810E-10	3.490E-10	1.320E-09	3.470E-09	7.390E-06	1.740E-05
TE129M	1.010E-05	4.350E-06	1.590E-06	3.910E-06	2.270E-05	1.200E-03	4.930E-05

CONAC SYSTEM # 6

TE-129	5.630E-11	2.480E-11	1.340E-11	4.820E-11	1.250E-10	2.140E-06	1.880E-05
TE131M	7.620E-08	3.930E-08	2.590E-08	6.380E-08	1.890E-07	1.420E-04	8.510E-05
TE-131	1.240E-11	5.870E-12	3.570E-12	1.130E-11	2.850E-11	1.470E-06	5.870E-06
TE-132	2.660E-07	1.690E-07	1.260E-07	1.990E-07	7.390E-07	2.430E-04	3.150E-05
CS-134	2.830E-04	5.020E-04	5.320E-05	0.	1.360E-04	5.690E-05	9.530E-07
CS-136	3.450E-05	9.610E-05	3.780E-05	0.	4.030E-05	8.400E-06	1.020E-06
CS-137	3.920E-04	4.370E-04	3.250E-05	0.	1.230E-04	5.090E-05	9.530E-07
CS-138	3.610E-07	5.580E-07	2.840E-07	0.	2.930E-07	4.670E-08	6.250E-07
BA-139	1.060E-09	7.030E-13	3.070E-11	0.	4.230E-13	4.250E-06	3.640E-05
BA-140	4.000E-05	4.000E-08	2.070E-06	0.	9.590E-09	1.140E-03	2.740E-05
BA-141	1.120E-10	7.700E-14	3.550E-12	0.	4.640E-14	2.120E-06	3.390E-06
BA-142	2.840E-11	2.360E-14	1.400E-12	0.	1.360E-14	1.110E-06	4.950E-07
LA-140	3.610E-07	1.430E-07	3.680E-08	0.	0.	1.200E-04	6.060E-05
LA-142	7.360E-10	2.690E-10	6.460E-11	0.	0.	5.870E-05	4.250E-05
CE-141	1.980E-05	1.190E-05	1.420E-06	0.	3.750E-06	3.690E-04	1.540E-05
CE-143	2.090E-07	1.380E-07	1.580E-08	0.	4.030E-08	8.300E-05	3.550E-05
CE-144	2.280E-03	8.650E-04	1.260E-04	0.	3.840E-04	7.030E-03	1.060E-04
PR-143	1.000E-05	3.740E-06	4.990E-07	0.	1.410E-06	3.090E-04	2.660E-05
PR-144	3.420E-11	1.320E-11	1.720E-12	0.	4.800E-12	1.150E-06	3.060E-06
ND-147	5.670E-06	5.810E-06	3.570E-07	0.	2.250E-06	2.300E-04	2.230E-05
W -187	9.260E-09	6.440E-09	2.230E-09	0.	0.	2.830E-05	2.540E-05
NP-239	2.650E-07	2.370E-08	1.340E-08	0.	4.730E-08	4.250E-05	1.780E-05

CONAC SYSTEM # 7

BR-83	2.900E-01	6.400E-11	9.300E-11	0.	0.	0.	2.500E-01
BR-84	1.310E 00	1.200E-08	1.400E-08	0.	0.	0.	2.500E-01
BR-85	1.450E 01	0.	0.	0.	0.	0.	2.500E-01
I -131	3.590E-03	2.800E-09	3.400E-09	2.000E-02	6.000E-03	2.900E-03	1.000E 00
I -132	3.010E-01	1.700E-08	2.000E-08	2.000E-02	6.000E-03	2.900E-03	1.000E 00
I -133	3.330E-02	3.700E-09	4.500E-09	2.000E-02	6.000E-03	2.900E-03	1.000E 00
I -134	7.910E-01	1.600E-08	1.900E-08	2.000E-02	6.000E-03	2.900E-03	1.000E 00
I -135	1.050E-01	1.200E-08	1.400E-08	2.000E-02	6.000E-03	2.900E-03	1.000E 00
KR-83M	1.035E-04	0.	0.	0.	0.	0.	0.
KR-85M	4.298E-05	0.	0.	0.	0.	0.	0.
KR-85	2.047E-09	0.	0.	0.	0.	0.	0.
KR-87	1.520E-04	0.	0.	0.	0.	0.	0.
KR-88	6.876E-05	0.	0.	0.	0.	0.	0.
KR-89	3.656E-03	0.	0.	0.	0.	0.	0.
XE131M	6.691E-07	0.	0.	0.	0.	0.	0.
XE133M	3.598E-06	0.	0.	0.	0.	0.	0.
XE-133	1.517E-06	0.	0.	0.	0.	0.	0.
XE135M	7.551E-04	0.	0.	0.	0.	0.	0.
XE-135	2.100E-05	0.	0.	0.	0.	0.	0.
XE-137	3.008E-03	0.	0.	0.	0.	0.	0.
XE-138	8.136E-04	0.	0.	0.	0.	0.	0.
XE-139	1.716E-02	0.	0.	0.	0.	0.	0.
XE-140	5.097E-02	0.	0.	0.	0.	0.	0.
H -3	6.410E-06	0.	0.	4.800E 00	1.000E-02	1.200E-02	2.500E-01
C -14	1.380E-08	0.	0.	5.500E 00	1.200E-02	3.100E-02	2.500E-01
NA-24	4.620E-02	2.500E-08	2.900E-08	5.200E-02	4.000E-02	3.000E-02	2.000E-01
P -32	2.020E-03	0.	0.	1.100E 00	2.500E-02	4.600E-02	2.000E-01
CR-51	1.040E-03	2.200E-10	2.600E-10	2.500E-04	2.200E-03	2.400E-03	2.000E-01
MN-54	9.240E-05	5.800E-09	6.800E-09	2.900E-02	2.500E-04	8.000E-04	2.000E-01
MN-56	2.690E-01	1.100E-08	1.300E-08	2.900E-02	2.500E-04	8.000E-04	2.000E-01
FE-55	2.930E-05	0.	0.	6.600E-04	1.200E-03	4.000E-02	2.000E-01
FE-59	6.480E-04	8.000E-09	9.400E-09	6.600E-04	1.200E-03	4.000E-02	2.000E-01
CO-58	4.080E-04	7.000E-09	8.200E-09	9.400E-03	1.000E-03	1.300E-02	2.000E-01
CO-60	1.500E-05	1.700E-08	2.000E-08	9.400E-03	1.000E-03	1.300E-02	2.000E-01
NI-63	8.240E-07	0.	0.	1.900E-02	6.700E-03	5.300E-02	2.000E-01
NI-65	2.750E-01	3.700E-09	4.300E-09	1.900E-02	6.700E-03	5.300E-02	2.000E-01
CU-64	5.460E-02	1.500E-09	1.700E-09	1.200E-01	1.400E-02	8.000E-03	2.000E-01
ZN-65	1.180E-04	4.000E-09	4.600E-09	4.000E-01	3.900E-02	3.000E-02	2.000E-01
ZN-69	7.300E-01	0.	0.	4.000E-01	3.900E-02	3.000E-02	2.000E-01
RB-86	2.900E-01	6.400E-11	9.300E-11	0.	0.	0.	2.500E-01
RB-88	1.310E 00	1.200E-08	1.400E-08	0.	0.	0.	2.500E-01
RB-89	1.450E 01	0.	0.	0.	0.	0.	2.500E-01
SR-89	1.550E-03	6.300E-10	7.200E-10	1.300E-01	3.000E-02	3.100E-02	2.000E-01
SR-90	2.340E 00	3.500E-09	4.000E-09	1.300E-01	3.000E-02	3.100E-02	2.000E-01
SR-91	2.740E 00	1.500E-08	1.800E-08	1.300E-01	3.000E-02	3.100E-02	2.000E-01
SR-92	5.710E-04	5.600E-13	6.500E-13	1.700E-02	8.000E-04	6.000E-04	2.000E-01
Y -90	2.780E-06	0.	0.	1.700E-02	8.000E-04	6.000E-04	2.000E-01
Y -91M	7.300E-02	7.100E-09	8.300E-09	1.700E-02	8.000E-04	6.000E-04	2.000E-01
Y -91	2.560E-01	9.000E-09	1.000E-08	1.700E-02	8.000E-04	6.000E-04	2.000E-01
Y -92	1.080E-02	2.200E-12	2.600E-12	2.600E-03	1.000E-05	4.600E-03	2.000E-01
Y -93	8.370E-01	3.800E-09	4.400E-09	2.600E-03	1.000E-05	4.600E-03	2.000E-01
ZR-95	4.940E-04	2.400E-11	2.700E-11	2.600E-03	1.000E-05	4.600E-03	2.000E-01
ZR-97	1.960E-01	1.600E-09	1.900E-09	2.600E-03	1.000E-05	4.600E-03	2.000E-01
NB-95	6.860E-02	5.700E-10	7.800E-10	2.600E-03	1.000E-05	4.600E-03	2.000E-01
MO-99	4.510E-04	5.000E-09	5.800E-09	1.700E-04	5.000E-06	3.400E-02	2.000E-01
TC-99M	4.100E-02	5.500E-09	6.400E-09	1.700E-04	5.000E-06	3.400E-02	2.000E-01
TC-101	8.220E-04	5.100E-09	6.000E-09	9.400E-03	2.500E-03	2.800E-01	2.000E-01
RU-103	1.050E-02	1.900E-09	2.200E-09	1.200E-01	7.500E-03	8.000E-03	2.000E-01
RU-105	1.150E-01	9.600E-10	1.100E-09	2.500E-01	2.500E-02	4.000E-01	2.000E-01
RU-106	2.930E 00	2.700E-09	3.000E-09	2.500E-01	2.500E-02	4.000E-01	2.000E-01
AG110M	7.340E-04	3.600E-09	4.200E-09	5.000E-02	1.000E-06	4.000E-01	2.000E-01
TE125M	1.560E-01	4.500E-09	5.100E-09	5.000E-02	1.000E-06	4.000E-01	2.000E-01
TE127M	7.840E-05	1.500E-09	1.800E-09	5.000E-02	1.000E-06	4.000E-01	2.000E-01
TE-127	1.150E-04	1.800E-08	2.100E-08	1.500E-01	5.000E-02	1.700E-02	2.000E-01
TE129M	4.980E-04	3.500E-11	4.800E-11	1.300E 00	1.000E-03	7.700E-02	2.000E-01

CONAC SYSTEM # 7

TE-129	2.650E-04	1.100E-12	1.300E-12	1.300E 00	1.000E-03	7.700E-02	2.000E-01
TE131M	7.410E-02	1.000E-11	1.100E-11	1.300E 00	1.000E-03	7.700E-02	2.000E-01
TE-131	8.600E-04	7.700E-10	9.000E-10	1.300E 00	1.000E-03	7.700E-02	2.000E-01
TE-132	8.600E-04	7.100E-10	8.400E-10	1.300E 00	1.000E-03	7.700E-02	2.000E-01
CS-134	3.840E-05	1.200E-08	1.400E-08	1.000E-02	1.200E-02	4.000E-03	2.000E-01
CS-136	2.200E-03	1.500E-08	1.700E-08	1.000E-02	1.200E-02	4.000E-03	2.000E-01
CS-137	2.620E-06	4.200E-09	4.900E-09	1.000E-02	1.200E-02	4.000E-03	2.000E-01
CS-138	1.290E 00	2.100E-08	2.400E-08	1.000E-02	1.200E-02	4.000E-03	2.000E-01
BA-139	5.030E-01	2.400E-09	2.700E-09	5.000E-03	4.000E-04	3.200E-03	2.000E-01
BA-140	2.260E-03	2.100E-09	2.400E-09	5.000E-03	4.000E-04	3.200E-03	2.000E-01
BA-141	2.280E 00	4.300E-09	4.900E-09	5.000E-03	4.000E-04	3.200E-03	2.000E-01
BA-142	3.890E 00	7.900E-09	9.000E-09	5.000E-03	4.000E-04	3.200E-03	2.000E-01
LA-140	1.720E-02	1.500E-08	1.700E-08	2.500E-03	5.000E-06	2.000E-04	2.000E-01
LA-142	4.490E-01	1.500E-08	1.800E-08	2.500E-03	5.000E-06	2.000E-04	2.000E-01
CE-141	8.890E-04	5.500E-10	6.200E-10	2.500E-03	1.000E-04	1.200E-03	2.000E-01
CE-143	2.100E-02	2.200E-09	2.500E-09	2.500E-03	1.000E-04	1.200E-03	2.000E-01
CE-144	1.020E-04	3.200E-10	3.700E-10	2.500E-03	1.000E-04	1.200E-03	2.000E-01
PR-143	2.130E-03	0.	0.	2.500E-03	5.000E-06	4.700E-03	2.000E-01
PR-144	2.410E 00	2.000E-10	2.300E-10	2.500E-03	5.000E-06	4.700E-03	2.000E-01
ND-147	2.610E-03	1.000E-09	1.200E-09	2.400E-03	5.000E-06	3.300E-03	2.000E-01
W -187	2.900E-02	3.100E-09	3.600E-09	1.800E-02	5.000E-04	1.300E-03	2.000E-01
NP-239	1.230E-02	9.500E-10	1.100E-09	2.500E-03	5.000E-06	2.000E-04	2.000E-01

CONAC SYSTEM # 8

BR-83	0.	0.	4.020E-08	0.	0.	0.	5.790E-08
BR-84	0.	0.	5.210E-08	0.	0.	0.	4.090E-13
BR-85	0.	0.	2.140E-09	0.	0.	0.	1.000E-24
I -131	4.160E-06	5.950E-06	3.410E-06	1.950E-03	1.020E-05	0.	1.570E-06
I -132	2.030E-07	5.430E-07	1.900E-07	1.900E-05	8.650E-07	0.	1.020E-07
I -133	1.420E-06	2.470E-06	7.530E-07	3.630E-04	4.310E-06	0.	2.220E-06
I -134	1.060E-07	2.880E-07	1.030E-07	4.990E-06	4.580E-07	0.	2.510E-10
I -135	4.430E-07	1.160E-06	4.280E-07	7.650E-05	1.860E-06	0.	1.310E-06
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	1.050E-07	1.050E-07	1.050E-07	1.050E-07	1.050E-07	1.050E-07
C -14	2.840E-06	5.680E-07	5.680E-07	5.680E-07	5.680E-07	5.680E-07	5.680E-07
NA-24	1.700E-06	1.700E-06	1.700E-06	1.700E-06	1.700E-06	1.700E-06	1.700E-06
P -32	1.930E-04	1.200E-05	7.460E-06	0.	0.	0.	2.170E-05
CR-51	0.	0.	2.660E-09	1.590E-09	5.860E-10	3.530E-09	6.690E-07
MN-54	0.	4.570E-06	8.720E-07	0.	1.360E-06	0.	1.400E-05
MN-56	0.	1.150E-07	2.040E-08	0.	1.460E-07	0.	3.670E-06
FE-55	2.750E-06	1.900E-06	4.430E-07	0.	0.	1.060E-06	1.090E-06
FE-59	4.340E-06	1.020E-05	3.910E-06	0.	0.	2.850E-06	3.400E-05
CO-58	0.	7.450E-07	1.670E-06	0.	0.	0.	1.510E-05
CO-60	0.	2.140E-06	4.720E-06	0.	0.	0.	4.020E-05
NI-63	1.300E-04	9.010E-06	4.360E-06	0.	0.	0.	1.880E-06
NI-65	5.280E-07	6.860E-08	3.130E-08	0.	0.	0.	1.740E-06
CU-64	0.	8.330E-08	3.910E-08	0.	2.100E-07	0.	7.100E-06
ZN-65	4.840E-06	1.540E-05	6.960E-06	0.	1.030E-05	0.	9.700E-06
ZN-69	1.030E-08	1.970E-08	1.370E-09	0.	1.280E-08	0.	2.960E-09
RB-86	0.	2.110E-05	9.830E-06	0.	0.	0.	4.160E-06
RB-88	0.	6.050E-08	3.210E-08	0.	0.	0.	8.360E-19
RB-89	0.	4.010E-08	2.820E-08	0.	0.	0.	2.330E-21
SR-89	3.080E-04	0.	8.840E-06	0.	0.	0.	4.940E-05
SR-90	7.580E-03	0.	1.860E-03	0.	0.	0.	2.190E-04
SR-91	5.670E-06	0.	2.290E-07	0.	0.	0.	2.700E-05
SR-92	2.150E-06	0.	9.300E-08	0.	0.	0.	4.260E-05
Y -90	9.620E-09	0.	2.580E-10	0.	0.	0.	1.020E-04
Y -91M	9.090E-11	0.	3.520E-12	0.	0.	0.	2.670E-10
Y -91	1.410E-07	0.	3.770E-09	0.	0.	0.	7.750E-05
Y -92	8.450E-10	0.	2.470E-11	0.	0.	0.	1.480E-05
Y -93	2.680E-09	0.	7.400E-11	0.	0.	0.	8.500E-05
ZR-95	3.040E-08	9.750E-09	6.600E-09	0.	1.530E-08	0.	3.090E-05
ZR-97	1.680E-09	3.390E-10	1.550E-10	0.	5.120E-10	0.	1.050E-04
NB-95	6.220E-09	3.460E-09	1.860E-09	0.	3.420E-09	0.	2.100E-05
MO-99	0.	4.310E-06	8.200E-07	0.	9.760E-06	0.	9.990E-06
TC-99M	2.470E-10	6.980E-10	8.890E-09	0.	1.060E-08	3.420E-10	4.130E-07
TC-101	2.540E-10	3.660E-10	3.590E-09	0.	6.590E-09	1.870E-10	1.100E-21
RU-103	1.850E-07	0.	7.970E-08	0.	7.060E-07	0.	2.160E-05
RU-105	1.540E-08	0.	6.080E-09	0.	1.990E-07	0.	9.420E-06
RU-106	2.750E-06	0.	3.480E-07	0.	5.310E-06	0.	1.780E-04
AG110M	1.600E-07	1.480E-07	8.790E-08	0.	2.910E-07	0.	6.040E-05
TE125M	2.680E-06	9.710E-07	3.590E-07	8.060E-07	1.090E-05	0.	1.070E-05
TE127M	6.770E-06	2.420E-06	8.250E-07	1.730E-06	2.750E-05	0.	2.270E-05
TE-127	1.100E-07	3.950E-08	2.380E-08	8.150E-08	4.480E-07	0.	8.680E-06
TE129M	1.150E-05	4.290E-06	1.820E-06	3.950E-06	4.800E-05	0.	5.790E-05

CONAC SYSTEM # 8

TE-129	3.140E-08	1.180E-08	7.650E-09	2.410E-08	1.320E-07	0.	2.370E-08
TE131M	1.730E-06	8.460E-07	7.050E-07	1.340E-06	8.570E-06	0.	8.400E-05
TE-131	1.970E-08	8.230E-09	6.220E-09	1.620E-08	8.630E-08	0.	2.790E-09
TE-132	2.520E-06	1.630E-06	1.530E-06	1.800E-06	1.570E-05	0.	7.710E-05
CS-134	6.220E-05	1.480E-04	1.210E-04	0.	4.790E-05	1.590E-05	2.590E-06
CS-136	6.510E-06	2.570E-05	1.850E-05	0.	1.430E-05	1.960E-06	2.920E-06
CS-137	7.970E-05	1.090E-04	7.140E-05	0.	3.700E-05	1.230E-05	2.110E-06
CS-138	5.520E-08	1.090E-07	5.400E-08	0.	8.010E-08	7.910E-09	4.650E-13
BA-139	9.700E-08	6.910E-11	2.840E-09	0.	6.460E-11	3.920E-11	1.720E-07
BA-140	2.030E-05	2.550E-08	1.330E-06	0.	8.670E-09	1.460E-08	4.180E-05
BA-141	4.710E-08	3.560E-11	1.590E-09	0.	3.310E-11	2.020E-11	2.220E-17
BA-142	2.130E-08	2.190E-11	1.340E-09	0.	1.850E-11	1.240E-11	3.000E-26
LA-140	2.500E-09	1.260E-09	3.330E-10	0.	0.	0.	9.250E-05
LA-142	1.280E-10	5.820E-11	1.450E-11	0.	0.	0.	4.250E-07
CE-141	9.360E-09	6.330E-09	7.180E-10	0.	2.940E-09	0.	2.420E-05
CE-143	1.650E-09	1.220E-06	1.350E-10	0.	5.370E-10	0.	4.560E-05
CE-144	4.880E-07	2.040E-07	2.620E-08	0.	1.210E-07	0.	1.650E-04
PR-143	9.200E-09	3.690E-09	4.560E-10	0.	2.130E-09	0.	4.030E-05
PR-144	3.010E-11	1.250E-11	1.530E-12	0.	7.050E-12	0.	4.330E-18
ND-147	6.290E-09	7.270E-09	4.350E-10	0.	4.250E-09	0.	3.490E-05
W -187	1.030E-07	8.610E-08	3.010E-08	0.	0.	0.	2.820E-05
NP-239	1.190E-09	1.170E-10	6.450E-11	0.	3.650E-10	0.	2.400E-05

CONAC SYSTEM # 9

BR-83	0.	0.	5.740E-08	0.	0.	0.	1.000E-24
BR-84	0.	0.	7.220E-08	0.	0.	0.	1.000E-24
BR-85	0.	0.	3.050E-09	0.	0.	0.	1.000E-24
I -131	5.850E-06	8.190E-06	4.400E-06	2.390E-03	1.410E-05	0.	1.620E-06
I -132	2.790E-07	7.300E-07	2.620E-07	2.460E-05	1.150E-06	0.	3.180E-07
I -133	2.010E-06	3.410E-06	1.040E-06	4.760E-04	5.980E-06	0.	2.580E-06
I -134	1.460E-07	3.870E-07	1.390E-07	6.450E-06	6.100E-07	0.	5.100E-09
I -135	6.100E-07	1.570E-06	5.820E-07	1.010E-04	2.480E-06	0.	1.740E-06
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	1.060E-07	1.060E-07	1.060E-07	1.060E-07	1.060E-07	1.060E-07
C -14	4.060E-06	8.120E-07	8.120E-07	8.120E-07	8.120E-07	8.120E-07	8.120E-07
NA-24	2.300E-06	2.300E-06	2.300E-06	2.300E-06	2.300E-06	2.300E-06	2.300E-06
P -32	2.760E-04	1.710E-05	1.070E-05	0.	0.	0.	2.320E-05
CR-51	0.	0.	3.600E-09	2.000E-09	7.890E-10	5.140E-09	6.050E-07
MN-54	0.	5.900E-06	1.170E-06	0.	1.760E-06	0.	1.210E-05
MN-56	0.	1.580E-07	2.810E-08	0.	2.000E-07	0.	1.040E-05
FE-55	3.780E-06	2.680E-06	6.250E-07	0.	0.	1.700E-06	1.160E-06
FE-59	5.870E-06	1.370E-05	5.290E-06	0.	0.	4.320E-06	3.240E-05
CO-58	0.	9.720E-07	2.240E-06	0.	0.	0.	1.340E-05
CO-60	0.	2.810E-06	6.330E-06	0.	0.	0.	3.660E-05
NI-63	1.770E-04	1.250E-05	6.000E-06	0.	0.	0.	1.990E-06
NI-65	7.490E-07	9.570E-08	4.360E-08	0.	0.	0.	5.190E-06
CU-64	0.	1.150E-07	5.410E-08	0.	2.910E-07	0.	8.920E-06
ZN-65	5.760E-06	2.000E-05	9.330E-06	0.	1.280E-05	0.	8.470E-06
ZN-69	1.470E-08	2.800E-08	1.960E-09	0.	1.830E-08	0.	5.160E-08
RB-86	0.	2.980E-05	1.400E-05	0.	0.	0.	4.410E-06
RB-88	0.	8.520E-08	4.540E-08	0.	0.	0.	7.300E-15
RB-89	0.	5.500E-08	3.890E-08	0.	0.	0.	8.430E-17
SR-89	4.400E-04	0.	1.260E-05	0.	0.	0.	5.240E-05
SR-90	8.300E-03	0.	2.050E-03	0.	0.	0.	2.330E-04
SR-91	8.070E-06	0.	3.210E-07	0.	0.	0.	3.660E-05
SR-92	3.050E-06	0.	1.300E-07	0.	0.	0.	7.770E-05
Y -90	1.370E-08	0.	3.690E-10	0.	0.	0.	1.130E-04
Y -91M	1.290E-10	0.	4.930E-12	0.	0.	0.	6.090E-09
Y -91	2.010E-07	0.	5.390E-09	0.	0.	0.	8.240E-05
Y -92	1.210E-09	0.	3.500E-11	0.	0.	0.	3.320E-05
Y -93	3.830E-09	0.	1.050E-10	0.	0.	0.	1.170E-04
ZR-95	4.120E-08	1.300E-08	8.940E-09	0.	1.910E-08	0.	3.000E-05
ZR-97	2.370E-09	4.690E-10	2.160E-10	0.	7.110E-10	0.	1.270E-04
NB-95	8.220E-09	4.560E-09	2.510E-09	0.	4.420E-09	0.	1.950E-05
MO-99	0.	6.030E-06	1.150E-06	0.	1.380E-05	0.	1.080E-05
TC-99M	3.320E-10	9.260E-10	1.200E-08	0.	1.380E-08	5.140E-10	6.080E-07
TC-101	3.600E-10	5.120E-10	5.030E-09	0.	9.260E-09	3.120E-10	8.750E-17
RU-103	2.550E-07	0.	1.090E-07	0.	8.990E-07	0.	2.130E-05
RU-105	2.180E-08	0.	8.460E-09	0.	2.750E-07	0.	1.760E-05
RU-106	3.920E-06	0.	4.940E-07	0.	7.560E-06	0.	1.880E-04
AG110M	2.050E-07	1.940E-07	1.180E-07	0.	3.700E-07	0.	5.450E-05
TE125M	3.830E-06	1.380E-06	5.120E-07	1.070E-06	0.	0.	1.130E-05
TE127M	9.670E-06	3.430E-06	1.150E-06	2.300E-06	3.920E-05	0.	2.410E-05
TE-127	1.580E-07	5.600E-08	3.400E-08	1.090E-07	6.400E-07	0.	1.220E-05
TE129M	1.630E-05	6.050E-06	2.580E-06	5.260E-06	6.820E-05	0.	6.120E-05

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TE-129	4.480E-08	1.670E-08	1.090E-08	3.200E-08	1.880E-07	0.	2.450E-07
TE131M	2.440E-06	1.170E-06	9.760E-07	1.760E-06	1.220E-05	0.	9.390E-05
TE-131	2.790E-03	1.150E-08	8.720E-09	2.150E-08	1.220E-07	0.	2.290E-09
TE-132	3.490E-06	2.210E-06	2.080E-06	2.330E-06	2.120E-05	0.	7.000E-05
CS-134	8.370E-05	1.970E-04	9.140E-05	0.	6.260E-05	2.390E-05	2.450E-06
CS-136	8.590E-06	3.380E-05	2.270E-05	0.	1.840E-05	2.900E-06	2.720E-06
CS-137	1.120E-04	1.490E-04	5.190E-05	0.	5.070E-05	1.970E-05	2.120E-06
CS-138	7.760E-08	1.490E-07	7.450E-08	0.	1.100E-07	1.280E-08	6.750E-11
BA-139	1.390E-07	9.780E-11	4.050E-09	0.	9.220E-11	6.740E-11	1.240E-06
BA-140	2.840E-05	3.480E-08	1.830E-06	0.	1.180E-08	2.340E-08	4.380E-05
BA-141	6.710E-08	5.010E-11	2.240E-09	0.	4.650E-11	3.430E-11	1.430E-13
BA-142	2.990E-08	2.990E-11	1.840E-09	0.	2.530E-11	1.990E-11	9.180E-20
LA-140	3.480E-09	1.710E-09	4.550E-10	0.	0.	0.	9.820E-05
LA-142	1.790E-10	7.950E-11	1.980E-11	0.	0.	0.	2.420E-06
CE-141	1.330E-08	8.880E-09	1.020E-09	0.	4.180E-09	0.	2.540E-05
CE-143	2.350E-09	1.710E-06	1.910E-10	0.	7.670E-10	0.	5.140E-05
CE-144	6.960E-07	2.880E-07	3.740E-08	0.	1.720E-07	0.	1.750E-04
PR-143	1.310E-08	5.230E-09	6.520E-10	0.	3.040E-09	0.	4.310E-05
PR-144	4.300E-11	1.760E-11	2.180E-12	0.	1.010E-11	0.	4.740E-14
ND-147	9.380E-09	1.020E-08	6.110E-10	0.	5.990E-09	0.	3.680E-05
W -187	1.460E-07	1.190E-07	4.170E-08	0.	0.	0.	3.220E-05
NP-239	1.760E-09	1.660E-10	9.220E-11	0.	5.210E-10	0.	2.670E-05

CONAC SYSTEM # 10

BR-83	0.	0.	1.710E-07	0.	0.	0.	1.000E-24
BR-84	0.	0.	1.980E-07	0.	0.	0.	1.000E-24
BR-85	0.	0.	9.120E-09	0.	0.	0.	1.000E-24
I -131	1.720E-05	1.730E-05	9.830E-06	5.720E-03	2.840E-05	0.	1.540E-06
I -132	8.000E-07	1.470E-06	6.760E-07	6.820E-05	2.250E-06	0.	1.730E-06
I -133	5.920E-06	7.320E-06	2.770E-06	1.360E-03	1.220E-05	0.	2.950E-06
I -134	4.190E-07	7.780E-07	3.580E-07	1.790E-05	1.190E-06	0.	5.160E-07
I -135	1.750E-06	3.150E-06	1.490E-06	2.790E-04	4.830E-06	0.	2.400E-06
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	2.030E-07	2.030E-07	2.030E-07	2.030E-07	2.030E-07	2.030E-07
C -14	1.210E-05	2.420E-06	2.420E-06	2.420E-06	2.420E-06	2.420E-06	2.420E-06
NA-24	5.800E-06	5.800E-06	5.800E-06	5.800E-06	5.800E-06	5.800E-06	5.800E-06
P -32	8.250E-04	3.060E-05	3.180E-05	0.	0.	0.	2.280E-05
CR-51	0.	0.	8.900E-09	4.940E-09	1.350E-09	9.020E-09	4.720E-07
MN-54	0.	1.070E-05	2.850E-06	0.	3.000E-06	0.	8.980E-06
MN-56	0.	3.340E-07	7.540E-08	0.	4.040E-07	0.	4.840E-05
FE-55	1.150E-05	6.100E-06	1.890E-06	0.	0.	3.450E-06	1.130E-06
FE-59	1.650E-05	2.670E-05	1.330E-05	0.	0.	7.740E-06	2.780E-05
CO-58	0.	1.800E-06	5.510E-06	0.	0.	0.	1.050E-05
CO-60	0.	5.290E-06	1.560E-05	0.	0.	0.	2.930E-05
NI-63	5.380E-04	2.880E-05	1.830E-05	0.	0.	0.	1.940E-06
NI-65	2.220E-06	2.090E-07	1.220E-07	0.	0.	0.	2.560E-05
CU-64	0.	2.450E-07	1.480E-07	0.	5.920E-07	0.	1.150E-05
ZN-65	1.370E-05	3.650E-05	2.270E-05	0.	2.300E-05	0.	6.410E-06
ZN-69	4.380E-08	6.330E-08	5.850E-09	0.	3.840E-08	0.	3.990E-06
RB-86	0.	6.700E-05	4.120E-05	0.	0.	0.	4.310E-06
RB-88	0.	1.900E-07	1.320E-07	0.	0.	0.	9.320E-09
RB-89	0.	1.170E-07	1.040E-07	0.	0.	0.	1.020E-09
SR-89	1.320E-03	0.	3.770E-05	0.	0.	0.	5.110E-05
SR-90	1.700E-02	0.	4.310E-03	0.	0.	0.	2.290E-04
SR-91	2.400E-05	0.	9.060E-07	0.	0.	0.	5.300E-05
SR-92	9.030E-06	0.	3.620E-07	0.	0.	0.	1.710E-04
Y -90	4.110E-08	0.	1.100E-09	0.	0.	0.	1.170E-04
Y -91M	3.620E-10	0.	1.390E-11	0.	0.	0.	7.480E-07
Y -91	6.020E-07	0.	1.610E-08	0.	0.	0.	8.020E-05
Y -92	3.600E-09	0.	1.030E-10	0.	0.	0.	1.040E-04
Y -93	1.140E-08	0.	3.130E-10	0.	0.	0.	1.700E-04
ZR-95	1.160E-07	2.550E-08	2.270E-08	0.	3.650E-08	0.	2.660E-05
ZR-97	6.990E-09	1.010E-09	5.960E-10	0.	1.450E-09	0.	1.530E-04
NB-95	2.250E-08	8.760E-09	6.260E-09	0.	8.230E-09	0.	1.620E-05
MO-99	0.	1.330E-05	3.290E-06	0.	2.840E-05	0.	1.100E-05
TC-99M	9.230E-10	1.810E-09	3.000E-08	0.	2.630E-08	9.190E-10	1.030E-06
TC-101	1.070E-09	1.120E-09	1.420E-08	0.	1.910E-08	5.920E-10	3.560E-09
RU-103	7.310E-07	0.	2.810E-07	0.	1.840E-06	0.	1.890E-05
RU-105	6.450E-08	0.	2.340E-08	0.	5.670E-07	0.	4.210E-05
RU-106	1.170E-05	0.	1.460E-06	0.	1.580E-05	0.	1.820E-04
AG110M	5.390E-07	3.640E-07	2.910E-07	0.	6.780E-07	0.	4.330E-05
TE125M	1.140E-05	3.090E-06	1.520E-06	3.200E-06	0.	0.	1.100E-05
TE127M	2.890E-05	7.780E-06	3.430E-06	6.910E-06	8.240E-05	0.	2.340E-05
TE-127	4.710E-07	1.270E-07	1.010E-07	3.260E-07	1.340E-06	0.	1.840E-05
TE129M	4.870E-05	1.360E-05	7.560E-06	1.570E-05	1.430E-04	0.	5.940E-05

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TE-129	1.340E-07	3.740E-08	3.180E-08	9.560E-08	3.920E-07	0.	8.340E-06
TE131M	7.200E-06	2.490E-06	2.650E-06	5.120E-06	2.410E-05	0.	1.010E-04
TE-131	8.300E-08	2.530E-08	2.470E-08	6.350E-08	2.510E-07	0.	4.360E-07
TE-132	1.010E-05	4.470E-06	5.400E-06	6.510E-06	4.150E-05	0.	4.500E-05
CS-134	2.340E-04	3.840E-04	8.100E-05	0.	1.190E-04	4.270E-05	2.070E-06
CS-136	2.350E-05	6.460E-05	4.180E-05	0.	3.440E-05	5.130E-06	2.270E-06
CS-137	3.270E-04	3.130E-04	4.620E-05	0.	1.020E-04	3.670E-05	1.960E-06
CS-138	2.280E-07	3.170E-07	2.010E-07	0.	2.230E-07	2.400E-08	1.460E-07
BA-139	4.140E-07	2.210E-10	1.200E-08	0.	1.930E-10	1.300E-10	2.390E-05
BA-140	8.310E-05	7.280E-08	4.850E-06	0.	2.370E-08	4.340E-08	4.210E-05
BA-141	2.000E-07	1.120E-10	6.510E-09	0.	9.690E-11	6.580E-10	1.140E-07
BA-142	8.740E-08	6.290E-11	4.880E-09	0.	5.090E-11	3.700E-11	1.140E-09
LA-140	1.010E-08	3.530E-09	1.190E-09	0.	0.	0.	9.840E-05
LA-142	5.240E-10	1.670E-10	5.230E-11	0.	0.	0.	3.310E-05
CE-141	3.970E-08	1.980E-08	2.940E-09	0.	8.680E-09	0.	2.470E-05
CE-143	6.990E-09	3.790E-06	5.490E-10	0.	1.590E-09	0.	5.550E-05
CE-144	2.080E-06	6.520E-07	1.110E-07	0.	3.610E-07	0.	1.700E-04
PR-143	3.930E-08	1.180E-08	1.950E-09	0.	6.390E-09	0.	4.240E-05
PR-144	1.290E-10	3.990E-11	6.490E-12	0.	2.110E-11	0.	8.590E-08
ND-147	2.790E-08	2.260E-08	1.750E-09	0.	1.240E-08	0.	3.580E-05
W -187	4.290E-07	2.540E-07	1.140E-07	0.	0.	0.	3.570E-05
NP-239	5.250E-09	3.770E-10	2.650E-10	0.	1.090E-09	0.	2.790E-05

CONAC SYSTEM # 11

BR-83	0.	0.	3.630E-07	0.	0.	0.	1.000E-24
BR-84	0.	0.	3.820E-07	0.	0.	0.	1.000E-24
BR-85	0.	0.	1.940E-08	0.	0.	0.	1.000E-24
I -131	3.590E-05	4.230E-05	1.860E-05	1.390E-02	4.940E-05	0.	1.510E-06
I -132	1.660E-06	3.370E-06	1.200E-06	1.580E-04	3.760E-06	0.	2.730E-06
I -133	1.250E-05	1.820E-05	5.330E-06	3.310E-03	2.140E-05	0.	3.080E-06
I -134	8.690E-07	1.780E-06	6.330E-07	4.150E-05	1.990E-06	0.	1.840E-06
I -135	3.640E-06	7.240E-06	2.640E-06	6.490E-04	8.070E-06	0.	2.620E-06
KR-83M	0.	0.	0.	0.	0.	0.	0.
KR-85M	0.	0.	0.	0.	0.	0.	0.
KR-85	0.	0.	0.	0.	0.	0.	0.
KR-87	0.	0.	0.	0.	0.	0.	0.
KR-88	0.	0.	0.	0.	0.	0.	0.
KR-89	0.	0.	0.	0.	0.	0.	0.
XE131M	0.	0.	0.	0.	0.	0.	0.
XE133M	0.	0.	0.	0.	0.	0.	0.
XE-133	0.	0.	0.	0.	0.	0.	0.
XE135M	0.	0.	0.	0.	0.	0.	0.
XE-135	0.	0.	0.	0.	0.	0.	0.
XE-137	0.	0.	0.	0.	0.	0.	0.
XE-138	0.	0.	0.	0.	0.	0.	0.
XE-139	0.	0.	0.	0.	0.	0.	0.
XE-140	0.	0.	0.	0.	0.	0.	0.
H -3	0.	3.080E-07	3.080E-07	3.080E-07	3.080E-07	3.080E-07	3.080E-07
C -14	2.370E-05	5.060E-06	5.060E-06	5.060E-06	5.060E-06	5.060E-06	5.060E-06
NA-24	1.010E-05	1.010E-05	1.010E-05	1.010E-05	1.010E-05	1.010E-05	1.010E-05
P -32	1.700E-03	1.000E-04	6.590E-05	0.	0.	0.	2.300E-05
CR-51	0.	0.	1.410E-08	9.200E-09	2.010E-09	1.790E-08	4.110E-07
MN-54	0.	1.990E-05	4.510E-06	0.	4.410E-06	0.	7.310E-06
MN-56	0.	8.180E-07	1.410E-07	0.	7.030E-07	0.	7.430E-05
FE-55	1.390E-05	8.980E-06	2.400E-06	0.	0.	4.390E-06	1.140E-06
FE-59	3.080E-05	5.380E-05	2.120E-05	0.	0.	1.590E-05	2.570E-05
CO-58	0.	3.600E-06	8.980E-06	0.	0.	0.	8.970E-06
CO-60	0.	1.080E-05	2.550E-05	0.	0.	0.	2.570E-05
NI-63	6.340E-04	3.920E-05	2.200E-05	0.	0.	0.	1.950E-06
NI-65	4.700E-06	5.320E-07	2.420E-07	0.	0.	0.	4.050E-05
CU-64	0.	6.090E-07	2.820E-07	0.	1.030E-06	0.	1.250E-05
ZN-65	1.840E-05	6.310E-05	2.910E-05	0.	3.060E-05	0.	5.330E-05
ZN-69	9.330E-08	1.680E-07	1.250E-08	0.	6.980E-08	0.	1.370E-05
RB-86	0.	1.700E-04	8.400E-05	0.	0.	0.	4.350E-06
RB-88	0.	4.980E-07	2.730E-07	0.	0.	0.	4.850E-07
RB-89	0.	2.860E-07	1.970E-07	0.	0.	0.	9.740E-08
SR-89	2.510E-03	0.	7.200E-05	0.	0.	0.	5.160E-05
SR-90	1.850E-02	0.	4.710E-03	0.	0.	0.	2.310E-04
SR-91	5.000E-05	0.	1.810E-06	0.	0.	0.	5.920E-05
SR-92	1.920E-05	0.	7.130E-07	0.	0.	0.	2.070E-04
Y -90	8.690E-08	0.	2.330E-09	0.	0.	0.	1.200E-04
Y -91M	8.100E-10	0.	2.760E-11	0.	0.	0.	2.700E-06
Y -91	1.130E-06	0.	3.010E-08	0.	0.	0.	8.100E-05
Y -92	7.650E-09	0.	2.150E-10	0.	0.	0.	1.460E-04
Y -93	2.430E-08	0.	6.620E-10	0.	0.	0.	1.920E-04
ZR-95	2.060E-07	5.020E-08	3.560E-08	0.	5.410E-08	0.	2.500E-05
ZR-97	1.480E-08	2.540E-09	1.160E-09	0.	2.560E-09	0.	1.620E-04
NB-95	4.200E-08	1.730E-08	1.000E-08	0.	1.240E-08	0.	1.460E-05
MO-99	0.	3.400E-05	6.630E-06	0.	5.080E-05	0.	1.120E-05
TC-99M	1.920E-09	3.960E-09	5.100E-08	0.	4.260E-08	2.070E-09	1.150E-06
TC-101	2.270E-09	2.860E-09	2.830E-08	0.	3.400E-08	1.560E-09	4.860E-07
RU-103	1.480E-06	0.	4.950E-07	0.	3.080E-06	0.	1.800E-05
RU-105	1.360E-07	0.	4.580E-08	0.	1.000E-06	0.	5.410E-05
RU-106	2.410E-05	0.	3.010E-06	0.	2.850E-05	0.	1.830E-04
AG110M	9.960E-07	7.270E-07	4.810E-07	0.	1.040E-06	0.	3.770E-05
TE125M	2.330E-05	7.790E-06	3.150E-06	7.840E-06	0.	0.	1.110E-05
TE127M	5.850E-05	1.940E-05	7.080E-06	1.690E-05	1.440E-04	0.	2.360E-05
TE-127	1.000E-06	3.350E-07	2.150E-07	8.140E-07	2.440E-06	0.	2.100E-05
TE129M	1.000E-04	3.430E-05	1.540E-05	3.840E-05	2.500E-04	0.	5.970E-05

CONAC SYSTEM # 11

TE-129	2.840E-07	9.790E-08	6.630E-08	2.380E-07	7.070E-07	0.	2.270E-05
TE131M	1.520E-05	6.120E-06	5.050E-06	1.240E-05	4.210E-05	0.	1.030E-04
TE-131	1.760E-07	6.500E-08	4.940E-08	1.570E-07	4.500E-07	0.	7.110E-06
TE-132	2.080E-05	1.030E-05	9.610E-06	1.520E-05	6.440E-05	0.	3.810E-05
CS-134	3.770E-04	7.030E-04	7.100E-05	0.	1.810E-04	7.420E-05	1.910E-06
CS-136	4.590E-05	1.350E-04	5.040E-05	0.	5.380E-05	1.100E-05	2.050E-06
CS-137	5.220E-04	6.110E-04	4.330E-05	0.	1.640E-04	6.640E-05	1.910E-06
CS-138	4.810E-07	7.820E-07	3.790E-07	0.	3.900E-07	6.090E-08	1.250E-06
BA-139	8.810E-07	5.840E-10	2.550E-08	0.	3.510E-10	3.540E-10	5.580E-05
BA-140	1.710E-04	1.710E-07	8.810E-06	0.	4.060E-08	1.050E-07	4.200E-05
BA-141	4.250E-07	2.910E-10	1.340E-08	0.	1.750E-10	1.770E-10	5.190E-06
BA-142	1.840E-07	1.530E-10	9.060E-09	0.	8.810E-11	9.260E-11	7.590E-07
LA-140	2.110E-08	8.320E-09	2.140E-09	0.	0.	0.	9.770E-05
LA-142	1.100E-09	4.040E-10	9.670E-11	0.	0.	0.	6.860E-05
CE-141	7.870E-08	4.800E-08	5.650E-09	0.	1.480E-08	0.	2.480E-05
CE-143	1.480E-08	9.820E-06	1.120E-09	0.	2.860E-09	0.	5.730E-05
CE-144	2.980E-06	1.220E-06	1.670E-07	0.	4.930E-07	0.	1.710E-04
PR-143	8.130E-08	3.040E-08	4.030E-09	0.	1.130E-08	0.	4.290E-05
PR-144	2.740E-10	1.060E-10	1.380E-11	0.	3.840E-11	0.	4.930E-06
ND-147	5.530E-08	5.680E-08	3.480E-09	0.	2.190E-08	0.	3.600E-05
W -187	9.030E-07	6.280E-07	2.170E-07	0.	0.	0.	3.690E-05
NP-239	1.110E-08	9.930E-10	5.610E-10	0.	1.980E-09	0.	2.870E-05

APPENDIX E
SAMPLE PROBLEM

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **          00000150
CRD NO....2  IACT 1  P 2952  NCOMP 1  RPURGE 1  $                                 00000160
CRD NO....3  NBOOK 1 $ TESTING FOR DATA BOOK WRITEUP                              00000170
CRD NO....4  DIST 800 4000   $ DIST. FOR EA & LPZ IN METERS                       00000180
CRD NO....5  CHIQ(1,1) 2.0-4 *10  $  X/Q FOR EA                                   00000190
CRD NO....6  CHIQ(1,2) 4.0-5 *3 3.0-5 1.3-5 *2 8.0-6 *2 3.0-6 1.5-6 $$ LPZ X/Q    00000200
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NRC CRDA ** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **

NUMBER OF DAMAGED RODS	770.
FRACTIONAL HALOGEN RELEASE	0.103
FRACTIONAL HAL. WASHOUT PLATEOUT IN CONDENSER	0.900
FRACTION HAL RELEASED FROM REACTOR WATER	0.100
REACTOR THERMAL POWER (MWT)	2952.
NUMBER OF BUNDLES	624.
RODS PER BUNDLE	62.
FRACTIONAL NOBLE GAS RELEASED FROM DAMAGED FUEL	0.107

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3	HAL. DCF REM/CI
I-131	9.08E-07	1.90E-01	3.81E-01	2.63E 04	1.59E 03	4.38E-02	9.53E-02	1.49E 06
I-132	8.37E-05	5.01E-01	2.28E 00	3.85E 04	2.33E 03	1.15E-01	5.70E-01	1.43E 04
I-133	9.26E-06	4.10E-01	6.10E-01	5.50E 04	3.33E 03	9.42E-02	1.52E-01	2.69E 05
I-134	2.20E-04	6.10E-01	2.63E 00	6.06E 04	3.67E 03	1.40E-01	6.57E-01	3.73E 03
I-135	2.91E-05	3.68E-01	1.57E 00	5.20E 04	3.15E 03	8.45E-02	3.93E-01	5.60E 04

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3
KR-83M	1.05E-04	3.02E-02	2.58E-03	3.14E 03	1.97E 04	8.78E-03	6.45E-04
KR-85M	4.30E-05	2.55E-01	1.58E-01	6.73E 03	4.23E 04	5.86E-02	3.95E-02
KR-85	2.05E-09	2.51E-01	2.23E-03	3.02E 02	1.89E 03	5.76E-02	5.58E-04
KR-87	1.51E-04	1.33E 00	7.93E-01	1.29E 04	8.11E 04	3.05E-01	1.98E-01
KR-88	6.78E-05	3.50E-01	1.98E 00	1.83E 04	1.15E 05	8.04E-02	4.94E-01
KR-89	3.64E-03	1.31E 00	1.87E 00	2.28E 04	1.43E 05	3.02E-01	4.68E-01
XE131M	6.74E-07	1.42E-01	2.01E-02	1.58E 02	9.94E 02	3.27E-02	5.02E-03
XE133M	3.67E-06	1.90E-01	4.15E-02	2.31E 03	1.45E 04	4.37E-02	1.04E-02
XE-133	1.53E-06	1.35E-01	4.61E-02	5.53E 04	3.47E 05	3.11E-02	1.15E-02
XE135M	7.38E-04	9.58E-02	4.31E-01	1.04E 04	6.54E 04	2.20E-02	1.08E-01
XE-135	2.12E-05	3.17E-01	2.48E-01	7.15E 03	4.49E 04	7.29E-02	6.20E-02
XE-137	3.02E-03	1.78E 00	1.82E-01	4.85E 04	3.05E 05	4.09E-01	4.56E-02
XE-138	8.15E-04	6.30E-01	1.13E 00	4.61E 04	2.90E 05	1.45E-01	2.82E-01

NRC CRDA ** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **

NUMBER OF COMPARTMENTS = 1

	TIME, SEC.	COMPARTMENT NUMBER 1	2	3	4	5
LEAK RATE, % PER DAY	0.	0.	0.	0.	0.	0.
PURGE RATE, % PER DAY	0.	1.000E 00	0.	0.	0.	0.
RECIRC RATE, % PER DAY	0.	0.	0.	0.	0.	0.
LEAK FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.
PURGE FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.
RECIRC FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.47E-04	3.47E-04	3.47E-04	3.47E-04	3.47E-04	3.47E-04	1.75E-04	1.75E-04	2.32E-04	2.32E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC CRDA ** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **

TABLE 15.1.38 ACTIVITY AIRBORNE IN CONDENSER , CURIES

ISOTOPE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
I-131	1.59E 03	1.59E 03	1.59E 03	1.58E 03	1.57E 03	1.54E 03	1.52E 03	1.45E 03	1.08E 03	8.09E 01
I-132	2.32E 03	2.21E 03	1.72E 03	1.27E 03	6.97E 02	2.08E 02	6.23E 01	1.67E 00	6.10E-10	0.
I-133	3.33E 03	3.31E 03	3.22E 03	3.12E 03	2.91E 03	2.54E 03	2.22E 03	1.48E 03	1.31E 02	9.38E-08
I-134	3.62E 03	3.22E 03	1.66E 03	7.54E 02	1.55E 02	6.55E 00	2.77E-01	2.09E-05	0.	0.
I-135	3.14E 03	3.09E 03	2.83E 03	2.55E 03	2.07E 03	1.36E 03	8.90E 02	2.51E 02	1.28E-01	0.
TOTAL I	1.40E 04	1.34E 04	1.10E 04	9.27E 03	7.40E 03	5.66E 03	4.69E 03	3.18E 03	1.22E 03	8.89E 01
KR-83M	1.96E 04	1.85E 04	1.35E 04	9.23E 03	4.32E 03	9.49E 02	2.08E 02	2.20E 00	3.07E-12	0.
KR-85M	4.22E 04	4.12E 04	3.62E 04	3.10E 04	2.27E 04	1.22E 04	6.57E 03	1.02E 03	1.44E-02	0.
KR-85	1.89E 03	1.89E 03	1.89E 03	1.89E 03	1.89E 03	1.89E 03	1.88E 03	1.87E 03	1.82E 03	1.40E 03
KR-87	8.04E 04	7.41E 04	4.70E 04	2.73E 04	9.16E 03	1.03E 03	1.17E 02	1.67E-01	0.	0.
KR-88	1.14E 05	1.10E 05	9.00E 04	7.05E 04	4.32E 04	1.63E 04	6.11E 03	3.25E 02	7.36E-06	0.
KR-89	1.15E 05	1.61E 04	2.87E-01	5.76E-07	0.	0.	0.	0.	0.	0.
XE131M	9.94E 02	9.93E 02	9.91E 02	9.88E 02	9.82E 02	9.71E 02	9.60E 02	9.28E 02	7.56E 02	1.28E 02
XE133M	1.45E 04	1.44E 04	1.43E 04	1.41E 04	1.37E 04	1.30E 04	1.23E 04	1.04E 04	3.92E 03	7.99E-01
XE-133	3.47E 05	3.47E 05	3.45E 05	3.43E 05	3.39E 05	3.31E 05	3.23E 05	3.01E 05	1.97E 05	4.88E 03
XE135M	6.26E 04	4.20E 04	4.59E 03	3.22E 02	1.58E 00	3.81E-05	9.20E-10	0.	0.	0.
XE-135	4.48E 04	4.43E 04	4.16E 04	3.85E 04	3.30E 04	2.43E 04	1.79E 04	7.12E 03	2.84E 01	0.
XE-137	2.54E 05	4.99E 04	5.87E 00	1.13E-04	4.18E-14	0.	0.	0.	0.	0.
XE-138	2.76E 05	1.78E 05	1.54E 04	8.17E 02	2.30E 00	1.83E-05	1.46E-10	0.	0.	0.
TOTAL NG	1.37E 06	9.38E 05	6.11E 05	5.38E 05	4.68E 05	4.02E 05	3.69E 05	3.23E 05	2.03E 05	6.40E 03

NRC CRDA ** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **

TABLE 15.1.38 ACTIVITY RELEASED TO ENVIRONMENT , CURIES

ISOTOPE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
I-131	1.11E-02	1.11E-01	6.63E-01	1.32E 00	2.64E 00	5.23E 00	7.78E 00	1.52E 01	5.29E 01	1.56E 02
I-132	1.61E-02	1.58E-01	8.38E-01	1.46E 00	2.25E 00	2.93E 00	3.13E 00	3.21E 00	3.22E 00	3.22E 00
I-133	2.31E-02	2.31E-01	1.37E 00	2.69E 00	5.20E 00	9.74E 00	1.37E 01	2.28E 01	3.95E 01	4.12E 01
I-134	2.53E-02	2.39E-01	1.06E 00	1.54E 00	1.85E 00	1.93E 00	1.93E 00	1.93E 00	1.93E 00	1.93E 00
I-135	2.18E-02	2.17E-01	1.24E 00	2.36E 00	4.28E 00	7.09E 00	8.93E 00	1.15E 01	1.25E 01	1.25E 01
TOTAL I	9.75E-02	9.54E-01	5.17E 00	9.37E 00	1.62E 01	2.69E 01	3.55E 01	5.46E 01	1.10E 02	2.15E 02
KR-83M	1.36E-01	1.33E 00	6.83E 00	1.15E 01	1.69E 01	2.06E 01	2.14E 01	2.17E 01	2.17E 01	2.17E 01
KR-85M	2.93E-01	2.90E 00	1.63E 01	3.03E 01	5.25E 01	8.08E 01	9.59E 01	1.11E 02	1.14E 02	1.14E 02
KR-85	1.32E-02	1.31E-01	7.89E-01	1.58E 00	3.15E 00	6.30E 00	9.44E 00	1.88E 01	7.42E 01	4.90E 02
KR-87	5.61E-01	5.39E 00	2.61E 01	4.12E 01	5.50E 01	6.12E 01	6.19E 01	6.20E 01	6.20E 01	6.20E 01
KR-88	7.97E-01	7.82E 00	4.25E 01	7.58E 01	1.22E 02	1.68E 02	1.85E 02	1.95E 02	1.96E 02	1.96E 02
KR-89	8.92E-01	4.03E 00	4.54E 00	4.54E 00	4.54E 00	4.54E 00	4.54E 00	4.54E 00	4.54E 00	4.54E 00
XE131M	6.90E-03	6.90E-02	4.13E-01	8.26E-01	1.65E 00	3.27E 00	4.88E 00	9.60E 00	3.48E 01	1.27E 02
XE133M	1.01E-01	1.00E 00	5.99E 00	1.19E 01	2.35E 01	4.57E 01	6.68E 01	1.23E 02	3.23E 02	4.43E 02
XE-133	2.41E 00	2.41E 01	1.44E 02	2.88E 02	5.72E 02	1.13E 03	1.68E 03	3.24E 03	1.06E 04	2.41E 04
XE135M	4.45E-01	3.67E 00	9.54E 00	1.02E 01	1.03E 01	1.03E 01	1.03E 01	1.03E 01	1.03E 01	1.03E 01
XE-135	3.12E-01	3.10E 00	1.80E 01	3.47E 01	6.44E 01	1.12E 02	1.47E 02	2.05E 02	2.44E 02	2.44E 02
XE-137	1.94E 00	9.78E 00	1.17E 01	1.17E 01	1.17E 01	1.17E 01	1.17E 01	1.17E 01	1.17E 01	1.17E 01
XE-138	1.96E 00	1.59E 01	3.89E 01	4.10E 01	4.11E 01	4.11E 01	4.11E 01	4.11E 01	4.11E 01	4.11E 01
TOTAL NG	9.86E 00	7.92E 01	3.26E 02	5.63E 02	9.79E 02	1.70E 03	2.34E 03	4.05E 03	1.17E 04	2.56E 04

NRC CRDA ** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	2.00E-04	1.68E-03	3.42E-04	3.45E-04	6.86E-04
10-MIN	2.00E-04	1.68E-02	2.62E-03	2.24E-03	4.86E-03
1-HOUR	2.00E-04	1.00E-01	9.25E-03	6.21E-03	1.55E-02
2-HOUR	2.00E-04	1.98E-01	1.42E-02	9.18E-03	2.34E-02
4-HOUR	2.00E-04	3.89E-01	2.10E-02	1.35E-02	3.44E-02
8-HOUR	2.00E-04	7.53E-01	2.84E-02	1.95E-02	4.79E-02
12-HR	2.00E-04	9.27E-01	3.23E-02	2.43E-02	5.66E-02
1-DAY	2.00E-04	1.41E 00	3.85E-02	3.61E-02	7.46E-02
4-DAY	2.00E-04	4.22E 00	5.78E-02	8.58E-02	1.44E-01
30-DAY	2.00E-04	1.14E 01	9.13E-02	1.77E-01	2.68E-01

NRC CRDA ** TEST CASE * 2952 MWT * DBA CRDA * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	4.00E-05	3.37E-04	6.84E-05	6.89E-05	1.37E-04
10-MIN	4.00E-05	3.36E-03	5.24E-04	4.46E-04	9.72E-04
1-HOUR	4.00E-05	2.00E-02	1.85E-03	1.24E-03	3.09E-03
2-HOUR	3.00E-05	3.47E-02	2.59E-03	1.69E-03	4.28E-03
4-HOUR	1.30E-05	4.71E-02	3.03E-03	1.97E-03	5.00E-03
8-HOUR	1.30E-05	7.08E-02	3.51E-03	2.36E-03	5.87E-03
12-HR	8.00E-06	7.78E-02	3.67E-03	2.55E-03	6.22E-03
1-DAY	8.00E-06	9.69E-02	3.92E-03	3.02E-03	6.94E-03
4-DAY	3.00E-06	1.39E-01	4.21E-03	3.77E-03	7.98E-03
30-DAY	1.50E-06	1.93E-01	4.46E-03	4.45E-03	8.91E-03

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE * 2952 MWT * DBA LOCA * 30-IV-1981 **        00000220
CRD NO....2  IACT 2  RPURGE 1  FPURGE 99  $$                                    00000230
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NRC LOCA ** TEST CASE * 2952 MWT * DBA LOCA * 30-IV-1981 **

FRACTION HALOGEN RELEASE 0.250
FRACTION NOBLE GAS RELEASE 1.000
REACTOR THERMAL POWER (MWT) 2952.0

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3	HAL. DCF REM/CI
I-131	9.98E-07	1.90E-01	3.81E-01	2.63E 04	1.94E 07	4.38E-02	9.53E-02	1.49E 06
I-132	8.37E-05	5.01E-01	2.28E 00	3.85E 04	2.84E 07	1.15E-01	5.70E-01	1.43E 04
I-133	9.26E-06	4.10E-01	6.10E-01	5.50E 04	4.06E 07	9.42E-02	1.52E-01	2.69E 05
I-134	2.20E-04	6.10E-01	2.63E 00	6.06E 04	4.47E 07	1.40E-01	6.57E-01	3.73E 03
I-135	2.91E-05	3.68E-01	1.57E 00	5.20E 04	3.83E 07	8.45E-02	3.93E-01	5.60E 04

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3
KR-83M	1.05E-04	3.82E-02	2.58E-03	3.14E 03	9.26E 06	8.78E-03	6.45E-04
KR-85M	4.30E-05	2.55E-01	1.58E-01	6.73E 03	1.99E 07	5.86E-02	3.95E-02
KR-85	2.05E-09	2.51E-01	2.23E-03	3.02E 02	8.90E 05	5.76E-02	5.58E-04
KR-87	1.51E-04	1.33E 00	7.93E-01	1.29E 04	3.81E 07	3.05E-01	1.98E-01
KR-88	6.78E-05	3.50E-01	1.98E 00	1.83E 04	5.40E 07	8.04E-02	4.94E-01
KR-89	3.64E-03	1.31E 00	1.87E 00	2.28E 04	6.72E 07	3.02E-01	4.68E-01
XE131M	6.74E-07	1.42E-01	2.01E-02	1.58E 02	4.67E 05	3.27E-02	5.02E-03
XE133M	3.67E-06	1.90E-01	4.15E-02	2.31E 03	6.80E 06	4.37E-02	1.04E-02
XE-133	1.53E-06	1.35E-01	4.61E-02	5.53E 04	1.63E 08	3.11E-02	1.15E-02
XE135M	7.38E-04	9.58E-02	4.31E-01	1.04E 04	3.08E 07	2.20E-02	1.08E-01
XE-135	2.12E-05	3.17E-01	2.48E-01	7.15E 03	2.11E 07	7.29E-02	6.20E-02
XE-137	3.02E-03	1.78E 00	1.82E-01	4.85E 04	1.43E 08	4.09E-01	4.56E-02
XE-138	8.15E-04	6.30E-01	1.13E 00	4.61E 04	1.36E 08	1.45E-01	2.82E-01

NRC LOCA ** TEST CASE * 2952 MWT * DBA LOCA * 30-IV-1981 **

NUMBER OF COMPARTMENTS = 1

	TIME, SEC.	COMPARTMENT NUMBER 1	2	3	4	5
LEAK RATE, % PER DAY	0.	0.	0.	0.	0.	0.
PURGE RATE, % PER.DAY	0.	1.000E 00.	0.	0.	0.	0.
RECIRC RATE, % PER DAY	0.	0.	0.	0.	0.	0.
LEAK FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.
PURGE FILTERS EFFICIENCY, %	0.	9.900E 01	0.	0.	0.	0.
RECIRC FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	1.7E-04	1.7E-04	2.3E-04	2.3E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC LOCA ** TEST CASE * 2952 MWT * DBA LOCA * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	2.00E-04	2.05E-01	1.58E-01	1.61E-01	3.19E-01
10-MIN	2.00E-04	2.05E 00	1.21E 00	1.05E 00	2.25E 00
1-HOUR	2.00E-04	1.22E 01	4.21E 00	2.88E 00	7.09E 00
2-HOUR	2.00E-04	2.41E 01	6.44E 00	4.25E 00	1.07E 01
4-HOUR	2.00E-04	4.74E 01	9.49E 00	6.24E 00	1.57E 01
8-HOUR	2.00E-04	9.18E 01	1.28E 01	9.02E 00	2.18E 01
12-HR	2.00E-04	1.13E 02	1.45E 01	1.12E 01	2.57E 01
1-DAY	2.00E-04	1.71E 02	1.72E 01	1.67E 01	3.39E 01
4-DAY	2.00E-04	5.15E 02	2.58E 01	3.98E 01	6.56E 01
30-DAY	2.00E-04	1.39E 03	4.09E 01	8.24E 01	1.23E 02

NRC LOCA ** TEST CASE * 2952 MWT * DBA LOCA * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	4.00E-05	4.10E-02	3.16E-02	3.23E-02	6.38E-02
10-MIN	4.00E-05	4.10E-01	2.41E-01	2.09E-01	4.50E-01
1-HOUR	4.00E-05	2.44E 00	8.42E-01	5.76E-01	1.42E 00
2-HOUR	3.00E-05	4.23E 00	1.18E 00	7.82E-01	1.96E 00
4-HOUR	1.30E-05	5.74E 00	1.37E 00	9.11E-01	2.29E 00
8-HOUR	1.30E-05	8.62E 00	1.59E 00	1.09E 00	2.68E 00
12-HR	8.00E-06	9.47E 00	1.66E 00	1.18E 00	2.84E 00
1-DAY	8.00E-06	1.18E 01	1.77E 00	1.40E 00	3.16E 00
4-DAY	3.00E-06	1.70E 01	1.90E 00	1.74E 00	3.64E 00
30-DAY	1.50E-06	2.35E 01	2.01E 00	2.06E 00	4.07E 00

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE * 2952 MWT * DBA FUHA * 30-IV-1981 **        00000250
CRD NO....2  IACT 3  RPURGE 3600  FPURGE 99  $$                                 00000260
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NRC FUHA ** TEST CASE * 2952 MWT * DBA FUHA * 30-IV-1981 **

NUMBER OF DAMAGED RODS	101.
FRACTIONAL RELEASE	0.100
FRACTIONAL RELEASE OF KR-85	0.300
HALOGEN DECONTAMINATION FACTOR	0.010
REACTOR THERMAL POWER (MWT)	2952.
NUMBER OF BUNDLES	624.
RODS PER BUNDLE	62.
RADIAL PEAKING FACTOR	1.500

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3	HAL. DCF REM/CI
I-131	9.98E-07	1.90E-01	3.81E-01	2.45E 04	2.83E 02	4.38E-02	9.53E-02	1.49E 06
I-132	8.37E-05	5.01E-01	2.20E 00	3.15E 04	3.65E 02	1.15E-01	5.70E-01	1.43E 04
I-133	9.26E-06	4.10E-01	6.10E-01	2.53E 04	2.92E 02	9.42E-02	1.52E-01	2.69E 05
I-134	2.20E-04	6.10E-01	2.63E 00	1.38E-03	1.60E-05	1.40E-01	6.57E-01	3.73E 03
I-135	2.91E-05	3.68E-01	1.57E 00	4.15E 03	4.80E 01	8.45E-02	3.93E-01	5.60E 04

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3
KR-83M	1.05E-04	3.82E-02	2.58E-03	1.31E 01	1.51E 01	8.78E-03	6.45E-04
KR-85M	4.30E-05	2.55E-01	1.58E-01	1.66E 02	1.92E 02	5.86E-02	3.95E-02
KR-85	2.05E-09	2.51E-01	2.23E-03	3.02E 02	1.05E 03	5.76E-02	5.58E-04
KR-87	1.51E-04	1.33E 00	7.93E-01	2.50E-02	2.99E-02	3.05E-01	1.98E-01
KR-88	6.78E-05	3.50E-01	1.98E 00	4.82E 01	5.57E 01	8.04E-02	4.94E-01
KR-89	3.64E-03	1.31E 00	1.87E 00	6.25E-10	7.22E-10	3.02E-01	4.68E-01
XE131M	6.74E-07	1.42E-01	2.01E-02	1.58E 02	1.83E 02	3.27E-02	5.02E-03
XE133M	3.67E-06	1.90E-01	4.15E-02	2.09E 03	2.42E 03	4.37E-02	1.04E-02
XE-133	1.53E-06	1.35E-01	4.61E-02	5.33E 04	6.16E 04	3.11E-02	1.15E-02
XE135M	7.38E-04	9.58E-02	4.31E-01	6.36E 02	7.35E 02	2.20E-02	1.08E-01
XE-135	2.12E-05	3.17E-01	2.46E-01	1.22E 04	1.41E 04	7.29E-02	6.20E-02
XE-137	3.02E-03	1.78E 00	1.82E-01	1.35E-09	1.56E-09	4.09E-01	4.56E-02
XE-138	8.15E-04	6.30E-01	1.13E 00	1.28E-09	1.48E-09	1.45E-01	2.82E-01

NRC FUHA ** TEST CASE * 2952 MWT * DBA FUHA * 30-IV-1981 **

NUMBER OF COMPARTMENTS = 1

	TIME, SEC.	COMPARTMENT NUMBER 1	2	3	4	5
LEAK RATE, % PER DAY	0.	0.	0.	0.	0.	0.
PURGE RATE, % PER DAY	0.	3.600E 03	0.	0.	0.	0.
RECIRC RATE, % PER DAY	0.	0.	0.	0.	0.	0.
LEAK FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.
PURGE FILTERS EFFICIENCY, %	0.	9.900E 01	0.	0.	0.	0.
RECIRC FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	1.7E-04	1.7E-04	2.3E-04	2.3E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC FUHA ** TEST CASE * 2952 MWT * DBA FUHA * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	2.00E-04	8.70E-03	8.53E-03	1.56E-02	2.41E-02
10-MIN	2.00E-04	7.79E-02	7.56E-02	1.39E-01	2.15E-01
1-HOUR	2.00E-04	2.73E-01	2.58E-01	4.83E-01	7.41E-01
2-HOUR	2.00E-04	3.33E-01	3.11E-01	5.88E-01	8.99E-01
4-HOUR	2.00E-04	3.49E-01	3.25E-01	6.16E-01	9.41E-01
8-HOUR	2.00E-04	3.50E-01	3.26E-01	6.17E-01	9.43E-01
12-HR	2.00E-04	3.50E-01	3.26E-01	6.17E-01	9.43E-01
1-DAY	2.00E-04	3.50E-01	3.26E-01	6.17E-01	9.43E-01
4-DAY	2.00E-04	3.50E-01	3.26E-01	6.17E-01	9.43E-01
30-DAY	2.00E-04	3.50E-01	3.26E-01	6.17E-01	9.43E-01

NRC FUHA ** TEST CASE * 2952 MWT * DBA FUHA * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	4.00E-05	1.74E-03	1.71E-03	3.11E-03	4.82E-03
10-MIN	4.00E-05	1.56E-02	1.51E-02	2.78E-02	4.29E-02
1-HOUR	4.00E-05	5.45E-02	5.15E-02	9.67E-02	1.48E-01
2-HOUR	3.00E-05	6.35E-02	5.96E-02	1.12E-01	1.72E-01
4-HOUR	1.30E-05	6.46E-02	6.05E-02	1.14E-01	1.75E-01
8-HOUR	1.30E-05	6.46E-02	6.05E-02	1.14E-01	1.75E-01
12-HR	8.00E-06	6.46E-02	6.05E-02	1.14E-01	1.75E-01
1-DAY	8.00E-06	6.46E-02	6.05E-02	1.14E-01	1.75E-01
4-DAY	3.00E-06	6.46E-02	6.05E-02	1.14E-01	1.75E-01
30-DAY	1.50E-06	6.46E-02	6.05E-02	1.14E-01	1.75E-01

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE * 2952 MWT * DBA SLBA * 30-IV-1981 **        00000280
CRD NO....2  IACT 4  RPURGE 0  FPURGE 0  $$                                     00000290
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NRC SLBA            ** TEST CASE * 2952 MWT * DBA SLBA * 30-IV-1981 *=

STEAM VOLUME, FT 3                 5220.0
MASS RELEASED FROM BREAK , LBS.
    -LIQUID                       76500.0
    -STEAM                        19400.0
STEAM SPECIFIC VOLUME, FT 3/LBM      0.42220
STEAM CARRYOVER FRACTION             0.02000
NRC RELEASE RATE FACTOR              3.0
SUM OF NOBLE GAS CONTRIBUTIONS      99.9358


   IODINE RELEASED TO THE ENVIRONMENT BASED ON
   THE COOLANT CONCENTRATION AND THE MASS OF EQUIVALENT
   LIQUID RELEASED. THE MASS OF EQUIVALENT LIQUID RELEASED
   IS BASED ON THE FOLLOWING CONDITIONS

        - INITIAL LIQUID RELEASE , LBS                  =  76500.0
        - LIQUID FLASHED TO STEAM DURING BLOWDOWN, LBS  =   7036.2
        - CARRYOVER EQUIVALENT , LBS                    =    247.3

        TOTAL EQUIVALENT LIQUID RELEASED , LBS          =  83783.5     (  3.8004E 07 GRAMS)

BASE OFFGAS RELEASE RATE, CI/SEC                   0.45
VALVE CLOSURE TIME, SEC                            5.50
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NRC SLBA ** TEST CASE * 2952 MWT * DBA SLBA * 30-IV-1981 **

ISOTOPE	BETA ENG. MEV/DIS	GAMMA ENG. MEV/DIS	COOLANT CONC. (UCI/G)	PERCENT NOBLE GAS
I-131	1.90E-01	3.81E-01	7.3E-02	
I-132	5.01E-01	2.28E 00	7.1E-01	
I-133	4.10E-01	6.10E-01	5.0E-01	
I-134	6.10E-01	2.63E 00	1.4E 00	
I-135	3.68E-01	1.57E 00	7.3E-01	
KR-83M	3.82E-02	2.58E-03		9.36E-01
KR-85M	2.55E-01	1.58E-01		1.64E 00
KR-85	2.51E-01	2.23E-03		6.40E-03
KR-87	1.33E 00	7.93E-01		5.11E 00
KR-88	3.50E-01	1.98E 00		5.24E 00
KR-89	1.31E 00	1.87E 00		2.18E 01
XE131M	1.42E-01	2.01E-02		5.23E-03
XE133M	1.90E-01	4.15E-02		7.82E-02
XE-133	1.35E-01	4.61E-02		2.19E 00
XE135M	9.58E-02	4.31E-01		6.41E 00
XE-135	3.17E-01	2.48E-01		5.92E 00
XE-137	1.78E 00	1.82E-01		2.88E 01
XE-138	6.30E-01	1.13E 00		2.18E 01

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	1.7E-04	1.7E-04	2.3E-04	2.3E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC SLBA ** TEST CASE * 2952 MWT * DBA SLBA * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	2.00E-04	7.90E-01	1.32E-02	3.33E-03	1.65E-02

NRC SLBA ** TEST CASE * 2952 MWT * DBA SLBA * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	1.00E-05	1.58E-01	2.64E-03	6.65E-04	3.31E-03

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE FOR FAEL * 2952 MWT * SRP FAEL * 30-IV-1981 *     00000310
CRD NO....2  IACT 5  $$                                                              00000320
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NRC FAEL ** TEST CASE FOR FAEL * 2952 MWT * SRP FAEL * 30-IV-1981 *

IODINE CARRY-OVER FRACTION = 2.00E-02

CONDENSER DECONTAMINATION FRACT. = 7.20E-03

BASE OFFGAS RELEASE RATE , UCI/S = 4.50E-01

STEAM FLOW RATE , LB/HR = 1.25E 07

TIME TO ISOLATE , MIN. = 1.00E 01

ISOTOPE	BETA ENG. MEV/DIS	GAMMA ENG. MEV/DIS	COOLANT CONC. (UCI/G)	PERCENT NOBLE GAS
I-131	1.90E-01	3.81E-01	7.3E-02	
I-132	5.01E-01	2.28E 00	7.1E-01	
I-133	4.10E-01	6.10E-01	5.0E-01	
I-134	6.10E-01	2.63E 00	1.4E 00	
I-135	3.68E-01	1.57E 00	7.3E-01	
KR-83M	3.82E-02	2.58E-03		9.36E-01
KR-85M	2.55E-01	1.58E-01		1.64E 00
KR-85	2.51E-01	2.23E-03		6.40E-03
KR-87	1.33E 00	7.93E-01		5.11E 00
KR-88	3.50E-01	1.98E 00		5.24E 00
KR-89	1.31E 00	1.87E 00		2.18E 01
XE131M	1.42E-01	2.01E-02		5.23E-03
XE133M	1.90E-01	4.15E-02		7.82E-02
XE-133	1.35E-01	4.61E-02		2.19E 00
XE135M	9.58E-02	4.31E-01		6.41E 00
XE-135	3.17E-01	2.48E-01		5.92E 00
XE-137	1.78E 00	1.82E-01		2.88E 01
XE-138	6.30E-01	1.13E 00		2.18E 01

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	1.7E-04	1.7E-04	2.3E-04	2.3E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC FAEL ** TEST CASE FOR FAEL * 2952 MWT * SRP FAEL * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	2.00E-04	2.82E-03	1.21E-02	1.31E-02	2.53E-02

NRC FAEL ** TEST CASE FOR FAEL * 2952 MWT * SRP FAEL * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM).

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	4.00E-05	5.63E-04	2.43E-03	2.62E-03	5.05E-03

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE FOR FLBA * 2952 MWT * SRP FLBA * 30-IV-1981 *     00000340
CRD NO....2  IACT 6  SMASS 500000 $$ TOTAL WATER RELEASED , LBS                      00000350
```

NRC FLBA ** TEST CASE FOR FLBA * 2952 MWT * SRP FLBA * 30-IV-1981 *

TOTAL LIQUID & STEAM RELEASED,LB.= 5.00E 05

DEMINERALIZER EFFICIENCY , FRACT.= 9.00E-01

FRACTION OF TOTAL MASS FILTERED = 1.00E 00

FRACTION OF NON-FLASHED LIQUID = 8.00E-01

FRACTION OF LIQ. FLASHED TO STEAM= 2.00E-01

EQUIVALENT MASS RELEASED , GRAM = 1.91E 07

IODINE CARRY-OVER FRACTION = 2.00E-02

IODINE PLATE-OUT FRACTION = 5.00E-01

ISOTOPE	BETA ENG. MEV/DIS	GAMMA ENG. MEV/DIS	COOLANT CONC. (UCI/G)	PERCENT NOBLE GAS
I-131	1.90E-01	3.81E-01	7.3E-02	
I-132	5.01E-01	2.28E 00	7.1E-01	
I-133	4.10E-01	6.10E-01	5.0E-01	
I-134	6.10E-01	2.63E 00	1.4E 00	
I-135	3.68E-01	1.57E 00	7.3E-01	

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	1.7E-04	1.7E-04	2.3E-04	2.3E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC FLBA ** TEST CASE FOR FLBA * 2952 MWT * SRP FLBA * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	2.00E-04	3.96E-03	1.22E-02	1.31E-02	2.53E-02

NRC FLBA ** TEST CASE FOR FLBA * 2952 MWT * SRP FLBA * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	4.00E-05	7.92E-04	2.43E-03	2.62E-03	5.06E-03

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE FOR ILBA * 2952 MWT * SRP ILBA * 30-IV-1981 *    00000370
CRD NO....2  IACT 7  RPURGE 100  FPURGE 99  NCOMP 1  $$                             00000380
```

NRC ILBA ** TEST CASE FOR ILBA * 2952 MWT = SRP ILBA * 30-IV-1981 *

WATER INVENTORY (LBS) = 4.47E 05

IODINE PLATEOUT FRAC. = 5.00E-01

SPIKING ACTIVITY RELATIVE TO I-131

RATIO FOR I-131 = 1.00E 00
RATIO FOR I-132 = 9.70E 00
RATIO FOR I-133 = 6.80E 00
RATIO FOR I-134 = 1.88E 01
RATIO FOR I-135 = 1.00E 01

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3	HAL. DCF REM/CI
I-131	9.99E-07	1.90E-01	3.81E-01	0.	1.39E-02	4.38E-02	9.53E-02	1.49E 05
I-132	8.37E-05	5.01E-01	2.28E 00	0.	1.35E-01	1.15E-01	5.70E-01	1.43E 04
I-133	9.26E-06	4.10E-01	6.10E-01	0.	9.53E-02	9.42E-02	1.52E-01	2.69E 05
I-134	2.20E-04	6.10E-01	2.63E 00	0.	2.67E-01	1.40E-01	6.57E-01	3.73E 03
I-135	2.91E-05	3.68E-01	1.57E 00	0.	1.39E-01	8.45E-02	3.93E-01	5.60E 04

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3
KR-83M	1.05E-04	3.82E-02	2.58E-03	0.	2.53E 00	8.78E-03	6.45E-04
KR-85M	4.30E-05	2.55E-01	1.58E-01	0.	4.43E 00	5.86E-02	3.95E-02
KR-85	2.05E-09	2.51E-01	2.23E-03	0.	1.73E-02	5.76E-02	5.58E-04
KR-87	1.51E-04	1.33E 00	7.93E-01	0.	1.38E 01	3.05E-01	1.98E-01
KR-88	6.78E-05	3.50E-01	1.98E 00	0.	1.41E 01	8.04E-02	4.94E-01
KR-89	3.64E-03	1.31E 00	1.87E 00	0.	5.89E 01	3.02E-01	4.68E-01
XE131M	6.74E-07	1.42E-01	2.01E-02	0.	1.41E-02	3.27E-02	5.02E-03
XE133M	3.67E-06	1.90E-01	4.15E-02	0.	2.11E-01	4.37E-02	1.04E-02
XE-133	1.53E-06	1.35E-01	4.61E-02	0.	5.91E 00	3.11E-02	1.15E-02
XE135M	7.38E-04	9.58E-02	4.31E-01	0.	1.73E 01	2.20E-02	1.08E-01
XE-135	2.12E-05	3.17E-01	2.48E-01	0.	1.60E 01	7.29E-02	6.20E-02
XE-137	5.01E-03	1.78E 00	1.82E-01	0.	7.78E 01	4.09E-01	4.56E-02
XE-138	6.15E-04	6.30E-01	1.13E 00	0.	5.89E 01	1.45E-01	2.82E-01

NRC ILBA ** TEST CASE FOR ILBA * 2952 MWT * SRP ILBA * 30-IV-1981 *

NUMBER OF COMPARTMENTS = 1

	TIME, SEC.	COMPARTMENT NUMBER 1	2	3	4	5
LEAK RATE, % PER DAY	0.	0.	0.	0.	0.	0.
PURGE RATE, % PER DAY	0.	1.000E 02	0.	0.	0.	0.
RECIRC RATE, % PER DAY	0.	0.	0.	0.	0.	0.
LEAK FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.
PURGE FILTERS EFFICIENCY, %	0.	9.900E 01	0.	0.	0.	0.
RECIRC FILTERS EFFICIENCY, %	0.	0.	0.	0.	0.	0.

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	1.7E-04	1.7E-04	2.3E-04	2.3E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC ILBA ** TEST CASE FOR ILBA * 2952 MWT * SRP ILBA * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	2.00E-04	2.85E-08	7.90E-06	8.43E-06	1.63E-05
10-MIN	2.00E-04	3.77E-07	5.28E-05	4.95E-05	1.02E-04
1-HOUR	2.00E-04	5.22E-06	1.47E-04	1.07E-04	2.54E-04
2-HOUR	2.00E-04	1.72E-05	2.06E-04	1.41E-04	3.47E-04
4-HOUR	2.00E-04	5.93E-05	2.79E-04	1.81E-04	4.60E-04
8-HOUR	2.00E-04	2.05E-04	3.48E-04	2.20E-04	5.69E-04
12-HR	2.00E-04	3.11E-04	3.76E-04	2.41E-04	6.17E-04
1-DAY	2.00E-04	7.39E-04	4.04E-04	2.68E-04	6.71E-04
4-DAY	2.00E-04	5.86E-03	4.40E-04	2.91E-04	7.31E-04
30-DAY	2.00E-04	5.31E-02	6.84E-04	3.64E-04	1.05E-03

NRC ILBA ** TEST CASE FOR ILBA * 2952 MWT * SRP ILBA * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
1-MIN	4.00E-05	5.70E-09	1.58E-06	1.69E-06	3.27E-06
10-MIN	4.00E-05	7.53E-08	1.06E-05	9.90E-06	2.05E-05
1-HOUR	4.00E-05	1.04E-06	2.94E-05	2.14E-05	5.09E-05
2-HOUR	3.00E-05	2.84E-06	3.83E-05	2.65E-05	6.47E-05
4-HOUR	1.30E-05	5.57E-06	4.31E-05	2.91E-05	7.21E-05
8-HOUR	1.30E-05	1.50E-05	4.75E-05	3.16E-05	7.92E-05
12-HR	8.00E-06	1.93E-05	4.87E-05	3.25E-05	8.11E-05
1-DAY	8.00E-06	3.72E-05	4.97E-05	3.35E-05	8.33E-05
4-DAY	3.00E-06	1.14E-04	5.03E-05	3.39E-05	8.42E-05
30-DAY	1.50E-06	4.68E-04	5.21E-05	3.44E-05	8.65E-05

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE FOR LRTA * 2952 MWT * SRP LRTA * 30-IV-1981 *     00000400
CRD NO....2  SA(1,8) 2.5 6.2-3 0.15 1.0-6 7.3-3 $ BWR-6 GESSAR II VALUES (238)       00000410
CRD NO....3  IACT 8  NT 1  NTANK  7HCON. WT $$ REALISTIC CASE                        00000420
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NRC LRTA ** TEST CASE FOR LRTA * 2952 MWT * SRP LRTA * 30-IV-1981 *

FRACTION OF IODINE RELEASED = 0.10

DISTANCE,M 800.0 4000.0

TIME	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
BREATHING RATE,M**3/SEC	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	3.5E-04	1.7E-04	1.7E-04	2.3E-04	2.3E-04

INPUT CHIQ, SEC/M**3

DISTANCE	1-MIN	10-MIN	1-HOUR	2-HOUR	4-HOUR	8-HOUR	12-HR	1-DAY	4-DAY	30-DAY
800.	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04	2.00E-04
4000.	4.00E-05	4.00E-05	4.00E-05	3.00E-05	1.30E-05	1.30E-05	8.00E-06	8.00E-06	3.00E-06	1.50E-06

BUILDING CROSS SECTION,M**2 0.

HEIGHT,M 0.

NRC LRTA ** TEST CASE FOR LRTA * 2952 MWT * SRP LRTA * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	2.00E-04	2.72E-02	1.21E-02	1.31E-02	2.52E-02

NRC LRTA ** TEST CASE FOR LRTA * 2952 MWT * SRP LRTA * 30-IV-1981 *

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	4.00E-05	5.43E-03	2.42E-03	2.62E-03	5.04E-03

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE FOR OGSA * N-66 OFF-GAS * 30-IV-1981 **        00000440
CRD NO....2  IACT 9  NSYS  2  1  $$ N-66 OFFGAS & ADULT DCF                        00000450
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NRC OGSA ** TEST CASE FOR OOSA * N-66 OFF-GAS * 30-IV-1981 **

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*************************************
**  THIS IS A GE N-66 OFFGAS SYSTEM **
**  AND ADULT DCF FROM R.G. 1.109   **
*************************************
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ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3	HAL. DCF REM/CI
I-131	9.98E-07	1.90E-01	3.81E-01	0.	3.36E-03	4.38E-02	9.53E-02	1.49E 06
I-132	8.37E-05	5.01E-01	2.28E 00	0.	4.27E-02	1.15E-01	5.70E-01	1.43E 04
I-133	9.26E-06	4.10E-01	6.10E-01	0.	2.49E-02	9.42E-02	1.52E-01	2.69E 05
I-134	2.20E-04	6.10E-01	2.63E 00	0.	7.91E-02	1.40E-01	6.57E-01	3.73E 03
I-135	2.91E-05	3.68E-01	1.57E 00	0.	3.99E-02	8.45E-02	3.93E-01	5.60E 04

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3
KR-83M	1.05E-04	3.82E-02	2.58E-03	0.	1.41E 01	8.78E-03	6.45E-04
KR-85M	4.30E-05	2.55E-01	1.58E-01	0.	4.68E 01	5.86E-02	3.95E-02
KR-85	2.05E-09	2.51E-01	2.23E-03	0.	8.11E-01	5.76E-02	5.58E-04
KR-87	1.51E-04	1.33E 00	7.93E-01	0.	6.05E 01	3.05E-01	1.98E-01
KR-88	6.78E-05	3.50E-01	1.98E 00	0.	1.04E 02	8.04E-02	4.94E-01
KR-89	3.64E-03	1.31E 00	1.87E 00	0.	4.35E 02	3.02E-01	4.68E-01
XE131M	6.74E-07	1.42E-01	2.01E-02	0.	1.40E 01	3.27E-02	5.02E-03
XE133M	3.67E-06	1.90E-01	4.15E-02	0.	2.36E 01	4.37E-02	1.04E-02
XE-133	1.53E-06	1.35E-01	4.61E-02	0.	1.52E 03	3.11E-02	1.15E-02
XE135M	7.38E-04	9.58E-02	4.31E-01	0.	6.45E 01	2.20E-02	1.08E-01
XE-135	2.12E-05	3.17E-01	2.48E-01	0.	1.63E 02	7.29E-02	6.20E-02
XE-137	3.02E-03	1.78E 00	1.82E-01	0.	5.16E 02	4.09E-01	4.56E-02
XE-138	8.15E-04	6.30E-01	1.13E 00	0.	2.53E 02	1.45E-01	2.82E-01

NRC OGSA ** TEST CASE FOR OGSA * N-66 OFF-GAS * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	2.00E-04	1.02E-03	4.04E-02	4.21E-02	8.25E-02

TABLE 15.7-5

DESIGN BASIS ANALYSIS

GASEOUS RADWASTE SYSTEM ACCIDENT

OFF-SITE RADIOLOGICAL EFFECTS (REM)

DISTANCE = 8.00E 02 (M) , X/Q = 2.00E-04 (SEC/M3)

	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
HALOGEN	4.40E-06	9.05E-06	3.35E-06	1.03E-03	1.50E-05	0.	4.08E-06
NOBLE GAS			4.04E-02*				
OTHER	7.83E-06	2.20E-05	1.13E-05	7.19E-09	1.44E-07	2.74E-05	7.66E-06
TOTAL	1.22E-05	3.10E-05	4.04E-02	1.03E-03	1.52E-05	2.74E-05	1.17E-05

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*DECAY IN FLIGHT ACCOUNTED FOR

NRC OGSA ** TEST CASE FOR OGSA * N-66 OFF-GAS * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	4.00E-05	2.00E-04	3.94E-03	3.67E-03	7.61E-03

TABLE 15.7-5

DESIGN BASIS ANALYSIS

GASEOUS RADWASTE SYSTEM ACCIDENT

OFF-SITE RADIOLOGICAL EFFECTS (REM)

DISTANCE = 4.00E 03 (M) , X/Q = 4.00E-05 (SEC/M3)

	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
HALOGEN	8.80E-07	1.81E-06	6.71E-07	2.06E-04	3.01E-06	0.	8.16E-07
NOBLE GAS			3.94E-03*				
OTHER	1.57E-06	4.40E-06	2.26E-06	1.44E-09	2.87E-08	5.48E-06	1.53E-06
TOTAL	2.45E-06	6.21E-06	3.95E-03	2.06E-04	3.04E-06	5.48E-06	2.35E-06

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*DECAY IN FLIGHT ACCOUNTED FOR

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DTA CALL NO.....1              INPUT EDITS

CRD NO....1  TITLE 60H** TEST CASE FOR OGSA * N-64 OFF-GAS * 30-IV-1981 **        00000470
CRD NO....2  IACT 9  NSYS 1  1  $ N-64 OFFGAS & ADULT DCF                          00000480
CRD NO....3  IFC 1  WSPD 2 *10  PERSIS 1 *10 $$ FINITE CLOUD & PASQUILL F          00000490
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NRC OGSA ** TEST CASE FOR OGSA * N-64 OFF-GAS * 30-IV-1981 **

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**************************************
**  THIS IS A GE N-64 OFFGAS SYSTEM **
**  AND ADULT DCF FROM  R.G. 1.109  **
**************************************
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ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3	HAL. DCF REM/CI
I-131	9.98E-07	1.90E-01	3.81E-01	0.	3.38E-03	4.38E-02	9.53E-02	1.49E 06
I-132	8.37E-05	5.01E-01	2.28E 00	0.	4.32E-02	1.15E-01	5.70E-01	1.43E 04
I-133	9.26E-06	4.10E-01	6.10E-01	0.	2.48E-02	9.42E-02	1.52E-01	2.69E 05
I-134	2.20E-04	6.10E-01	2.63E 00	0.	7.90E-02	1.40E-01	6.57E-01	3.73E 03
I-135	2.91E-05	3.68E-01	1.57E 00	0.	3.97E-02	8.45E-02	3.93E-01	5.60E 04

ISOTOPE	LAMBDA 1/SEC	BETA ENERGY MEV/DIS	GAM. ENERGY MEV/DIS	SPECIFIC ACT CI/MWT	AIRBORNE ACT CI	BETA DCF REM/SEC-CI/M**3	GAMMA DCF REM/SEC-CI/M**3
KR-83M	1.05E-04	3.82E-02	2.58E-03	0.	7.25E 01	8.78E-03	6.45E-04
KR-85M	4.30E-05	2.55E-01	1.58E-01	0.	1.28E 02	5.86E-02	3.95E-02
KR-85	2.05E-09	2.51E-01	2.23E-03	0.	9.73E-02	5.76E-02	5.58E-04
KR-87	1.51E-04	1.33E 00	7.93E-01	0.	3.29E 02	3.05E-01	1.98E-01
KR-88	6.78E-05	3.50E-01	1.98E 00	0.	4.00E 02	8.04E-02	4.94E-01
KR-89	3.64E-03	1.31E 00	1.87E 00	0.	6.00E 02	3.02E-01	4.68E-01
XE131M	6.74E-07	1.42E-01	2.01E-02	0.	7.27E-01	3.27E-02	5.02E-03
XE133M	3.67E-06	1.90E-01	4.15E-02	0.	7.43E 00	4.37E-02	1.04E-02
XE-133	1.53E-06	1.35E-01	4.61E-02	0.	1.81E 02	3.11E-02	1.15E-02
XE135M	7.38E-04	9.58E-02	4.31E-01	0.	2.26E 02	2.20E-02	1.08E-01
XE-135	2.12E-05	3.17E-01	2.48E-01	0.	5.34E 02	7.29E-02	6.20E-02
XE-137	3.02E-03	1.78E 00	1.82E-01	0.	7.65E 02	4.09E-01	4.56E-02
XE-138	8.15E-04	6.30E-01	1.13E 00	0.	7.23E 02	1.45E-01	2.82E-01

NRC OGSA ** TEST CASE FOR OGSA * N-64 OFF-GAS * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 800.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	4.37E-04	2.24E-03	4.73E-02	1.72E-01	2.19E-01

```
*************************************
****  THIS IS A FINITE CLOUD MODEL  ***
*************************************
```

METEOROLOGICAL DATA FOR THE FINITE CLOUD

RELEASE HEIGHT (METERS) =	0.										
PASQUILL STABILITY CLASS =	6	6	6	6	6	6	6	6	6	6
WIND SPEEDS (M/SEC) =	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PERSISTANCIES (FRACTION) =	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

TABLE 15.7-5

DESIGN BASIS ANALYSIS

GASEOUS RADWASTE SYSTEM ACCIDENT

OFF-SITE RADIOLOGICAL EFFECTS (REM)

DISTANCE = 8.00E 02 (M) , X/Q = 4.37E-04 (SEC/M3)

	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
HALOGEN	9.62E-06	1.98E-05	7.33E-06	2.25E-03	3.28E-05	0.	8.89E-06
NOBLE GAS			4.73E-02*				
OTHER	1.41E-05	3.42E-05	1.82E-05	7.91E-08	1.58E-05	1.83E-05	8.57E-06
TOTAL	2.37E-05	5.39E-05	4.73E-02	2.25E-03	4.86E-05	1.83E-05	1.75E-05

---

*DECAY IN FLIGHT ACCOUNTED FOR

NRC OGSA ** TEST CASE FOR OGSA * N-64 OFF-GAS * 30-IV-1981 **

RADIOLOGICAL EFFECT (REM)

DISTANCE 4000.M

TIME	X/Q (SEC/M3)	THYROID	WHOLE BODY	BETA	SKIN
TOTAL	3.84E-05	1.91E-04	4.55E-03	6.73E-03	1.13E-02

```
****************************************
****  THIS IS A FINITE CLOUD MODEL  ***
****************************************
```

METEOROLOGICAL DATA FOR THE FINITE CLOUD

RELEASE HEIGHT (METERS) =	0.										
PASQUILL STABILITY CLASS =	6	6	6	6	6	6	6	6	6	6
WIND SPEEDS (M/SEC) =	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
PERSISTANCIES (FRACTION) =	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

TABLE 15.7-5

DESIGN BASIS ANALYSIS

GASEOUS RADWASTE SYSTEM ACCIDENT

OFF-SITE RADIOLOGICAL EFFECTS (REM)

DISTANCE = 4.00E 03 (M) , X/Q = 3.84E-05 (SEC/M3)

	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
HALOGEN	8.43E-07	1.73E-06	6.43E-07	1.93E-04	2.98E-06	0.	7.80E-07
NOBLE GAS			4.55E-03*				
OTHER	1.24E-06	3.00E-06	1.60E-06	6.94E-09	1.38E-06	1.60E-06	7.52E-07
TOTAL	2.06E-06	4.73E-06	4.55E-03	1.98E-04	4.26E-06	1.60E-06	1.53E-06

---

*DECAY IN FLIGHT ACCOUNTED FOR

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TITLE PAGE

AUTHOR	SUBJECT	TIE NUMBER
H.A.Careway, Van-Dat Nguyen, P.P.Stancavage	730	81NED332
		DATE February 1982
TITLE Radiological Accident Evaluation - The CONAC03 Code		GE CLASS I
		GOVERNMENT CLASS
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SUMMARY

Current NRC regulatory requirements and regulatory guides define methods and dose limits acceptable to the NRC relative to design basis accidents. To simplify radiological calculations required to fulfill these guides as well as to provide accurate results, a computer program, CONAC03 has been developed by GE. The purpose of this report is to describe the models, assumptions, and conditions applicable to this program as well as to provide a sample problem and input requirements.

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By cutting out this rectangle and folding in half, the above information can be fitted into a standard card file.

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