Docket Number 50-397

February 26, 1986

Mr. Conrad Sherman
U.S. Nuclear Regulatory Commission
1450 Maria Lane
Suite 210
Walnut Creek, CA 94596

Dear Mr. Sherman:

Subject: DESIGN DOCUMENT FOR EMERGENCY DOSE PROJECTION SYSTEM (EDPS)

In response to your telephone request of G. V. Oldfield for emergency
source term calculational methodology, we are enclosing a portion of
the design document for our Emergency Dose Projection System (EDPS).
It describes the methods used to calculate the reactor building source
term based upon elevated release point (ERP) high range monitor read-
ings.

The calculational method initially assumes a design basis analysis
mixture of fission products in the reactor building (FSAR Table 15.6-13).
This mixture may be modified if grab sample analysis results are
available. The EDPS program corrects the mixture for decay from the
time of reactor shutdown then calculates the ERP monitor response to
that mixture using nuclide specific calibration factors. The actual
ERP monitor reading is divided by the calculated response to generate
a normalization factor. The design basis concentrations are multiplied
by the normalization factor to calculate actual release concentrations.
Release concentrations are multiplied by the flow rate to determine
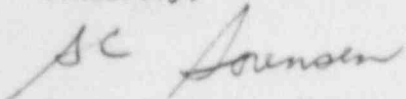release rate.

Mr. Conrad Sherman
Page 2
February 26, 1986
Docket Number 50-397

Similar calculational methods are used to calculate source terms from
other monitor readings (intermediate and low level) in the reactor,
turbine generator, and radwaste buildings. If you have any questions
concerning these methods, please feel free to contact Mr. Oldfield.

Sincerely,

G. C. Sorensen, Manager
Regulatory Programs

GVO/pm

Enclosure

DESIGN OF SUBROUTINE PREDCAL IN EDPS

1. Tables are defined the same as in the CALC phantom in EDPS. They are:

    Activity in Containment (FSAR Table 15.6-11)

    a.   Design Base Analysis (Ci)

    b.   Half-life (min)

    LOCA

    c.   Elevated Release Point Location Monitor Calibration Factor (R/Hr per Ci/m^3)

    d.   Wole Body Dose Factor (R/Hr per Ci/m^3)

    e.   Thyroid Dose Factor (R/Hr per Ci/m^3)

2. If both Met and Effluent are not in predictive mode, write an error message
    and return.

3. Zero out predictive effluent arrays.

4. Read in predictive effluent arrays that were stored with user's responses.

5. If source term for all three buildings < 0.001, write an error message
    and return.

6. Get times in minutes as entered by the user.

    a.   Elapsed time is decay time (time from reactor shutdown until release).

    b.   Delay time is the duration of the release.

7. Replace the values for the iodines in the DBA table with grab sample values.
    If there were predictive grab samples read in, use those; otherwise, use
    manual ones.

8. Calculate D(I) = Decayed activity in primary containment of Ith nuclide.

    Using the formula:

    $$D(I) = A(I) \ e^{-0.693M/T(I)}$$

    Where:

    A(I) = Initial airborne activity of nuclide I (from Design Base Analysis
         Table)
    M =   Elapsed time (min.)   ← *Time to start of release from reactor*
                                                shutdown
    T(I) = Half life of Nuclide I in minutes

    If $^M/T(I) > 50$, Set D(I) = 0

9. Calculate $C(I)$ = concentration of Ith nuclide in, ~secondary~ containment

   Using the formula:

   $$C(I) = D(I) \times 9.10 \times 10^{-6} \;(^{Ci}/m^3)$$

10. Calculate contribution to measured exposure rate in elevated release duct from nuclide I at concentration $C(I)$. In case of iodines, concentration in duct will be reduced by SGTS.

    $$C(I) \text{ duct} = C(I) \text{ containment} \times (1-0.01S)$$

    Where S = % removed by SGTS (either 0 or 99.7)

11. Calculate $E(I)$ = exposure rate calculated at the ERP Monitor resulting from Nuclide I in R/Hr

    Using the formula:

    $$E(I) = C(I)_{duct} \times F(I)$$

    Where $F(I)$ is from the Calibration Factor table.

12. The total exposure rate calculated at the ERP Monitor (x) would be given by:

    $$x = \sum_{I=1}^{18} E(I)$$

13. Make determination whether to use high or intermediate range monitor for reactor building. Use intermediate range if its reading ≤100 and high range reading ≤.5. Otherwise, use high range.

    a. If high range (ion chamber) used,

       The actual exposure rate measured by the ERP Monitor (R) is divided by the calculated exposure rate to determine a normalization factor (N).

       $$N = {^R}/X$$

       The source term for each nuclide, $Q(I)$, is calculated by multiplying $C(I)_{duct}$ by the flow rate, G, and the normalization factor, N.

       $$Q(I) \;^{Ci}/sec. = C(I) \;^{Ci}/m^3 \times G^{ft.^3}/min. \times N \times 4.72 \times 10^{-4} \;\frac{m^3 \; min}{ft.^3 \; sec}$$

DESIGN OF CALC PHANTOM IN EDPS

1. The following tables are defined:

Nuclide	Design Base Analysis (Ci)	Half-Life (Min)	ERP Loc. Mon. Calib. Fact. (R/Hr per Ci/M³)	Whole Body Dose Factor (R/Hr per Ci/m³)	Thyroid Dose Factor (R/Hr per Ci/m³)
I-131	2.2 E+7	1.21 E+4	3.35	242	3.42 E+6
I-132	3.3 E+7	137.0	24.4	1.43 E+3	4.08 E+4
I-133	4.9 E+7	1.25 E+3	4.0	383	8.11 E+5
I-134	5.6 E+7	52.5	21.9	1.65 E+3	1.07 E+4
I-135	4.4 E+7	397.	14.9	1.04 E+3	1.67 E+5
Kr-83M	1.4 E+7	110.	9.94E-9	8.62 E-3	0
Kr-85M	4.5 E+7	269.0	1.23	133	0
Kr-85	1.4 E+6	5.63 E+6	0.0254	1.84	0
Kr-87	8.0 E+7	76.3	11.8	675	0
Kr-88	1.1 E+8	172	13.3	1.68 E+3	0
Kr-89	1.1 E+8	3.18	16.7	1.89 E+3	0
Xe-131M	9.0 E+5	1.69 E+4	0.0218	10.4	0
Xe-133M	4.8 E+6	3.16 E+3	0.0298	28.6	0
Xe-133	1.9 E+8	7.55 E+3	0.0766	33.5	0
Xe-135M	5.1 E+7	15.7	3.55	356	0
Xe-135	1.9 E+8	546.	2.13	206	0
Xe-137	1.5 E+8	3.82	1.86	162	0
Xe-138	1.6 E+8	14.2	12.5	1.01 E+3	0

TABLE 15.6-13

LOSS-OF-COOLANT ACCIDENT

(DESIGN BASIS ANALYSIS)

ACTIVITY AIRBORNE IN PRIMARY CONTAINMENT (CURIES)

ISOTOPE	1 MIN	30 MIN	1 HR	2 HR	4 HR	8 HR	12 HR	1 DAY	4 DAY	30 DAY
I-131	2.2E 07	2.2E 07	2.2E 07	2.2E 07	2.1E 07	2.1E 07	2.1E 07	2.0E 07	1.5E 07	1.6E 06
I-132	3.3E 07	2.8E 07	2.4E 07	1.8E 07	9.8E 06	2.9E 06	8.6E 05	2.3E 04	7.1E-06	0.
I-133	4.9E 07	4.8E 07	4.7E 07	4.5E 07	4.3E 07	3.7E 07	3.3E 07	2.2E 07	2.0E 06	1.9E-03
I-134	5.6E 07	3.0E 07	2.6E 07	1.2E 07	2.4E 06	1.0E 05	4.2E 03	3.2E-01	0.	0.
I-135	4.4E 07	4.2E 07	4.0E 07	3.6E 07	2.9E 07	1.9E 07	1.2E 07	3.5E 06	1.8E 03	0.
TOTAL	2.0E 08	1.8E 08	1.6E 08	1.3E 08	1.1E 08	8.0E 07	6.7E 07	4.5E 07	1.7E 07	1.6E 06
Kr-83m	1.4E 07	1.2E 07	9.9E 06	6.8E 06	3.2E 06	7.2E 05	1.6E 05	1.8E 03	3.4E-09	0.
Kr-85m	4.5E 07	4.2E 07	3.8E 07	3.3E 07	2.4E 07	1.3E 07	7.0E 06	1.1E 06	1.5E 01	0.
Kr-85	1.4E 06	1.4E 06	1.4E 06	1.4E 06	1.4E 06	1.4E 06	1.4E 06	1.4E 06	1.4E 06	1.4E 06
Kr-87	8.0E 07	6.1E 07	4.7E 07	2.7E 07	9.0E 06	1.0E 06	1.1E 05	1.6E 02	0.	0.
Kr-88	1.1E 08	9.8E 07	8.6E 07	6.7E 07	4.1E 07	1.5E 07	5.7E 06	2.9E 05	5.1E-03	0.
Kr-89	1.1E 08	1.9E 05	2.6E 02	4.9E-04	0.	0.	0.	0.	0.	0.
Xe-131m	9.0E 05	9.0E 05	9.0E 05	8.9E 05	8.9E 05	8.8E 05	8.7E 05	8.5E 05	7.1E 05	1.6E 05
Xe-133m	4.8E 06	4.8E 06	4.7E 06	4.7E 06	4.5E 06	4.3E 06	4.1E 06	3.5E 06	1.4E 06	4.3E 02
Xe-133	1.9E 08	1.9E 08	1.9E 08	1.9E 08	1.9E 08	1.9E 08	1.8E 08	1.7E 08	1.1E 08	3.8E 06
Xe-135m	5.1E 07	1.4E 07	3.6E 06	2.3E 05	1.0E 03	1.9E-02	3.7E-07	0.	0.	0.
Xe-135	1.9E 00	1.8E 08	1.7E 08	1.6E 08	1.4E 08	1.0E 08	7.5E 07	3.0E 07	1.3E 05	0.
Xe-137	1.5E 08	7.8E 05	3.5E 03	6.8E-02	2.6E-11	0.	0.	0.	0.	0.
Xe-138	1.6E 08	3.8E 07	8.8E 06	4.7E 05	1.3E 03	1.1E-02	8.8E-08	0.	0.	0.
TOTAL NG	1.1E 09	6.5E 08	5.7E 08	4.9E 08	4.1E 08	3.2E 08	2.8E 08	2.1E 08	1.2E 08	5.4E 06