OAK RIDGE NATIONAL LABORATORY
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UNION CARBIDE CORPORATION
NUCLEAR DIVISION

POST OFFICE BOX Y
OAK RIDGE, TENNESSEE 37830

January 3, 1983

Mr. Gunter Arndt
Mechanical/Structural Engineering Branch
Division of Engineering Technology
NL 238
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Gunter:

This letter summarizes our progress on the Containment Leak Rate Testing Investigations (Fin. No. B0489) Program for the month of December 1982.

Technical Highlights

The data from the test reports on plants which conducted short duration tests have been reviewed. Fourteen short duration tests representative of eleven plants were reviewed. Ten of the fourteen tests were conducted in accordance with the Bechtel guidelines in BN-TOP-1 while the other four tests were ended based on utility criteria that showed the leak rate to be converging. The distribution of the test duations is shown in Figure 1.

A review of the draft report "Criteria for Determining the Duration of Containment Integrated Leakage Rate Tests," prepared by Quadrex Corporation for the Electric Power Research Institute, has been initiated. Short duration tests appear to be practical in many instances. Some criteria are necessary to determine when a test may be terminated. It should be clear that the criteria must be a combination of elapsed time and the quality of the data. The Quadrex Corporation draft report represents a recent proposal for short duration test criteria and its evaluation will be completed during the next reporting period.

Copies of relevant Licensee Event Reports concerning Type A tests have been ordered from the Nuclear Safety Information Center and are expected to arrive shortly. A series of 26 technical evaluation reports on containment leakage rate testing has been received. These reports were prepared by the Franklin Research Center for the NRC. The reports deal primarily with exemption requests made by the utilities and therefore provide an excellent data base for analyzing and summarizing exemption requests.

The evaluation of the EXTRAN formulation of the leak rate equation was extended for an additional data set. In 36 of 37 instances, the temperature term calculated by the EXTRAN equation was within one percent of the value calculated by the ANSI/ANS equation. In the other instance, the difference was on the order of one and one-half percent.

To further test the significance of the EXTRAN temperature term calculation, a computer program was developed that generates random temperature values to simulate temperature sensor data taken during a leak rate test. Input data consists of the initial containment average temperature, the number of temperature sensors, the number of time steps, the approximate total change in the average temperature during the test, and the maximum allowable spatial temperature variations (excluding hot or cold spots). The program also can simulate a single hot or cold spot, which requires the inputting of the approximate temperature difference and the number of affected sensors. Initial temperatures are assigned by the program to each sensor by adding or subtracting a random percentage (less than 100) of the spatial variation of the initial average temperature. For each successive time step, an increment equal to the approximate total change in containment temperature divided by the number of time steps is added to the initial average temperature. Individual sensor temperatures are obtained by adding or subtracting a random percentage (less than 100) of the spatial variations to the updated average temperature. Sensor temperatures representing a hot or cold spot are obtained by modifying the average temperature by the specified difference and then proceeding with the spatial variations. Following typical practice, the input temperatures are in degrees Farenheit which are internally converted so that the output is in degrees Kelvin. The output represents the average containment temperature as calculated by the two methods.

Figures 2-4 present examples of the simulated sensor temperature data and the EXTRAN and ANSI/ANS comparisons. Figure 2 is a reasonable example with a cool down of two degrees and a spatial variation of five degrees. No difference is observed in the temperature term calculations for this example. Figure 3 is a little less realistic but is still a reasonable example with a five degree heat up, a spatial variation of ten degrees, and a 20 degree hot spot affecting five sensors. Again, the differences in the two methods of calculation are negligible. In fact, in order to obtain differences of any significance, the spatial variation must be a ridiculous amount. Figure 4 presents such an example and the differences in the temperature terms are still not very large. Therefore, for the range of practical applications, either method of determining the average containment temperature may be used with indistinguishable differences.

The next scheduled plant visit to observe an ILRT in progress is Browns Ferry during the second week of January.

Expenditures

Expenditures under this program are shown below

	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.*
Expenditure ($K)	0.1	2.8	0	0.1	4.0	7.2	8.9	7.3
Cumulative ($K)	0.1	2.9	2.9	3.0	7.0	14.2	23.1	30.4

*Estimated

Sincerely,

Dan

D. J. Naus

DJN:ege

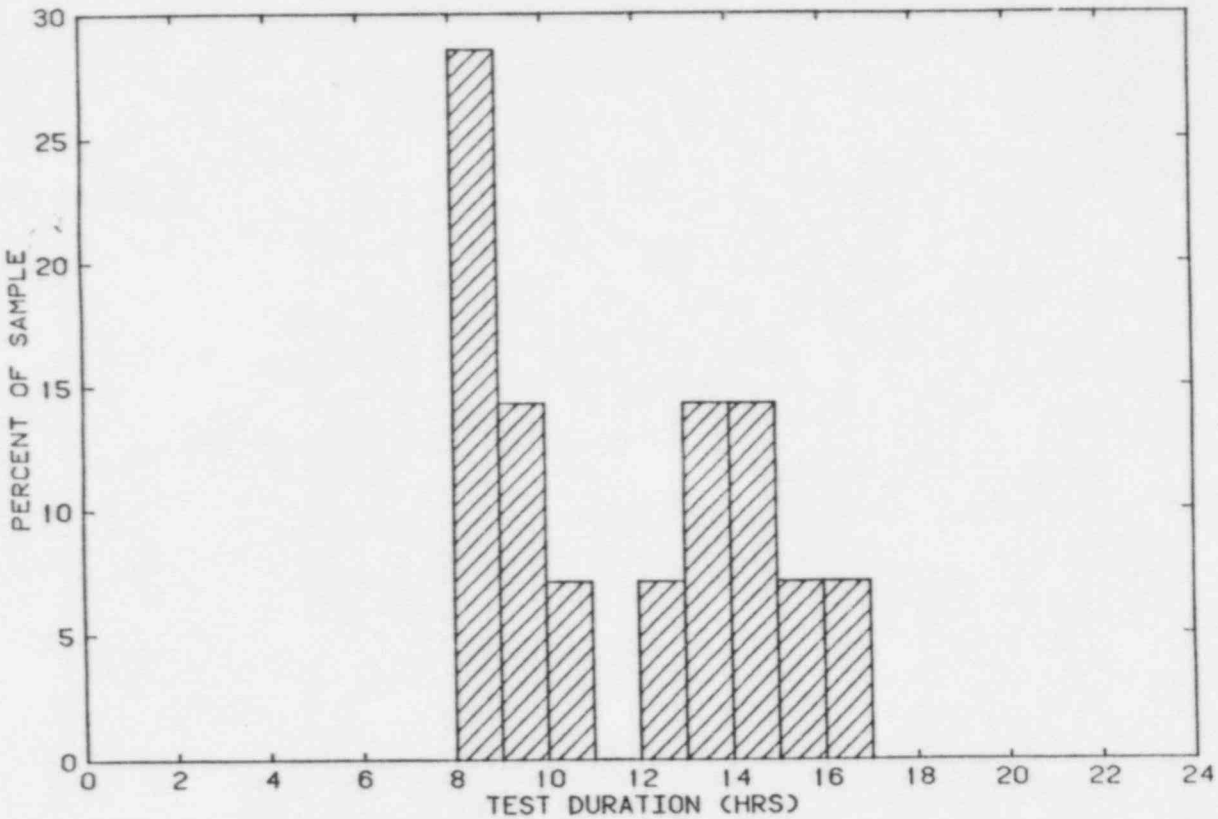

Figure 1. Distribution of test durations.

```
Input the initial containment average temperature (F): 80
Input the number of temperature sensors: 20
Input the number of time steps: 15
Input the total change in average temperature over the test (F): -2
Input the maximum variation in temperatures per time step (F): 5
Include a hot or cold spot?: NO
```

AVERAGE CONTAINMENT TEMPERATURE (K)

SET	EXTRAN	ANSI/ANS	DIFFERENCE	%
1	2.9999E+002	2.9999E+002	8.8281E-003	0.00
2	2.9965E+002	2.9966E+002	8.9497E-003	0.00
3	2.9989E+002	2.9990E+002	1.0187E-002	0.00
4	2.9928E+002	2.9928E+002	4.9593E-003	0.00
5	2.9922E+002	2.9923E+002	8.0508E-003	0.00
6	2.9930E+002	2.9931E+002	5.4477E-003	0.00
7	2.9952E+002	2.9953E+002	1.0853E-002	0.00
8	2.9973E+002	2.9974E+002	7.7890E-003	0.00
9	2.9904E+002	2.9905E+002	8.6907E-003	0.00
10	2.9931E+002	2.9931E+002	7.8228E-003	0.00
11	2.9880E+002	2.9880E+002	7.6565E-003	0.00
12	2.9855E+002	2.9856E+002	6.5223E-003	0.00
13	2.9896E+002	2.9898E+002	1.2335E-002	0.00
14	2.9908E+002	2.9909E+002	7.0403E-003	0.00
15	2.9861E+002	2.9861E+002	9.1132E-003	0.00

Figure 2. Average temperature calculations for a realistic example with no hot or cold spots.

```
Input the initial containment average temperature (F): 65
Input the number of temperature sensors: 30
Input the number of time steps: 15
Input the total change in average temperature over the test (F): 5
Input the maximum variation in temperatures per time step (F): 10
Include a hot or cold spot?: YES
Input the temperature difference (F): 20
How many sensors are affected: 5
```

AVERAGE CONTAINMENT TEMPERATURE (K)

SET	EXTRAN	ANSI/ANS	DIFFERENCE	%
1	2.9326E+002	2.9335E+002	8.5838E-002	0.03
2	2.9442E+002	2.9455E+002	1.2987E-001	0.04
3	2.9375E+002	2.9385E+002	1.0454E-001	0.04
4	2.9351E+002	2.9360E+002	8.3246E-002	0.03
5	2.9366E+002	2.9374E+002	7.9874E-002	0.03
6	2.9411E+002	2.9418E+002	7.0335E-002	0.02
7	2.9448E+002	2.9457E+002	9.4585E-002	0.03
8	2.9519E+002	2.9526E+002	7.1537E-002	0.02
9	2.9497E+002	2.9507E+002	1.0702E-001	0.04
10	2.9507E+002	2.9520E+002	1.3572E-001	0.05
11	2.9474E+002	2.9485E+002	1.0773E-001	0.04
12	2.9559E+002	2.9569E+002	1.0077E-001	0.03
13	2.9552E+002	2.9559E+002	7.4312E-002	0.03
14	2.9488E+002	2.9501E+002	1.2808E-001	0.04
15	2.9665E+002	2.9675E+002	9.6265E-002	0.03

Figure 3. Average temperature calculations for a realistic example with a hot spot.

```
Input the initial containment average temperature (F): 70
Input the number of temperature sensors: 25
Input the number of time steps: 15
Input the total change in average temperature over the test (F): 10
Input the maximum variation in temperatures per time step (F): 200
Include a hot or cold spot?: YES
Input the temperature difference (F): -65
How many sensors are affected: 5
```

AVERAGE CONTAINMENT TEMPERATURE (K)

SET	EXTRAN	ANSI/ANS	DIFFERENCE	%
1	2.9009E+002	2.9295E+002	2.8608E+000	0.99
2	2.9784E+002	2.9184E+002	3.9925E+000	1.39
3	2.7542E+002	2.7985E+002	4.4327E+000	1.61
4	2.8092E+002	2.8736E+002	6.4375E+000	2.29
5	2.8660E+002	2.9096E+002	4.3614E+000	1.52
6	2.7543E+002	2.7922E+002	3.7887E+000	1.38
7	2.8670E+002	2.9242E+002	5.7214E+000	2.00
8	2.8707E+002	2.9152E+002	4.4515E+000	1.55
9	2.7650E+002	2.8211E+002	5.6134E+000	2.03
10	2.9081E+002	2.9653E+002	5.7131E+000	1.96
11	2.9074E+002	2.9564E+002	4.9044E+000	1.69
12	2.9256E+002	2.9582E+002	3.2593E+000	1.11
13	2.8945E+002	2.9430E+002	4.8518E+000	1.68
14	2.7858E+002	2.8211E+002	3.5384E+000	1.27
15	2.9147E+002	2.9439E+002	2.9254E+000	1.00

Figure 4. Average temperature calculations for an unrealistic example.

REQUEST FOR PAYMENT TO GUEST LECTURERS
OR AGREEMENT FOR SHORT TERM CONSULTING OR PROFESSIONAL SERVICES

INSTALLATION: ☐ ORGDP ☒ Y-12 ☐ ORNL ☐ PADUCAH

☐ Guest Lecturer ☒ Short Term Consulting or Professional Service (Requires Signature of Individual on reverse side)

DATE: 1/14/83 | TRAVEL ORDER NO:

I. REQUEST FOR PAYMENT

INDIVIDUAL'S NAME: Zinovy V. Reytblatt	SOCIAL SECURITY OR TAXPAYER'S ACCOUNT NUMBER: 144 38 4184 (SS#) Company ID: 36-2946522	CHARGE ACCOUNT NUMBER: 4435-0974
MAILING ADDRESS: P. O. Box 2849 Chicago, Illinois 60690	ORGANIZATION REPRESENTED AND POSITION: Self	
TRAVEL FROM:	TO:	
RETURN TO:	BEGINNING DATE: 2/1/83	NUMBER OF DAYS: 8

TRAVEL EXPENSES REQUESTED ☐ YES ☒ NO — IF YES, REIMBURSE ☐ UCN POLICY ☐ OTHER (See S.P.P. D-2-8)

HONORARIUM OR FLAT FEE REQUESTED ☐ YES ☒ NO — IF YES, TOTAL AMOUNT $

DAILY FEE REQUESTED ☒ YES ☐ NO — IF YES, RATE PER DAY $ 200

DAILY FEE TO:

A. ☐ INCLUDE ☐ EXCLUDE TRAVEL TIME ☐ CLASSIFIED INFORMATION INVOLVED

B. ☒ INCLUDE ☐ EXCLUDE WEEK ENDS ☒ NO CLASSIFIED INFORMATION INVOLVED

II. PURPOSE OF VISIT OR REMARKS (EXPLAIN FULLY)

1. Identify potential sources of error in leak rate testing as typically conducted. Show the significance of these errors on the leak rate through the use of worked examples. Extreme examples may be used to illustrate a point but they must be accompanied by a practical example typical of industry obtained data.

2. Discuss procedures for optimizing the placement and weighting factors for the sensors.

3. Specify portions of the existing standards that could be improved. Provide a brief discussion along with recommendations.

III. ALIEN TAX CLASSIFICATION

If individual is a citizen of another country, part III must be completed prior to submission to travel office.

CITIZENSHIP: | TYPE VISA:

CHECK APPROPRIATE BOX: ☐ RESIDENT ALIEN (1) ☐ NONRESIDENT ALIEN ☐ TAX TREATY-WITHHOLDING EXEMPTION (2)

(1) IRS Form 1078 Certificate of Alien Claiming Residence in the U.S., must be completed in duplicate by the resident alien and submitted to the Travel Office prior to payment.

(2) If nonresident aliens claim they should be exempted from withholding due to existing tax treaty conditions, they must submit a written statement to the Travel Office stating their claim and specifically indicating the number of days they 'have been' and 'will be' in the U.S. and the amount of their earnings in the U.S. to date.

NOTE: IRS Regulations require UCN to withhold income tax from all honoraria or fees paid to nonresident aliens unless specifically exempted by tax treaty conditions.

IV. APPROVAL

INSTALLATION HEAD OR DESIGNATED REPRESENTATIVE:

DISTRIBUTION: Copies 1-3 Travel Section; Copy 4 Division Head

FOIA-85-143

18

22

UCN-237