Docket No. 50-346

License No. NPF-3

Serial No. 1015

December 30, 1983

TOLEDO EDISON

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Director of Nuclear Reactor Regulation
Attention: Mr. John F. Stolz
Operating Reactors Branch No. 4
Division of Operating Reactors
United States Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Stolz:

On September 30, 1983, the Toledo Edison Company (TED) submitted to your staff a request for exemption from certain requirements of Appendix R to 10 CFR Part 50 (Serial No. 991), as they pertain to the Davis-Besse Nuclear Power Station, Unit 1 (DB-1).

As part of that request, information was detailed to support the exemption from Appendix R, Section III. G.2 requirements concerning a door located between Rooms 237 and 238. The door in question was designed and installed as a pressure door providing protection from a High Energy Line Break (HELB).

The intent of the door analysis was to demonstrate that the design of the door and its fixtures provided evidence of the door's acceptability as a fire barrier, based on the construction details, existing fire protection, and low in-situ combustible loadings.

An evaluation was performed in support of the door exemption request. The evaluation mathematically simulated the fire test requirements of NFPA 251 and demonstrated the door's ability to withstand a fire of greater duration than that supported by the level of in-situ combustibles.

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1/1

Per the request of Mr. Al DeAgazio, TED is forwarding a calculation (enclosed) which supports the fire resistance capabilities of the door.

Toledo Edison will provide any additional information as necessary.

Very truly yours,

RPC:JSH:nlf
encl.
cc: DB-1 NRC Resident Inspector

Docket No. 50-346
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Enclosure

CALCULATION/PROBLEM COVER SHEET

Calculation/Problem No: 1040-014-101

Title: Auxiliary F/W Pump Rooms - Fire Door Evaluation

Client: Toledo Edison **Project:** Davis-Besse 1

Job No: 1040-014-1671

Design Input/References:

See Calculation

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Assumptions:

See Calculation

Method:

See Calculation

Remarks:

REV. NO.	REVISION	PERFORMED BY	CHECKED	APPROVED	DATE
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1.0 PURPOSE

In Davis-Besse Nuclear Power Station Unit No. 1, Auxiliary Feed Pump Unit Rooms (AFPR) are adjacent and separated by "three hours" fire rated walls. Communication between the rooms is through a pressure retaining door. This calculation evaluates the adequacy of this door as a fire barrier from Room 237 to Room 238.

2.0 DESIGN INPUT/REFERENCES

1* - Resnick and Halliday, "Physics," 1966 Ed.

2* - Eckert and Drake, "Heat and Mass Transfer," 2nd Ed.

3* - Marks, "St'd H/B for M/E," 7th Ed.

4* - Keenan, Chao and Kaye, "Gas Tables," 2nd Ed.

5* - Overly Nuclear Products Division Drawings:
Davis-Besse Nuclear Power Station

a. E201 of 5, Rev. 2
b. E202 of 5, Rev. 3
c. E203 of 5, Rev. 3
d. E204 of 5, Rev. 4
e. E205 of 5, Rev. 3
f. E101 of 5, Rev. 2
g. E102 of 5, Rev. 3
h. E103 of 5, Rev. 3
i. E104 of 5, Rev. 4
j. E105 of 5, Rev. 3

6* - Fire Protection General Floor Plan Drawings:

a. El. 565'-0", Drawing No. A-202F, Rev. 0
b. El. 585'-0", Drawing No. A-203F, Rev. 0

7* - Davis-Besse Nuclear Power Station Unit No. 1

a. File Preplan, FP 9237.00/Room 237
b. File Preplan, FP 9238.00/Room 238

8* - Van Wylen and Sonntag, "Fundamentals of Classical Thermodynamics," 1st Ed.

9* - JP Holman, "Heat Transfer," 4th Ed.

3.0 BASIC CRITERIA AND ASSUMPTIONS

A fire is postulated in either Room 237 or 238 and the temperature on the face of the door in the room without fire should not exceed ambient temperature plus 250°F.

The assumptions are:

1° - When a fire occurs in either room, all combustibles burn in 9 minutes and a temperature of 1300°F is achieved at the end of the fire.

2° - At the beginning of the calculation, time t = 0, the face of the door exposed to the fire is at 1300°F and the face not exposed to the fire is at ambient temperature (100°F).

3° - The heat transfer process occurs only by conduction and convection.

4° - The system to be analyzed is one-dimensional.

4.0 METHOD OF ANALYSIS

The door is made up of three sheet metal plates (t = 3/16" each) separated by:

a. I beams (S3) between the first and second sheets with a surface ratio of 20% and air pockets with a surface ratio of approximately 80%.

b. Steel bars 6" deep between the second and third sheets (10% surface ratio) and air pockets (90% surface ratio).

The model represents:

- The first sheet metal at a constant temperature T_2 = 1300°F.
- The equivalent conductance (k_2) of the I beams and air pockets.
- The second sheet metal at a uniform temperature T_3 = 100°F at time = 0 sec.
- The equivalent conductance (k_3) of the bars and air pockets.

- o The third sheet metal at a uniform temperature T_4 = 100°F at time = 0 sec.
- o In phase 1, the cold room was represented as an infinite heat sink with an ambient temperature T_5 = 100°F and a film coefficient conductance (k_4) was taken into account.
- o In phase 2 it was conservatively assumed that no heat loss occurs from the door to the cold room and that all the heat transferred would be stored in the door (note that the weight of the door with its packing mechanism is approximately 2000 lbs.).

4.1 PHASE 1

The temperature increase in the second sheet metal is given by the following energy balance equation:

$$C_1^* \frac{dT_3}{dt} = k_2 (T_2 - T_3) - k_3 (T_3 - T_4)$$

The temperature increase in the third sheet metal is given by the following energy balance equation:

$$C_2^* \frac{dT_4}{dt} = k_3 (T_3 - T_4) - k_4 (T_4 - T_5)$$

Where it can be shown that:

1° - The equivalent heat conductance from sheet one to sheet two:
k_2 = 549.07 Btu/hr°F

2° - The equivalent heat conductance from sheet two to sheet three:
k_3 = 138.04 Btu/hr°F

3° - The heat conductance from the third sheet to the cold room:
k_4 = 56.94 Btu/hr°F

4° - Assuming the total heat capacity is equally shared by sheets two and three:
$C_1^* = C_2^*$ = 120 Btu/°F

Solving the two linear first order differential equations, an expression for the third sheet metal temperature (°F) as a function of time (seconds) is obtained:

$$T_4(t) = 893.13 + 223.02e^{-1.67\times10^{-3}t} - 1016.16e^{-3.67\times10^{-4}t}$$

Therefore, with heat loss to the cold room, at t = 27 minutes, T_4 = 347.3°F.

4.2 PHASE 2

Setting the heat conductance k_4 from the third sheet metal to the cold room as equal to zero and once again solving the two linear first order differential equations, we obtain the following expression for the third sheet metal temperature (°F) as a function of time (seconds):

$$T_4\ (t) = 1300 + 206e^{-1.67\times10^{-3}t} - 1406e^{-2.44\times10^{-4}t}$$

Therefore, without heat loss to the cold room, at t = 25.5 minutes, T_4 = 348°F.

5.0 RESULTS AND CONCLUSION

It takes 27 minutes to reach 350°F on the downstream "cold room" side of the door assuming some heat loss to the cold room.

It takes 25.5 minutes to reach 350°F on the downstream "cold room" side of the door assuming no heat loss to the cold room (conservative).

Twenty-five minutes is considered to be a sufficiently long time to allow for the fire brigade to take counter measures and have the situation under control. For example, by spraying to cool the door, and then opening the door to let the heat escape from the fire location.

The door is considered to be an acceptable fire barrier.