

TOLEDO EDISON COMPANY
DAVIS-BESSE NUCLEAR POWER STATION UNIT 1

FIRE EQUIVALENCY TEST

FOR

SILICONE FOAM

(SF-20 vs Dow Corning 3-6548)

May 25, 1977

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Introduction

The purpose of this report is to describe the circumstances leading up to the need for a substitute material for BISCO SF-20 silicone foam, the selection and testing of Dow Corning Corporation 3-6548 silicone foam, and our evaluation of the suitability of DC 3-6548 for use at Davis Besse Nuclear Power Station Unit 1.

Discontinuation of BISCO SF-20

The BISCO SF-20 silicone foam is a four-part mixture of Dow Corning material. The formulation of this four-part mixture is a proprietary process with BISCO. Subsequent to the BISCO development of their formulation, Dow Corning proceeded to develop a two-part mixture which was proprietary to Dow Corning and which is available to any applicator and is marketed under the name of Dow Corning 3-6548 Silicone RTV Foam. The BISCO SF-20 material had been fully qualified by testing for application at Davis-Besse and was approved by NEL-PIA for fire barriers on the project.

On April 6, 1977 BISCO informed us that some components of the SF-20 formulation were no longer being manufactured by Dow Corning and would not be available to complete the BISCO work. Immediate action was required as the project was preparing to load fuel that month.

As a result of this disclosure, BISCO was requested to be at the Davis-Besse site on April 7 to review this situation. We contacted Dow Corning and were informed that there was no possibility that additional production of the components for the BISCO SF-20 material would be undertaken.

Efforts were made to review _____s in the country that might have a stock of this material, including _____ General Electric and TVA, but no material could be found.

On April 8 discussions at the Davis-Besse site between Bechtel, BISCO and TECO led to the decision to attempt to qualify the DC 3-6548 material for use on the Davis-Besse project. NEL-PIA indicated that they would approve this material based upon an equivalency fire exposure test performed in accordance with the requirements of ASTM E 119-73 "Standard for Fire Tests of the Building Construction and Materials".

Testing

A three-hour fire exposure test was performed at the Fire Research Laboratory of the Portland Cement Association in Skokie, Illinois on April 12, 1977. A 12-inch thick concrete slab was prepared containing four one-foot square blockouts. Two of the one cubic foot blockouts were filled with SF-20 material, and the other two of the one cubic foot blockouts were filled with Dow Corning 3-6548 silicone foam. Each blockout was filled to the full depth of 12 inches, which is the minimum depth used as a fire barrier at Davis Besse Unit 1.

The fire endurance test was conducted in accordance with ASTM E 119-73. The test slab was placed horizontally on the furnace such that the heat would impinge upwards against the material. The foam materials were exposed to heat in accordance with Section 2, Time-Temperature Curve, of ASTM E 119-73.

The temperatures within each seal were measured during the fire exposure. The actual temperature data taken during this test is attached in Tables I, II, III and IV. During the test the temperatures at the unexposed surface did not exceed the ASTM Heat Transmission End Point Criteria. The temperature 3 inches beneath the unexposed surface (as close as less than 2 inches from the charring surface) did not exceed 160°F. The temperatures at the surfaces of each seal, and the temperatures at similar depths within each seal correspond with slight exceptions.

Following the three-hour fire exposure it was noted that no smoke or flame had penetrated or bypassed the unexposed seal surface. When the test slab was removed from the furnace it was placed charred-face downward on a refractory blanket and allowed to cool. During this cooling period the material was allowed to smolder, thus continuing to degrade the sealing material. After approximately 30 minutes the slab was raised, and the charred material was scraped away so that depth measurements could be made. The SF-20 material was charred to a maximum depth of 6 inches in both blockouts. The Dow Corning 3-6548 material was charred to a maximum depth of 7 3/8 inches in one blockout and 7 1/2 inches in the other blockout.

Evaluation

The fire equivalency test satisfied the requirements of ASTM E 119-73 and NEL-PIA and is consistent with testing performed to qualify the SF-20 material for use at Davis-Besse Unit 1.

The arrangement of the test apparatus provided conservatism in that by being placed above the flame, much of the charred material fell from the blockout during the test. This caused the remaining material to be exposed to more direct furnace heat, thus increasing the rate of material degeneration.

Additional conservatism was provided when the material was allowed to smolder for 30 minutes following the fire exposure test. This caused the materials to char to a greater depth than had occurred during the test.

The differences in the depth of charring between the two materials is not considered to be significant as compared with the total depth of the penetration seal. More importantly, in no case did the seal permit the transmission of flame or smoke, the unexposed surface of the seal remained near ambient temperature, and even seal material within 2 inches of the charring surface remained cool with respect to the furnace temperature.

Conclusions

The results of the fire equivalency test provide complete confidence that the Dow Corning 3-6548 silicone foam will perform as a suitable fire barrier. The testing, which was observed by representatives of Toledo Edison Company, Bechtel Company, BISCO and NEL-PIA, met the conditions of acceptance of ASTM E 119-73. By virtue of this test and receipt of NEL-PIA approval of the material, all established criteria had been satisfied to qualify Dow Corning 3-6548 silicone foam as a three-hour fire barrier.

3 HOUR FIRE EXPOSURE EQUIVALENCY TEST
of
BISCO SF-20 FOUR COMPONENT SILICONE FOAM
and
DOW CORNING CORP. 3-6548 SILICONE FOAM

TABLE I

Surface Temperature -°F

Minutes	A	B	C	D
0	90	90	90	90
30	85	80	85	85
60	80	80	80	80
90	85	85	80	85
120	85	85	85	85
150	85	85	85	85
180	90	90	85	90

TABLE II

Temperature immediately below skin -°F

Minutes	A	B	C	D
0	80	80	90	90
30	80	80	85	85
60	80	85	80	80
90	80	85	85	90
120	80	85	90	90
150	85	80	90	90
180	85	85	95	100

Note: Seals A & B - BISCO SF-20
Seals C & D - Dow Corning 3-6548

3 HOUR FIRE EXPOSURE EQUIVALENCY TEST
of
BISCO SF-20 FOUR COMPONENT SILICONE FOAM
and
DOW CORNING CORP. 3-6548 SILICONE FOAM

TABLE III

Temperatures 3" from surface -°F

Minutes	A	B	C	D
0	80	80	80	90
30	80	85	85	90
60	80	85	90	90
90	85	85	100	100
120	90	85	110	120
150	115	90	125	140
180	150	105	150	160

TABLE IV

Temperatures 6" from surface -°F

Minutes	A	B	C	D
0	80	80	90	90
30	85	85	100	100
60	85	95	130	125
90	90	110	190	170
120	125	130	270	245
150	330	200	350	330
180	495	340	460	450

Note: Seals A & B - BISCO SF-20

Seals C & D - Dow Corning 3-6548