



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO FIRE DOOR-TO-FRAME  
FRAME-TO-WALL AND ANCHOR BOLT IRREGULARITIES  
BOSTON EDISON COMPANY  
PILGRIM NUCLEAR POWER STATION  
DOCKET NO. 50-293

1.0 INTRODUCTION

By letter dated February 3, 1988 (BECO 88-018), the Licensee provided technical evaluations and acceptance criteria to address fire door-to-frame, frame-to-wall and anchor bolting irregularities. The Licensee provided this information as a result of staff concerns expressed at a meeting with BECO on November 24, 1987.

2.0 EVALUATION

The Licensee submitted a detailed and formal Fire Protection Engineering Evaluation (FPEE) for each class of irregularity noted above. The object of each FPEE was to address fire door installation and establish acceptance criteria that ensure the doors provide the required fire protection.

The staff reviewed and evaluated each FPEE separately. The results of this review and evaluation are presented below:

A. Fire Door Clearance (FPEE 88, Rev. 1 dated 1/27/88)

i. Background

Licensee inspections conducted during the current outage (refuel outage number seven) revealed a number of existing fire door units that had clearance between the door and frame in excess of the 1/8 inch allowed by either Underwriters Laboratories (UL) reference 108-1979, "Fire Tests of Door Assemblies," or National Fire Protection Association (NFPA) reference 80-1986, "Standard for Fire Doors and Windows." Adjustments to reduce the door-to-frame clearance were made where possible, yet some could not be reduced to the required maximum.

The Licensee reviewed the consequences of a fire within the plant on either side of a fire door with excessive clearances and determined that if the gaps do not exceed the following criteria, there would be no change in the degree of protection provided by the door.

ii. Acceptance Criteria:

Clearance between the door and frame, and between the meeting edges of doors swinging in pairs, shall meet the following conditions:

- a. The average gap along the jambs head and between the leaves of double doors shall not exceed 3/16 inch. The total allowable area of the gap is 3/16 inch times the total length of the gap.

- b. Provided item a. is met, the maximum gap is to be less than or equal to 1/4 inch at any location.

iii. Technical Evaluation

In 1985 UL conducted a fire test (Project 84Nkz7489, File NC603) with two door/frame assemblies to evaluate the effect of a gap between the frame of a door and a masonry-type wall. The installed configuration resulted in door to frame clearances greater than the 1/8 inch clearance allowed by UL in their own test standard. Two of the three jambs on each of the doors were noted as having an average clearance of 3/16 inch.

Both of the door assemblies in this UL fire test withstood the fire endurance and hose stream portions of the test without developing any openings.

A second set of tests conducted by Warnock Hersey, independent of the UL test, was specifically designed to evaluate the effects of excessive clearance between the door and frame in both single and double leaf assemblies. These tests were conducted in accordance with UL 10B (and other compatible fire door test standards) requirements, with the exception of the following clearance changes:

- All door-to-frame gaps were increased to 1/4 inch.
- Gaps at the bottom of the doors were increased to 1 inch.
- Strike plates were shimmed to obtain a clearance of 1/8 inch between door and strike plate to ensure adequate engagement of the 1/2 inch latch bolt.

As in the UL test, the results of the Warnock Hersey test showed that the modified door assemblies with excess clearances were still capable of passing a 3 hour fire endurance and hose stream test.

The slightly larger door-to-frame gap has no effect on the conduction and radiation methods of heat transfer or fire spread because:

1. The wider gap is still totally obstructed by the frame's stop, thus blocking the "line of sight" for radiant energy transfer between the fire and any exposed combustible material on the non-fire side of the door. Therefore, it is unlikely that fire can be spread by radiant energy.
2. The gap has no effect on conduction because there is no solid material, or mass, even in a properly spaced gap for this heat transfer method to take place.

To further enhance the fire endurance of these door assemblies, the Licensee has developed administrative controls to prevent the accumulation of transient combustibles in areas adjacent to fire doors. These administrative controls include a procedure that addresses proper storage of flammable and combustible materials as well as a procedure requiring periodic inspections. The periodic inspections are intended to ensure that excessive amounts of transient combustible materials are not brought into the plant and that no combustibles are stored in unacceptable locations, especially in the immediate area of fire doors. With these administrative controls in place, it is unlikely that any flame extension beyond the door surface would be sufficient to reach combustible materials on the non-fire side of the door.

i. Conclusion

Based upon the technical evaluation presented above, the staff concludes that Pilgrim fire doors meeting the acceptance criteria of 2.A.ii will be capable of providing the required fire resistance.

B. Frame-to-Wall Clearance (FPEE 89, Rev. 0 dated 12/21/87)

i. Background

Licensee inspections conducted during the current outage (refuel outage number seven) revealed a number of existing fire door units for which clearance between the door frame and wall opening exceeded the original assembly requirement of one quarter inch. Because no current references were found that specifically address this issue for fire doors, the Licensee contacted Underwriters Laboratories for guidance. Underwriters Laboratories established that the existing frame to wall gaps were not in strict compliance with "normal" installation criteria and provided the following two methods to resolve the deviation: fill the gap with fire retardant material, or install metal shims behind each door frame anchor to improve fit.

ii. Technical Evaluation

Filling the gap between the fire door frame and wall with a fire resistant cementitious material will retard the spalling of existing grout under the door frame backbend. This justification is based on the results of a penetration seal test conducted by Promatech (Three Hour Fire Qualification Test, CTP 1001A, dated 7/25/80), in which a 3/4 inch bead of silicone caulk provided a 3 hour fire seal for a 1/2 inch angular space around a 2-1/2 inch pipe penetration.

The installation of metal shims behind each fire door frame anchor has been tested and proven acceptable. Underwriters Laboratories conducted their test 108-1977, "Fire Tests of Door Assemblies" on a fire door assembly having a maximum 1/4 inch gap between the frame and wall. The tested assembly used metal shims behind each frame anchor to eliminate the gap at door anchor locations and is therefore accepted only when the frame-to-wall gap is 1/4 inch or less.

iii. Conclusion

Based on the technical evaluation presented above, the staff concludes that Pilgrim fire doors that are caulked or metal shimmed as described in 2.B.ii. will be capable of maintaining their fire resistance rating.

C. Fire Door Anchor Bolting (FPEE 90, Rev. 0 dated 12/18/87)

i. Background

Licensee inspections conducted during the current outage (refuel outage number seven) revealed a number of existing fire door units that had fewer, and sometimes smaller, anchor bolts than required by Underwriters Laboratories standard 63-1976, "Fire Door Frames."

The Licensee contacted Underwriters Laboratories and proposed installation of additional 3/4 inch diameter anchor bolts to reach the required number in each fire door frame. Underwriters Laboratories replied that this solution was not necessary, as long as the total anchorage system provided the same pullout resistance as UL standard 63-1976, "Fire Door Frames."

ii. Technical Evaluation

The Licensee performed a calculation (No. C15.0.2220, Rev. 0, "Fire Door Anchorage") to determine the number and type of additional bolts required to equal the pull out resistance of four, 3/4 inch expansion shell anchor type bolts. Because of the location of existing bolts and the amount of labor required to remove a frame, the licensee elected to use a bolting system that would eliminate the need to pull the frame from the opening. This bolting system can be installed by drilling a hole through the frame and into the wall to the required depth. The bolts can then be inserted through the frame, into the wall and set to establish the required anchorage. The calculation demonstrated that an additional three, 3/8 inch "Kwik" or "hol-hugger" type bolts are required on each side jamb, no matter what the size of the existing bolts.

While grout placed within and behind the frame may help existing frame anchor bolts resist rotation and/or pull-out, the Licensee could not quantify the additional value of the grout. Therefore, for conservatism, an additional three anchor bolts will be installed in each fire door jamb that is grouted.

As for the use of reinforcements required on the inside of the frame soffit behind new anchor bolts, the Licensee has determined that one of the following options is an acceptable alternative:

1. If the frame is not grouted, a reinforcement shim shall be installed to prevent frame deformation or bolt pull-through during tightening, or
2. Grouted frames will not require the inclusion of a reinforcement shim since the grout will prevent frame deformation and resist bolt pull-through.

iii. Conclusion

Based on the technical evaluation presented above, fire door frames that are reanchored and/or reinforced with shims as described will be capable of maintaining their fire resistance rating.

3.0 SUMMARY CONCLUSION

Based on the three technical evaluations presented herein, the staff finds that Pilgrim fire door assemblies that meet the installation or acceptance criteria described above will be capable of maintaining their fire resistance rating.

ACKNOWLEDGEMENT

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