NEW YORK POWER AUTHORITY
Indian Point 3 Nuclear Power Plant

FIRE BARRIER INSPECTION SUMMARY REPORT

Plant Improvement Program Item 177.1, Tasks 10 & 28

Evaluation Number: IP3-RPT-FP-01030, Revision 0

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1.0 SUMMARY

This report presents a summary description of the fire barrier baseline inspection performed under engineering acceptance test ENG-527, "Fire Barrier Inspections", a summary of the inspection results and the significance of any deficiencies identified during the inspection effort.

This report also identifies planned or initiated corrective actions necessary to prevent reoccurrence; see Section 3.4.

2.0 INTRODUCTION

The fire barrier inspection effort was undertaken to address NRC concerns identified during a NRC Region I Special Inspection (Ref. 1). Other generic NRC concerns have been presented in Information Notice (IN) 88-04 including Supplement 1 and Information Notice 88-56 (Ref. 11 & 12).

The program used to address the aforementioned concerns is Plant Improvement Program Item 177.1, Tasks 10 and 28. Engineering acceptance test ENG-527 was developed to facilitate the data acquisition and evaluation & review of fire seals. The stated purpose of ENG-527 is to "establish an adequate level of confidence with regard to the functional integrity of penetration seals [and] adequately qualify and document the functional integrity of those fire seals." The inspection effort addressed the completeness of the fire barrier program and the adequacy of inspection method, including breadth of inspection criteria. The fire barrier inspection effort also served to address qualification and documentation of fire seals and fire seal integrity

At IP3 fire barriers have been established to conform to Branch Technical Position 9.5-1, Appendix A (by commitments made thereto), comply with 10CFR50, Appendix R, and/or as a measure of prudent industrial fire protection. The scope of the inspection included 100% (or approximately 1200) of each type of seal material and structural type, and involved the removal of damming material (if present), followed by an inspection of the seal material present (ie, silicone foam, elastomer or flamemastic).

3.0 DISCUSSION

3.1 General Inspection Method

The inspection effort was divided into two phases: 1) the data acquisition phase and 2) the evaluation & review phase.

3.1.1 The Data Acquisition Phase

Each barrier was inspected in a systematic manner to ensure that each penetration was identified. Each penetration and its associated fire seal was then inspected against specific inspection criteria based on the type of seal material installed. If the face of a seal was invisible due to the presence of damming material, the damming material was removed and a visual inspection of the surface of the seal was performed; following the inspection, the damming material was reinstalled as necessary. In addition to the inspection of each penetration, conduits were inspected to determine the need for their sealing.

The inspection criteria were intended to identify deficiencies such as unacceptable holes, separation or shrinkage in the surface of each seal. During this phase, each inspector was also required to note audible or apparent air passage through the seal, as further indication of its integrity. Following the inspection, the results along with some descriptive information of the penetration and fire seal were recorded on the Field Inspection Form (Attachment 2 of ENG-527). The descriptive information recorded included: penetration type, structural type, nominal size, location, number, size and type of penetrating items, seal material, etc.

This phase of the inspection considered the condition of the seal surface on a side-by-side basis.

3.1.2 The Evaluation & Review Phase

The results of the inspection of each seal surface were combined and the overall fire seal configuration was considered. The review included specific information such as, the condition of each side (integrity), the overall depth of the seal, the assigned typical seal detail, the referenced fire test and tested configuration, additional testing as necessary, etc. As a result of this review, each fire seal was judged to be functional or non-functional.

If the fire seal was judged to be functional, where functional has been defined as: *the ability to remain in place and retain integrity when subjected to an exposure fire and subsequently, a fire suppression agent,* a status of "Functional" was indicated on the Evaluation Form (Attachment 4 of ENG-527). If a penetration fire seal or firestop was judged to be non-functional, a status of "Non-functional" was indicated on the Evaluation Form.

When a fire seal was judged to be non-functional, the fire barrier in which the seal is located was reviewed for functional integrity where functional integrity of a fire barrier has been defined as: *given the hazards present, the ability to provide an adequate level of protection necessary, to prevent or significantly retard (limit) the spread of fire.* If a fire barrier was judged to be "Non-functional", a Significant Occurrence Report (SOR) (or Deviation Event Report (DER)), was initiated and compensatory actions were established as necessary. For barriers governed by Technical Specifications, the necessary compensatory actions are defined by Technical Specification 3.14.C.2. For all other barriers, the necessary compensatory actions were commensurate with the hazards present; such actions were typically parallel to those defined in Technical Specifications unless other factors precluded such actions.

3.2 Results of the Inspection Effort

The inspections results summarized in this section have been presented in percentages of the total number of penetration seals inspected (unless otherwise stated), and are intended to represent approximations.

3.2.1 Functional and Non-functional Fire Seals

Of the total number (or 1200) fire seals inspected: 8% of the seals were judged to be non-functional with the remaining 92% judged to be functional. Of the fire barriers which contained the non-functional fire seals, 2 were determined to be non-functional with the remaining functional (refer to Table 3.2.1.1).

Of the total number of fire seals inspected, the breakdown by seal material type is as follows:

- silicone foam: 45%
- silicone elastomer: 17%
- flamemastic w/fiberfill: 12%
- 3M system: 2%
- other: 24%

Of the approximate 100 fire seals (of 1200) judged to be non-functional, the breakdown by the seal material type, was as follows:

- silicone foam: 16%
- silicone elastomer: 17%
- flamemastic w/fiberfill: 42%†
- 3M system: 2%
- other: 23%

† Note: The high rate of failure is attributed to the lack of a step-by-step installation procedure, see Section 3.3.1.

For a breakdown of seal material type verses non-functional fire seals, refer to Table 3.2.1.2.

3.2.2 Repair of Fire Seals

Approximately 450 of the 1200 fire seals inspected, were repaired. Of the these, 77% were repaired to enhance the aesthetics or provide a means to impede mechanic damage in high traffic areas. In addition, some of the seals were reworked to enhance their integrity and maintain consistency between installed seal configurations and typical design details. Fire seals repaired in this category, were judged to be functional.

Enhancement repairs included: filling of minor holes or voids in the seal surface, repairing existing damming material, repairing the Flamemastic layer of Flamemastic firestops (see Section 3.4), installing a protective elastomer cap on seals in high traffic areas, adding additional seal material to the existing seals, and installing smoke and hot gas seals to enhance the level of protection provided.

Table 3.2.1.1 - Functional vs. Non-functional Fire Seals and Fire Barriers

Number of fire seals inspected	Evaluation results of fire seals (%)	Evaluation results of fire barriers (no.)
fire seals: 1200	functional: 92%	functional: all[1]
	non-functional: 8%	non-functional: 2 barriers

Notes:

1. *If the fire seal was judged to be functional, the fire barrier was assumed functional due to the absence of a fire seal concern.*

Table 3.2.1.2 - Breakdown of Seal Material Types and Seal Material Types per Non-functional Fire Seals

Number of Fire Seals Inspected	Breakdown of Fire Seals by Seal Material Type	Breakdown of Non-functional Fire Seals
fire seals: 1200	silicone foam: 45%	silicone foam: 16%
	silicone elastomer: 17%	silicone elastomer: 17%
	flamemastic w/fiberfill: 12%	flamemastic w/fiberfill: 42%
	3M system: 2%	3M system: 2%
	other: 24%	other: 23%

The remaining 23% were repaired to upgrade a non-functional fire seal to a "Functional" status. Upgrade repairs included: repairing of significant holes or voids through the seal configuration, adding additional seal material to existing fire seal, developing and implementing a design change that would govern the installation of protection for the DG wall openings (see Section 3.3.2).

3.3 Causal Factors Identified During the Inspection Effort Leading to Fire Seal and/or Fire Barrier Deficiencies

Three general categories of causal factors for both functional and non-functional fire seals have been identified based on a review of the deficiencies and non-conformances found during the inspection effort. These are as follows: 1) inadequate procedural controls governing the installation process, 2) inadequate fire seal or firestop design, and 3) normal wear and tear.

3.3.1 Inadequate Procedural Controls Governing the Installation Process

Typically, procedural controls governing a fire seal installation process are established based on the parameters necessary to achieve an adequate installation (e.g., installation technique), and maintain the parameters necessary (ie, maximum allowable opening size, minimum seal depth, etc) to achieve the required rating. The fire rating is generally determined by a fire endurance and hose stream test.

Inadequate procedural controls were a direct cause of three typical conditions identified during the inspection effort. The conditions identified were the existence of holes or voids at the seal surface or through the fire seal configuration, the existence of inadequate seal material depth, and a lack of detailed installation details associated with fire seals of the Forman Wall.

While the majority of the holes and voids identified were at the surface of the fire seal and considered minor, several significant holes or voids were identified through several fire seal configuration. This condition was found during the data acquisition phase, once damming material was removed. The condition is the result of an improper installation technique, and an incomplete final acceptance inspection following installation. The condition was primarily limited to silicone foam seals.

The second condition identified during the inspection phase was inadequate seal material depth. This condition was found during the evaluation phase (e.g., once both seal surfaces were combined and the overall fire seal configuration was considered).

The third condition identified, was the lack of detailed installation details associated with fire seals installed of the Forman Wall. This condition resulted in several non-conforming fire seal configurations and a typical installation that was not easily maintained.

Similarly, a condition identified in the Control Building (e.g., the inconsistency in Flamemastic coating on the cables, cracks and holes in the outer, exposed Flamemastic layers, and the presence of various non-conforming fill material within the firestopped opening) was attributed to the lack of detailed step-by-step installation procedure. Currently no standardized procedural controls exist for the installation of Flamemastic firestops; installation is performed in accordance with either of two design details. This concern was discussed under Significant Occurrence Report SOR 93-597 (Ref. 9) and Licensee Event Report LER 93-041-00 (Ref. 8). Also see Section 3.4 of this report.

Corrective Actions:

The following corrective actions will be performed to address the above concerns:

a. The installation procedures associated with the installation of silicone foam and silicone elastomer will be revised to incorporate a revised installation technique and final acceptance inspection criteria. This corrective action is an outcome of the process control and procedure assessment performed to address commitment IPN-93-105-02 made in LER 93-029-00.

b. A new installation procedure describing a step-by-step installation of Flamemastic firestops will be developed. The installation procedure will be similar to those used for the installation of silicone foam and silicone elastomer fire seals. This corrective action is an outcome of the process control and procedure assessment performed to address commitment IPN-93-105-02 made in LER 93-029-00.

c. A design change package will be developed to address long-term repair and maintenance of the Forman Wall fire seals. Performance inspection procedures governing the surveillance of these walls will be revised to include their periodic inspection. This corrective action is an outcome of the process control and procedure assessment performed to address commitment IPN-93-105-02 made in LER 93-029-00.

3.3.2 Inadequate Fire Seal Designs or Specifications

Inadequate fire seal designs or specifications were a direct cause of two conditions identified during the inspection effort. The conditions identified were the existence of non-rated seals (3'x 6' opening protection) in the Diesel Generator Building, and an inconsistency with regards to internal conduit seals.

During the inspection effort, approximately 50 embedded conduits that run between the Control Building and Manhole 34 in the yard were found unsealed. While the installation of a fire seal was not necessary due to the length of run (approximately 70 feet, buried), the absence of these seals is not consistent with the sealing of the other embedded conduit runs throughout the plant.

The other condition identified during the inspection effort was the lack of rated protection for two openings between diesel generator cells. This condition resulted in non-functional seals and two non-functional fire barriers. The non-functional barriers were identified under Significant Occurrence Report SOR 93-447 (Ref. 7) and Licensee Event Report LER 93-029-00 (Ref. 6).

Corrective Actions:

The following corrective actions have been initiated to address the above concerns:

a. A design equivalent modification DEM 93-03-246FBAR (Ref. 4) was initiated to incorporate specific guidance regarding the installation requirements for internal conduit seals, and various new seal designs and enhancements. Maintenance procedures governing the installation and maintenance of fire seals will be revised to incorporate these requirements, and new designs and enhancements. This corrective action is an outcome of the process control and procedure assessment performed to address commitment IPN-93-105-02 made in LER 93-029-00.

b. A design change package, DC 93-03-300FBAR (Ref. 5) was developed and installed restoring the two openings between diesel cells, back to a "Functional" status. This corrective action is complete; refer to commitment IPN-93-105-01 made in LER 93-029-00.

3.3.3 Normal Wear and Tear

Normal wear and tear was direct cause of three conditions identified during the inspection effort. The conditions identified were the existence of cracked or broken Transite board of Flamemastic firestops, damaged fire seals in high traffic areas, and missing, partially missing, or damaged ceramic damming material. For the purpose of this evaluation, normal wear and tear is considered that wear and tear associated with normal operation of the plant that may result in damage to a fire seal.

Corrective Actions:

The following corrective actions will be performed or have been completed to address the above concerns:

a. A seal design using silicone elastomer as a protective outer coating has been developed and used during the repair process to provide enhanced protection to the seal surface. This corrective action is complete.

b. Performance inspection procedures governing the surveillance of the fire seals will be revised to incorporate expanded seal inspection criteria. This corrective action clarifies commitment IPN-93-136-02 made in LER 93-041-00.

3.3.4 Other Program Corrective Actions

In addition to the corrective actions as identified under Sections 3.3.1, 3.3.2 and 3.3.3 of this report, the following corrective actions will be performed or have been completed to address the overall Fire Barrier Program:

a. A database will be created to identify each penetration by penetration number and descriptive information that can be used during the periodic surveillance. This corrective action clarifies informational and database needs identified in commitment IPN-93-105-02 made in LER 93-029-00.

b. Fire barrier penetration drawings will be revised to include additional or clarifying information as identified during this inspection effort. This corrective action is an outcome of the process control and procedure assessment performed to address commitment IPN-93-105-02 made in LER 93-029-00.

c. Performance inspection procedures governing the surveillance of the fire seals will be revised to identify and incorporate each barrier established to conform to Branch Technical Position 9.5-1, Appendix A (by commitments made thereto), comply with 10CFR50, Appendix R, and comply with Technical Specifications into the surveillance program. This corrective action clarifies commitment IPN-93-136-01 made in LER 93-041-00.

3.4 Reinspection Effort of Flamemastic Firestops in the Control Building

During the initial inspections performed under ENG-527, several non-conformances were noted regarding the internal fill material of the Flamemastic firestopped openings of the Control Building and a reinspection effort was undertaken to address the concern.

A typical cross sectional view of a Flamemastic firestop consists of a top layer of Flamemastic (1/4" thick), a depth of fiberglass fill, and a bottom layer of Flamemastic (also 1/4" thick). Since the initial inspections were a visual inspection only, the internal materials within the firestopped openings were not visible or identifiable. Visual inspection included the review of the outer, exposed face of the Flamemastic on both the top and bottom sides of the firestop.

While the initial inspections of the Flamemastic firestops did not note significant concerns, initial inspections of fifteen fire seals in the Electrical Tunnels raised a potential generic concern regarding fill material.

In the Electric Tunnels, several silicone foam and silicone elastomer fire seals which had been upgraded from Flamemastic firestops were inspected and found to have a fill material other than fiberglass. These materials were identified during the visual inspections of these fire seal upgrades where the bottom Flamemastic layers and fiberglass were removed. Of the fifteen upgraded fire seals of this type, two were found to have a fill material other than fiberglass.

As a result of the findings regarding various non-conforming materials present in the penetrations of the Electrical Tunnel floor, and generic implications with regard to similar materials in existing Flamemastic firestops. A random sample reinspection effort was undertaken to address this concern. The random inspections were destructive inspections to a degree greater than the initial inspections and encompassed the control room and cable spreading room floors.

3.4.1 General Reinspection Method

A random inspection, sample plan was developed to sample a lot size to either establish an adequate level of confidence with regard to the functional integrity of Flamemastic firestops or identify the extent of condition.

The sample plan, acceptable quality level, and sample size of the random sample reinspection was based on guidance of Military Standard 105D.

The acceptable quality level was established at 5 (or a maximum of 5 defects per 100 Flamemastic firestops), as an acceptance process average. The acceptable quality level was established based on engineering judgement, the significance of the unapproved materials found to date at the time of establishment and the other available fire protection features of the cable spreading and 480V switchgear rooms.

The sample plan was based on a multiple sampling procedure with a sample size of thirteen firestops. The sample size was based on a lot size of 300 flamemastic sealed surfaces (ie, 150 firestops) in the Control Building. Continuation of the sample inspection, or acceptance or rejection of lot was controlled by the number of acceptable or unacceptable results. If unacceptable results were found during the first sample inspection, a second sample inspection would be performed; and if the second sample inspection rendered unacceptable results, a third sample inspection would be performed and so on. Refer to Table 3.4.1 for sample plan.

3.4.2 Results of the Reinspection Effort

The sample reinspection included two sample inspections for a cumulative sample size of 26. Of the 26 firestops reinspected, fourteen were found to contain no non-conforming material and an acceptable quantity of fiber fill, ten were found to contain a relatively insignificant amount of non-conforming material (both combustible and non-combustible), one firestop was found void of fiber fill (penetration was a spare penetration), and the last firestop was found to contain a significant piece of combustible material.

Of the 26 firestops reinspected, only one firestop was considered unacceptable and judged a failure of the reinspection sample plan. The remaining 25 firestops were considered acceptable based on the insignificance of the materials found and the depth of fiberglass fill present. The materials found were either considered to be of such minor nature (ie, empty 1" diameter tape spool or tie wraps), or insignificant quantity (5 tie wraps), that they were judged not to present a significant hazard to their respective firestops. Based on the results of the reinspection the lot of 300 firestops was accepted.

TABLE 3.4.1 - Flamemastic Firestop Sample Plan Inspection for a Lot Size of 300

SAMPLE NO.	SAMPLE SIZE	CUMULATIVE SAMPLE SIZE	ACCEPT (SEE NOTE 1)	REJECT
first	13	13	Note 2	4
second	13	26	1	5
third	13	39	2	6
fourth	13	52	3	7
fifth	13	65	5	8
sixth	13	78	7	9
seventh	13	91	9	10

Notes:

1. *This column establishes the acceptance and rejection criteria of the lot. The ACCEPT number represents the maximum number of defects allowed for a given sample (or cumulative sample) when the lot can be accepted. The REJECT number represents the number of defects that when reached or exceeded the lot should be rejected.*

2. *The lot can not be accepted during the first sample inspection.*

3.5 Overall Assessment of Safety Significance of Identified Non-Functional Fire Seals and Fire Barriers

The identification of 8% non-functional fire seals had no significant effect on the health and safety of the public nor on the ability of the plant to maintain adequate fire area separation. Each fire barrier was reviewed on a case-by-case basis, once a fire seal in that barrier was judged to be non-functional. In all but two cases, the fire barriers were determined to provide an adequate level of protection necessary to prevent or significantly retard (limit) the spread of fire, given the hazard present. The two exceptions involved the fire barriers separating the diesel generators where alternate safe shutdown independent of the Control Building and Diesel Generator Building has been provided. Typical in all areas of the plant, installed suppression systems and early warning detection systems would prompt mitigating response by the on-site fire brigade to severely minimize the significance of a non-functional fire seal.

4.0 CONCLUSIONS

The initiation and performance of ENG-527 and the repairs performed provides a high level of confidence with regard to the functional integrity of all penetration seals of fire barriers established to conform to Branch Technical Position 9.5-1, Appendix A (by commitments made thereto), comply with 10CFR50, Appendix R, and comply with Technical Specifications.

Additionally, continued improvement to the program via planned corrective actions which included procedure revisions, drawing revisions and the creation of a fire barrier penetration database, will provide adequate documentation to qualify the functional integrity of the fire seals as well as ensure continued high quality maintenance.

5.0 REFERENCES

1. NRC Region I Special Inspection 50-286/93-80 conducted during April 26 - May 28, 1993, transmitted under NRC letter dated July 21, 1993.

2. Engineering Acceptance Test ENG-527, "Fire Barrier Inspections" including evaluations performed during the performance of the ENG-527:

   - Eval. 1 - Silicone Foam Electrical Penetration Fire Seal
   - Eval. 2 - Elastomer Electrical Penetration Fire Seal
   - Eval. 3 - Internal Conduit Seal Program
   - Eval. 4 - Elastomer Coating Over Silicone Foam
   - Eval. 5 - Penetration Fire Seal Program
   - Eval. 6 - Penetration Items of a Silicone Foam Fire Seal
   - Eval. 7 - Adhesive Sealant Mechanical or Electrical Penetration Fire Seal
   - Eval. 8 - Silicone Foam Electrical Penetration Fire Seal
   - Eval. 9 - Barriers Separating the DG Ventilation Areas from each other and from the Control Building
   - Eval. 10 - Flamemastic Firestops
   - Eval. 11 - Diesel Generator Bus Duct Penetration Seals and Fire Stops
   - Eval. 12 - Barriers Separating the CR from the CSR and the CSR from the 480V Switchgear Room
   - Eval. 13 - Flamemastic Firestops Reinspection
   - Eval. 14 - Disposition of Penetration Fire Seals and Firestops
   - Eval. 15 - Forman Wall
   - Eval. 16 - Enclosure of Battery Rooms 31 and 32
   - Eval. 17 - Barriers Required for Appendix R Separation
   - Eval. 18 - Results of the Flamemastic Firestops Reinspection
   - Eval. 19 - Alternative Repair Method for Single Penetrants in the Forman Wall

3. Fire Barrier Analysis IP3-ANAL-FP-00756, Rev. 0, "Fire Barriers, Fire Barrier Wrap and Radiant Energy Shields Required to be Maintained for Conformance to BTP 9.5-1, Appendix A (by Commitments Made thereto), Compliance with 10CFR50, Appendix R, and/or as a Measure of Prudent Industrial Fire Protection"

4. Design Equivalent Modification (DEM) 93-03-246FBAR, "Fire Barrier Seal Configurations"

5. Design Change (DC) 93-03-300FBAR, "Fire Protection Upgrade of Openings between the EDG Cells"

6. Licensee Event Report (LER) 93-029-00, dated September 16, 1993 transmitted under Authority letter IPN-93-105 regarding nonfunctional fire barriers between the diesel generator cells.

7. Significance Occurrence Report (SOR) 93-447 initiated August 19, 1993 regarding the identification of the nonfunctional fire barriers between the diesel generator cells.

8. Licensee Event Report (LER) 93-041-00, dated November 6, 1993 transmitted under Authority letter IPN-93-136 regarding missed penetration fire barrier surveillance of the DG Building.

9. Significance Occurrence Report (SOR) 93-597 initiated October 5, 1993 regarding the discrepant results noted during the inspection of CR/CSR floor Flamemastic firestops.

10. Significance Occurrence Report (SOR) 93-605 initiated October 7, 1993 regarding missed tech spec surveillance of the DG Building fire barriers.

11. Information Notice (IN) 88-04 including Supplement 1, "Inadequate Qualification and Documentation of Fire Barrier Penetration Seals, " dated February 5 and August 9, 1988 respectively.

12. Information Notice (IN) 88-56, "Potential Problems with Silicone Foam Fire Barrier Penetration Seals, " dated August 4, 1988.