INDIAN POINT UNIT No. 2

APPENDIX R EVALUATION

OF

PENETRATION H-20

TENERA REPORT NO. 94111701

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1.0 INTRODUCTION

The cables for the Alternate Safe Shutdown System source range flux, reactor coolant hot leg temperature, and reactor coolant cold leg temperature instrumentation are routed from Containment through penetration H-20 and the Electrical Penetration Area (E-Pen) to the Alternate Safe Shutdown System Instrument Panel in the Fan House. This instrumentation can be used for monitoring both hot and cold shutdown conditions for fires that could cause the loss of normally operating Indian Point 2 (IP-2) instrumentation. Circuits used to monitor hot shutdown must be capable of meeting the Appendix R "free of fire damage" requirements in a post-fire scenario. Since the Electrical Penetration Area is one of the fire areas that is required to be circumvented by the Alternate Safe Shutdown System (ASSS), and the cables for these alternate instruments were located within the area, an enclosure was constructed around penetration H-20 in the E-Pen (outside of containment). The H-20 enclosure and the conduit carrying the ASSS instrument cables to the roof of the E-Pen are encapsulated in Thermo-Lag, which at the time of its installation was believed to provide a 3-hour fire rated barrier based on documented test reports supplied by the vendor. The fire rated enclosure created an independent fire area from the rest of the E-Pen, thereby complying with the 3-hour rated Appendix R barrier requirement. At the time of installation, the encapsulation of H-20 in Thermo-Lag was judged to be the optimal solution since it was simple, inexpensive, permanent, and obviated the need to request additional exemptions from Appendix R.

However, the Thermo-Lag material has since been found unacceptable by the NRC as a 3-hour rated fire barrier. As a compensatory action, Con Edison has established a fire watch tour in the E-Pen until the issue of fire protecting the source range flux, reactor coolant hot leg temperature, and reactor coolant cold leg temperature instrument cables is resolved.

This report will review the regulatory requirements for instrumentation and the requirements for protection of the instrumentation associated with penetration H-20. The Con Edison commitments regarding penetration H-20 and the nature of the protection will be reviewed. The technical basis for protection of penetration H-20 and the nature of the protection will be evaluated. Items that will be considered in the evaluation include the need for the affected instrumentation during safe shutdown, fire resistance of the ASSS instrument cabling, the fire hazard in the area, and similarities to exemptions granted by the NRC.

The intent of this report is to demonstrate the defense-in-depth provided for safe shutdown of Indian Point Unit 2. This defense-in-depth is expected to be sufficient basis for an exemption from the Appendix R requirement to provide a high degree of protection for the cables for these three ASSS instruments.

2.0 APPENDIX R AND REGULATORY REQUIREMENTS

2.1 Methodology

This evaluation will first review the regulatory requirements for instrumentation and requirements for protection of the instrumentation associated with penetration H-20. The Con Edison commitments regarding penetration H-20 will then be reviewed. With requirements and commitments identified, the technical basis for protection of penetration H-20 can be evaluated. Items that will be considered in the evaluation include the need for the instrumentation during safe shutdown, fire resistance of the cables, the fire hazard in the area, the type of fire postulated, the fire suppression equipment available, the expected fire brigade response, and similarities to exemptions granted by the NRC. This evaluation will demonstrate that the nature of the fire hazard in the E-Pen, especially in the vicinity of H-20, does not support the need for a 3-hour rated fire barrier and is a justifiable basis for exemption.

2.2 Basic Requirements

10CFR50, Appendix R [Reference 1] specifies the requirements for protection of one train of systems needed for safe shutdown of a nuclear plant in the event of a fire. Hot shutdown systems must be free of fire damage, whereas repairs are allowed for systems required to achieve and maintain cold shutdown. Section III.G of Appendix R specifies methods for ensuring that the hot shutdown capability is protected from fires. The methods given for ensuring that shutdown capability is available for systems outside containment are listed below.

a. Redundant systems including cables, equipment, and associated circuits may be separated by a three-hour fire rated barrier; or,

b. Redundant systems including cables, equipment, and associated circuits may be separated by a horizontal distance of more than 20 feet with no intervening combustibles. In addition, fire detection and an automatic fire suppression system are required; or,

c. Redundant systems including cables, equipment, and associated circuits may be enclosed by a one-hour fire rated barrier. In addition, fire detection and an automatic fire suppression system are required.

If a., b., or c. cannot be met, alternative shutdown capability can be provided in the room, area, or zone under consideration (with provision for fire detection and fixed suppression) or exemptions can be sought on a justifiable basis.

Appendix R specifies in Section III.L.d that alternative shutdown capability shall include direct readings of the process variables necessary to perform and control the shutdown functions. The NRC Staff position [Reference 2] states that the monitored variables should include reactor coolant hot leg or core exit temperature, reactor coolant cold leg temperature, and source range flux.

2.3 Thermo-Lag Approaches

In response to the Thermo-Lag issue, the NRC has proposed several approaches for complying with the current NRC requirements. SECY-94-127 [Reference 3] states that the NRC Staff "would consider limited plant-specific exemptions on a case-by-case basis provided the licensee submits a technical basis that demonstrates that the in-plant condition or configuration provides an adequate level of fire safety." In response to SECY-94-127 [Reference 4], the Commission approved the use of plant-specific exemptions where justified. In addition, the Commission requested that the Staff "evaluate the feasibility of developing new guidance for rating fire barriers on the basis of representative plant fire hazards." In a recent letter to Con Edison [Reference 12], the NRC confirmed the exemption approach to resolving the Thermo-Lag issue. The letter contains an overview of the technical information needed to support requests for exemptions. Therefore, the methodology employed by Con Edison for addressing the Thermo-Lag installation on H-20 is consistent with NRC guidance and appears to be the approach preferred by the NRC. The NRC letter to Con Edison states that alternate fire protection configurations may be accepted if based on a fire hazards analysis, and that an existing fire hazards analysis may be used if appropriate. The following list was identified by the NRC [Reference 12] as the minimum set of information needed in a full fire hazards analysis. This evaluation includes the specified information in appropriate sections throughout this report.

- The NRC fire protection requirements and guidance that apply. [Sections 2.2, 2.3]
- Amounts, types, configurations, and locations of cable insulation and other combustible materials. [Section 4.2]
- Fire loading and calculated fire severities. [Sections 4.2.2, 4.2.3]
- In-situ fire hazards. [Section 4.2.2]
- Automatic fire detection and suppression capability. [Section 4.2.2]
- Layout and configurations of safety trains. [Section 4.2.2]
- Reliance on and qualifications of fire barriers, including fire test results, the quality of the materials and system, and the quality of the installation. [Section 4.2]
- Fire area construction (walls, floor, ceiling, dimensions, volume, ventilation, and congestion). [Section 4.2.2]
- Location and type of manual fire fighting equipment and accessibility for manual fire fighting. [Section 4.2.2]

- Potential disabling effects of fire suppression systems on shutdown capability. [Previously addressed in Exemption Request Number 15. See Section 10.2.12 of Reference 11.]

- Availability of oxygen (for example, inerted containment). [Not Applicable]

- Alternative or dedicated shutdown capability. [Not Applicable]

3.0 CON EDISON COMMITMENTS

3.1 Submittals of January 10, 1983 and May 23, 1985

The Evaluation of the Indian Point 2 Fire Protection Program submitted to the NRC in January 1983 [Reference 5] contains evaluations of fire protection features, requests for exemptions, and recommendations for improvements or modifications. Proposed improvements included the installation of a source range flux monitor and reactor coolant hot leg temperature (T-hot) and cold leg temperature (T-cold) instrumentation as part of the ASSS. In Section 2 of the January 10, 1983 submittal, Con Edison states that the minimum instrumentation necessary for achieving safe shutdown for a postulated fire are pressurizer level and pressure and steam generator level. These primary indications are necessary to maintain reactor coolant system inventory and to insure decay heat removal capability. The ASSS is provided with separate pneumatic indication of these variables which is independent of the plant's electrical cable system and independent of Zone 74A. As an enhancement to this instrumentation, Con Edison committed to provide T-hot and T-cold indication for confirmation of natural circulation, and source range flux monitoring for confirmation of reactivity control as part of the ASSS.

In fulfillment of the commitments above, Con Edison installed alternate source range flux, T-hot, and T-cold instrumentation during the 1984 refueling outage. The modification was described for the NRC in Attachment 2 to Reference 6. The modification entailed the installation of independent sensors inside the Containment and routing of the instrument cables from Containment to the instrument rack in the Fan House. The cable routing passes through several fire zones including a short run in the E-Pen (Zone 74A) which is one of the zones in Fire Area A that was being circumvented by the ASSS.

3.2 Penetration H-20 Enclosure Design Details

With ASSS instrumentation installed and Appendix R Section III.G.2.b separation requirements not met in the E-Pen, to comply with Appendix R and to eliminate the need to request additional exemptions at that time, penetration H-20 and the conduit containing the ASSS instrument cables were encapsulated in a separate 1-ft.-10-in.-square by 4-ft.-5-in. long (approximate) box enclosure within the E-Pen that was designed to have a 3-hour fire rating. It consists of a seismically secured, welded structural steel frame, mounted on the concrete containment exterior wall, to which Thermo-Lag 330-1 3-hour pre-formed panels (See Figure 1) manufactured by Thermal Science, Inc. (TSI) are attached. The instrument cables are routed inside the box enclosure to a conduit which routes a short distance from the top of the enclosure to the roof of the E-Pen. The conduit is protected with Thermo-Lag 330-1 3-hour pre-formed conduit shapes within the E-Pen (See Figure 2). Other non-safe shutdown plant instrument cables connected to penetration H-20 exit the enclosure through a seal composed of 12 inches of Dow Corning 3-6548 RTV silicone foam formed in a 8-in.-square by 12-in.-long 10-gauge sheet metal sleeve that is covered with Thermo-Lag 330-1 3-hour pre-formed panels (See Figure 3). The Thermo-Lag was installed in accordance with the TSI installation procedure manual for nuclear plant applications and was supervised by a TSI representative. The enclosure and the conduit create a separate fire zone (Zone 74B) and fire area (Area Q) within the E-Pen.

3.3 Submittals of July 24, 1992, September 30, 1992, and April 16, 1993

NRC Bulletin No. 92-01 [Reference 14] and Supplement 1 [Reference 15] were issued to address the failure of Thermo-Lag 330-1 to perform its intended rated fire barrier function. In response [Reference 7] to the bulletin, Con Edison instituted a fire watch tour and committed to applying the results of the industry effort being coordinated by NUMARC. The response [Reference 8] to the supplement further committed to evaluating the Thermo-Lag installations to determine if replacement or cable rerouting were possible.

In addition to the NRC Bulletin and its supplement, the NRC also issued Generic Letter 92-08 [Reference 16]. In the Generic Letter response [Reference 9], Con Edison restated the commitments made in the responses to the earlier bulletin and its supplement.

3.4 Submittal of February 11, 1994

In response [Reference 10] to a request for additional information [Reference 17] regarding Generic Letter 92-08, Con Edison indicated their intent to incorporate the results of several of the industry-sponsored Thermo-Lag tests to develop, for purposes of analysis, a composite tested configuration that is representative of the installed configuration. A written justification would then have been prepared to qualify the installed configuration based on the composite configuration. If the testing program results were not favorable, Con Edison proposed to perform an engineering evaluation of the installed configuration to analyze the adequacy of the fire barrier based on Generic Letter 86-10 criteria. The results of the evaluation would determine the barrier's ability to withstand the representative fire hazards in the area. The Con Edison response described other alternatives such as reducing the scope of protected circuits and their associated fire barriers by re-evaluating the existing engineering analyses, or submitting exemption requests based on the use of fire modeling or probabilistic safety analysis, or a combination of the above alternatives.

4.0 RE-EVALUATION OF BASIS OF PENETRATION H-20 INSTRUMENTATION

Since Thermo-Lag 330-1 has been found by the NRC to be unacceptable for use as a 3-hour fire rated barrier material, the existing basis that Con Edison used for compliance with Appendix R for penetration H-20 is assumed to be no longer valid. To establish a new basis for these ASSS instrument cables and their protection requirements in the E-Pen, Con Edison has decided to pursue removing the Thermo-Lag altogether, based upon an analysis of representative fire hazards in the area and the 10-year history of this installation. This section will discuss various factors that should be considered in determining the requirements for the ASSS source range flux, T-hot, and T-cold instrument cables in the E-Pen.

4.1 Use of Instrumentation For Safe Shutdown Operation

The NRC Staff Position on process monitoring is that source range flux, T-hot, and T-cold monitors should be included in the instrumentation protected for hot shutdown. However, when Con Edison committed to installing T-hot, T-cold, and source range flux monitoring instrumentation for the ASSS, they were identified in the submittal to the NRC [Reference 5] as enhancements beyond the minimum process information necessary to achieve safe shutdown. The justification provided for interim operation of the plant was based on the fact that the new ASSS instrumentation is an enhancement. The following quote is from Reference 5, Section 2.0, page 2-30:

> "Operation of IP-2 in the interim until installation of the T_H and T_C instrumentation as part of the SSS is considered acceptable since this instrumentation is not essential for operators to take the actions described in the response to Action Item 4 regarding the maintenance of RCS inventory and the removal of decay heat, including the assurance of subcooling of the RCS. This instrumentation will provide an additional level of confidence that appropriate actions have been taken.
>
> "Similarly operation of IP-2 in the interim until installation of the SRM instrumentation is considered acceptable since it will only serve as verification that the control rods have inserted upon reactor trip. The instrumentation is considered to be a backup because of the high reliability of the reactor trip system as determined in the IPPSS and as verified by successful plant operating experience."

Originally stated in Reference 5, Section 2.0, page 2-10 and re-stated in Section 10.2.3.3, page 10-18 of the Fire Protection Program Plan [Reference 11], the Con Edison position on this instrumentation is:

> "While not essential for taking actions, instrumentation to confirm that natural circulation and reactivity control have occurred include hot and cold leg temperature monitors and source range flux monitors. These instruments represent an enhancement to the ASSS that have been installed."

Thus, the Con Edison view has always been that the T-hot, T-cold, and source range flux are not primary indications necessary to maintain RCS inventory or to insure decay heat removal capability, and are not necessary to assist the operator in confirming system operation. Interim operation without the T-hot, T-cold, and source range flux instrumentation was allowed by the NRC based on the non-essential, backup nature of the instrumentation. Likewise, the non-essential, backup nature supports the elimination of the need for a high degree of protection during normal operation.

Additionally, for a fire that may affect normal plant safe shutdown instrument cables in every other fire zone except the E-Pen, including other fire zones within the same fire area (A), the ASSS instrument cables passing through the E-Pen will be unaffected. This is so because fires in zones outside of the E-Pen can not involve these ASSS instrument cables as they only route in a short run within the E-Pen from H-20 to the ceiling. Such a fire would also be slow burning and detectable in its early stages allowing prompt response by the fire brigade. Thus, the only potential to simultaneously damage the ASSS instrument cables and normal safe shutdown instrument cables exists in the E-Pen and in the vicinity of H-20. This next section evaluates that potential for damage.

4.2 Electrical Penetration Area Fire Hazard

The fire hazard in the Electrical Penetration Area is minimal because of the very low combustible loading in the vicinity of H-20, the high ignition threshold of the Indian Point 2 cables, the sparseness of components in the area, the routing of cables out and away from the penetrations, the low level of personnel traffic, and the low potential to introduce combustibles and/or ignition sources.

4.2.1 Inherent Ruggedness of IP-2 Cables

Based on previous experience, Con Edison engineers specified cables for Indian Point 2 during its design and construction which demonstrated good fire retardation characteristics and the ability to function after being subjected to intense flames. The original cable specified for low power and control applications is:

a. silicone rubber insulated cable with a lapped mylar tape separator and **an overall braid of closely woven asbestos and saturated with a flame and moisture resistant finish,**

b. EPR insulated cable with **a neoprene or lead jacket,** or

c. PVC insulated cable with a closely woven glass braid and overall covering of lapped mylar tape and **closely woven asbestos braid saturated with a flame and moisture resistant finish.**

The fire retardant properties of Indian Point 2 cables have been demonstrated by the following tests:

a. Standard vertical flame test in accordance with ASTM D-470-59T, "Tests for Rubber and Thermoplastic Insulated Wire and Cable;"

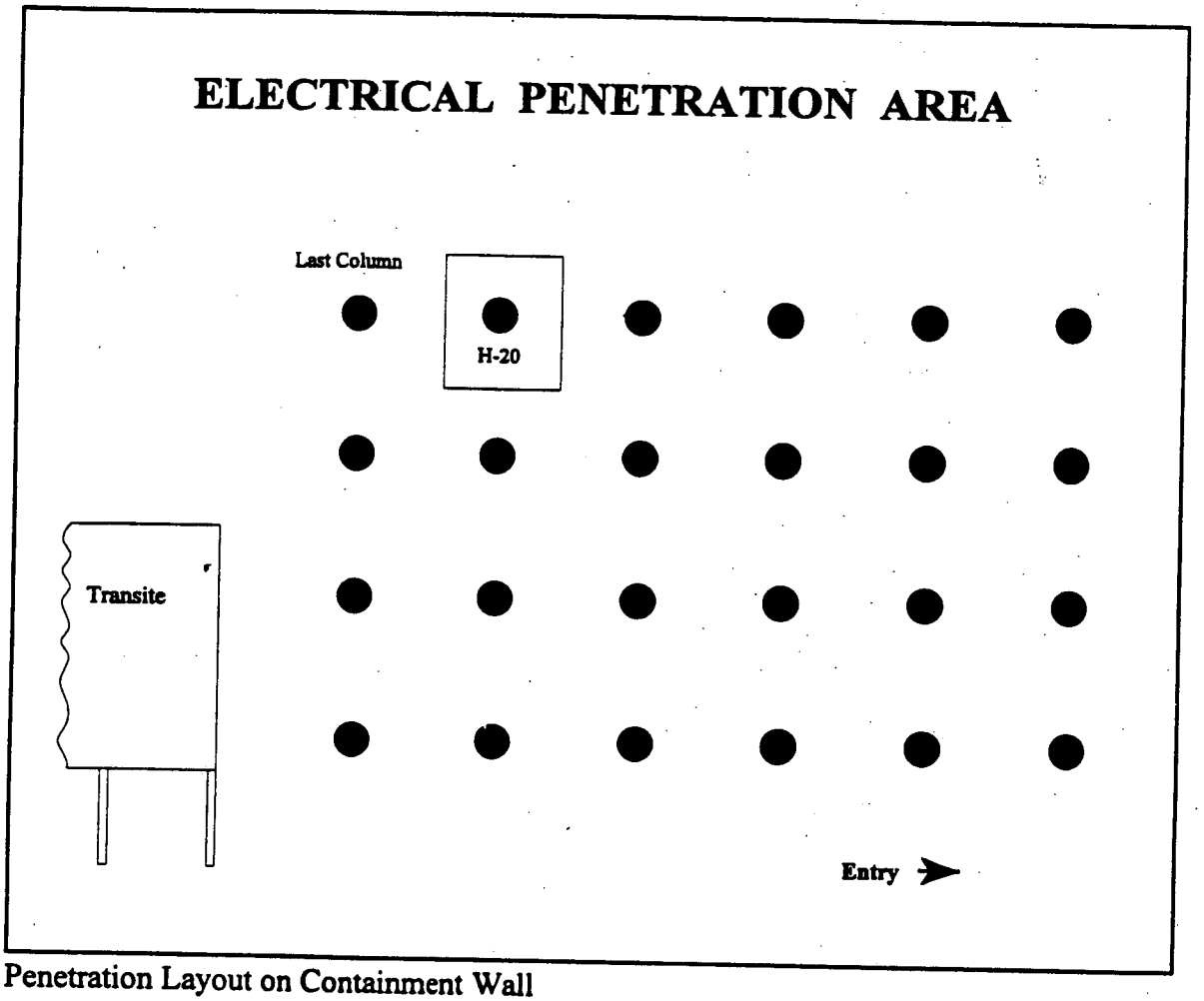
b. Vertical flame test made with the cable held in a vertical position and a 1750 F flame applied for five minutes; and

c. Bonfire test which exposed bundles of 3 or 6 cables to a flame produced by igniting transformer oil in a 12-inch pail for five minutes. The cable bundles were supported horizontally over the center of the pail with the lowest cable 3 inches above the top of the pail.

The tests demonstrated that a fire will not propagate along the cable [Reference 11]. Further, in the Safety Evaluation for License Amendment No. 46 [Reference 13], the NRC stated that cables used at IP-2 will not burn vigorously under test conditions, that additional testing would not provide new information, and that the cables used and flame testing performed are acceptable. New low power, control, and instrumentation cable is required to meet IEEE-383, "IEEE Standard for Type Tests of Class 1E Electrical Cables, Field Splices, and Connections for Nuclear Power Generating Stations." The IEEE-383 requirements exceed the flame resistance requirements of the original cable and is used exclusively in new installations. Therefore, the cables in use at IP-2 are constructed in a manner such that a fire resistant barrier is essentially formed in each cable.

4.2.2 Electrical Penetration Area Layout

The schematic layout below shows the arrangement of the penetrations in the E-Pen. The separation between penetrations is 3 feet. Penetration H-20 is the top penetration in the next to the last column (See Figure 4) and is 11 feet above the floor. The E-Pen is an uncongested area with easy access to all locations. Cables from the penetrations enter trays and cross to the opposite wall where they exit through the floor or remain in trays to exit the end of the room. The E-Pen floor and three of the walls are constructed of concrete that is at least three feet thick. The wall between the E-Pen and Piping Penetration Area is concrete or metal sandwich. The penetrations through the wall have been sealed with silicone foam to provide a fire stop, except for the normally closed steel door. The ceiling is six inch concrete with built-up roofing and an equipment hatch. The area is curved with a minimum width of about 14 feet, a length of about 80 feet, and a 20 foot ceiling.



Penetration Layout on Containment Wall

Figures 1 through 12 are pictures of the E-Pen and the penetration H-20 enclosure. The pictures provide a graphic illustration of the openness of the E-Pen and low fire loading near H-20. Figure 1 is a general view of the enclosure and the non-ASSS cables exiting the side containing the 12 inch silicone foam seal. Figure 2 is a close-up of the enclosure and clearly shows the enclosed conduit rising to the ceiling of the room. Figure 3 gives a good view of the side of the enclosure and those non-ASSS cables. The open view to the side and above H-20 is seen in Figure 4. Figure 5 is a view near the entrance to the E-Pen looking back. H-20 would be toward the back on the right side. The arrangement of the cable trays crossing the room from the penetrations to the outer wall is well illustrated. It is significant that the cables cross to the outer wall opposite the penetrations because this keeps the combustible load in the vicinity of Penetration H-20 (and the other penetrations) to a minimum (i.e., the general routing is open, out and away from the penetrations). In addition, there are fewer cables in the penetrations near the back of the room. Figure 6 shows the typical configuration of the cables exiting a penetration, entering a tray, and turning to cross to the opposite side of the room. Figure 7 also shows the trays crossing to the outer wall. Figure 8 shows the outer wall looking from the back of the room toward the entrance. The open, uncongested nature of the area and the absence of equipment other than cables and closed distribution panels are readily apparent. The low cable density around H-20 can be seen in Figure 9. Tray 41D at the bottom of

the picture has two layers of cables and the small trays near H-20 have only seven cables each. The cables in these two trays are low energy instrument cables, and introduce minimal fire hazard to H-20. Figure 10 shows the low cable density beneath H-20. When considering that these cables are fire retardant, it is evident that the fire load in the vicinity of H-20 is quite low. Figure 11 is a close-up underneath the enclosure and Figure 12 is a close-up of the silicone foam seal.

The other non-ASSS plant instrument cables which connect to penetration H-20 could not affect the ASSS instrument cables because fire propagation along those cables would be stopped by the 12-inch silicone fire seal (See Figure 3). The E-Pen contains only cabling, electric panels, and switches and is absent of highly combustible items and potential ignition sources. There are no pumps, valves, or other oil containing machinery and transient combustibles are under strict control. The E-Pen is in a controlled access area with no through traffic since there is only one entry and exit door. There is no other equipment to be serviced which would require that combustibles be brought into the area.

The E-Pen is equipped with automatic fixed early warning ionization detectors which alarm in the Central Control Room, allowing rapid fire brigade response. This selection is appropriate because potential cable fires are slow burning, highly smoke-generating, and low flaming type fires which will be detected in their incipient stages by this system. The E-Pen is easily accessible through the Piping Penetration Area either from the electrical and piping tunnel of the Primary Auxiliary Building (PAB) or from the fan house after passing through elevation 80 feet of the PAB. A hose station is located nearby in the Piping Penetration Area and portable extinguishers are located throughout that zone.

4.2.3 Fire Effects Thermal Analysis

The fixed combustible material in the E-Pen is for the most part electrical cable insulation entering the containment through penetrations or entering the Auxiliary Boiler Feed Pump room through conduits. A large portion of the cabling is encapsulated by an asbestos jacket, essentially forming a fire resistant barrier in each cable. The remainder of the cabling is IEEE 383 qualified fire retardant type cross-linked polyethylene cable with a neoprene jacket, also providing a substantial fire resistive barrier. The fire resistant characteristics of both of these cable types are described in Section 4.2.1. The maximum amount of transient combustibles is expected to be negligible. Over the ten years that penetration H-20 has been enclosed, there has been no appreciable increase in the fire load in this area. Future changes to the fire load in the E-Pen are expected to be insignificant.

Exemption Number 15 in Section 10.2.12 of Reference 11 documents the results of a quantitative fire effects thermal analysis that was performed to investigate the potential for a hypothetical conservatively bounding exposure fire to ignite cables in cable trays. Based on the potential transient combustibles that could credibly be expected within the zone, an exposure equivalent fire of 1 gallon of heptane was assumed for the quantitative fire effects thermal analysis. The gallon of heptane is equivalent to approximately 18 pounds of Class A type combustibles, such as rags or protective clothing. The analysis considered an exposure fire in a 2-foot diameter pan located directly below the stack of cable trays on the outer wall. This scenario more than conservatively

bounds any credible fire loading in the vicinity of H-20 (i.e., this model is a far worse case situation than what can be expected to exist near H-20 [See Figure 10]).

The analysis determined that the heat flux observed by a cable in the lowest tray would reach a peak value of approximately 16 kw/m^2 at 2 to 3 minutes into the fire. At this point, the heptane fuel would have been exhausted. The following characteristics of asbestos jacketed cable were taken from Section 10.2.12 of Reference 11 (exemption request 15):

piloted ignition	26 kw/m^2
auto ignition	31 kw/m^2
electrical failure	70 kw/m^2

Since the exposure fire heat flux does not exceed the critical values for cable ignition (with ample margin), damage to electrical cables in the E-Pen would not result from such a severe bounding fire scenario. This result is expected because the cables essentially have their own fire resistive barrier. Although the actual fire load is significantly lower than that assumed here, even if H-20 could be exposed to such a severe fire, ASSS instrument cable damage is predicted to not occur. In fact, damage to normal safe shutdown instrument cables that provide T-hot, T-cold and source range flux indication is also predicted to not occur. Hence, the ruggedness and fire resistive design of the Con Edison cables and the type of fire load are added levels of defense-in-depth.

4.3 Appendix R Exemptions Granted

The NRC has granted Con Edison several exemptions from literal compliance with the technical requirements of Appendix R. Two of the exemptions relate to safe shutdown equipment in the Piping Penetration and E-Pen areas and can be used in support of the basis for establishing the level of protection of the source range flux, T-hot, and T-cold instrument cables.

4.3.1 Exemption Number 9

An exemption from the separation requirements was granted by the NRC for fire zone 1A, the Piping Penetration and Electrical Tunnel Area. (Exemption Request Number 9 in Reference 11). The NRC's safety evaluation report (SER) covering this exemption request is described below:

> The technical requirements of Section III.G are not met in this fire zone due to the absence of a fixed fire suppression system. Also, some components of the licensee's alternate shutdown system are not independent of the fire zone.
>
> The NRC expressed a concern that if a fire of significant magnitude occurred in this area, it would damage normal shutdown related systems as well as the components of the alternate shutdown capability since a one-hour enclosure was not provided. Further, such a fire might propagate beyond the perimeter of this area into adjoining plant locations.

> The upgrading of the perimeter walls and ceiling as described will provide reasonable assurance that the damaging effects of a fire within the Piping/Electrical Tunnel will be confined within the area and would, therefore, not pose a threat to shutdown related systems in other areas.
>
> The pneumatic instrument lines for the alternate shutdown capability will be protected by a barrier that achieves a 1/2-hour rating when tested in accordance with ASTM E-119. Because of the limited amount of combustibles in the area and the existing automatic and manual fire protection, we do not expect a fire to develop the elevated temperatures comparable to the E-119 test fire. Therefore, the fire barrier for the instrument lines will be expected to maintain its integrity for a significantly longer period of time. (Emphasis added.)
>
> Because of the presence of smoke detectors, a fire would be discovered in its initial stages before significant damage occurred. The fire brigade would then respond and would effect extinguishment using manual fire fighting equipment. During the time delay associated with these actions, the instrument lines would be protected from damage by the fire barrier. Therefore, if redundant shutdown systems were damaged, the alternate shutdown capability would be available to achieve and maintain safe shutdown conditions.
>
> Based on this evaluation, the NRC concluded that Con Edison's alternate fire protection configuration will achieve an acceptable level of fire protection equivalent to that provided by Section III.G. Therefore, Con Edison's request for exemption for the Piping and Electrical Tunnel and Piping Penetration Area was approved.

Several of the conditions identified above for the Piping Penetration Area are also applicable to the E-Pen. The E-Pen does not have a fixed fire suppression system and the ASSS source range flux, T-hot, and T-cold instrument cables are not independent of this area (due to their short run to the ceiling of the E-Pen) and are not separated by greater than 20 feet with no intervening combustibles. The perimeter walls and the ceiling of the E-Pen are constructed of concrete. The barrier to Zone 1A was upgraded by sealing cable penetrations with 4 inches of silicone foam, although the barrier does contain an unrated door. Thus, a fire outside the E-Pen would not consequently pose a credible threat to safe shutdown related cabling in the E-Pen and the ASSS instrument cables would be unaffected. Smoke detectors are present in the E-Pen and Piping Penetration Area which alarm in the Central Control Room and allow discovery of a fire in its early stages.

The only credible fire within the E-Pen is a cable fire since that is the only significant combustible. A cable fire generates much smoke and is slow burning or a smoldering fire. An E-Pen fire would not be a catastrophic fire but would progress slowly along the cables. This is especially true for the fire resistant cables at Indian Point 2 as discussed in Section 4.2.1. The cable fire will promptly activate the fire detection in the area and the Fire Brigade response would extinguish the fire quickly. The wall to Zone 1A would most likely prevent the spread of the fire beyond the E-Pen such that safe shutdown systems in other plant areas would not be threatened. The silicone foam fire stop that will remain after removal of the Thermo-Lag would halt the progress of the fire into the vicinity of

H-20 if those non-ASSS cables exiting to the trays were propagating fire, and the ASSS instrument cables would continue to function.

4.3.2 Exemption Number 15

An exemption from providing fixed fire suppression was granted by the NRC for the E-Pen based on Exemption Request Number 15 in Reference 11. The NRC's evaluation of the exemption request is described below:

> The technical requirements of Section III.G are not met in this fire zone due to the absence of a fixed fire suppression system.
>
> The NRC expressed a concern that if a fire of significant magnitude occurred, it would propagate through unprotected openings in the common wall between the electrical and piping penetration areas and cause damage to components for both normal and alternate shutdown systems. The common wall is of concrete construction and all openings have been sealed to prevent the passage of flame and hot gases. Therefore, there is reasonable assurance that if a fire occurred in the electrical penetration area, the systems for the alternate shutdown capability will be free of fire damage.
>
> Because the fire load is low and the area is equipped with a smoke detection system, the fire brigade is expected to respond and effect fire extinguishment before serious damage occurs. If a fire should cause damage to redundant shutdown systems in the area, an alternate capability exists which is physically and electrically independent of the area. Therefore, an automatic fire suppression system is not necessary to assure that safe shutdown conditions can be achieved and maintained. (Emphasis added.)
>
> Based on this evaluation, the NRC concluded that Con Edison's alternate fire protection configuration will achieve an acceptable level of fire protection equivalent to that provided by Section III.G. Therefore, Con Edison's request for exemption for the Electrical Penetration Area (Zone 74A) was approved.

At the time Exemption 15 was granted, the T-hot, T-cold, and source range flux instrumentation for the ASSS was not installed. In granting Exemption 15, the NRC relied on the interim justification for operation without T-hot, T-cold, and source range flux instrumentation discussed in Section 4.1. Thus, the interim justification combined with the basis for Exemption 15 supports the basis for an exemption regarding protection of the T-hot, T-cold, and source range monitor cables. To state it more explicitly: the instrumentation is not essential for safe shutdown as described in the interim justification, the fire load is low, and the automatic detection would summon the Fire Brigade before serious damage occurred, as was concluded by the approval of Exemption 15.

5.0 CONCLUSIONS

The preceding sections discuss various aspects of the T-hot, T-cold, source range flux instrumentation and the Thermo-Lag encapsulated penetration H-20, and document a defense-in-depth for the safe shutdown of Indian Point 2 with respect to a fire outside or within the E-Pen. The defense-in-depth incorporated into the Indian Point 2 safe shutdown systems shows that a further degree of protection for penetration H-20 and the ASSS T-hot, T-cold, and source range flux instrument cables is not warranted. The key aspects of defense-in-depth are the non-essential nature of the instrument cables being protected, the type of fire hazard in the zone, the low fire hazard in the vicinity of H-20 especially considering the fire resistant characteristics of plant cables, and the early detection and extinguishment of a potential fire.

The ASSS T-hot, T-cold, and source range flux instrumentation was installed as an enhancement to the minimum process information necessary for safe shutdown operation. The NRC has previously allowed interim operation without the instrumentation and the earlier justification for interim operation is still valid. It is important to note that Con Edison is only removing the Thermo-Lag and this instrumentation will remain part of the ASSS.

Penetration H-20 is located in an area where cable insulation is the only potential combustible hazard. The only items located near H-20 are rugged, fire resistant cables. There is a very low fire load in the immediate vicinity of H-20 and no significant transient combustibles are expected during plant operation. Access to the area is under strict administrative controls at all times. A bounding quantitative fire effects thermal analysis identified no cable damage. For fires in all other plant fire zones, the ASSS instrument cables in H-20 would be unaffected altogether.

If an E-Pen fire were to occur, it would be a slow burning, highly smoke-generating fire. The automatic ionization detection present in the E-Pen would quickly alarm in the Central Control Room. A fire would be discovered in its initial stages and the Fire Brigade could promptly respond with manual fire fighting equipment. The Fire Brigade training and the pre-fire planning significantly enhance the ability to rapidly extinguish a fire.

The defense-in-depth provided for safe shutdown of Indian Point Unit 2 is sufficient basis for an exemption to the Appendix R requirement to provide a high degree of protection to the ASSS T-hot, T-cold, and source range flux instrument cables. Elimination of the Thermo-Lag that encapsulates penetration H-20 will not result in any unacceptable safety related consequences.

6.0 REFERENCES

1. 10CFR50 Appendix R, Fire Protection Program for Nuclear Power Facilities Operating Prior to January, 1979.

2. NRC Memorandum for Roger J. Mattson from L. S. Rubenstein, dated March 18, 1983, "Revision to Statement of Staff Position Regarding Source Range Flux, Reactor Coolant Temperature, and Steam Generator Pressure Indication to Meet Appendix R."

3. SECY-94-127 dated May 12, 1994, "Options For Resolving The Thermo-Lag Fire Barrier Issues."

4. Staff Requirements Memorandum dated June 27, 1994, "Options for Resolving the Thermo-Lag Fire Barrier Issues."

5. Letter from J. D. O'Toole (Con Edison) to Darrell G. Eisenhut (NRC) dated January 10, 1983, "Final Report on Indian Point 2 Fire Protection Program Evaluation."

6. Letter from John O'Toole (Con Edison) to Hugh Thompson (NRC) dated May 23, 1985.

7. Letter from Stephen Bram (Con Edison) to NRC dated July 24, 1992, Response to NRC Bulletin No. 92-01.

8. Letter from Stephen Bram (Con Edison) to NRC dated September 30, 1992, Response to NRC Bulletin No. 92-01, Supplement 1.

9. Letter from Stephen Bram (Con Edison) to NRC dated April 16, 1993, Response to Generic Letter 92-08.

10. Letter from Stephen Bram (Con Edison) to NRC dated February 11, 1994, Response to Request for Additional Information Regarding Generic Letter 92-08.

11. Indian Point Unit 2 Fire Protection Program Plan, Revision 8.

12. Letter from Roy P. Zimmerman (NRC) to Stephen E. Quinn (Con Edison) dated September 20, 1994, Followup to the Request for Additional Information Regarding Generic Letter 92-08 Issued Pursuant to 10CFR50.54(f) on December 22, 1993, Indian Point Nuclear Generating Unit No. 2.

13. Letter from A. Schwencer (NRC) to William J. Cahill, Jr. (Con Edison) dated January 31, 1979 and the enclosed Safety Evaluation.

14. NRC Bulletin 92-01, "Failure of Thermo-Lag 330 Fire Barrier System to Maintain Cabling in Wide Cable Trays and Small Conduits Free from Fire Damage", dated June 24, 1992.

15. NRC Bulletin 92-01, Supplement 1, "Failure of Thermo-Lag 330 Fire Barrier System to Perform its Specified Fire Endurance Function", dated August 28, 1992.

16. Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers", dated December 17, 1992.

17. Letter dated December 22, 1993, L.J. Callan to S.B. Bram, "Request for Additional Information Regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10CFR 50.54(f)-Indian Point Nuclear Generating Unit No. 2 (TAC No. M85560)"

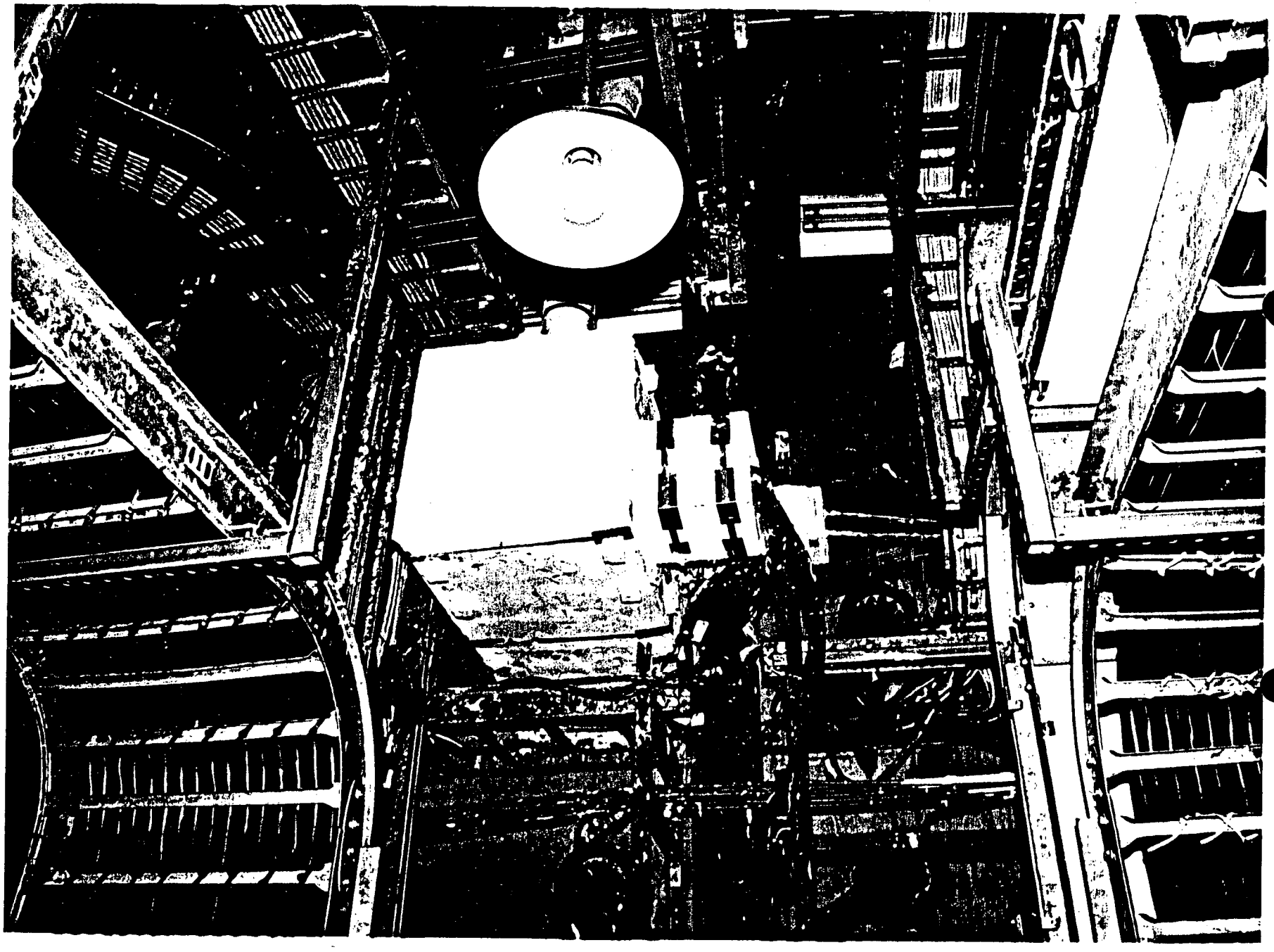


FIGURE 1 - Penetration H-20 Enclosure

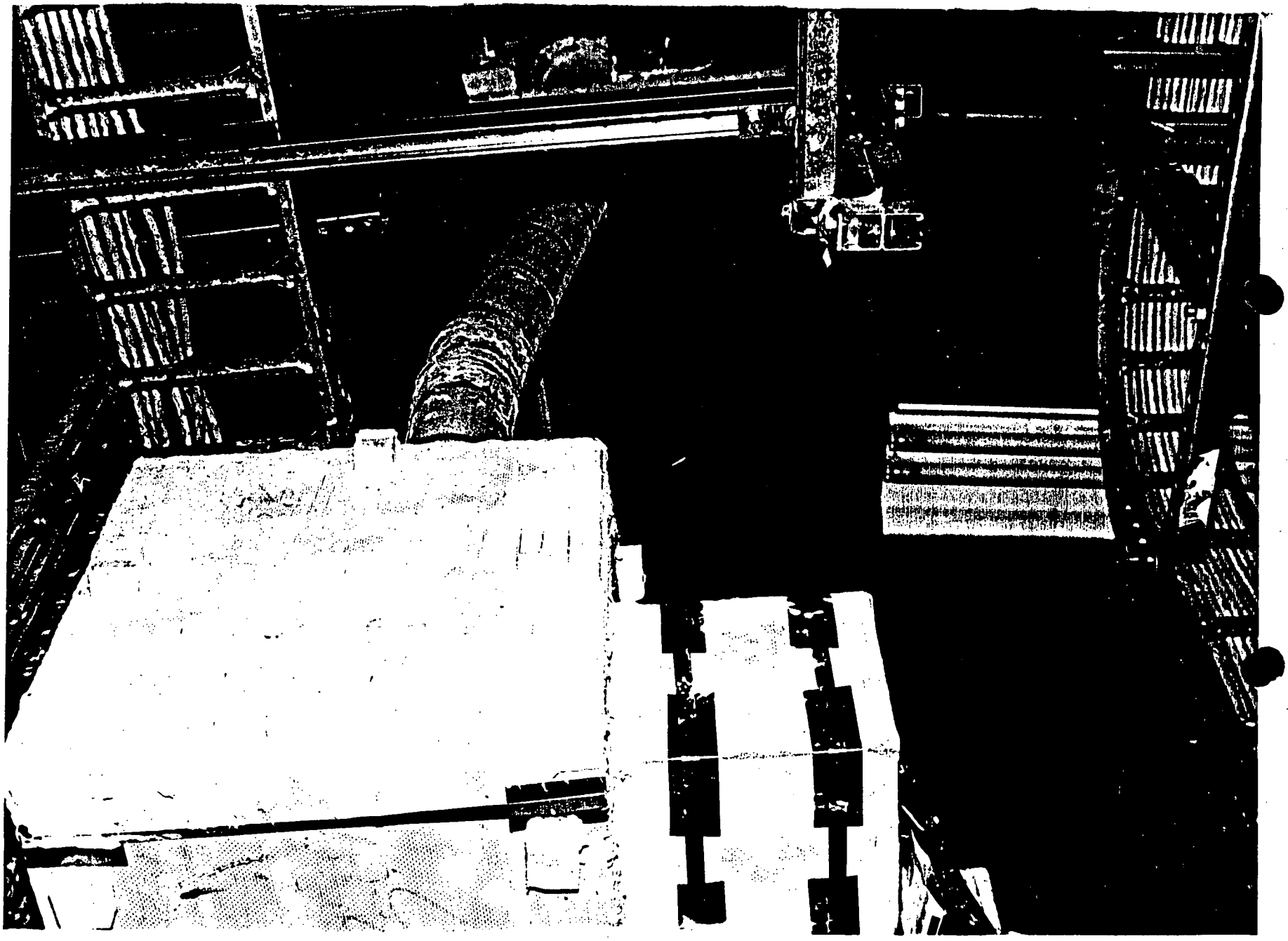


FIGURE 2 - Enclosed Conduit Routed to Ceiling

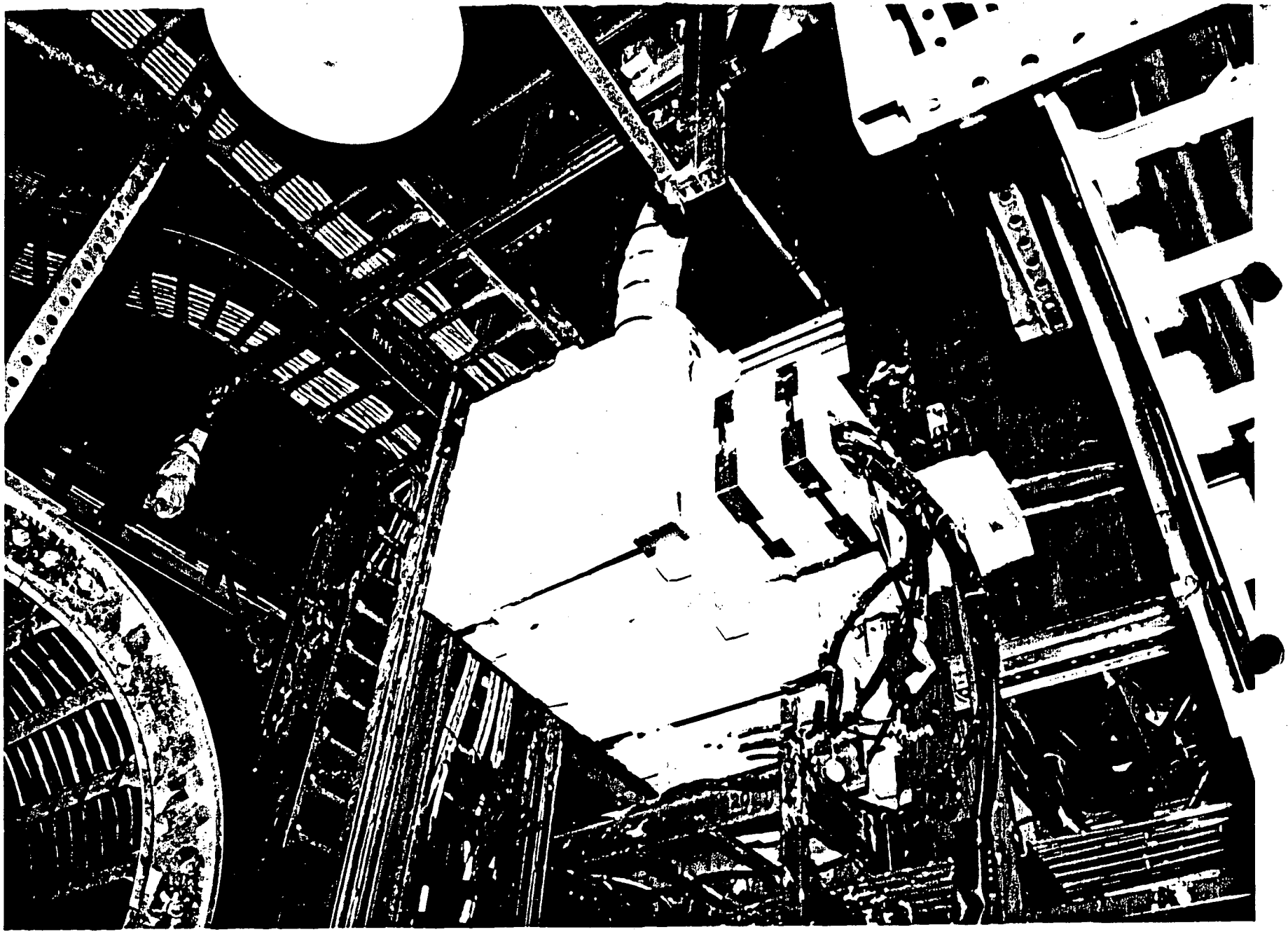


FIGURE 3 - Other Cables Exiting Enclosure Through Silicone Foam Seal

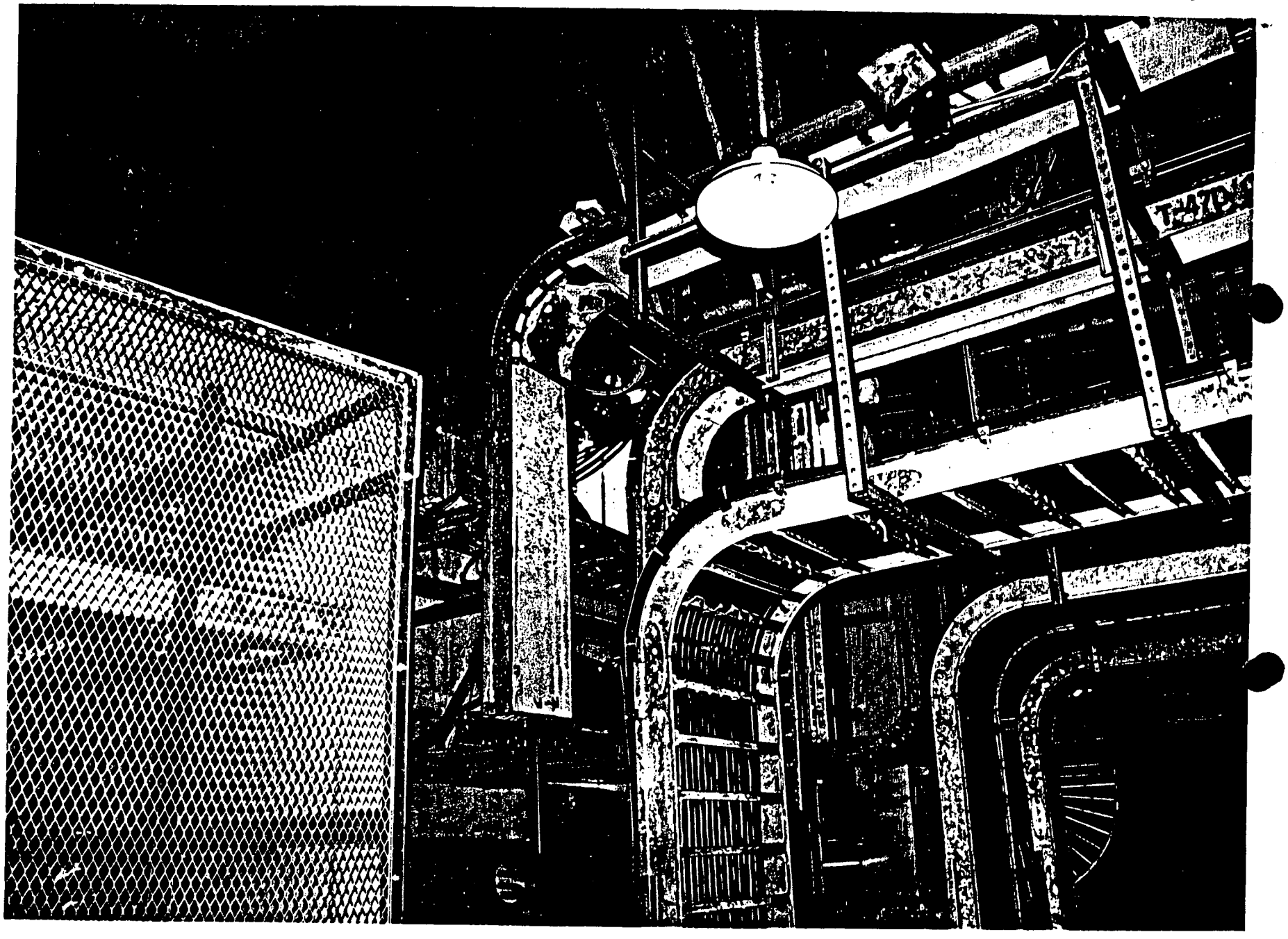


FIGURE 4 - Open Area Above H-20

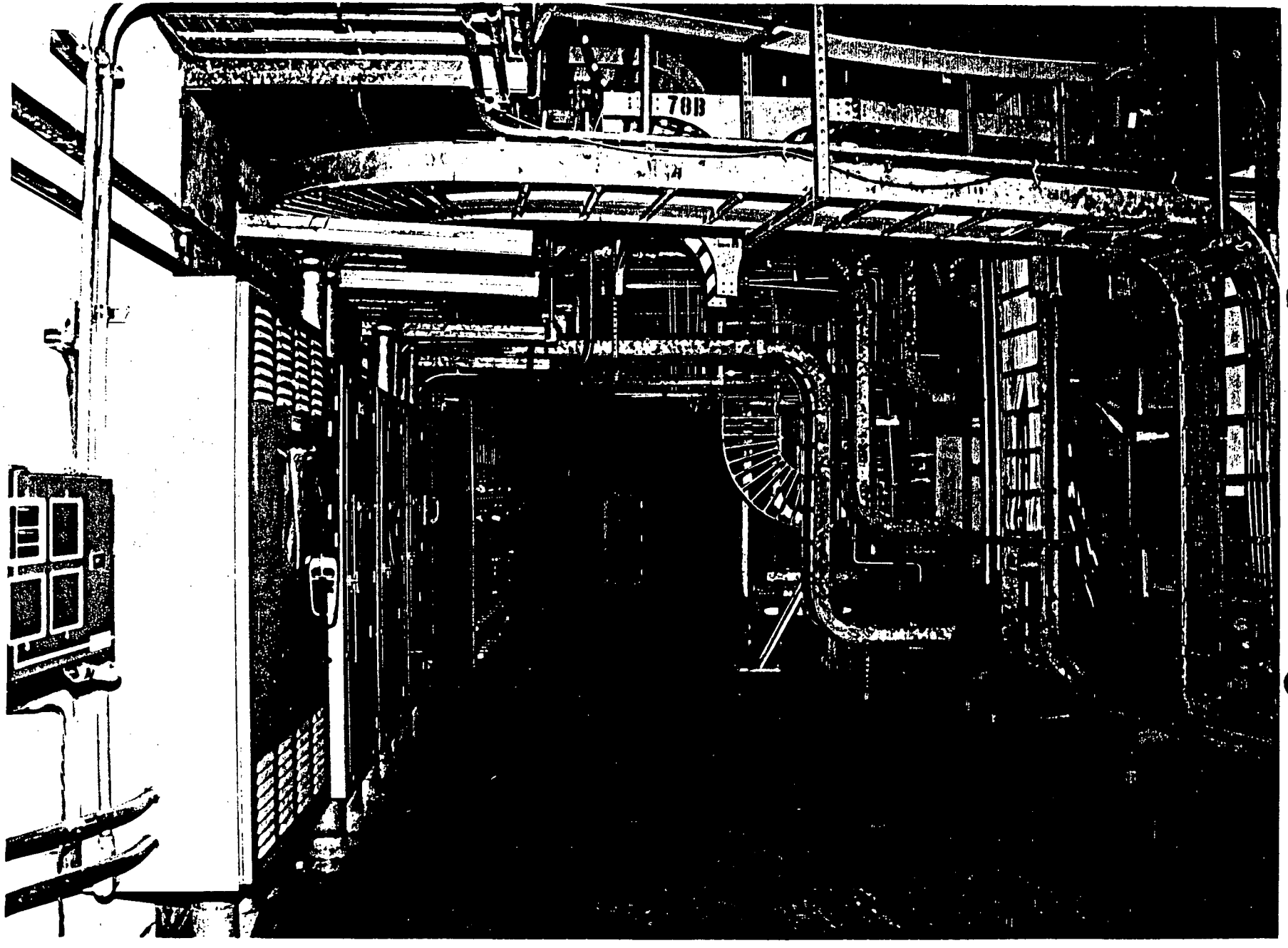


FIGURE 5 - E-Pen Open Area

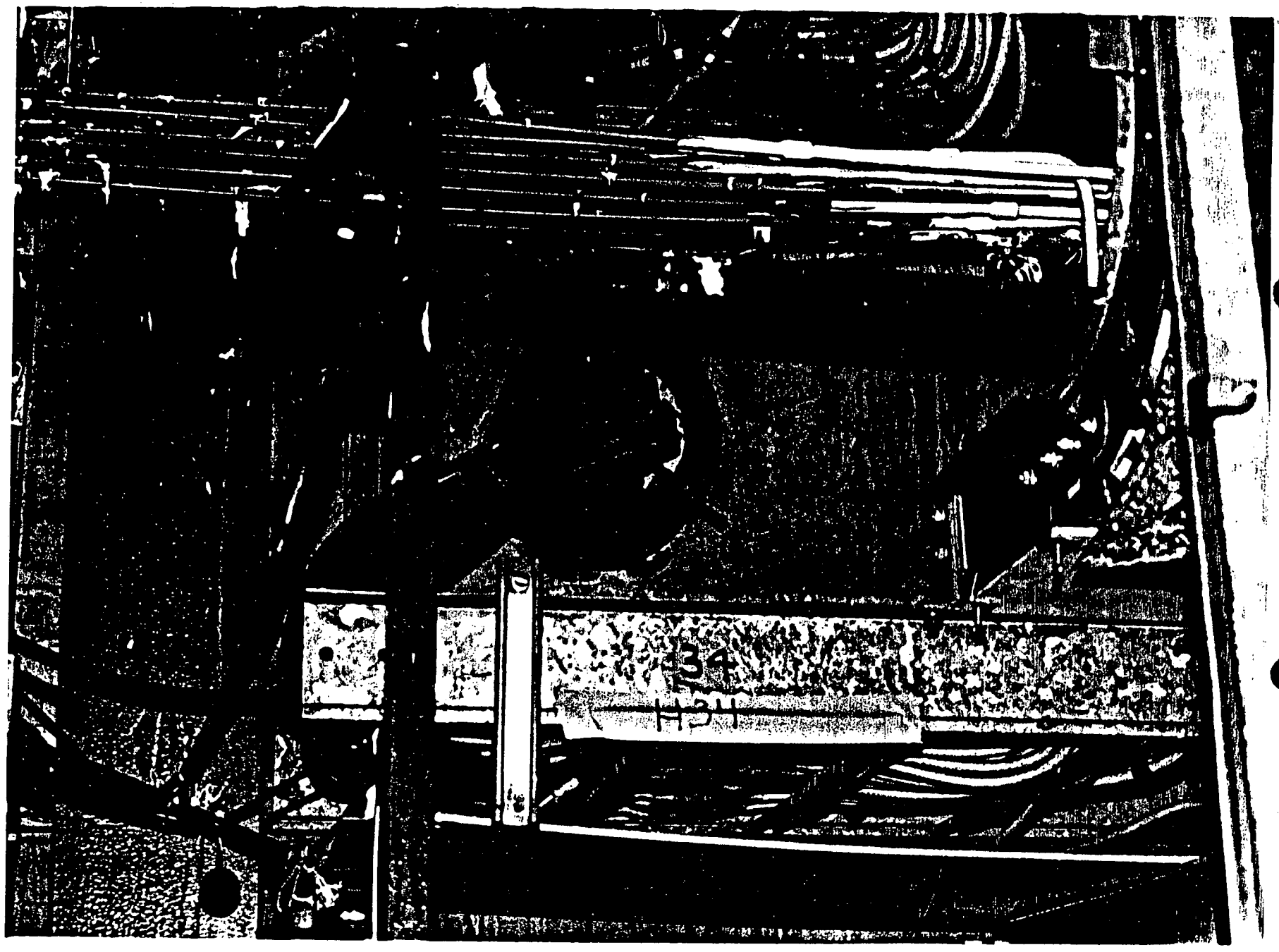


FIGURE 6 - Typical Cables from a Penetration Routed into a Tray

K&M DIVISION POLY-VU
Torrance, CA 90503 # PV119

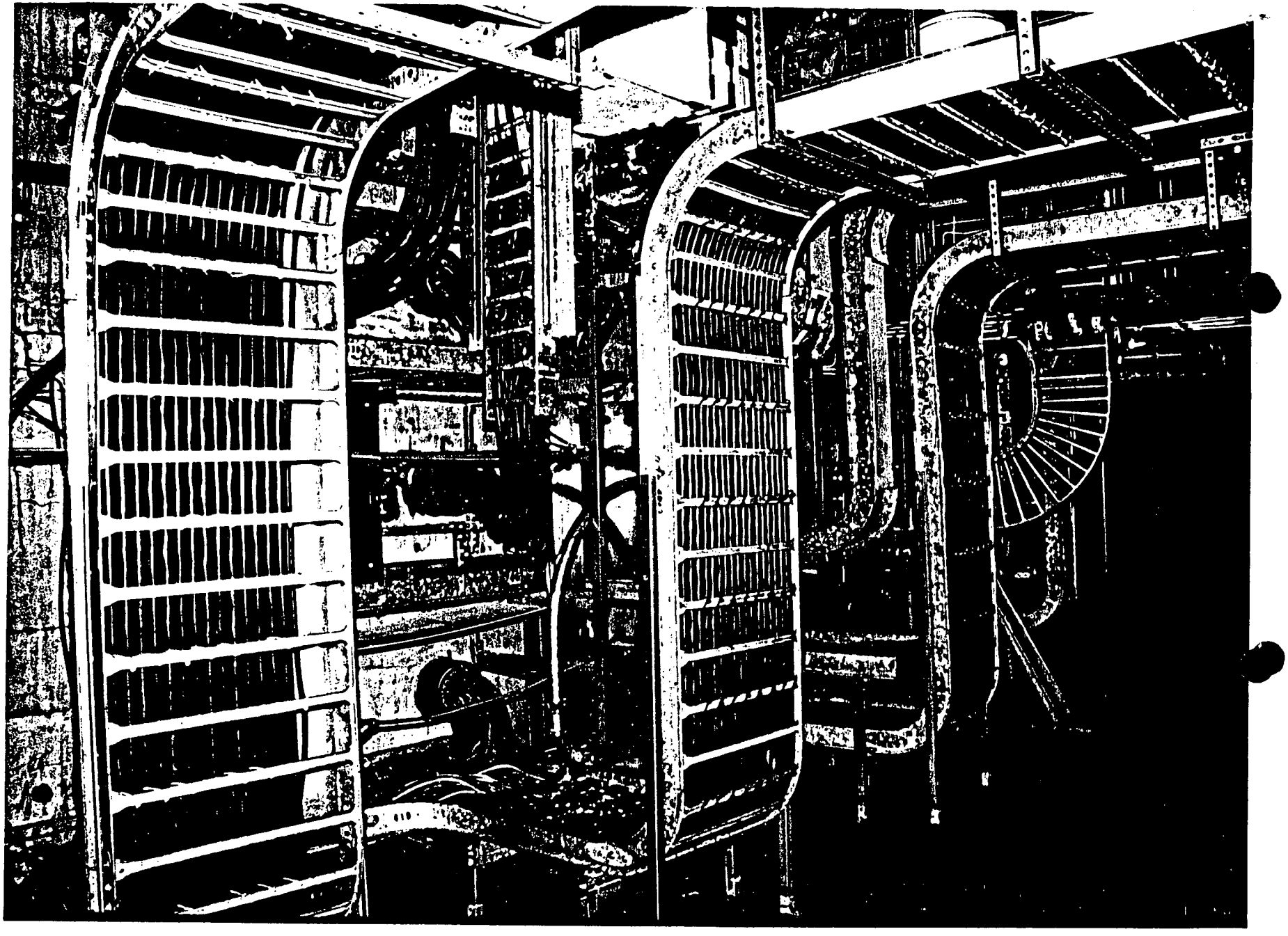


FIGURE 7 - Penetrations on Inner Wall with Trays Crossing to Outer Wall

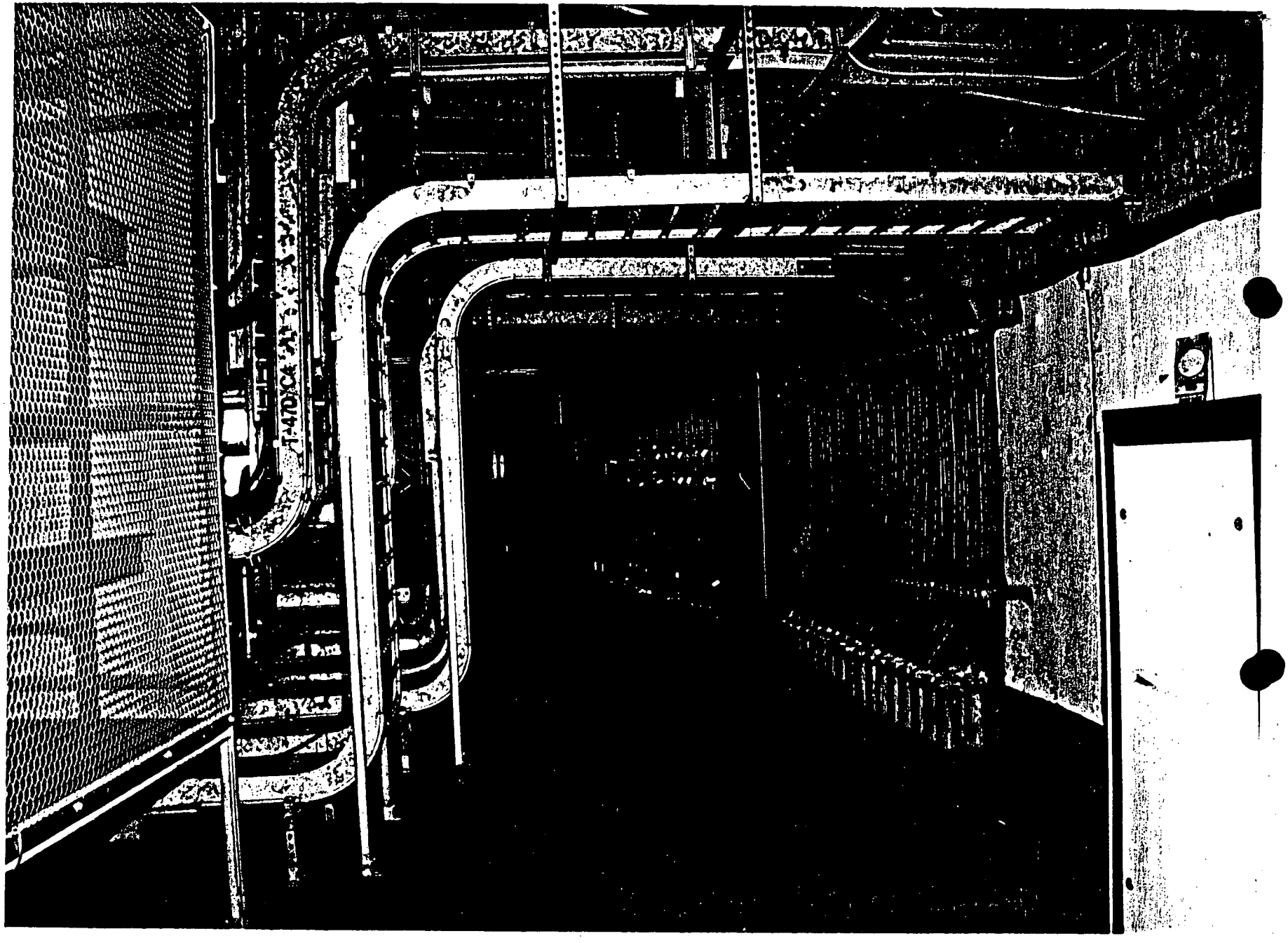


FIGURE 8 - Outer Wall

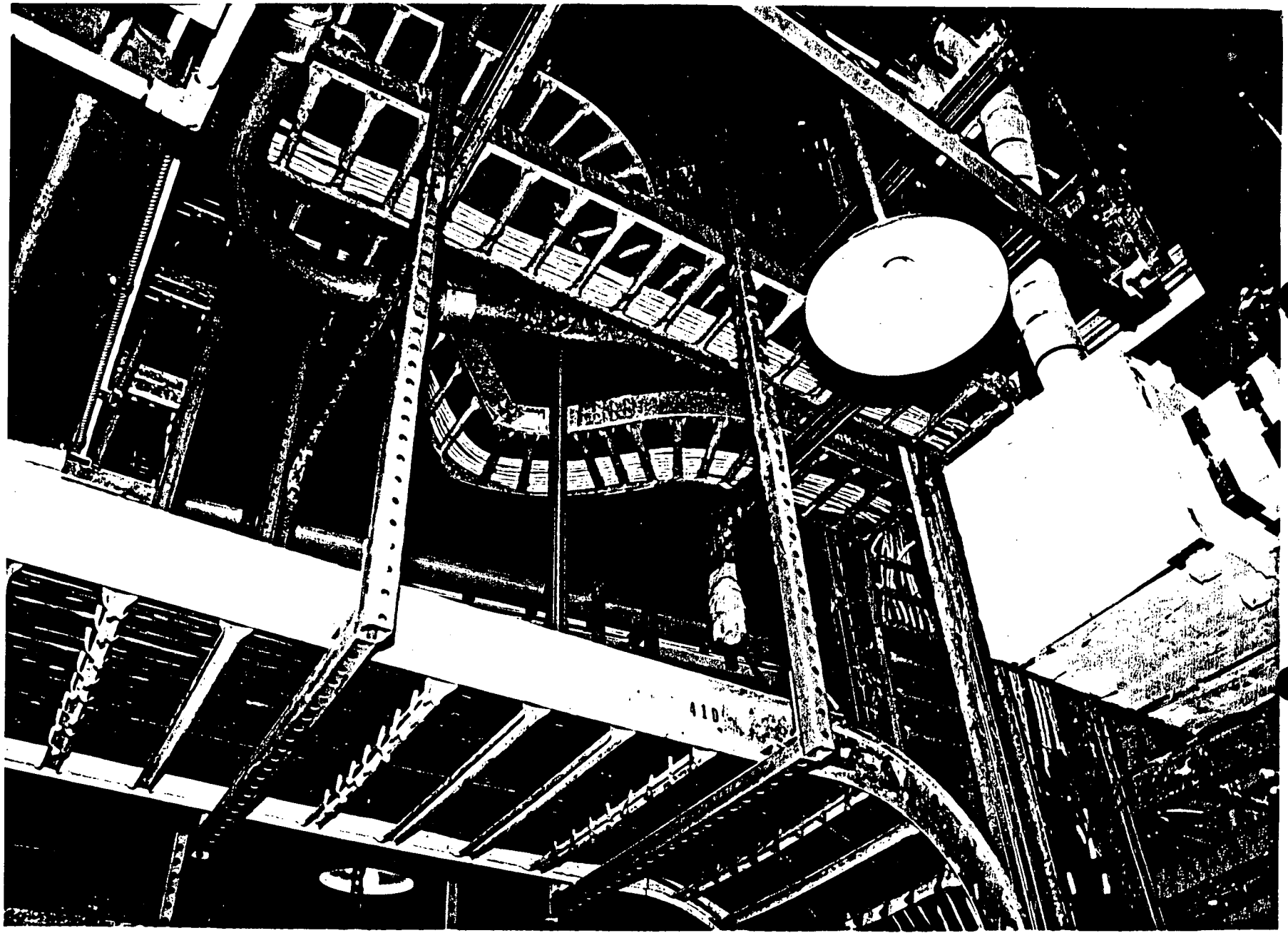


FIGURE 9 - Low Cable Density Around H-20

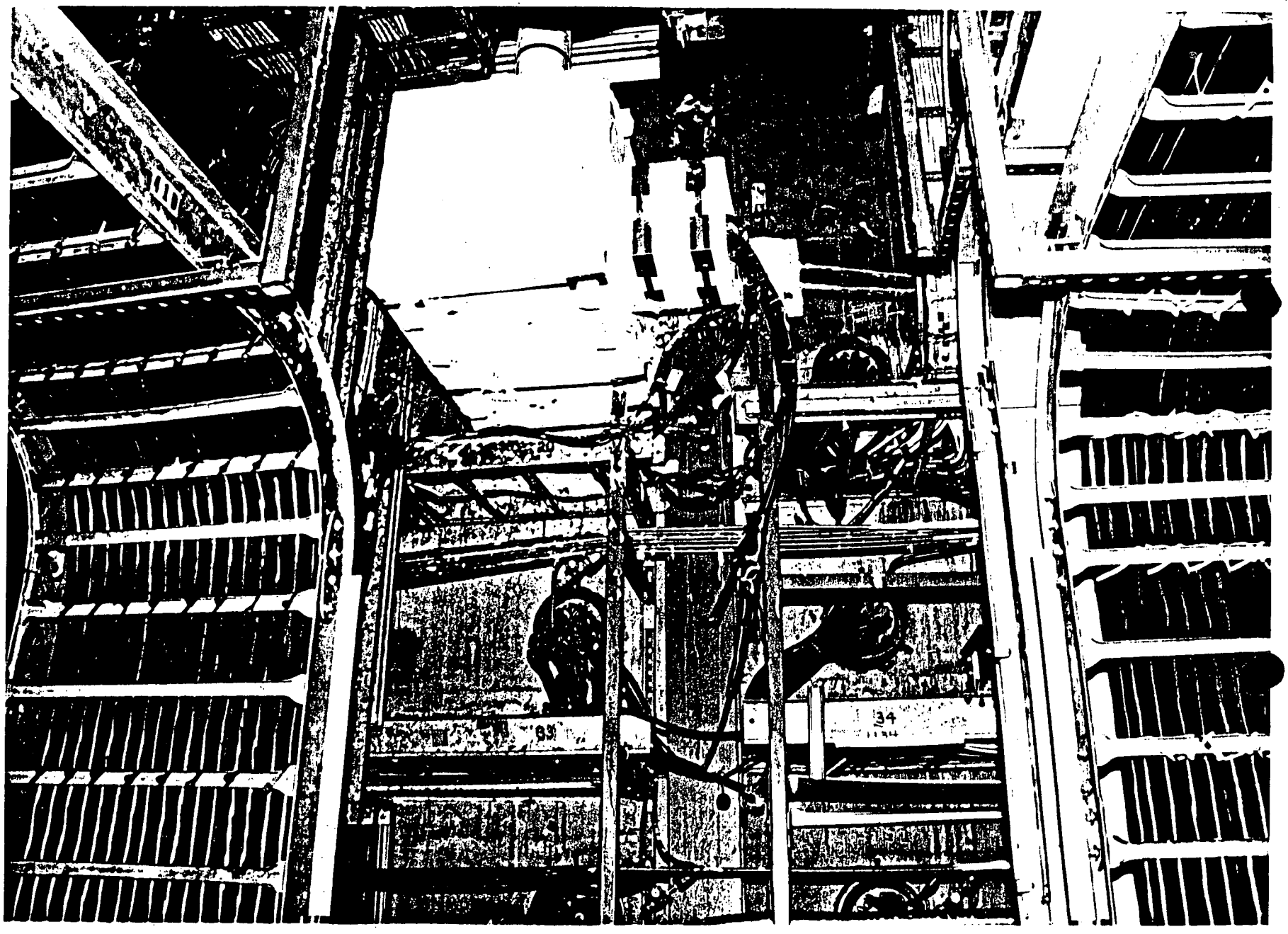


FIGURE 10 - Low Cable Density Beneath H-20

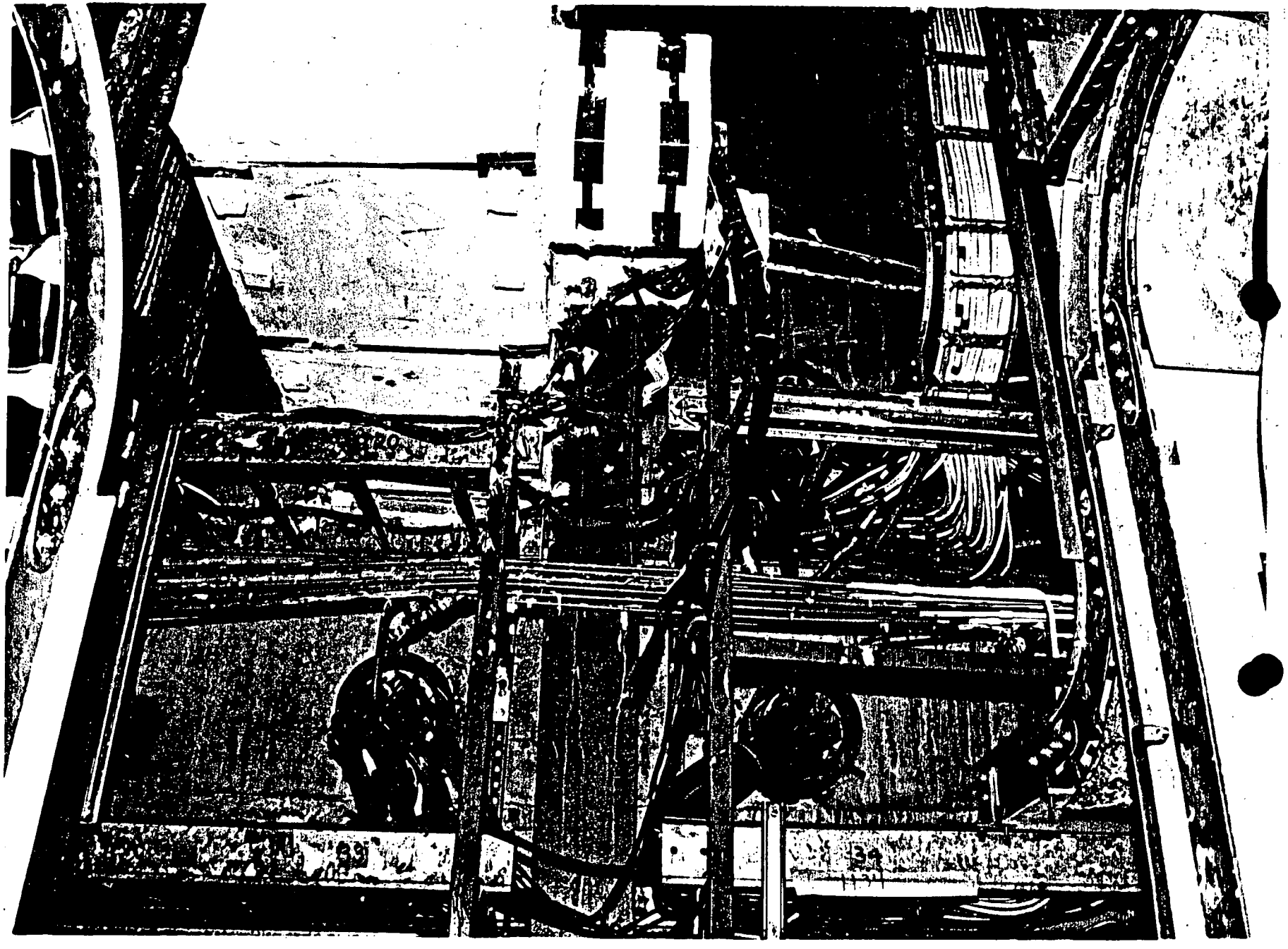


FIGURE 11 - Close-up of Enclosure

FIGURE 12 - Close-up of Silicone Foam Seal