December 22, 1995

MEMORANDUM TO: James L. Caldwell, Deputy Director
Division of Nuclear Material Safety
Region III

FROM: Michael J. Bell, Chief /s/
Engineering and Geosciences Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

SUBJECT: INSPECTION REPORT ON STRUCTURAL INTEGRITY OF THE ADVANCED MEDICAL SYSTEMS, INC., FACILITY (DOCKET 030-16055)

The attached special inspection report addresses the three site inspections my staff participated in to develop information relative to the assessment of the structural integrity of the buildings at the facility that may be critical to the protection of stored radioactive material, waste, and any associated contamination. In addition, the report addresses the implications that the basement flooding that occurred at the facility might have had on the structures.

There will no doubt be additional discussions required with the licensee on these conclusions and recommendations. In conjunction with the licensee's recent submittal on the emergency plan, my staff briefly reviewed a referenced report by the licensee's engineer entitled "Structural Adequacy of Building", and comments were provided to Kevin Ramsey, IMOB/IMNS/NMSS, who is incorporating them in his evaluation. In general, while the report was to have been based on an inspection, it was not evident from the report what was actually done or seen during the inspection. The general tone and conclusions of the licensee's engineering report are not consistent with the attached report that recommends some actions be taken.

My staff will be available to assist you in the final resolution of these related issues. If there are any questions, please contact me at (301) 415-7286.

Attachment: Rpt. 030-16055/95006(DNMS)

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December 20, 1995

U.S. NUCLEAR REGULATORY COMMISSION
HEADQUARTERS

Report No. 030-16055/95006(DNMS)

License No. 34-19089-01 (Current) Priority I Category B
License No. 34-07225-09 (Former)

Docket No. 030-16055 (Current); None Specified (Former)

Licensees: Advanced Medical Systems, Inc (Current)
Picker Corporation (Former)

Facility: 1020 London Road
Cleveland, OH 44110

Site Inspection and Interviews Conducted: October 11, 1994 through July 21, 1995

Inspector: Robert E. Shewmaker
Robert E. Shewmaker, PE
Senior Structural Engineer
12/21/95
Date

Accompanying Personnel: Wayne Slawinski
Senior Radiation Specialist
RIII

Reviewed By: M J Bell for R Weller
Richard Weller, Section Leader
Engineering and Materials Section
12/22/95
Date

Approved By: Michael J Bell
Michael J. Bell, Chief
Engineering and Geosciences Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards
12/22/95
Date

Inspection Summary:

Inspections during the period of October 11, 1994 through July 21, 1995
(Report No. 030-16055/95006(DNMS))
Areas Reviewed: This series of special inspections consisted of three separate inspections relative to assessing the current and future structural integrity of certain specific areas within the Advanced Medical Systems, Inc.

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(AMS) facility at 1020 London Road, Cleveland, Ohio. Areas of main focus were the hot cell, the waste hold-up tank (WHUT) room, the original radiography room (now known as the "high level" waste storage room), the source room, the front and back basements and the HEPA filter equipment room. In addition, the impact on the structural integrity of a water back-up condition that occurred in the basement areas of the facility was also assessed.
Results: One area of distress in a load-bearing masonry wall, supporting the roof structural steel framing in conjunction with the wall of the HEPA filter equipment room, was identified. This area also exhibited a breech in the building's waterproof envelope, leaving structural components exposed to a more rapid degradation rate than if protection were intact. One other area was found where the waterproof building envelope was not intact, however, any future structural distress resulting from this would not impact stored radioactive materials or wastes. Evidence of degradation in the form of rust on the exterior of concrete elements that had formed over the current service life of the structures was also found. It was concluded that with repairs and continued monitoring, the structural integrity of the 1958 building could be maintained consistent with the original design conditions with monitoring on a 10-year cycle.

DETAILS

1. Persons Contacted

Mary Bennett, Administrative Assistant, Division of Building and Housing, City of Cleveland

Carol Berger, Project Manager, Integrated Environmental Management, Inc. (IEM), AMS consultant

David Ceasar, Treasurer and Chief Financial Officer, AMS

John W. Denega, Project Engineer, Neff and Associates, AMS consultant

Donald Jones, President, Quality Environmental Solutions, Inc. (QES), AMS consultant

Evans Matiatos, Environmental Chemist, Quality Environmental Solutions (QES), AMS consultant

Robert Meschter, Radiation Safety Officer, AMS

William J. Muniak, Attorney, Arter and Hadden, legal counsel for AMS

Vince Rocco, former Health Physics Technician, AMS

2. Purpose and Scope of Inspection

This was a series of limited scope special inspections related to the structural integrity of the physical building facility at 1020 London Road in Cleveland, Ohio, including the specific elements such as the hot cell, the waste hold-up tank (WHUT) room, the original radiography room (now known as the "high level" waste storage room), the source garden, the front and back basements and the HEPA filter equipment room. The structural integrity of the building facility with areas of contamination, waste storage or source material storage needs to be assured for the expected future time period over which the radioactivity should be controlled, that includes during events that are addressed in the emergency response plan for the facility. Depending on various decisions that may be made by AMS management, this time period may extend as much as an additional 25 to 30 years or more beyond the current time. The original inspection scope was later expanded in the late fall and early winter of 1994/1995 to include the assessment of any impact on structural integrity caused by basement flooding that resulted from the deliberate plugging of the outfall lateral line of the combined sanitary and storm sewers by the Northeast Ohio Regional Sewer District at the street trunk line.

On-site inspections were conducted three times during this period based on the changing conditions at the facility and the gradual discovery and flow of

factual information related to the facility, the life of which to date has spanned nearly a forty-year period, with portions spanning over 60 years. The first site inspection was conducted from October 11 through October 13, 1994, addressing the general facility configuration, general construction materials, general facility conditions, and the usage of the facility. The second site inspection was conducted on February 2, 1995, during the time when there was water in the basement of the facility in order to observe any potential damage to the facility. The third site inspection was conducted from July 19 through July 21, 1995, in order to complete additional detailed observations and review of existing conditions of the building structures of the facility and to observe the corrective actions being made in the subsurface drainage system.

3. Background on the Development of the Facility

The 1958 design, development and construction of the building facility for Phase I of the Picker X-Ray Corporation, that was subsequently acquired by AMS, encompassed the integration of a then existing warehouse/industrial building, with masonry load bearing walls and steel trusses as the roof framing steel, into the facility. That original building dating to at least 1934 (based on a City of Cleveland, Record of Permits Issued with an entry under "Electrical" and dated 12/3/34) was approximately 60 feet by 100 feet and 30 feet high. The 60 foot wide front portion of the warehouse/industrial building was enveloped by the construction of a new building with a front dimension of approximately 130 feet in width. Of that 130 foot east wall building front, approximately 107.5 feet of it is load bearing masonry and 22.5 feet of it is a masonry curtain wall surrounded by a structural steel bay of framing at the north end for the lobby-stairwell area. The south and exterior west walls of the facility are also load bearing masonry. The north wall is a masonry curtain wall within the structural steel frame of the lobby-stairwell area. Phase II consisted of a two-story addition of classrooms, completed in 1963.

It should be noted that a relatively complete set of design drawings are available for the facility at 1020 London Road for those portions built in 1958 and 1963 and these were used in the inspection and evaluation process. A listing of the design drawings used in the inspection and review process is attached as Appendix A. Other portions of the facility's building complex used by the licensee for handling radioactive materials, namely the isotope warehouse, were not included in any of the drawings or other records available at the site.

During the inspection and review process, the City of Cleveland, Division of Building and Housing, was contacted in order to review the records of permits associated with the 1020 London Road address. Appendix B lists the relevant permits issued against the address beginning with site clearing for the 1958 building construction. From these records it was determined that the building permit for the 1958 building was issued on 4/18/58 as Permit Number J46366 for the "Phase I Addition to Existing Brick and Block Warehouse." The permit for the addition that is known as the isotope warehouse was issued 5/4/62, under Permit Number K30250, for the L-shaped storage building

addition. A single sheet drawing was on file with the City of Cleveland for this structure which contained minimal information.

4. Design Bases of Building Facilities

There has been no general building code reference found on any of the documents, including the drawings, so the City of Cleveland was contacted to ascertain what building code was in effect when the building permit was issued. It was learned that the City of Cleveland had adopted its own building code in 1951 that was in effect in the 1958 time frame when the building permit was issued. Archival copies of that document and the relevant revisions are available for review at the Cleveland City Hall, but the document has not been reviewed.

The results of six (6) soil borings, made prior to the 1958 building construction for the foundation investigation, were summarized on the Site Development Plan (Dwg. SD-1) and indicated that the footings for the reinforced concrete (R/C) core of the 1958 building were founded in a grey to grey-brown shale above the normal water table. The Foundation Plan & Details (Dwg. F-1) indicated that the allowable bearing stress for those footings that were located below Elevation 640 feet was 5 T/sq. ft. Individual column footings for the interior steel frame portions of the 1958 building were founded in a hard, grey-brown shaley clay with Dwg. F-1 indicating an allowable bearing stress of 3 T/sq. ft. from Elevation 640 to 647 feet.

The design loadings for the 1958 building as specified on the concrete drawings for the R/C core were as indicated below, but no specific codes or standards related to reinforced concrete (R/C) or masonry design were cited. The general code for the design of reinforced concrete in effect at the time was the American Concrete Institute (ACI) Building Code for Concrete (ACI 318-56), dated 1956.

First floor of R/C core: Live Load(LL) = 500psf; Dead Load(DL) = 175psf

Second floor of R/C core: LL = 150psf DL = 90psf

The surrounding portion of the 1958 building's structural system is composed of a hybrid system containing load-bearing masonry walls, structural steel and reinforced concrete elements. The portions of the building envelope or exterior skin that are not formed as part of the structural system are masonry filler walls that act as curtain walls. The design loadings as specified on the structural steel drawings were as indicated below with a reference to the Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, American Institute of Steel Construction (AISC), with no specific reference to the edition being used for the project. The particular edition of AISC in effect during this time frame was the 1949 edition.

First floor of remainder of bldg.: Ground supported slab

Second floor of remainder of bldg.: LL = 150psf DL = 70psf

Roof for entire complex : LL= 30psf DL= 30psf with 2.5K hanger load at center of purl s and beams

All of the loadings identified on the drawings, as noted above, include only vertical gravity loadings, with no indication of considerations made for lateral loads from wind, tornado, seismic events, or other events creating differential pressures or other loadings on the facility.

The specifications for materials used in the structural system were, in general, not available in the documents that were used in the inspection and evaluation process. Dwg. F-1 indicated that the concrete for the foundation was to be 3000 psi concrete at 28 days, but no information was provided on the properties of the reinforcing steel. Other materials used in the structural system were not identified by ASTM standards or by other numerical methods such as the identification of grade, strength or other specified properties.

5. Field Observations and Structural Evaluation

Based on experience in the design and construction of various types of facilities and structures with the various materials used in the civil engineering/building field, a general survey of the building's structural framing was performed. From this general survey critical areas of the structural system were reviewed and any areas of potential distress were identified.

In general, the reinforced concrete core structure of the 1958 building that forms the hot cell, the WHUT room, the original radiography room, the source garden and the front and back basements was found to be in good condition based on a visual survey of the exposed externally visible surfaces, with the exception of one questionable area. In this area there is evidence of considerable amounts of water or other fluid apparently having penetrated on the second floor of the facility. The floor in that area is a 6-inch thick reinforced concrete slab. The underside of the second floor slab in this area forms the ceiling of the first floor. Evidence of the fluid that penetrated exists on the ceiling adjacent to the hot cell and in front of the radiography room and around the corner of the radiography room into a hallway at the north side of the radiography room. It is not known what the source of this fluid was, but it could have been a source such as a ruptured pipe from freezing conditions or from the failure and leakage of exterior roof surfaces over the second floor. At the roof level in this general vicinity is the interface between the pre-1935 old warehouse building and the 1958 building. These interfaces are typically a source of leakage of roof water. Evidence of significant roof leakage can be seen on the suspended ceiling of the second floor in several areas of the building, but the period of time over which water was allowed to penetrate the building's originally waterproof envelope is unknown. In several areas such as in the southeast corner of the building and along the east front wall, there is evidence of water penetration of the roof deck structure. This structure is made up of haydite (lightweight) precast concrete roof panels, that exhibit corrosion products from the embedded reinforcing steel. The roof leakage apparently continued until

October of 1994 when some major roof repairs were made. It was noted during the inspection of the roof that the sprayed foam coating appeared to be holding considerable moisture. No information was available on the material so it is unknown whether or not under freezing conditions there would be expansive forces created that would rupture the waterproof roof envelop again.

Distress in the form of significant cracking in the southeast corner of the load-bearing masonry wall of the east front, near the second floor level, was identified as well as significant cracking in the north bay of the east masonry filler/curtain wall above the second floor elevation. Both these elements of the 1958 building serve to form part of the building envelope. The source garden, housed in the basement with access from the first floor, is located in the southwest corner of the 1958 building and is completely surrounded by reinforced concrete structural elements. This portion of the 1958 building appears to be in a condition that is adequate to meet the original design conditions although the visible portions of walls directly surrounding the source material are very limited.

The two areas of significant distress tend to indicate that the visible damage arose from the response of the structural system to a lateral load component that was parallel to the east wall which the structure was apparently not designed to resist. The most significant lateral load that could be identified that the building has experienced is the January 31, 1986, magnitude 5.2 earthquake that occurred in northeast Ohio although the observed distress and this event have not been clearly linked.

The distress at the southeast corner of the building associated with the east 3-wythe load-bearing brick masonry wall can be characterized as a saw-tooth crack extending horizontally 12 to 13-feet from the south building face and extending over approximately 4 feet vertically. The open crack, representing permanent displacement, indicates approximately a 5/8-inch horizontal differential displacement in the once continuous load bearing masonry wall that is 12 and 1/2-inches thick (Dwgs A-10 and P-2). The depth of the cracking into the 3-wythe wall is not known since the back side (inside the building) of the wall surface was not readily accessible. The face brick wythe is bonded to the two inner wythes with a header course each six courses of brick. Whether or not the wall was constructed with a mortared collar joint is unknown, but it is assumed the wall was constructed as a solid masonry bearing wall. The crack then appears to trace downward at the vertical joint between the corner stone return on the southeast corner and the east wall. The crack then shows as a fracture in the stone ledge of the east wall at the corner. Originally, the sections of stone were pinned together with brass dowels and the joints were mortared. At some of these joints there has been rotation and translation with rupture and mortar loss. Above the distressed region, the load-bearing wall supports the southern most roof structural steel purlin (P2) in a wall beam pocket on a 3/8" x 7" x 8" steel bearing plate. The purlin span is over 26-feet. On the inside of the 1958 building at this purlin bearing there is evidence of movement between the bearing wall and the purlin in the longitudinal direction of the purlin. It is not known at this time which structural element remains with the permanent movement; the east wall in the perpendicular direction or the purlin in its longitudinal direction. In addition to the cracking of the east wall,

evidence of lateral loading was found at a point about 17-feet from the east wall in an area along the south wall that the purlin runs parallel to with its 26-foot span. At this area the purlin penetrates an interior non-load bearing concrete block masonry wall (Dwg P-3) that is perpendicular to the south wall. Rupture of the joints of this wall where the masonry was fit around the purlin has occurred and there is a permanent opening of over 1-inch between the non-load bearing wall and the load bearing brick south wall indicating permanent differential movement.

The distress of the east wall near the northeast corner of the 1958 building is associated with a rupture type failure that is evident on the inside of the building as a cracked and displaced concrete block filler or curtain wall. This wall section is within the region above the lobby area where the structural elements are steel framing as opposed to a load bearing type masonry wall. The rupture line is most pronounced in a vertical direction just adjacent to the northeast steel column of the building within the area from the second floor level to the roof. The rupture line extends over approximately 12-feet of the 14-foot story height and has approximately a 1 and 1/4-inch displacement out of plane at the maximum offset. This rupture surface is generally through every other course of concrete block and does not follow a saw-tooth pattern along the mortar joints. The concrete block in this curtain wall appears to be nominal 4-inch thick block (half block) that was made into a wall in which the concrete block portion is confined between the webs of the two columns (F1 and D1, Dwgs. S-1, A-7 and A-10), the second floor concrete slab surface and the underside of the flange of the structural steel roof beam (RB3). It is possible to see through the ruptured concrete block of the inner wythe of the wall to the brick, but it was not possible to determine the bond mechanism between the inner wythe of concrete block and the two outer wythes of brick. The outer two wythes of brick are supported between the columns (F1 and D1) by a lintel beam (C1), at approximately 4'9" below the level of the second floor, that is part of the lobby entrance structural steel framing in this bay. The existing design drawings do not provide any information on the details of this wall section, but it is assumed the 3-wythe wall was intended to be bonded construction. At a level approximately two courses of concrete block above the second floor level, the rupture line turns horizontal and runs along the mortar joint between courses. Approaching the next column (D1) along this joint rupture, the rupture becomes a crack that then becomes invisible to the unaided eye. The interface between the top of this wall and the structural steel framing is along a non-bonded, but tight joint on the underside of the bottom flange of structural steel roof beam (RB3). At the rupture surface intersection with this joint there is a 1 to 1 and 1/4-inch displacement of the top of the wall outward from under the beam flange. This offset continues toward the next column (D1) that is approximately 22 feet away. The offset is not visible at the next column. This distressed area represents an approximately 12'x 20' area of curtain wall (inner wythe) that is now free or ruptured on three of the four edges representing an "inner flap" in the wall. An inspection of the outer surface of this wall did not reveal any cracking when viewed from ground level. It did reveal that an outward bulge of the brick wall in the area directly opposite the "inner flap" now exists. In addition, the stone corner and stone return at this northeast corner of the 1958 building show displacement and rotation at the corner with failed joints. The distress was also reflected in

the displacement of the stone coping at the top of the walls as they intersect at this northeast corner of the building. Differential movement of 2-1/2 to 3 inches was found at this corner between the coping and the walls. Sighting horizontally along the line formed by the corner of the coping stone on top of the east wall as well as vertically upward along the corner of the stone return at the north east corner of the building, it is obvious that there is a level of distress remaining in the elements described.
The building permit for Phase II was issued 4/22/63 for an addition to the north of Phase I and consisted of a steel-frame building approximately 160' in the N-S direction and 175' in the E-W direction. This was to be used as classrooms. No extensive inspection or evaluation efforts were made on this addition since no known contamination exists in that addition and there are no known plans to allow storage of radioactive waste or source material in the Phase II addition.

Based on the observations of the areas of distress of the two ends of the east front wall of the 1958 building, the interface of the 1963 Phase II building and the 1958 building was an area that needed to be examined. This was based on the fact that under seismic loading the front portion of the 1958 building would be expected to respond as a much stiffer building element in the structure than the 1963 structural steel building frame that did not appear to be a braced frame nor a rigid frame type design. The possibility exists that the 1963 building could be more flexible, thus exhibiting a larger deflection than the 1958 building and could have actually transferred additional lateral load into the 1958 building than would have occurred without the 1963 building. It was noted in the review of the drawings for the 1963 building that revisions had apparently been made in the framing of the 1963 building at the interface with the 1958 building along the original 1958 building north wall. Drawings S-1 and S-2 in the preliminary versions showed the structural steel roof framing system purlins, designated P1, as framing into beam pockets cut into the masonry wall and seated on bearing plates, BP1, or as second floor structural steel framing system beams, designated B1, framing into similar beam pockets with bearing plates, BP2. The as-constructed conditions found in the field during the inspection revealed that the beam pockets in the masonry wall of the 1958 building had not been used to support the structural steel framing of the roof and second floor framing, but additional columns and beams had been erected. Drawing F-1, Revision 1, for the Phase II 1963 building indicated the addition of Footing M on Column Line 2 as part of the changes made in the framing system. This deliberate separation of the primary structural elements may have been as a result of the recognition of the possibility of the different connecting phases of the building phases responding to loads over time in a different manner. Whether the concern was over what would be considered a more normal concern, related to differential vertical movement, since the foundations were separate, rather than over lateral loads is not known since no design calculations were available. In the actual configuration, both the precast concrete roof panels as well as the cast-in-place concrete slab on the steel frame of the second floor represent a stiff diaphragm capable of transmitting considerable lateral load. Only a 1/2 inch premolded expansion joint separated the two structures, probably insufficient rattle space for the dynamic lateral response of the two buildings. Such a loading could explain the observed distress.

As is discussed in Section 6 of this report, the basement slab underwent some uplift loading as a result of differential water pressures, so that once the basement was drained and dry, it was necessary to inspect the concrete structural elements to determine whether or not the basement flooding event had any impact on the structural integrity of the 1958 building. Cracks that were observed in the basement floor slab were judged by an NRC inspector to be cracks that probably existed previously, but which opened an additional amount during the basement flooding and allowed additional flow to occur into the basement. No additional signs of distress were noted by the inspector who had inspected the facility before and after the flooding event. While it is possible that contaminants that could increase the rate of corrosion of the reinforcing steel in the submerged reinforced concrete elements, could have been transported and deposited so as to attack the steel, at present, there is no visible evidence of such degradation. Therefore, it is concluded that there was no observable significant impact on the structural integrity of the 1958 building as a result of the basement flooding event.

At this time, the design basis and condition of the isotope warehouse, built in 1962, has not been fully assessed regarding its ability to protect stored source material. Source material contained in a certified shipping cask would potentially resist the collapse of the one story warehouse building. The only record found to exist for this 1962 addition that also modified the area identified as the air lock was located in the public records maintained by the City of Cleveland. These records were related to the issuance of the building permit for the modification and addition. The record consists of a single drawing providing some information on the addition. The structure is a combination of structural steel columns, structural steel beams, open-web bar joists, and load-bearing concrete block masonry walls. The drawing provides the geometry of the facility and the necessary details for the steel elements, but provides no information on the load-bearing concrete block walls regarding the block type, reinforcing and other construction details. No information was found relative to the original design criteria for this addition.

6. Background on Subsurface Drainage

Another known condition that the facility has been subjected to is an artificially high water level outside the basement of the facility as a result of the deliberate closure of the combined sanitary and stormwater sewer system at the lateral discharge point into the public sanitary district mainline. This resulted in the eventual backup flooding of the basement to a depth of over four feet with a portion of the initial quantity of water entering through an open 32-inch high standpipe and the remainder apparently entering via seepage paths.

During the period when the basement of the facility was covered with water as a result of the non-functioning subsurface drainage system, an inspection was performed on February 2, 1995. The main focus was the integrity of the basement floor slab under the uplift forces created by the differential water head between the inside and outside of the basement. Once the initial charge of water was introduced through a 32-inch high open standpipe, the water level in the basement continued to rise based on the head differential to the

outside of the basement. No specific leakage paths had been found, but indications of some cracks in the floor slab had been noted through the water. It was not possible to determine whether the cracks were new cracks or old cracks that may have opened some additional amount as a result of the uplift pressure loads. During this time period some restrictions were placed on the differential water pressure to minimize the uplift on the floor slab. The differential pressure could be controlled by pumping the basement water into storage tanks.

In a letter dated March 22, 1995, AMS addressed, in Item #3, the re-connection of the foundation underdrain system to a new manhole and lateral and then to the main sewer line. As a result of issues raised related to this subject, NRC sent a letter to AMS dated June 14, 1995. The AMS response was contained in a letter that was discussed on a telephone conference call on July 18, 1995 between NRC and AMS. At the time of that telephone conference call, AMS had made a sketch available to NRC, that presented in plan view, the status of the work at the facility as of July 18, 1995. It was indicated on the sketch that the excavation and removal of the foundation drainage system perforated clay tile in front of the facility had been completed and a new PVC perforated drainage pipe had been completed in that same location. This system discharged in a new connector line to the new manhole. As of July 18, 1995, the new manhole had not been connected to the NEORSD mainline and no outfall or discharge was available from the new manhole. It was noted that the wye connection between the piping of the foundation drainage system and the 4-inch diameter sanitary sewer line coming from the building under the east wall footing as shown on the drawings was not found. The 4-inch diameter sanitary line had been cut and apparently the cut upstream end grouted closed. The sketch indicated the same work had been completed around the SE corner of the facility and along the south wall to near the re-entrant corner at the south stairwell. The open end of the new foundation drain pipe during the construction process was shown at the end of the backfilled zone of the excavated trench. The open excavation of the trench continued around the perimeter of the building and around the SE corner of the rear stairwell toward the SW corner of the building. The open trench extended only partially along the south wall of the stairwell since AMS had decided not to excavate in the vicinity of the source garden that is directly inside the basement walls at the SW corner of the 1958 building. In this region the sketch indicated that the existing foundation drain would be abandoned and a slurry wall installed around the abandoned pipe and the unexcavated soil mass. The slurry wall would continue around the SW corner of the building and past the northern extent of the source garden along the west wall and be continued to an area under the airlock slab and end adjacent to the west wall of the basement. The base of the slurry wall was to be cut into the very impervious shale material into which the building footings were founded. An impervious membrane cover was shown on the sketch that would then be attached to the exterior wall of the building and extended over the soil mass inside the slurry wall and then carried down to the top of the slurry wall and over its outside top corner so as to "shed" all precipitation outside the encircled volume. The new foundation drainage system would then be extended around the outside of the slurry wall. The remainder of the excavated trench was shown on the sketch as beginning against the west wall at a point just north of the northern extent of the source garden and the gas meter cover shed and continuing under the air

lock structure. It was also noted on the sketch that the existing foundation drainage pipe on the west side in this area had been removed and a tee connection had been found with a 4-inch sanitary pipe that penetrated the west wall footing and flowed to the east, under the basement floor. It was noted that the 4-inch diameter line at the outflow end of the tee from the old foundation perimeter drain (upstream end of 4-inch line going through the footing) was to be grouted closed.

7. Field Observations of Reconstructed Subsurface Drainage

Upon arrival at the site on the morning of July 19, 1995, the status of construction was as had been indicated in the sketch of July 18, 1995, except for the work that was underway that morning. Some additional trenching along the west wall, representing the trench for the slurry wall as it curved away from the northwest corner of the source garden area and the gas meter cover shed extending to the SW corner of the building, had been completed that morning. Work was underway in the trench by AMS contractors related to testing for contamination of soil/gravel and foundation material samples in the area along the west wall and under the airlock where the old existing foundation drainage system had ended and where the old foundation drain pipe had been removed.

On July 20, 1995, an AMS letter, dated July 19, 1995, was hand delivered at the site to an NRC inspector that summarized the July 18, 1995, telephone conference call and provided the status of the site as of July 18, 1995. AMS indicated that the 4-inch line the foundation drain system discharged into at the west wall would be grouted closed throughout the entire length (all under the building from the rear west wall to the front east wall). The material to be used in the pipe grouting procedure was identified in Attachment 2 of the submittal as AV-118 Duriflex, made by Avanti International, that is an acrylic resin based chemical grout. It is transferred to the grout location in a water solution prior to the time of catalyst reaction to form the gel state. Included with the letter as Attachment 1 was the sketch of the plan view that had been the subject of the July 18, 1995, telephone conference call. In addition, Attachment 3 presented a cross-section view through the proposed reconstruction zone adjacent to the source garden. This indicated a slurry wall was to be formed on one side that would be 6-inches thick and approximately 4-feet high within a 30-inch wide trench with no indication at what elevation the wall would begin or end with respect to the building footings except to indicate a bottom depth of 15-feet. The wall was apparently to be constructed with a grout material that had been recommended by the NEORSD in a July 3, 1995, letter to AMS. The grout would be a 50/50 cementitious material of Type I cement/Class F flyash with a local sand using an intrusion aid additive under the trade name of Mearl Foam. The grout formulation was to produce a 500 psi minimum strength material. The new 4-inch diameter perforated PVC foundation drainage system pipe was shown with gravel backfill, topped with a geotextile to act as a filter for the retention of fined-grained trench backfill soil material. A 20-mil geomembrane to perform as an impervious membrane was indicated for placement on the ground surface with a 6-inch thick free draining protective material topping.

AMS provided technical information from the manufacturers of the two grouting materials in the July 19, 1995 letter and an NRC inspector, after a review of the submitted information, concluded that if used properly, the materials should perform as intended by the consultants in this application.

As work continued on July 20, 1995, to complete the excavation of the trench for the slurry wall around the SW corner of the building at a distance outside the south wall of the stairwell and to the intersection with the trench extended from alongside the east wall of the stairway, the AMS contractors discussed how the formed slurry wall would be constructed. The AMS site personnel and the contractors then proposed the construction of the wall without forming and placing normal ready-mix concrete into the full trench width, thus avoiding any formwork except for bulkheads in the trench at the end of wall placements, therefore, avoiding placement of personnel in the deep trench. The 4-inch diameter foundation drain pipe would then be placed in another trench excavated outside the slurry wall after the wall has been constructed. NRC inspectors agreed that this proposal was an acceptable alternative to the approach presented in the July 19, 1995, letter. A revised Attachment 3 to the letter was provided to the inspectors at the site on July 20, 1995.

On July 21, 1995, work on the construction of the slurry wall continued in the morning while the inspectors were on site. It was pointed out by the inspectors that the loose shale material left in the bottom of the trench would prevent obtaining a "good seal" for water cutoff at the bottom of the slurry wall and the shale material. The AMS personnel and the contractors were informed of this observation so that corrective action could be taken prior to the placement of the concrete wall.

Since there was no direct observation of the backfilling of the foundation perimeter drainage system, discussions with AMS and the contractors indicated that no geotextile filter cloth was utilized along any of the new drainpipe and there was no placement of new, controlled gradation gravel around the foundation perimeter drainage system. Over the long term, it will be prudent to monitor the discharge from this system into the new manhole during periods where there is water infiltration into the ground and flow in the system in order to assure that migration of fines with clogging of the foundation drainage system does not occur.

8. Conclusions and Recommendations

As a result of the review, inspection and evaluation activities, it is concluded that the subsurface drainage conditions that resulted from the action to block the combined storm and sanitary systems, had no significant impact on the structural integrity of the 1958 built facility. While the structural integrity of the 1958 building system is probably at this time sufficient to withstand the original design loads (which apparently did not include any significant lateral loads), the building's waterproof envelope is not at this time intact as a result of the cracking and open joints in the building's exterior. This can lead to more rapid degradation rates of the structural system than would be expected if the waterproof envelope were

intact. The cracked bearing wall and the ruptured inside of a curtain wall section with the resulting outside distress that was induced, leaves the ends of the east (front) wall vulnerable to more rapid degradation with the entrance of water and freezing temperatures. Loss of the bearing wall which supports the roof system in the vicinity of the HEPA filter room could impact that contaminated enclosure on the second floor level. Loss of the curtain wall would not have any impact on radioactive material storage areas or contaminated areas. The hot cell, the WHUT room, the original radiography room, the source garden and the front and back basements, and the HEPA filter room, except as noted above, should maintain their structural integrity relative to the original design conditions. It is recommended that if these structural elements are to be relied on in the future, that an inspection and evaluation program be put into place. An interval of no more than ten years between structural integrity inspections/evaluations and after major loading events should be provided for in the program.

Based on the distress that has been identified from a limited visual inspection that focussed on obvious areas needing an evaluation, it is likely that the structure has undergone a loading event outside the original design envelope. This has left isolated portions of the building in a damaged condition. Action needs to be taken to restore the building's waterproof envelope that is violated in the damaged areas and restore the local integrity of the structural system.

The replacement of the subsurface drainage system based on the observations made by an NRC inspector and the information provided by the licensee, appears to be acceptable, but until a new connection is made to the public sewer system, the drainage system will not function without active pumping.

Without additional investigation and evaluation by the licensee, including repairs of the areas of distress discussed in this report, one could not conclude that the facility would remain intact for an additional 25 years. Without repairs it is likely that sections of the exterior curtain wall could collapse due to degrading conditions. It is recommended that an assessment of the structural integrity of the facility be made by the licensee prior to the development of any repair program to address the distressed areas observed in this inspection so that if additional areas of distress are discovered they can be considered, if necessary, for incorporation to the repair program. The precast concrete roof panels in several areas exhibit corrosion products on the visible surfaces indicating the attack of the embedded reinforcing steel. Also a closer examination of the area of the underside of the second floor concrete slab in the area of the original radiography laboratory should be undertaken.

A loading condition that departs from the design conditions, such as may have occurred in the past, could also cause damage that could be considered to raise the level of concern about the structural integrity of the facility since the damage may be clearly visible. It should be noted that it may also become necessary to consider new loading conditions if the useful life is to be extended or credible events for the emergency plan are outside the original design envelope of the structures.

APPENDIX A

REFERENCE
DESIGN DRAWINGS

1958 Building

1. SD-1, Site Development Plan
2. F-1, Foundation Plan and Details
3. A-7, Elevations
4. A-10, Wall Sections 3-3 Thru 6-6
5. S-1, Roof Steel Framing Plan
6. S-2, Second Floor Steel Framing Plan
7. P-2, First and Second Floor Plumbing
8. P-3, First Floor Toilets, Showers and Riser Diagrams

1963 Building

9. F-1, Foundation Plan
10. S-1, Roof Framing Plan
11. S-2, Second Floor Framing Plan

CONSTRUCTION SEQUENCE
AMS FACILITY
1020 LONDON ROAD
CLEVELAND, OHIO

December 15, 1995

CITY OF CLEVELAND BLDG PERMIT NUMBER	DATE	AMS CONTRACT NUMBER	PROJECT DESCRIPTION
J45739	3/24/58	635	Demolition of Frame Office Bldg
J46366	4/18/58	635	Phase I-Addition to Existing Brick and Block Warehouse (The 1958 Building)
		678	Completion of 2nd Floor (The 1958 Building)
K30250	5/4/62		Addition to Office and Lab of One Story L-Shaped Storage Bldg, 82'x 32.25' and 38'x 18' (Isotope Warehouse)
K40211	4/22/63	801	Phase II-Addition of Classrooms (The 1963 Building)
		846	Office Remodelling
L2485	5/12/67		One Story Masonry Storage Bldg, 16'x 16' (Small add-on by Truck Bay)
L28739	3/26/70		Addition for Storage