U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 030-16055/94001(DRSS)

License No. 34-19089-01

Organization: Advanced Medical Systems, Inc. (AMS)
1020 London Road
Cleveland, Ohio

Inspection At: City of Cleveland sewer interceptor (sewer interceptor) Intersection of sewer interceptor under London Road, upstream and downstream manholes, and the AMS manhole
Cleveland, Ohio

Inspection Conducted: August 17 through October 14, 1994

Inspectors: _____ 11/18/94
Michael Kurth Date
Radiation Specialist

_____ 11/18/94
Edward Kulzer Date
Radiation Specialist

Reviewed by: _____ _____
John R. Madera, Chief Date
Materials Licensing Section

Approved by: _____ _____
John A. Grobe, Chief Date
Nuclear Materials Inspection
Section II

Inspection Summary

Inspection on August 17 through October 14, 1994 (Report No. 030-16055/94001 (DRSS))
Areas Inspected: This was a special inspection conducted to perform surveys of the City of Cleveland sewer interceptor in the location of the AMS facility, Cleveland, Ohio, and in the AMS manhole. The inspection was prompted by the identification of elevated exposure rates on the sewer interceptor surface below the AMS lateral in July 1994. Samples of sewer debris, water effluent, and a series of wipes were collected for analyses.
Results: The NRC inspectors, accompanied by the Northeast Ohio Regional Sewer District (NEORSD), and NEORSD contractors, B. Koh & Associates, Inc., identified four areas of elevated exposure rates. These areas are located:

(1) below the intersection of the sewer interceptor and the AMS lateral; (2) within the processing drain line in the AMS sewer; (3) within the sanitary inlet into the AMS manhole; and (4) within the sanitary outlet from the AMS manhole into the sewer interceptor. The preliminary results of the sewer debris and wipe test analysis from the August 17, 1994, sampling identified positive cobalt-60 surface contamination levels ranging from 457 disintegrations per minute per 100 cm^2 (dpm/100 cm^2) to 2.7 x 10^6 dpm/100 cm^2, partial levels which exceed the 1,000 dpm/100 cm^2 limit found in NRC's guidance document, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Sources, or Special Nuclear Materials," dated August 1987. Also, between July 5 and October 10, 1994, cobalt-60 was identified, by the NRC and the NEORSD, in the water effluent discharged from the AMS lateral into the sewer interceptor. The September 20, 1994, sampling analysis verified prior indications of cobalt-60 contamination. However, further water discharge samples taken from the location on September 20 and October 4, 1994, did not identify the presence of cobalt-60.

One apparent violation was identified:

> Apparent failure to dispose of licensed material into the sanitary sewerage system that is readily soluble or is readily dispersible biological material in water, 10 CFR 20.2003 [(effective January 1, 1994) (Section 3. B. of this report)].

Also, given that cobalt-60, which is not considered to be readily soluble or readily dispersible biological material in water, was identified in effluent discharged from the AMS lateral and, that cobalt-60 was deemed to be removable within the AMS lateral through the conduct of wipe sampling, the probability exists that future effluent discharges may develop into the disposal of licensed material into the sanitary sewerage system.

DETAILS

1. Persons Contacted

Thomas Lenhart, Assistant General Counsel, Northeast Ohio Regional Sewer District (NEORSD)
*Lawrence English, Assistant General Counsel, NEORSD
*Richard Connelly, Manager Water Quality, NEORSD
*Len Jufko, NEORSD
*William Kasberg, NEORSD
*Theodore Adams, Vice President, B. Koh & Associates, Inc.
*'David Cesar, Treasurer, Advanced Medical Systems, Inc. (AMS)
•Joseph Michuta, Radiation Safety Officer, AMS
•Robert Neschter, Sr. Radiation Technician, AMS
•Vincent Rocco, Radiation Technician, AMS

*Denotes those present at interceptor sewer survey conducted August 17, and September 20, 1994.
•Denotes those present at the sewer survey conducted September 20, 1994.
'Denotes those present during the exit interview conducted by telephone on October 14, 1994.

2. Background

A. General History

In 1959, the Atomic Energy Commission issued License No. 34-07225-09 to Picker X-Ray Corporation (Picker Corporation), for the operation of an isotope manufacturing facility located at 1020 London Road, Cleveland, Ohio. The Picker Corporation license authorized possession of 150,000 curies of cobalt-60 and 3,000 curies of iridium-192 in solid metal form, and 40,000 curies and 100 curies of cesium-137 and thulium-170 respectively, as sealed sources. These licensed materials were authorized for: (1) processing incident to redistribution to authorized recipients; (2) radiation effects studies; and (3) research and development. The principal operation conducted under this license was the manufacture of cobalt-60 sealed sources for medical teletherapy and industrial radiography units, and subsequent distribution of the sources to authorized recipients throughout the world.

In 1979, the Picker Corporation London Road facility was purchased by Advanced Medical Systems, Inc. (AMS). License No. 34-07225-09 was terminated on November 9, 1979, at which time all licensed material possessed was transferred to AMS.

The NRC issued License No. 34-19089-01 to AMS on November 2, 1979. At this time, the licensed operations, facilities and equipment previously owned and operated by the Picker Corporation were assumed by AMS.

Both operations had released cobalt-60 through the London Road facility lateral into the sanitary sewer under the provisions of 10 CFR 20.303, "Disposal by Release into Sanitary Sewerage Systems," which was in effect through December 31, 1993. The NRC inspection in 1988 confirmed cobalt-60 contamination in the AMS sewer manhole on AMS property. At that time, the radiation level ranged as high as 70 mR/hr at the bottom of the manhole adjacent to the discharge pipe from the AMS building. The contaminated area was partially decontaminated and covered with a layer of concrete by the licensee. In May 1989, as stated in the NRC Inspection Report No. 030-16055/93002(DRSS), AMS discontinued the discharge of licensed material into the sanitary sewerage system. Also, AMS has not generated liquid waste for several years due to changes in its decontamination methods and termination of source manufacturing operations.

Beginning January 1, 1994, NRC licensees were required to comply with the revised 10 CFR Part 20, which contains more restrictive requirements for sanitary sewer disposal of liquid radioactive waste than previously existed.

The revised 10 CFR 20 specifies, in part, in 20.2003, "Disposal by Release into Sanitary Sewerage," that licensees may discharge licensed material into the sanitary sewerage system only if the material is readily soluble or is readily dispersible biological material in water.

In 1993, as documented in NRC Inspection Report No. 999-90003/93010(DRSS), an NRC inspector measured the exposure rates in the downstream manhole from the AMS facility in the London Road sewer interceptor. No detectable radiation exposure rates above background were identified. The location where the elevated exposure rate was identified in July 1994 by the NEORSD was inaccessible at the time of the 1993 NRC inspection and the NRC was unaware, in 1993, of the manhole's existence.

B. Specific History Prompting this Special Inspection

On July 5, 1994, surveys were conducted by the Northeast Ohio Regional Sewer District (NEORSD) contractors, B. Koh & Associates, Inc., along the City of Cleveland's interceptor sewer (interceptor sewer) in an area connecting with the AMS lateral under London Road. Elevated exposure rate readings were identified below the AMS lateral on the sewer interceptor brick and iron rungs. The NEORSD reported that the radiation exposure rate measured was approximately 7 milliroentgen per hour (mR/hr) on contact. Residue deposits on the sewer interceptor brick and iron rungs below the AMS lateral were collected, resulting in the identification of cobalt-60 contamination ranging from 0.084 to 0.12 microcuries per gram. Also, during the performance of the

surveys, the NEORSD discovered a manhole directly above the AMS lateral/sewer interceptor intersection which was buried below the London Road surface. The NEORSD has since raised the level of the manhole to the street surface.

Attachment No. 1 of this report illustrates the pathway and proximity of the AMS lateral in relation to the AMS facility. The approximate length of the lateral from the AMS manhole to the sewer interceptor is 40 feet (12 m). The lateral is made of 4 to 5 foot (91-122 cm) long sections of precast clay/ceramic piping butted together, forming the lateral. The lateral is approximately 18 inches (46 cm) in diameter. Attachment No. 3 contains a photograph of the AMS lateral protruding into the City of Cleveland sewer interceptor (sewer interceptor). The sewer interceptor is approximately 5 feet (1.5 m) in diameter and flows to the Easterly Wastewater Treatment Plant.

3. Survey and Sample Analysis Results

A. Survey Results

On August 17 and September 20, 1994, the NRC inspectors, accompanied by NEORSD personnel and NEORSD contractors, conducted a series of surveys in the sewer interceptor outside of the AMS facility under London Road. Also, on September 20, 1994, surveys were conducted in both manholes immediately upstream and downstream from the AMS facility along London Road, and in the AMS manhole. The survey instruments used were a Ludlum Model 19 Micro R Meter, NRC Tag No. 014808, a Ludlum Model 12 Count Ratemeter with attached pancake probe, NRC Tag No. 047068, a [1]Bicron MicroRem, Serial No. B709J, and a [2]Ludlum Model No. 2221 Scaler Ratemeter (No Serial No. available) with attached pancake probe.

The background exposure rate measured at the London Road street surface above the AMS lateral/sewer interceptor intersection was 12 [3]microroentgen per hour (μR/hr). The surveys conducted in the sewer interceptor demonstrated elevated exposure rate readings. A sewer interceptor surface area approximately 1.5 feet (46 cm) by 3 feet (91 cm) located directly below the AMS lateral showed elevated readings averaging 1.0 to 10 mR/hr on contact with the sewer interceptor brick. Attachment No. 2 of this report illustrates the location of the elevated exposure rates in the sewer interceptor. One spot was identified between the iron rungs on the sewer interceptor brick surface showing an exposure rate ranging from 20 to 25 mR/hr on contact. Also, a spot was

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[1]This instrument is owned and maintained by B. Koh & Associates, Inc.

[2]This instrument is owned and maintained by B. Koh & Associates, Inc.

[3]Assume that 1 roentgen = 1 Rem.

identified on the rung below the AMS lateral showing an elevated exposure rate of 14 mR/hr on contact. An average exposure rate of 0.5 mR/hr was identified both 3 feet (91 cm) upstream and downstream from the AMS lateral in the center of the sewer interceptor. Also, an exposure rate ranging from 1.5 to 2.0 mR/hr was identified in the center of the sewer interceptor directly across (approximately 61 cm) from the elevated area below the AMS lateral. Attachment No. 3 of this report contains several photographs of the sewer interceptor wall in the area of the AMS lateral.

Surveys conducted of the first manholes immediately upstream and downstream from the AMS facility identified exposure rates ranging from 5 to 9 μR/hr on the surface of London Road next to the manholes. Exposure rates ranging from 14 to 19.5 μR/hr (includes the background rate) were identified in the center of the sewer interceptor and on contact with the interceptor brick in both manholes. The slightly elevated exposure rates were attributed to naturally occurring radioactive materials (NORM) in the sewer brick. (NORM, such as potassium-40, radium-226, and thorium-232, are found in very small quantities in brick.)

Elevated exposure rates were identified in the AMS manhole. Exposure rates ranging from 2 to 3 mR/hr were identified, on contact, approximately 2 to 4 inches (5 to 10 cm) into the processing drain line, and the sanitary inlet and outlet in the AMS manhole. A survey instrument was lowered into the AMS manhole demonstrating exposure rates of 0.5 to 1.0 mR/hr in the center of the AMS manhole.

B. Sampling Analysis Results

On July 5, 1994, the NEORSD collected three sediment samples from the sewer interceptor in the location of the AMS lateral outfall. Also, a water effluent sample was collected from the AMS lateral. The analytical results of the sediment samples identified positive cobalt-60 concentrations ranging from 0.084 to 0.12 microcuries per gram. The result of the water sample identified a positive cobalt-60 concentration of 29 picocuries per liter (pCi/l).

The NRC collected numerous smears, sewage residues, and water samples on August 17 and September 20, 1994. Table No. 1 identifies the locations and analytical results of the smear and sewage residue samples collected on August 17, 1994. The samples were analyzed using the NRC Region III gamma spectroscopy system. On August 17, 1994, a total 4 smears and 4 sewage residue samples were collected.

As illustrated in Table No. 1, the analysis of the sewage residue samples demonstrated cobalt-60 contamination ranging from 1.63 to 1,230 nanocuries. Two of the 4 smears collected identified cobalt-60 contamination ranging from 2,750 to 103,840

disintegrations per 100 cm^2 (dpm/100 cm^2). Each smear collected was estimated to cover a 100 cm^2 area. The acceptable surface contamination level for removable cobalt-60 is 1,000 dpm/100 cm^2, as stated in the NRC document, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," dated August 1987, which is included as Attachment No. 4 of this report. The water effluent sample collected demonstrated positive indications of cobalt-60 contamination of 35 picocuries per liter (pCi/l).

Table No. 2 identifies the locations and analytical results of the NRC smears collected on September 20, 1994. As illustrated in Table No. 2, a smear result of 16,852 dpm/100 cm^2 removable cobalt-60 contamination was identified on the sewer interceptor wall below the AMS lateral.

On September 20, 1994, smears were also collected from the sewer interceptor walls in the areas of the first sewer interceptor manholes immediately upstream and downstream from the AMS facility along London Road, and the AMS manhole. As illustrated in Table No. 2, general smears of the sewer interceptor walls from the sewer interceptor manholes located immediately upstream and downstream from the AMS facility along London Road did not identify removable cobalt-60 contamination. There was, however, a surface contamination level of 97 dpm/100 cm^2 which was identified in the AMS manhole on the AMS lateral exiting into the sewer interceptor.

Table No. 3 identifies the dates, locations, and analytical results of the water effluent collected in the area of the AMS lateral by the NRC and the NEORSD. As illustrated in Table No. 3, water effluent samples taken from the upstream and downstream manholes, and from the AMS manhole, did not demonstrate positive indications of cobalt-60. However, water effluent collected from the outfall of the AMS lateral (into the sewer interceptor) on July 5, August 17, September 28, October 1, and October 10, 1994, demonstrated positive concentrations of cobalt-60 ranging from 13 to 306 pCi/l. Given that removable cobalt-60 was identified on the surface of the AMS lateral, it appears that the water effluent flowing through the AMS lateral sloughed the cobalt-60 from the lateral, causing the release of licensed material into the sanitary sewerage system. The discharge of licensed material, cobalt-60, which is not readily soluble or is readily dispersible biological material in water, into the sanitary sewerage system, is an apparent violation of 10 CFR 20.2003, which has been in effect since January 1, 1994.

One apparent violation of NRC requirements was identified.

4. Exit Meeting

During the performance of surveys and sample collecting, the preliminary findings were provided to those individuals present during the August 17 and September 20, 1994, on-site inspections, as identified in Section 1 of this report. A summary of the areas surveyed and the forthcoming letter were discussed. Also, on October 14, 1994, the results of this inspection were discussed in a telephone conversation between Mr. Cesar and Mr. Caniano. The AMS and NEORSD employees did not identify any information provided during the inspection as proprietary.

Attachments:

1) Illustration of pathway of AMS Lateral into sewer interceptor
2) Diagram of sewer interceptor
3) Series of photographs of sewer
4) Guideline for the Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material

TABLE NO. 1

NRC SEWER SAMPLE RESULTS

SEWER SAMPLES FROM THE CITY OF CLEVELAND INTERCEPTOR
IN THE IMMEDIATE AREA OF THE AMS LATERAL ON LONDON RD

SAMPLES TAKEN AUGUST 17, 1994

	SAMPLE LOCATION		RESULT ± *2σ
1.	Debris and sludge from left (upstream) of rungs below the AMS lateral		°4,290 pCi ± 32 pCi
2.	Black debris off of top rung below the AMS lateral		°434,000 pCi ± 3,000 pCi
3.	Black debris off of brick wall below the AMS lateral		°1,230,000 pCi ± 7,000 pCi
4.	Red debris off of rung above the AMS lateral		°1,630 ± 20 pCi
5. a.	Smear:	Rung immediately below the AMS lateral	less than 41 'dpm
5. b.	Smear:	NEORSD Sewer wall (sewer brick) below the AMS lateral	103,840 dpm ± 167 dpm
5. c.	Smear:	NEORSD Sewer wall (sewer brick) above the AMS lateral	2,750 dpm ± 52 dpm
5. d.	Smear:	Inside the AMS lateral	457 dpm ± 138 dpm

*Note: The reported uncertainty refers only to counting statistics.

°Note: Additional analysis error will be introduced due to the unique geometry associated with the debris. The geometry error is estimated to be less than 10 percent.

'Note: disintegration per minute = dpm. Also, each smear result is estimated to be averaged over a 100 cm^2 area.

TABLE NO. 2

NRC SMEAR RESULTS
SEWER SAMPLES FROM THE CITY OF CLEVELAND SEWER INTERCEPTOR
IN THE AREA OF THE AMS FACILITY ON LONDON ROAD
AND THE AMS SEWER

SAMPLES TAKEN SEPTEMBER 20, 1994

	LOCATION		RESULT ± 2σ
1	Smear:	Iron Rung Directly Below the AMS Lateral	*717 ± 17 dpm
2	Smear:	Sewer Interceptor Brick Directly Below the AMS Lateral (between lateral and 1st rung	16,852 ± 264 dpm
3	Smear:	Sewer Interceptor Brick Directly Above the AMS Lateral	< 16 dpm
4	Smear:	Approximately 1 foot inside the AMS Lateral between the positions of 12:00 and 3:00	56 ± 4 dpm
5	Smear:	Outer Surface of the AMS Lateral between the positions of 12:00 and 3:00	< 23 dpm
6	Skipped No. 6		
7	Smear:	Outer Surface of the AMS Lateral at the 6:00 position	490 ± 143 dpm
8	Smear:	Inside the AMS Lateral Approximately 1 foot at the 5:00 position (as close to water line as possible)	161 ± 7 dpm
9	Smear:	General Wipe of Upstream Sewer Interceptor	< 13 dpm
10	Smear:	General Wipe of Downstream Sewer Interceptor	< 14 dpm
11	Smear:	AMS Sewer- Floor of AMS Sewer	< 13 dpm
12	Smear:	AMS Sewer- Outlet from Processing Drain (East Drain near waterline)	< 16 dpm
13	Smear:	AMS Sewer- General Wipe of Sewer Wall	< 22 dpm
14	Smear:	AMS Sewer- South Inlet to Manhole (near waterline)	< 23 dpm
15	Smear:	AMS Sewer- AMS Sewer Outlet to Interceptor (near waterline)	97 ± 6 dpm

*Note: The reported uncertainty refers only to counting statistics.

[e]Note: Disintegrations per minute = dpm. Also, each result is estimated to averaged over a 100 cm^2 area.

TABLE NO. 3

NRC AND THE NEORSD WATER EFFLUENT SAMPLE RESULTS

	SAMPLE	DATE COLLECTED - LOCATION	RESULT ± *2σ
1	NEORSD	July 5, 1994 - AMS lateral outflow to sewer interceptor	29 pCi/l
[1]2	NRC	August 17, 1994 - AMS lateral outflow to sewer interceptor	35 pCi/l ± 0.4 pCi/l
3	NEORSD	August 17, 1994 - AMS lateral outflow to sewer interceptor	33 pCi/l
4	NRC	September 20, 1994 - AMS lateral outflow to sewer interceptor	˙< 10.3 pCi/l
5	NEORSD	September 20, 1994 - AMS lateral outflow to sewer interceptor	˙< 20 pCi/l
6	NRC	September 20, 1994 - AMS manhole	˙< 9.3 pCi/l
7	NRC	September 20, 1994 - Upstream manhole	˙< 8.9 pCi/l
8	NRC	September 20, 1994 - Downstream manhole	˙< 9.1 pCi/l
9	NEORSD	September 28, 1994 - AMS lateral outflow to sewer interceptor	13 pCi/l
10	NEORSD	October 1, 1994 - AMS lateral outflow to sewer interceptor	86 pCi/l
11	NEORSD	October 4, 1994 - AMS lateral outflow to sewer interceptor	˙< 0.1 pCi/l
12	NEORSD	October 10, 1994 - AMS lateral outflow to sewer interceptor	306 pCi/l

*Note: The reported uncertainty refers only to counting statistics.

˙Note: The analytical results demonstrating the less than symbol, "<", indicates that no measurable activity was identified below the minimum detectable level derived for that sample. The minimum detectable level for each sample in which no measurable activity was detected is recorded in the "RESULT" column.

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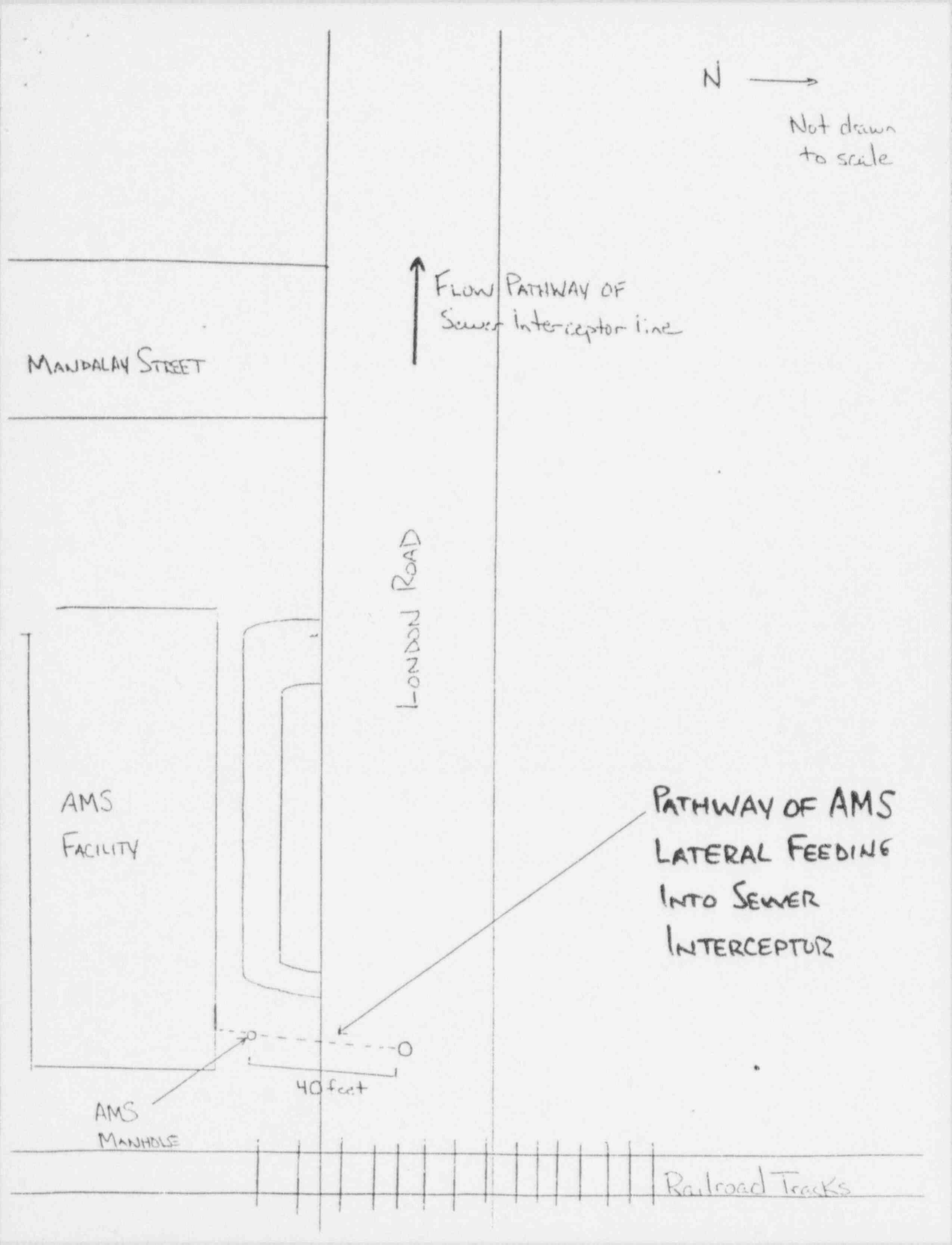
[1]This sample was analyzed by the NRC. After conducting the analysis, the sample was provided to the NEORSD for analysis (Sample Result No. 3 of this table). Therefore, Sample Nos. 2 and 3 were the same samples analyzed independently.

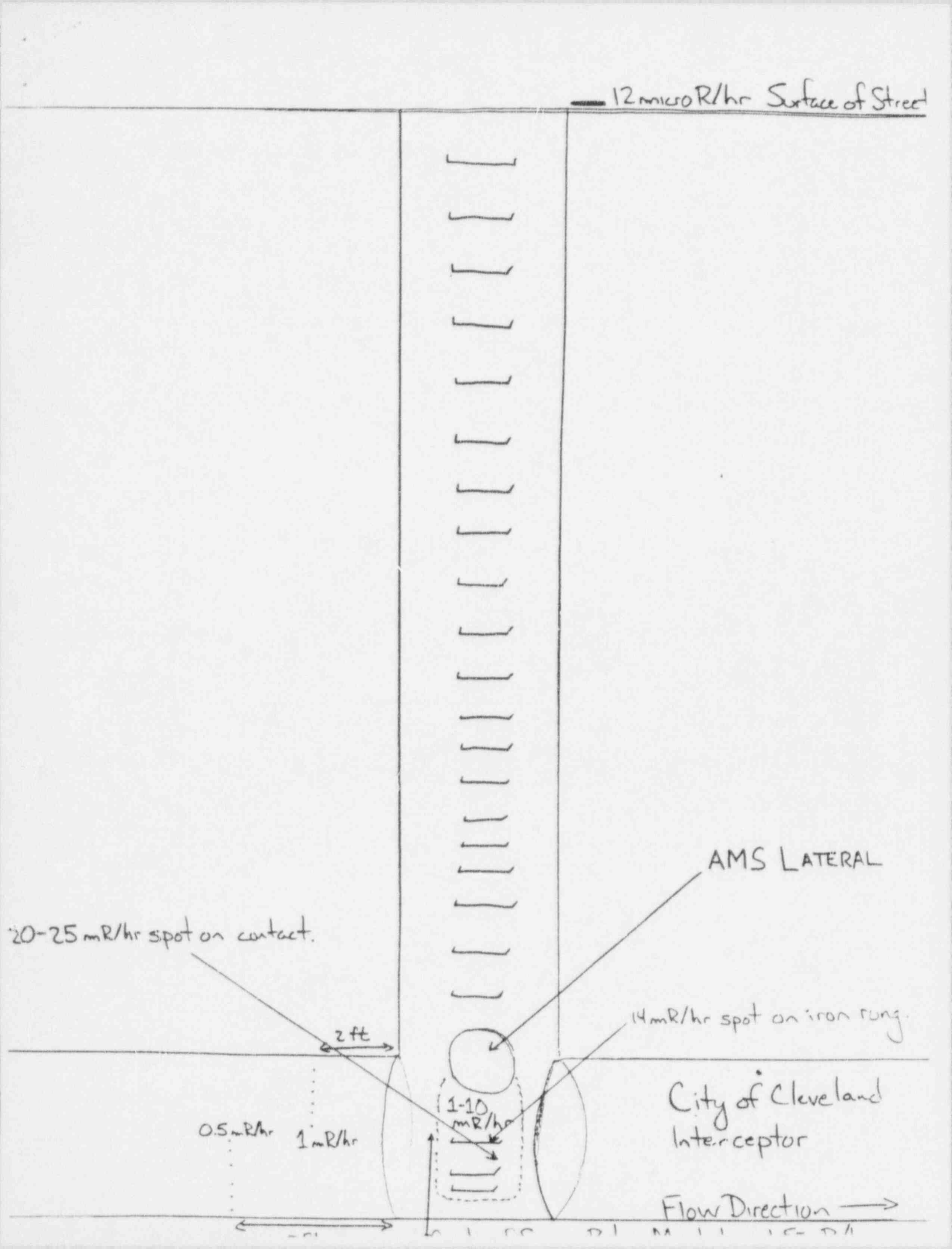
ATTACHMENT NO. 1

ILLUSTRATION OF PATHWAY OF AMS LATERAL
INTO SEWER INTERCEPTOR


N
Not drawn to scale
FLOW PATHWAY OF Sewer Interceptor line
MANDALAY STREET
LONDON ROAD
AMS FACILITY
PATHWAY OF AMS LATERAL FEEDING INTO SEWER INTERCEPTOR
40 feet
AMS MANHOLE
Railroad Tracks

ATTACHMENT NO. 2

DIAGRAM OF SEWER INTERCEPTOR

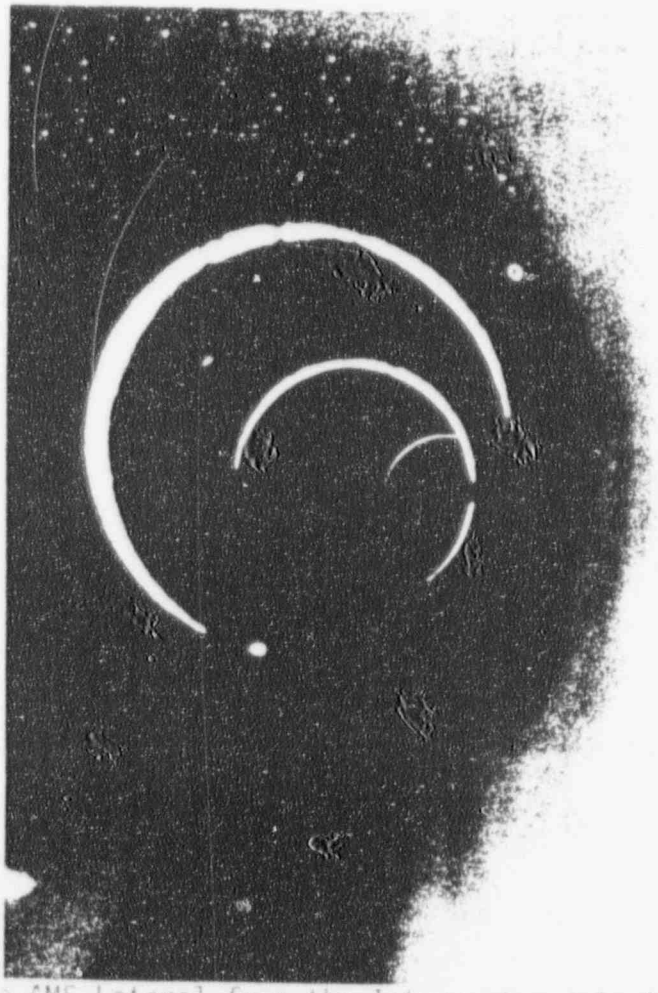

12 micro R/hr Surface of Street
AMS LATERAL
20-25 mR/hr spot on contact.
14 mR/hr spot on iron rung.
2 ft
1-10 mR/hr
0.5 mR/hr
1 mR/hr
City of Cleveland
Interceptor
Flow Direction

ATTACHMENT NO. 3

SERIES OF PHOTOGRAPHS OF SEWER

AMS Lateral Protruding Out into the City of Cleveland Sewer Interceptor

Sewer Interceptor and Iron Rungs Below the AMS Lateral



Pathway of the AMS Lateral from the Interceptor into the AMS Building

ATTACHMENT NO. 4

GUIDELINE FOR THE DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

GUIDELINES FOR DECONTAMINATION OF FACILITIES AND EQUIPMENT PRIOR TO RELEASE FOR UNRESTRICTED USE OR TERMINATION OF LICENSES FOR BYPRODUCT, SOURCE, OR SPECIAL NUCLEAR MATERIAL

U.S. Nuclear Regulatory Commission
Division of Industrial and
Medical Nuclear Safety
Washington, DC 20555

August 1987

The instructions in this guide, in conjunction with Table 1, specify the radionuclides and radiation exposure rate limits which should be used in decontamination and survey of surfaces or premises and equipment prior to abandonment or release for unrestricted use. The limits in Table 1 do not apply to premises, equipment, or scrap containing induced radioactivity for which the radiological considerations pertinent to their use may be different. The release of such facilities or items from regulatory control is considered on a case-by-case basis.

1. The licensee shall make a reasonable effort to eliminate residual contamination.

2. Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 1 prior to the application of the covering. A reasonable effort must be made to minimize the contamination prior to use of any covering.

3. The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps, and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork. Surfaces of premises, equipment, or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement shall be presumed to be contaminated in excess of the limits.

4. Upon request, the Commission may authorize a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with materials in excess of the limits specified. This may include, but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests must:

   a. Provide detailed, specific information describing the premises, equipment or scrap, radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

   b. Provide a detailed health and safety analysis which reflects that the residual amounts of materials on surface areas, together with other considerations such as prospective use of the premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

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ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES[a]	AVERAGE[b c f]	MAXIMUM[b d f]	REMOVABLE[b e f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1000 dpm/100 cm^2	3000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1000 dpm $\beta\gamma$/100 cm^2

Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

The maximum contamination level applies to an area of not more than 100 cm^2.

The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

5. Prior to release of premises for unrestricted use, the licensee shall make a comprehensive radiation survey which establishes that contamination is within the limits specified in Table 1. A copy of the survey report shall be filed with the Division of Industrial and Medical Nuclear Safety, U. S. Nuclear Regulatory Commission, Washington, DC 20555, and also the Administrator of the NRC Regional Office having jurisdiction. The report should be filed at least 30 days prior to the planned date of abandonment. The survey report shall:

   a. Identify the premises.

   b. Show that reasonable effort has been made to eliminate residual contamination.

   c. Describe the scope of the survey and general procedures followed.

   d. State the findings of the survey in units specified in the instruction.

   Following review of the report, the NRC will consider visiting the facilities to confirm the survey.