REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(Amended in its entirety)

NO.: NR115S101S DATE: MAY 1 0 1983 PAGE 1 OF 4

SEALED SOURCE TYPE: Sealed Source

MODEL: AMS-3800 Series

MANUFACTURER/DISTRIBUTOR: Advanced Medical Systems, Inc.
1020 London Rd.
Cleveland, OH 44110

MANUFACTURER/DISTRIBUTOR:

ISOTOPE: Cobalt-60 MAXIMUM ACTIVITY: 13,680 curies

LEAK TEST FREQUENCY: 6 months

PRINCIPAL USE: Medical Teletherapy

CUSTOM SOURCE: No

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(Amended in its entirety)

NO.: NR115S1015 DATE: MAY 1 0 1983

SEALED SOURCE TYPE: Sealed Source

DESCRIPTION:

Cobalt-60 metal is doubly encapsulated in heliarc welded stainless steel (#316LC). The outer dimensions of the double capsule are 3.3 cm in diameter x 3.8 cm in height for cobalt-60. Wall thicknesses of the inner and outer capsules are 20 mils or greater. The double capsule is then fitted into an international standard source holder. The active diameters of the cobalt-60 sources vary from.5 cm to 3.0 cm. A tungsten liner of variable diameter is used to fill the excess space inside the double capsule. Thus a source with a given active diameter may produce slightly higher head leakage levels than the same strength source with a small active diameter.

LICENSEABLE PRODUCTS

AMS, Inc. Cat. No.	Picker Corp. Cat. No.	Common Generic Name	Common Description of Unit
AMS-3800	P-3800-A	Cobalt Source	Double encapsulated cobalt-60 teletherapy and radiography source in International standard source holder. Active diameter 1 cm.
AMS-3801	P-3801-A	Cobalt Source	Same, except 1.5 cm active diameter
AMS-3802	P-3802-A	Cobalt Source	Same, except 2.0 cm active diameter
AMS-3803	P-3803-A	Cobalt Source	Same, except 2.5 cm active diameter
AMS-3804	P-3804-A	Cobalt Source	Same, except 3.0 cm active diameter
AMS-3805	P-3800-1	Cobalt Source	Same, except 0.5 cm active diameter

LABELING:

A certificate is prepared for each source indicating the source serial number, the output in Rhm, the type of device in which it is to be mounted, the type of collimating device and settings, and the date calibrated. The contained curies and date of assay are also included on this certificate.

DIAGRAM: See attachment

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF SEALED SOURCE
(Amended in its entirety)

NO.: NR115S101S DATE: MAY 1 0 1983

SEALED SOURCE TYPE: Sealed Source

CONDITIONS OF NORMAL USE:

The AMS-3800 series sealed sources are designed for use in shielded exposure devices for teletherapy or industrial radiography. The medical teletherapy sources will be used at ambient hospital conditions while the industrial radiography sources may be used at temperatures from 0°F to 110°F and in dusty (as in foundry) but dry conditions.

PROTOTYPE TESTING:

Prototype testing of two sources containing 20 gm of cobalt-59 (in place of cobalt-60) was performed in accordance with the recommendations contained in ANSI N542-1977, "Classification of Sealed Sources" (see NBS Handbook 126). The testing was performed by the Herron Testing Laboratories, Inc., and the test data showed that Model Model AMS-3800 series qualifies for an ANSI N542-1978 classification of ANSI 77E53524.

EXTERNAL RADIATION LEVELS:

The maximum radiation levels in air at 5 cm and 30 cm from the source are approximately 540 R/hr and 15 R/hr per curie contained, respectively.

QUALITY ASSURANCE AND CONTROL:

Advanced Medical Systems, Inc. stated that their quality assurance program will meet the guidelines outlined in ANSI N542-1977. The leak testing procedure of the inner capsule as defined in paragraph A2.2.2 and the wipe test of the outer capsule as defined in paragraph A2.1.1 both of ANSI N542-1977, are used to determine the integrity of each source.

A certificate is prepared for each source indicating the quantity of contamination removed during the wipe test. This certificate also gives the model number, the serial number of the source, and the date wipe tested.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

- This source shall be distributed only to specific licensees of the NRC or Agreement States.
- Leak Testing - This source shall be tested at six (6) month intervals using techniques approved by the licensing authority and capable of detecting 0.005 microcurie of activity.
- Handling, storage, use, transfer, and disposal to be determined by the licensing authority.

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES
SAFETY EVALUATION OF DEVICE

NO: NR1155?015 DATE: MAY 1 0 1983 PAGE 4 OF 4

DEVICE TYPE: Sealed Source

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE (Cont'd):

- This source shall not be subjected to environmental or other conditions of use which exceed its ANSI classification 77E53524 (ANSI N542-1977).
- This registration sheet and the information contained within the references shall not be changed or transferred without the written consent of the NRC.

SAFETY ANALYSIS SUMMARY:

Based on our review of the information and test data cited below, and that the source has been previously deemed acceptable for licensing purposes by the NRC, we continue to find the Advanced Medical System, Inc. Model No. AMS-3800 series sealed source design as acceptable for licensing purposes.

Furthermore, we conclude that these sources would be expected to maintain their containment integrity for normal research, development, and industrial uses and accident conditions which might occur during normal operational conditions of use or transportation, applicable to the uses specified in this certificate.

REFERENCES:

The following supporting documents for the AMS-3800 series sealed source design are hereby incorporated by reference and are made a part of this registry document:

- Advanced Medical Systems, Inc., letters dated July 9, 1979, October 23, 1979, April 23, 1983 and enclosures thereto.
- Supersedes registration sheet No. NR-115-S-101-U dated December 5, 1979

ISSUING AGENCY:

U.S. Nuclear Regulatory Commission

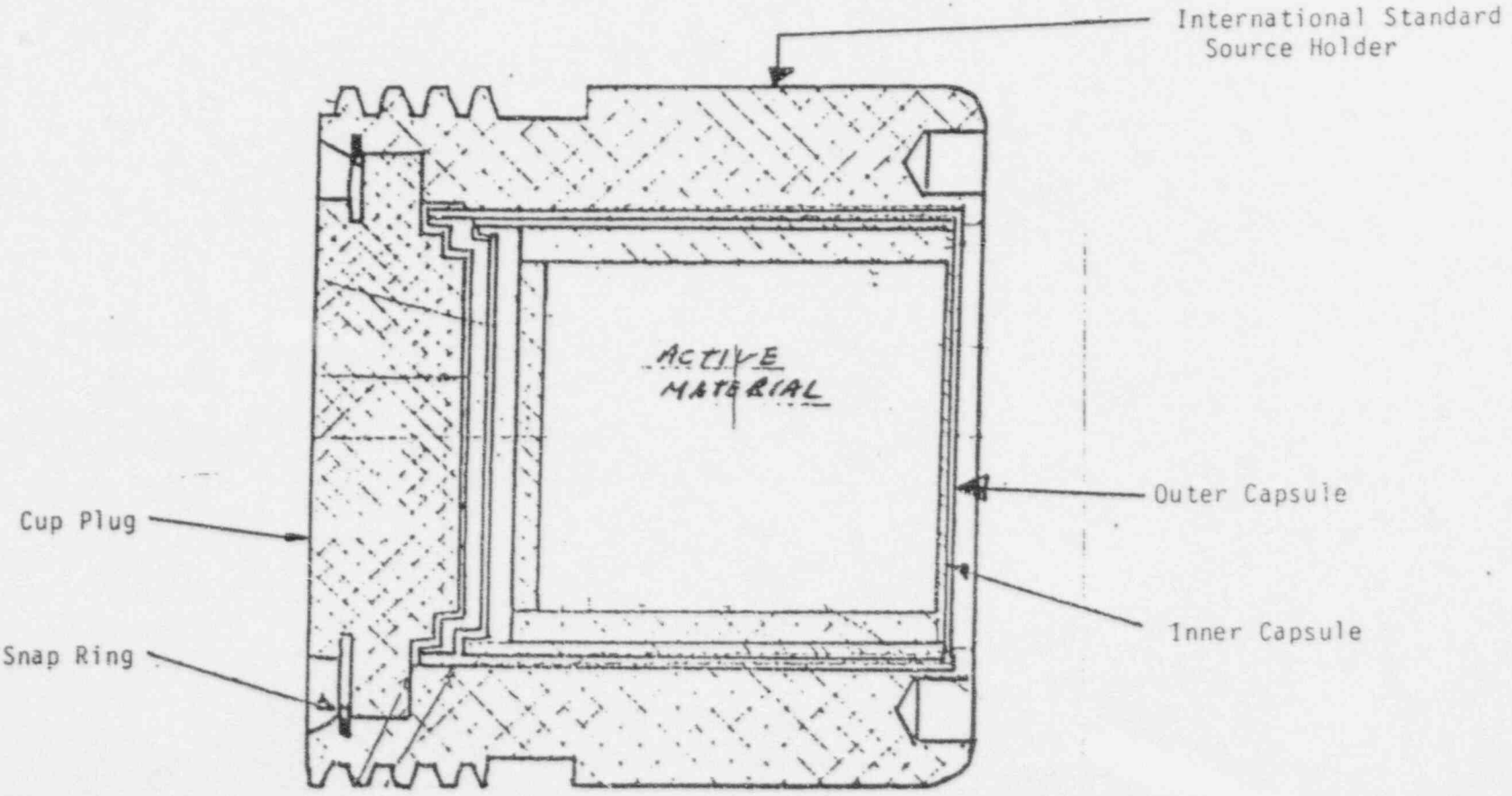
Date: MAY 1 0 1983 Reviewer: [signature]

Date: [illegible] Concurrence: [signature]

ATTACHMENT

DATE: MAY 1 0 1983

NO: NR115S010S



You should avoid submitting any information that cannot be made public. If this is not possible, you should review 10 CFR 2.790 regarding requests for withholding.

Information that is needed for NRC to evaluate the AMS proposal:

1. Confirm that AMS has exhausted all other means to secure funding for this operation.

2. Provide details of the source of the funding.

3. Will your proposal affect the existing $1.8 million letter of credit? If so, how will it change?

4. Provide modification to your decommissioning cost estimates to reflect the costs of the proposed decommissioning actions.

In writing

INTERNAL NRC INFORMATION ONLY

Options for Funding

1. Use corporate funds

2. Use funds now committed as collateral for letter of credit; would lower letter of credit amount. NRC would need to send existing letter of credit back if option is acceptable.

3. Request NRC to draw on the letter of credit.

   a. AMS must certify it is required to commence decommissioning.

   b. AMS must certify plans and procedures for decommissioning have been approved by NRC.

   c. AMS must certify AMS board of directors has adopted resolution authorizing commencement of decommissioning.

Cindy, This is our corrected version of George Pangburn's e-mail re: AMS.

-Mike

RIII (John Madera and Mike Weber) contacted IMOB on Friday regarding an issue with AMS and NEORSD. As you know, AMS routinely pumps water from its manhole to a 3000 gal tank. After analysis, the water is discharged onto AMS' parking lot from which it finds its way into the sewer system. In preparation for such discharges AMS routinely takes samples of that water for analysis and provides a sample to NEORSD for its analysis. So far, approximately 35,000 gals of water have been discharged this way.

In a sample taken from a tank that AMS was ready to discharge on Thursday, February 1, NEORSD's analysis of its sample found levels of ~~soluble~~ Co-60 of 6.0 pCi/liter (+/- 2.4 pCi liter) in the water and, after running the water through a 0.45 um filter, found levels of ~~insoluble~~ Co-60 of 2.7 pCi/l (+/- 2.0 pCi/l) on the filter. Since Co-60 was detected on the filter, NEORSD considers the Co-60 to be insoluble.

On January 31, NEORSD informed AMS' attorney, Dwight Miller, that these results indicated the sample was unacceptable to discharge under provisions of 10 CFR 20.2003, and requested assurance that AMS would not discharge the water, directly or indirectly to the sewer system. NEORSD subsequently contacted RIII, by phone and FAX ~~letter~~, and informed them of the results and indicated that due to the finding of insoluble Co-60, that the Region should not permit AMS to discharge the water.

AMS' own analysis found no detectable Co-60 (MDA = 53.4 pCi/l). However, to be sure, they submitted a sample to an independent lab for analysis. Late in the day on Friday, RIII received AMS' indepedent laboratory analysis results. Those results found no detectable Co-60 in the sample (MDA = 4.1 pCi/l). The laboratory did not filter the sample and test for insoluble Co-60, given these results. Accordingly, AMS intends to discharge the water to its parking lot on Monday, February 5, although they have indicated they will not do so until they hear back from RIII.

When we last talked on Friday, John was leaning toward sending an inspector out to collect a sample of the water for independent analysis. He was looking for our views on whether to do this or not. In addition, he was looking for our position on whether the Region could or should 1) attempt to either cajole or order AMS not to discharge the water or 2) simply allow the discharge to proceed. It is important to note that AMS is not required by license condition to obtain NRC approval before discharging water to its parking lot.

I told John my view was that we rely on licensee data to confirm compliance with the regulations. If AMS is in possession of analytical results that confirm that they would be in compliance with the provisions of 20.2003 regarding discharge of the water to the parking lot, they should proceed appropriately. I recognize that NEORSD may take legal actions in light of AMS' discharge, but from a policy perspective I don't see how we can prohibit AMS discharge based on the results of a third party's analysis.

Cindy

Financial Assurance History

1. July 1992 AMS submitted Letter of Credit for 750,000 dollars.

2. January 1995 AMS submitted DFP with cost estimate for app. 1.8 million dollars. This was submitted with application for renewal.

3. March 30, 1995 NRC mailed def. letter re: DFP stating we felt cost estimate was low. Asked for re-evaluation.

4. May 30, 1995 response received. AMS states they feel their cost estimate is reasonable.

5. August 17, 1995 NRC mails def. letter. NRC still feels their cost estimate is low. NRC feels that AMS has not performed an adequate site characterization to support their conclusions.

6. September 1, 1995 letter from AMS. In response to our 8/17 letter and as a result of discussions between Region III and HQ MGMT., AMS states they will be submitting a conceptual decomm. funding plan.

7. October 20, 1995 AMS submits their conceptual decomm. funding plan. Two estimates are submitted: 1) DECON option = 3.3 million dollars, and 2) SAFSTOR option = 912,000 dollars. Siting that SAFSTOR (or Decay in storage) presents lowest overall radiological risk and is in keeping with concept of ALARA, AMS elects this option. They also site that for their facility, a storage period of 50 years is appropriate.

8. March 20, 1996 deficiency letter from NRC re: AMS' 10/20 letter. NRC sites GEIS, NUREG-0586 report that discusses SAFSTOR being appropriate for reactors and possibly source manufacturers using RAM that decay within a few weeks or months. Our letter also sites NRC policy stating that D-I-S should not be used as a substitute for disposal if access to a disposal site is available. Barnwell is open.

9. April 12, 1996 AMS response. – Preparing a TAR

INSPECTION PLAN

Licensee: AMS
1020 London Rd.
Cleveland, OH

License No: 34-19089-01

Inspection Dates: April 30 - May 1, 1996

Inspectors: J. Madera, M. Weber

Purpose of Inspection: The inspection will be a routine, unannounced inspection and will include the areas described below.

1. Organization
   a. Management control
   b. RSC mtgs.

2. Program
   a. Walk through
   b. Progress of dirt building
   c. Status of Strategic Plan/DFI commitments

3. Daily, Weekly, Monthly Surveillances

4. Facilities and Equipment
   a. Postings (inside & outside building)
   b. Security upgrades
   c. Survey instruments
   d. Gamma spec. system (confirmatory measurement?)

5. Personnel Radiation Protection
   a. Personnel monitoring
   b. ALARA program and implementation
   c. Airborne potential
   d. Bioassay program

6. Receipt and Transfer (DOT)
   a. Procedures for opening packages
   b. Transfer
   c. Records

7. Independent Measurements

8. Allegation re: use of licensed materials

9. Exit Meeting

Reviewed By: _____ _____
John R. Madera, Chief Date
Materials Licensing Branch

Rough Estimate of Time Spent on AMS by RIII

FY 1995 (10/2/94-7/28/95)

Inspection:	2100 hrs (RITS data)
Licensing:	440 hrs (assume 6 hrs/wk, K. Null (35 wks) and J. Madera (39 wks))
J. Grobe:	720 hrs (assume 40 hrs/wk, 18 weeks)
TOTAL	3260 hrs

FY 1994

Inspection:	450 hrs (RITS data)
Licensing:	190 hrs (assume 4 hrs/wk, J. Madera (48 wks))
R. Caniano:	190 hrs (assume 4 hrs/wk, 48 wks)
TOTAL	830 hrs

Notes:

1) Number of hours are rounded to nearest 10.

2) The above does not include time spent by DRSS senior management.

Grit Samples
11/1-3/74

SAMPLING LOCATIONS AND FREQUENCIES

1) Easterly Grit Discharge Point
   1 location
   Once every 24 hrs

2) Easterly Sludge Pump
   Primary Only
   Primary + Secondary
   Once every 24 hrs

3) Any other intakes into Easterly
   3 separate points
   Once every 24 hrs

4) Southerly Intake Point for Easterly Sludge
   Once every 24 hrs

5) Southerly Grit Discharge Point
   2 to 4 different locations
   Once every 24 hrs

6) Southerly Vacuum Filter Area
   2 may be running at anyone time (depends on volume handled treated that time)
   Once every 24 hrs (if on-line during that day)

7) Southerly Gravity Belt
   Once every 24 hrs

8) Southerly Thermally Conditioned Sludge Thickeners
   Once every 24 hrs

9) Southerly Sludge Storage
   Once every 24 hrs

10) Southerly Thermal Conditioners
    Once every 24 hrs

D/11

FYI MK

Northeast Ohio Regional Sewer District

3826 Euclid Avenue • Cleveland, Ohio 44115-2504 216 • 881 • 6600 FAX: 216 • 881 • 9709

November 2, 1994

Director, Division of Freedom of
Information and Publications Services
Office of Administration
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: FOIA Request for Documents

Dear Director:

On February 17, 1993, representatives from the Northeast Ohio Regional Sewer District (District) reviewed all files available at the Region III office regarding Advanced Medical Systems, Inc., NRC License Number 34-19089-01 (AMS). This review was conducted as part of the District's investigation into the contamination of its Southerly wastewater treatment plant with Cobalt-60.

Pursuant to the Freedom of Information Act and 10 C.F.R. Sec. 9.15, the District requests that the NRC provide the District with copies of any and all records, documents or other information that has been entered in NRC files relating to AMS subsequent to February 17, 1993.

In addition, the District also requests that copies of any and all records, documents or other information that has been entered in NRC files regarding the District, without regard to date, be provided to the District.

The District is aware that this request will generate a very large volume of material. Therefore, as an alternative to an NRC search and production, the District is willing to again visit the Region III office and the Washington Headquarters office to review the requested files.

The District is a political subdivision and is making this request in conjunction with the investigation of contamination of its facilities with radioactive material and in conjunction with the prevention of future contamination. The District, therefore, has no commercial interest in the requested documents and requests a waiver of all fees pursuant to 10 C.F.R. Sec. 9.41.

D/12

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Please call me at (216) 881-6600 to discuss this request or to make arrangements for an onsite file review.

Sincerely,

Thomas E. Lenhart
Assistant General Counsel

TEL/td

cc: Sam Nulluswami, NRC, Headquarters
Gary Shear, NRC Region III
William B. Schatz
Sara J. Fagnilli
Lawrence K. English
Richard Connelly

Mr. William B. Schatz
General Counsel
Northeast Ohio Regional Sewer District
3826 Euclid Avenue
Cleveland, Ohio 44115-2504

November 2, 1994

Dear Mr. Schatz:

I am writing to acknowledge receipt of your letter of October 13, 1994, on behalf of the Northeast Ohio Regional Sewer District (NEORSD), to James Taylor, Executive Director for Operations of the U.S. Nuclear Regulatory Commission. The NRC considers your letter a supplement to your Petition dated March 3, 1993. The NEORSD requests, in addition to the enforcement action requested on September 13, 1994, that the NRC commence an enforcement action against Advanced Medical Systems, Inc. (AMS) for violation of 10 CFR 20.2003.

The NEORSD asserts as bases for the request that: 1) On January 1, 1994, 10 CFR 20.303 was superseded by 10 CFR 20.2003, which specifies that material may be discharged to the sanitary sewer only if it is soluble or readily dispersible biological material; 2) the cobalt-60 possessed by AMS is not soluble, and therefore cannot be legally discharged under 10 CFR 20.2003; 3) on July 5, 1994, NEORSD obtained a wastewater sample from the outfall from AMS where it discharges into the District's London Road sewer, containing 2.91×10^{-8} microcurie per milliliter of cobalt-60; 4) a sample obtained by the NRC at the same location on August 17, 1994, produced very similar results; and 5) five additional samples were obtained by the District between August 17 and October 4, 1994, and the cobalt-60 concentration ranged up to 86.6 picocuries per liter.

The NRC staff is reviewing the supplemental information in your October 13, 1994 letter and is continuing to review the information and issues related to your Petition dated March 3, 1993, submitted in accordance with 10 CFR 2.206. I will issue a final decision with regard to this supplemental information in conjunction with the Petition dated March 3, 1993, within a reasonable time.

Sincerely,

Robert M. Bernero, Director
Office of Nuclear Materials Safety
and Safeguards

cc: Advanced Medical
Systems, Inc.

Distribution
NRC File Center
CEstep
JAustin, DWM
PDR

EDO 8663
IMOB R/F
CPoland
RCaniano, RIII
LPDR

IMNS R/F
TJohnson, DWM
RIII Licensing Files for AMS

NMSS R/F

DOCUMENT NAME: G:\ACKN5TH.JED

OFC	IMOB	IMOB	IMOB	RIII	OGC	IMNS
NAME	JDeCicco/11	CJones	FCombs	WAxelson	JGoldberg	EWBrach
DATE	10/26/94	/94	/94	/94	10/28/94	/94

	IMNS	NMSS	NMSS			
NAME	CPaperiello	GArlotto	RBernero			
DATE	10/28/94	10/31/94	11/2/94			

OFFICIAL RECORD COPY

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D/13

November 7, 1994

MEMORANDUM TO: W. L. Axelson, Director
Division of Radiation Safety and Safeguards

FROM: Roy J. Caniano, Chief
Nuclear Materials Safety Branch

SUBJECT: FILE SEARCH TO DETERMINE POSSIBLE CONTRIBUTORS TO COBALT-60 CONTAMINATION AT THE NORTHEAST OHIO REGIONAL SEWER DISTRICT (NEORSD)

During an April 1991 aerial monitoring survey conducted over the Cleveland, Ohio area, radiation levels above natural background were identified at the NEORSD. Following the identification of the material as cobalt-60, NRC Region III, at that time, determined there were two licensees who could have contributed to the contamination. The licensees were Picker Corp. and Advanced Medical Systems, Inc. Both licensees operated cobalt-60 sealed source manufacturing facilities at 1020 London Road, Cleveland, Ohio.

In an attempt to determine any additional contributors of cobalt-60 contamination to the NEORSD, we requested that NEORSD provide us with a list of the zip codes that were in its service district. A file search and review was conducted of all available licenses located within these zip codes. This was initiated in August 1993 and continued through November 1993.

In addition, we contacted the Department of Energy (DOE) to determine if any of their activities in the Cleveland metropolitan area involved the use of unsealed cobalt-60. Mr. Edward Jascewsky, Chief, Health Protection Branch, Environment, Safety, and Health Division, DOE, stated that no contract activities with unsealed cobalt-60 have taken place in the Cleveland metropolitan area. The only DOE contract activity in the Cleveland metropolitan area was a uranium extrusion operation that was active in the middle 1960's. This DOE contract operation is no longer active.

In 1991, NRC contracted with Oak Ridge National Laboratories (ORNL) to evaluate all retired NRC license files to determine a potential for significant residual contamination in former licensed facilities. To date, ORNL has evaluated approximately 17,000 retired license files which included all retired files from the Cleveland, Ohio area. This evaluation determined that no former licensed facility has a potential for significant cobalt-60 contamination. However, Picker Corporation was a former licensee which operated a facility that posed a potential for significant cobalt-60 contamination which was transferred to Advanced Medical Systems, Inc. in 1979, when Picker terminated its license.

As a result of the review of the available information on terminated/retired as well as active licenses and the information provided by DOE, it appears that no facility, other than the licensed facility at 1020 London Road, Cleveland, Ohio was authorized for and disposed of the quantities of unsealed

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cobalt-60 material which could have significantly contributed to the source term at the NEORSD. As previously mentioned, Picker, Inc. and Advanced Medical Systems, Inc. conducted licensed activities at that facility.

The file search and review of documents also required telephone contact with certain licensees. This search included reviews of active as well as retired licenses which were retrieved from the NRC archives. This necessitated a trip by Pat Vacherlon to NMSS on August 19, 1993. The actual review of license documents was limited to the following for the reasons stated below:

1. Those licenses active from the time frame 1975 to the present since indications are that the contamination at the NEORSD occurred during the late 1970s. In April 1991 an aerial environmental radiation survey identified cobalt-60 in two distinct areas at the Southerly Wastewater Treatment Plant of the NEORSD; specifically, the north fill area and the current sanitary pond area. It was determined from the plants operational history, that this cobalt-60 contamination was deposited from the November 1978 to December 1982 time period when sludge was incinerated. From 1975 to November of 1978 the plant's incinerators were out of service for renovation and the sludge was trucked offsite to commercial land fills. Evidence shows that no location used by NEORSD exclusively before 1975, to dispose of ash, has significant levels of cobalt-60 contamination;

2. Those licenses issued pursuant to 10 CFR Part 30;

3. Those licenses that specifically authorized the possession of unsealed cobalt-60 since indications are that the source of contamination at the NEORSD was not the result of sealed sources. However, the ORNL file search previously described included licenses authorized for both unsealed and sealed cobalt-60.

4. Those licenses authorized for byproduct materials with atomic numbers 1-83 or 3-83 since the licensee may have possessed unsealed cobalt-60 under that authorization.

The following terminated licenses fitting the above criteria were identified as having authorization to possess cobalt-60:

Victoreen, Inc. had two licenses which were active during the time frame of 1975 to sometime between 1985 and 1987 when they were terminated. One authorized possession of radioisotopes with atomic numbers 3-83 in any chemical or physical form with a limit of 50 millicuries of cobalt-60. Liquid cobalt-60 was used for instrument calibrations. From the review of the file and discussions with Victoreen employees, it appears that liquid cobalt-60 possessed under this license was collected and re-used; indications are that none was disposed of via the sanitary sewer system. The other license authorized possession and use of cobalt-60 in liquid form for monitor calibrations

at nuclear power stations. Maximum activity used at any one time was approximately one millicurie. From the review of the file and discussions with Victoreen employees, it appears that liquid cobalt-60 was collected after each calibration and put into storage. This activity was then disposed of through a waste disposal company. Again, it appears that cobalt-60 was not disposed of via the sanitary sewer system.

Standard Oil was authorized to possess radioisotopes with atomic numbers 3-83 as irradiated engine parts from 1975 to approximately 1985. From the review of the file and discussions with a former licensee representative we were unable to determine if cobalt-60 was among the engine parts. The irradiated parts were inserted in engines to conduct engine wear studies. From discussions with the licensee, it appears that no material was released into the sanitary sewer system; any metal released during the engine wear studies was deposited in engine oil. The oil was collected and disposed of through a waste disposal firm.

Picker, Inc. had two licenses which authorized possession of cobalt-60 in unsealed form. One authorized cobalt-60 in unsealed metal form up to 150,000 curies for the manufacture of sealed sources. From a review of the file it was a common practice for Picker to dispose of millicurie amounts of unsealed cobalt-60 via the sanitary sewer from the 1950s to November 1979 under this license. Available licensee records indicate that Picker disposed of approximately 203 millicuries in 1965, 104 millicuries in 1973, and 62 millicuries in January 1974 through April 1, 1974, of unsealed cobalt-60 into the sanitary sewer. Picker did not have records of disposal for the time period of interest (late 1970s through 1979). In 1979 Picker sold its manufacturing operation authorized under this license to Advanced Medical Systems, Inc. The other license authorized radioisotopes with atomic numbers 3-83 in any chemical or physical form. According to the licensee, cobalt-60 in unsealed form was not used under this license.

The following active licenses fitting the previously listed criteria and that either had possessed or had the authorization to possess unsealed cobalt-60 were identified:

Advanced Medical Systems, Inc. (AMS) was authorized to possess up to 150,000 curies of cobalt-60 in unsealed metal form for the manufacture of sealed sources. According to records, AMS routinely disposed of millicurie amounts of unsealed cobalt-60 via the sanitary sewer system during the period 1980 to 1989. Licensee records indicate 209 millicuries of unsealed cobalt-60 was disposed of into the sanitary sewer system during that time. In June 1991, the license was amended to remove manufacturing operations. Currently, AMS is authorized to perform service operations on teletherapy units and health physics activities and it is not authorized to dispose of cobalt-60 via the sanitary sewer.

MetroHealth Medical Center is authorized to possess 1 millicurie of cobalt-60 in any form. From a review of the file and discussions with the licensee, it appears that they have not possessed this material. This license is pending renewal with the authorization for cobalt-60 to be removed.

Victoreen, Inc. currently has two licenses which authorizes possession of cobalt-60. One of the licenses is authorized for 100 millicuries of cobalt-60 in any form. From a review of this file and discussions with the licensee, indications are that no cobalt-60 in unsealed form was or is used under this license. The other license authorizes radioisotopes with atomic numbers 3-83 in any chemical or physical form not to exceed two millicuries each. Again, from a file review and discussions with the licensee, it appears that from September 2, 1987 to June 15, 1988, 71.9 microcuries of unsealed cobalt-60 was disposed of via the sanitary sewer system. From the end of June 1988 to the present, indications are that no unsealed cobalt-60 has been used under this license.

Cleveland Clinic Foundation is authorized to possess radioisotopes with atomic numbers 3-83 in any chemical or physical form for medical and research purposes. From a review of the file and discussions with the licensee, indications are that they do not use unsealed cobalt-60 and have not used it in the past.

BP America is authorized to possess radioisotopes with atomic numbers 3-83 in any chemical or physical form and they use microcurie amounts of cobalt-60 in liquid form for counting standards. The liquid cobalt-60 is collected on an exchange resin and shipped for waste disposal. This authorization was first granted on February 7, 1985. Prior to that date, the licensee only had authorization to possess cobalt-60 as sealed sources.

Picker, Inc. has one active license. Under this license Picker, Inc. took over Ohio Imaging's program in 1989. Prior to the takeover, Ohio Imaging did not have specific authorization to possess cobalt-60. Currently, under this active license, Picker, Inc. is authorized to possess radioisotopes with atomic numbers 3-83 in any chemical or physical form. According to the licensee, no unsealed cobalt-60 was or is used under this license.

cc: C. G. Jones, IMOB

DOCUMENT NAME: G:\PACKAGE.AMS

To receive a copy of this document, indicate in the box: "C" = Copy without attachment/enclosure "E" = Copy with attachment/enclosure "N" = No copy

OFFICE	RIII	RIII	RIII	RIII	RIII	~~RIII~~	~~RIII~~
NAME	Slawinski:dp	Madera	Benson	Caniano	Axelson	Lieberman	Bernero
	10/4/94	10/5/94	10/7/94	10/6/94	10/12/94	~~10/19/94~~	10/12/94

OGC Foundation for No Objection to Amendment Approval 10/20

November 7, 1994

Advanced Medical Systems, Inc.
ATTN: Seymour S. Stein, Ph.D.
President
121 N. Eagle Street
Geneva, OH 44041

Dear Dr. Stein:

This refers to the special safety inspection conducted by Messrs. Wayne Slawinski, Harold Walker and others of this office during the period August 4 through December 14, 1993, of activities authorized by NRC Byproduct Material License No. 34-19089-01.

The purpose of the inspection was to: (1) obtain information to better understand and evaluate the liquid radwaste effluent control and disposal past practices of both Picker X-Ray Corporation and Advanced Medical Systems, Inc. at the 1020 London Road facility; and (2) assemble information to assist the NRC staff in evaluating a 10 CFR 2.206 petition from the Northeast Ohio Regional Sewer District. The inspection was a continuation of the review performed on May 24-28, 1993, documented in Inspection Report No. 030-16055/93002(DRSS) and issued on August 2, 1993.

The enclosed copy of our inspection report identifies areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, independent measurements, and interviews with current and former Picker Corporation and Advanced Medical Systems employees involved in liquid radwaste processing and disposal at the 1020 London Road facility.

Based on the results of the inspection, certain of your previous activities appear to have been in violation of NRC requirements. In addition to the apparent violations, the inspection identified a concern associated with your past methods of processing and analyzing potentially contaminated wastewater, prior to its discharge to the sanitary sewer system.

We plan to meet with you in the near future to discuss these inspection findings. We will contact you at a later date to schedule this meeting. Following our meeting, a decision will be made on the appropriate enforcement action regarding the identified apparent violations. As such, no Notice of Violation is being issued at this time and no written response to this correspondence is required.

In addition, as discussed with Mr. Cesar during a telephone conference on October 14, 1994, we are evaluating the results of a special inspection conducted by Region III staff concerning the radiological conditions of the sewer interceptor located outside the AMS facility and the AMS manhole. The results of this special inspection will be forwarded to you in separate correspondence.

D/15

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosure will be placed in the NRC Public Document Room.

9411160080 2pp

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

ORIGINAL SIGNED BY W. L. AXELSON

W. L. Axelson, Director
Division of Radiation Safety
and Safeguards

License No. 34-19089-01
Docket No. 030-16055

Enclosure: Inspection Report
No. 030-16055/
93003(DRSS)

cc w/encl: Michael White, Mayor,
City of Cleveland
Roosevelt Coats, Councilman,
Ward 10, City of Cleveland
Michael Polensek, Councilman,
Ward 11, City of Cleveland
Michael Konicek, Dept. of
Public Utilities,
City of Cleveland
Lisa Mehringer, Dept. of Law,
City of Cleveland
Erwin Odeal, Northeast Ohio
Regional Sewer District
Robert Owen, Ohio Department
of Health
Erv Ball, Cuyahoga County
Board of Health
Timothy Gurin, Senior
Corporate Counsel,
Picker International

bcc w/encl: Timothy Johnson, LLW
PUBLIC - IE 07

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OFFICE	RIII	RIII	RIII	RIII	RIII	~~RIII~~	~~RIII~~
NAME	Slawinski:dp	Madera	Benson	Caniano	Axelson	Lieberman	Bernero
	10/4/94	10/5/94	10/7/94	10/11/94	10/ /94	10/19/94	10/21/94

11/4/94

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
801 WARRENVILLE ROAD
LISLE, ILLINOIS 60532-4351

November 7, 1994

Advanced Medical Systems, Inc.
ATTN: Seymour S. Stein, Ph.D.
President
121 N. Eagle Street
Geneva, OH 44041

Dear Dr. Stein:

This refers to the special safety inspection conducted by Messrs. Wayne Slawinski, Harold Walker and others of this office during the period August 4 through December 14, 1993, of activities authorized by NRC Byproduct Material License No. 34-19089-01.

The purpose of the inspection was to: (1) obtain information to better understand and evaluate the liquid radwaste effluent control and disposal past practices of both Picker X-Ray Corporation and Advanced Medical Systems, Inc. at the 1020 London Road facility; and (2) assemble information to assist the NRC staff in evaluating a 10 CFR 2.206 petition from the Northeast Ohio Regional Sewer District. The inspection was a continuation of the review performed on May 24-28, 1993, documented in Inspection Report No. 030-16055/93002(DRSS) and issued on August 2, 1993.

The enclosed copy of our inspection report identifies areas examined during the inspection. Within these areas, the inspection consisted of a selective examination of procedures and representative records, independent measurements, and interviews with current and former Picker Corporation and Advanced Medical Systems employees involved in liquid radwaste processing and disposal at the 1020 London Road facility.

Based on the results of the inspection, certain of your previous activities appear to have been in violation of NRC requirements. In addition to the apparent violations, the inspection identified a concern associated with your past methods of processing and analyzing potentially contaminated wastewater, prior to its discharge to the sanitary sewer system.

We plan to meet with you in the near future to discuss these inspection findings. We will contact you at a later date to schedule this meeting. Following our meeting, a decision will be made on the appropriate enforcement action regarding the identified apparent violations. As such, no Notice of Violation is being issued at this time and no written response to this correspondence is required.

In addition, as discussed with Mr. Cesar during a telephone conference on October 14, 1994, we are evaluating the results of a special inspection conducted by Region III staff concerning the radiological conditions of the sewer interceptor located outside the AMS facility and the AMS manhole. The results of this special inspection will be forwarded to you in separate correspondence.

In accordance with 10 CFR 2.790 of the Commission's regulations, a copy of this letter and the enclosure will be placed in the NRC Public Document Room.

We will gladly discuss any questions you have concerning this inspection.

Sincerely,

W. L. Axelson, Director
Division of Radiation Safety
and Safeguards

License No. 34-19089-01
Docket No. 030-16055

Enclosure: Inspection Report
No. 030-16055/
93003(DRSS)

cc w/encl: Michael White, Mayor,
City of Cleveland
Roosevelt Coats, Councilman,
Ward 10, City of Cleveland
Michael Polensek, Councilman,
Ward 11, City of Cleveland
Michael Konicek, Dept. of
Public Utilities,
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Erwin Odeal, Northeast Ohio
Regional Sewer District
Robert Owen, Ohio Department
of Health
Erv Ball, Cuyahoga County
Board of Health
Timothy Gurin, Senior
Corporate Counsel,
Picker International

U.S. NUCLEAR REGULATORY COMMISSION
REGION III

Report No. 030-16055/93003(DRSS)

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: August 4, 1993 through December 14, 1993

Inspector: Wayne Slawinski — Date: 10/4/94
Wayne Slawinski
Senior Radiation Specialist

Accompanying Personnel: Harold Walker, Senior Investigator, RIII, Office of Investigations

Kevin Null, Radiation Specialist

Donald Gibbons, Radiation Specialist

Reviewed By: John F. Madera — Date: 10/5/94
John Madera, Chief
Nuclear Materials Licensing Section

Approved By: Roy Caniano — Date: 10/11/94
Roy Caniano, Chief
Nuclear Materials Safety Branch

Inspection/Interview Summary:

Inspection and interviews during the period August 4, 1993 through December 14, 1993 (Report No. 030-16055/93003(DRSS))
Areas Reviewed: This special inspection principally consisted of pre-arranged interviews of available current and former Picker Corporation and Advanced Medical Systems, Inc. (AMS) employees involved in liquid radwaste (sanitary sewer) effluent discharges at the 1020 London Road, Cleveland, Ohio facility since the 1960s. The interviewees were questioned regarding the liquid radwaste management and control program implemented at the facility including:

(1) facility and equipment design and operation; (2) actual procedures or practices employed for liquid radwaste generation, collection, processing and disposal; (3) unplanned and/or unmonitored sanitary sewer effluent discharges; and (4) isolation of the room housing the liquid radwaste retention tanks. The inspection also included reviews of the active AMS and terminated Picker Corporation NRC/AEC license files maintained by the NRC, and procedures and available sanitary sewer effluent discharge records of each of these companies.

Results: Two apparent violations associated with liquid radwaste effluent (sanitary sewer) discharge procedures, and regulatory requirements were identified. The apparent violations consist of failures to: (1) filter liquid radioactive wastes pumped from the retention tanks to a batch discharge tank (AMS only - section 4(c)); (2) evaluate and record, in all instances, the quantity of liquid radwaste discharged into the sanitary sewer system (Picker Corporation and AMS - section 4(d)).

DETAILS

1. Persons Contacted

Robert Arndt, Radiation Safety Officer, Picker Corporation and Hot Cell Facility Manager, Picker Corporation/AMS
*William Bayes, Director, Remediation and Management Division, Alaron Corp.
*William Coughlin, Attorney, Calfee, Halter and Griswold
*W. K. Dagenhart, Ph.D., Engineering Applications Section, Oak Ridge National Laboratory
*Timothy Gurin, Senior Corporate Counsel, Picker International
Howard Irwin, Radiation Safety Officer, AMS
Robert Jucius, Radiation Safety Officer, AMS
Norman Kelbley, Hot Cell Facility Supervisor, Picker Corp. and Radiation Safety Officer, AMS
Tommy Kidd, Hot Cell Technician, Picker Corp./AMS
Mark Loeser, Radiation Safety Officer, AMS
Steven McDermott, Radiation Safety Officer, AMS
*Dwight Miller, Attorney, AMS
Clarence Pengov, Hot Cell Facility Quality Assurance Supervisor, Picker Corp.
Mark Rosumny, Hot Cell Technician, Picker Corp.
William Turbett, Isotope Handler, AMS

*Denotes current affiliation and title.

2. Purpose and Scope of Inspection

This was a limited scope special safety inspection of the liquid radwaste effluent management and control program implemented at the Picker Corporation and AMS facility located on 1020 London Road in Cleveland, Ohio, during the 1960s - 1980s. The inspection was a continuation of the review performed on May 24-28, 1993, documented in Inspection Report No. 030-16055/93002(DRSS) and issued on August 2, 1993.

As a result of the May 24-28, 1993 inspection, several aspects of the liquid effluent management and control program implemented at the London Road facility since the 1960s were unresolved or unknown. Although certain records and written procedures relating to liquid radwaste effluent discharges to the sanitary sewer system were reviewed during the May 1993 inspection, the actual practices and methods implemented by previous London Road facility employees were unknown.

The primary purpose of this inspection and related interviews of current and former facility workers was to obtain information to better understand and evaluate the past liquid radwaste effluent control and disposal practices of both Picker Corporation and AMS.

The interviews conducted during this inspection provided valuable insight into the liquid effluent management and control program implemented at the London Road facility during the 1960s - 1980s. The actual procedures and practices employed by both Picker Corp. and AMS employees involved in sanitary sewer discharges are described in Section 4. Issues previously considered unresolved in Inspection Report No. 03016055/93002(DRSS) are discussed in Section 5.

3. History and Overview

A. NRC License Authorization

In 1959, the Atomic Energy Commission (currently NRC) issued License No. 34-07225-09 to Picker X-Ray Corporation, for operation of an isotope manufacturing facility located at 1020 London Road, Cleveland, Ohio. The facility was specifically designed and constructed for Picker Corporation for its intended purpose. The facility included a hot cell (test cell) for processing large quantities of raw (unencapsulated) radioactive material (primarily cobalt-60) and various support facilities including a concrete shielded room housing two stainless steel tanks to collect and store liquid radwastes.

The Picker Corp. license authorized possession of 150,000 curies of cobalt-60 and 3000 curies of iridium-192 in solid metal form, and 40,000 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. AEC/NRC inspection reports indicate that iridium-192 and thulium-170 possession and use was limited and eventually phased out of the program. Picker Corp. also possessed other AEC/NRC licenses for installation and servicing of its teletherapy and radiography units and to conduct industrial radiography in a specially shielded room located within the London Road facility.

In 1979, the Picker Corp. London Road facility was purchased by AMS. License No. 34-07225-09 was terminated on November 9, 1979, at which time all licensed material possessed by Picker 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 Picker Corp. were assumed by AMS. Several of the Picker employees were also retained by AMS to continue hot cell facility operations and to maintain program continuity. From 1979 through mid-1991, the AMS license

authorized possession of 150,000 curies of cobalt-60 in solid metal form incident to the manufacture of NRC approved sealed sources, for distribution to authorized recipients. Kilocurie quantities of cobalt-60 and cesium-137 sealed sources were also authorized, incident to teletherapy and radiography unit installation, dismantling and servicing.

As of April 18, 1994, License No. 34-19089-01 authorizes AMS to possess up to 150,000 curies of cobalt-60 in solid metal form for storage only, incident to waste disposal or transfer to an authorized recipient. Due to the unavailability of trained and approved AMS personnel, the AMS license has not authorized the manufacture of sealed sources for distribution since May 1991. The current AMS license continues to authorize possession of kilocurie quantities of cobalt-60 and cesium-137 sealed sources, incident to teletherapy and industrial radiography unit installation, dismantling and servicing.

B. Sanitary Sewer Disposal Authorization

10 CFR 20.303 "Disposal By Release Into Sanitary Sewerage Systems," in effect from 1960 - 1993, authorized AEC/NRC licensees to discharge licensed material into the sewer system provided:

(a) It was readily soluble or dispersible in water;

and

(b) For cobalt-60, the quantity released into the sewer system in any one day and any one month did not exceed a concentration of 1 E-3 microcuries/ml, if diluted by the average daily and monthly (as appropriate) quantity of sewerage released by the licensee into the sewer;

and

(c) The gross quantity of cobalt-60 released into the sewerage system did not exceed one curie per year.

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 radwaste than previously existed.

The revised 10 CFR Part 20 specifies in 20.2003 "Disposal By Release Into Sanitary Sewerage," that licensees may discharge licensed material into the sanitary sewer system only if the material is readily soluble, or is readily dispersible biological material, in water. Additionally, the monthly permissible sanitary sewer discharge concentration limit for cobalt-60 was reduced from 1 E-3 to 3 E-5 microcuries/ml. The one curie annual gross quantity limit for cobalt-60 was not changed.

C. Liquid Radwaste Generation

As a consequence of the form of the cobalt-60 used in source manufacturing operations and facility, as well as equipment and personnel decontamination practices of both Picker and AMS, liquids contaminated with cobalt-60 were routinely generated throughout the 1960s, 1970s and most of the 1980s.

The cobalt-60 used at the facility is a solid metallic oxide pellet about one millimeter in length and one millimeter in diameter, and weighing about 5 milligrams. The pellets are purchased by the licensee as non-radioactive cobalt-59 and are irradiated with neutrons at a Department of Energy (e.g. Oak Ridge National Laboratory) or other authorized nuclear reactor, converting the pellets to radioactive cobalt-60. The specific activity of a newly irradiated pellet is about 200 curies/gram; therefore, a single pellet can have an activity of about one curie.

During cobalt-60 teletherapy source manufacturing, several thousand pellets are combined in a source capsule remotely within the facility's hot cell. A typical medical teletherapy unit's sealed source contains 5000-7500 curies of cobalt-60. The cobalt-60 pellets readily oxidize when exposed in air. According to Oak Ridge National Laboratory, the oxidation of the metal pellet produces a fluffy powdery particulate that is insoluble in water. The oxidation products consist of CoO, a greenish-brown colored particulate, and Co_2O_3 and Co_3O_4, both black in color. These oxides significantly contaminate the interior surfaces of the hot cell, equipment within it, and can migrate to other areas of the facility. The specific gravity of the oxidation product is five to six times that of water; consequently, the contaminant will not readily suspend in water.

Until the late 1980s, the hot cell and other facility areas contaminated with these cobalt-60 oxides were decontaminated (cleaned) by hosing down or mopping the area with water and collecting the water in holdup/retention tanks located in the basement of the facility. The holdup tanks would occasionally overflow, spilling contaminated water onto the floor of the room housing the tanks. In addition to the oxidation problem, during source manufacturing operations, cobalt-60 pellets would disperse and scatter within the hot cell and not all of them could be retrieved using the cell's remote manipulators. The pellets would, on occasion, be allowed to remain loose in the hot cell until collected during a more rigorous cell cleanup.

The quantity and volume of liquid radwaste produced depended on the scope and magnitude of the operations conducted during a given time period. Typically, the largest quantity of cobalt-60 liquid radwaste was generated as a result of facility decontamination activities, conducted after peak source manufacturing campaigns, or at various times to allow personnel entry into the hot cell for equipment maintenance.

As detailed in Section 4, liquid radwaste was discharged to the sanitary sewer system at irregular intervals, the frequency being dependent on the volume of waste produced during facility operations. The London Road facility was equipped with two liquid radwaste holdup/retention tanks with a cumulative total capacity of 600 gallons. In the 1960s and early 1970s, liquid radwaste was pumped directly from the holdup tanks to the sewer system when warranted by tank capacity limitations. Beginning in about 1974, 55-gallon aliquots of liquid radwaste were batch released into the sanitary sewer system rather than pumped directly from the holdup tanks to the sewer.

The cobalt-60 used at the London Road facility by both Picker Corp. and AMS was in a metallic form and was not water soluble. The cobalt, however, was considered dispersible in water. As previously stated, from 1960 - 1993, 10 CFR Part 20 authorized disposal of licensed material into the sanitary sewer system provided it was readily soluble or dispersible in water, and other specific criteria were met. As a result of the changes in the dispersibility requirements in the revised 10 CFR Part 20, beginning January 1, 1994, the cobalt-60 used at the London Road facility could no longer be discharged into the sanitary sewer system, unless the material was chemically altered to render it soluble in water. AMS, however, has no plans to attempt such alterations.

As stated in Inspection Report No. 030-16055/93002(DRSS), based on licensee statements and discharge log records, AMS has not discharged licensed material into the sanitary sewer system between May 1989 and the dates of this inspection. Furthermore, the licensee has not knowingly generated liquid radwaste in several years and, due to changes in its decontamination methods and termination of source manufacturing operations, does not plan to produce liquid radwaste in the future.

4. Specific Findings

Nine individuals who were involved in liquid radwaste generation, processing and disposal at the 1020 London Road facility, Cleveland, Ohio were interviewed during the course of this inspection. Three interviewees were employed by both Picker Corp. and AMS, two were Picker employees only and the remaining four were AMS employees only. Although two of those interviewed continue to be employed by Picker International, none interviewed regarding previous practices at the facility were current AMS employees. The interviewees included each of the radiation safety officers for the London Road hot cell facility for both Picker and AMS from 1964 - 1990, most of the hot cell facility supervisors and managers, and several laboratory technicians. One interviewee worked at the facility and was involved in liquid radwaste processing from 1960 - 1980. Each interviewee was questioned regarding his specific knowledge and involvement in the liquid radwaste program, actual practices/procedures employed, and facility and equipment design and usage.

The information obtained during these interviews and NRC's evaluation of the liquid radwaste management and control program implemented at the London Road facility are summarized in the sections below.

A. Overview of Facility/Equipment Use and Liquid Waste Collection/Disposal Practices

According to those interviewed, the London Road facility was equipped with two stainless steel holdup tanks located in a poured concrete room in the basement of the facility, designed to collect liquid radwaste resulting from various decontamination activities. These two holdup tanks were the sole means for liquid radwaste collection and storage from the 1960s through early 1986. The holdup tanks continue to remain positioned in the facility as originally installed in about 1959.

In 1986, AMS installed a 200-gallon plastic tank in a basement room adjacent to where the stainless steel holdup tanks were located, because the licensee planned to discontinue use of the stainless steel tanks. Both the plastic tank and one of the two stainless steel tanks were used to collect and store liquid radwaste generated in 1986, 1987 and part of 1988.

In 1988, use of both the stainless steel holdup tanks was discontinued, when the room housing them was isolated and its decontamination was postponed. The room's isolation was in response to an NRC Order issued to AMS in 1987, to decontaminate the entire facility due to the unacceptable radiological hazards present. The holdup tank room's isolation was authorized by the NRC on an interim basis in lieu of its cleanup, because of the significant radiological hazard its cleanup would pose to decontamination workers. Since room isolation, liquid radwaste generated as a result of facility operations was collected in the 200-gallon plastic tank.

According to the interviewees, two different systems were used at the facility to monitor/analyze liquid radwaste prior to sanitary sewer discharge. From 1960 until about 1974, liquid radwaste concentrations were measured by an in-line monitoring system which monitored the discharge line as liquids were pumped from the stainless steel holdup tanks and directly into the sanitary sewer system via a floor drain. In about 1974, the in-line monitor was replaced by a batching system, which continued to be used throughout the 1980s.

From 1974 through about April 1986, liquid radwaste was pumped from the stainless steel holdup tanks to a 55-gallon batch tank (steel drum) located in a basement room adjacent to the holdup tanks. The batch tank's contents were released to the sewer system after mixing, sampling and analysis. In April 1986, the 55-gallon batch tank was replaced by the aforementioned plastic

tank, which served as both a waste collection/storage tank and batch release tank. Like the 55-gallon batch tank, the 200-gallon plastic tank's contents were mixed, sampled and analyzed prior to release to the sewer system.

Figure I is a plan view of the facility basement showing the stainless steel holdup tanks, 55-gallon batch tank, 200-gallon plastic tank and other relevant features.

B. Details of Facility and Equipment Design/Use

From initiation of facility operations in about 1960 through about April 1986, liquid radwaste generated at the London Road facility was collected in two stainless steel holdup (settling) tanks located in the waste holdup tank (WHUT) room in the basement of the facility directly beneath the hot cell. A 500-gallon stainless steel tank received wastewater from the personnel decontamination showers and sinks in the isotope shop locker room change area, an isotope shop sink and a washing machine used to launder protective clothing. A 100-gallon stainless steel tank received wastewater from the hot cell sink, the decontamination room sink and floor drain and the isotope shop floor trench. Figure II depicts the wastewater inputs into the WHUTs. The WHUT room itself has no floor drains and is curbed to contain a capacity of approximately 2400 gallons of liquid. The curb was installed to prevent liquids from escaping the WHUT room should the holdup tanks overflow or leak.

The interviews disclosed that in 1986, drain lines from the locker room change area sinks, showers and washing machine, and isotope shop sink were diverted to a 200-gallon plastic tank (a.k.a. blue tank) located outside the WHUT room in the front basement, rather than the 500-gallon WHUT. The 100-gallon WHUT continued to receive liquid radwaste from the sources described above until mid-late 1988, when the WHUT room was isolated and its decontamination postponed. The licensee installed the blue tank and initiated its use in 1986 because it anticipated phasing out the use of the WHUT room due to the radiological hazards present in the room, prohibiting safe personnel entry. The plastic blue tank was and continues to be located outside the WHUT room in the front portion of the facility's basement. The blue tank currently contains no liquids.

Both Picker Corp. and AMS radiation safety procedure manuals state that "all drains to the holding tanks have screen filters in them to prevent solids of one millimeter or larger from passing into the tanks." However, no consensus regarding the use of screen filters was obtained from those interviewed. Specifically, two interviewees confirmed the existence of screen filters in the drains of the hot cell and decontamination room while two others denied them. Of these four interviewees, three were employed by both Picker Corporation and AMS and one by AMS only. The

remaining five interviewees did not know about or could not recall if floor drains or drain lines discharging to the WHUTs were equipped with screen traps or filters. One interviewee employed at the facility from 1960 - 1980 reported that he personally designed and installed stainless steel, one millimeter, screen mesh filters in the hot cell and decontamination room floor drains in about 1964, after it was realized that cobalt-60 pellets could be discharged through the hot cell drain into the 100-gallon WHUT. Another interviewee further recalled that cobalt-60 pellets would occasionally be found in the hot cell drain's screen mesh trap during cell cleanup.

During the WHUT room isolation and entombment project in 1988, all wastewater input lines into the WHUTs not previously diverted into the 200-gallon plastic tank were disconnected and removed except possibly the hot cell drain line which may continue to discharge to the 100-gallon WHUT. As reported in Inspection Report No. 030-16055/93002(DRSS), the AMS radiation safety officer entered the hot cell in 1993 and indicated that the cell drain appeared to be unplugged and should the hot cell sink be used, the water would likely drain into the WHUT room. Also, no screen filter was reported to exist in the hot cell drain at that time. The hot cell drain information could not be confirmed during this inspection, due to the radiological conditions in the hot cell and WHUT room, which prohibited inspector entry. If screen traps or filters did previously exist in those drains which discharged to the WHUTs, they may have been removed in 1988 during the WHUT room isolation project.

Prior to WHUT room isolation in 1988, radiation levels in excess of 1000 R/hr were measured near the surface of one of the WHUTs. Such radiation levels suggest that the WHUTs likely contain relatively high activity cobalt-60 sediment. Although the source and physical characteristics of the sediment are unknown, the sediment is likely a build up of cobalt-60 particulates resulting from the pellet oxidation problem previously described. As further supporting evidence of the sediment theory, one interviewee recalled two or three occasions between the late 1960s and late 1970s, when sediment contained in the 100-gallon WHUT was partially pumped out of the tank with a hose line and into a shielded container. The container was subsequently transferred to an authorized waste broker for disposal as solid radwaste. However, it is unknown if whole pellets reside in the WHUTs.

An approximately one-half to one-inch diameter hose inserted in each WHUT was used to transfer (pump) wastewater from the holding tanks directly into the sanitary sewer system or into a batch. The depth of hose insertion into the WHUTs is unknown; however, interviewees recalled that wastewater was transferred (pumped) from the "top" of the tanks to prevent discharging of potentially high activity cobalt-60 sediment into the sewer system.

Throughout the 1960s and early 1970s, wastewater pumped from the WHUTs via the hose line reportedly flowed directly to a floor drain in the back basement of the London Road facility. The floor drain discharged into the municipal sanitary sewer system. Two of the interviewees recalled that a specially designed and manufactured Geiger-Mueller (G-M) probe monitored the hose line. The interviewees, however, could not recall any details concerning the G-M monitoring system's capabilities, where it was located, or how it monitored the hose line. One interviewee recalled that the monitoring system included alarm and discharge pump shut-off capabilities, terminating sewer discharges when measured radiation levels in the hose line exceeded a preset value. According to the two interviewees, the in-line monitoring system was discontinued in about 1974, because the G-M probe was no longer manufactured and the existing probe was in need of replacement. A batch collection and wastewater sampling/analysis system replaced the in-line G-M flow monitoring system, as described below.

In the batch system, wastewater was pumped from the WHUTs and/or the WHUT room floor if the tanks overflowed, into a 55-gallon steel batch tank (drum) located outside the WHUT room in the back basement. The batch tank was equipped with an electrically driven trolling motor and impeller to mix its contents and a spigot near the bottom of the tank to collect wastewater samples. The batch tank was positioned atop a standpipe which protruded from the floor of the basement. The standpipe was connected to the floor drainpipe, which ultimately discharged to the sanitary sewer system. The batch tank contained a plug at its bottom which could be removed to allow the tank's contents to be released to the sewer system. The batch tank is depicted in Figure-III.

As described further below, the contents of the batch tank were mixed and a small sample was drawn and analyzed for compliance with regulatory limits, prior to discharge of the tank's contents to the sewer system. The 55-gallon batch tank system was used for sewer discharges until April 16, 1986, at which time its use was discontinued and replaced by the aforementioned 200-gallon plastic tank (blue tank). The blue tank served as both a liquid radwaste holdup tank and a batch release tank. Although Inspection Report No. 03016055/93002(DRSS) reports that the discharge lines from the locker room change area showers, sinks, washing machine and isotope shop sink were re-routed to discharge into the blue tank rather than one of the WHUTs in about 1988, interviewees recalled this being done in 1986. Interviewees also recalled that the 55-gallon batch tank was still positioned in the back basement in early 1988; however, it was not used for batch releases to the sanitary sewer system after mid-April 1986. The 55-gallon batch tank was physically removed from its radwaste processing position during the WHUT room isolation project in 1988. Results of recent radiation surveys of a 55-gallon batch tank which is stored at the AMS facility is provided in Section 6. Interviewees indicated that although the drain lines from the hot cell, the

decontamination room and isotope shop floor trench continued to discharge into the 100-gallon WHUT room tank until room isolation in 1988, significant quantities of wastewater were not discharged to the WHUTs after early 1986.

Liquid radwaste from the WHUT room tanks or floor was, according to the interviewees, not pumped into the blue tank. Consequently, the liquid radwaste deposited into the blue tank and subsequently released to the sanitary sewer system beginning in April 1986, was relatively low cobalt-60 content wastewater resulting from use of the locker room decontamination showers, sinks and washing machine. Potentially higher activity cobalt-60 wastewater housed in the WHUTs was reportedly not released to the sewer system since early 1986, and continues to be stored in these tanks.

C. Details of Liquid Radwaste Processing and Disposal Procedures/ Practices

(1) Waste Collection and Transfer

As described in the subsection above, in the 1960s until about 1974, liquid radwaste was pumped from the WHUTs directly into the sanitary sewer system via the back basement floor drain. The discharge hose which transferred the liquids from the WHUTs was continuously monitored by an in-line water monitoring system. The interviewees could not recall how the radiation levels monitored by the in-line monitor were equated to a liquid effluent concentration, how the monitoring system was calibrated, or other features of the system.

According to information in the Picker Corporation license file maintained in the NRC archives, the in-line monitoring system consisted of a Tracerlab Model MW-4 "Low-Level Liquid Sampler" which included 30 mg/cm^2 large volume Geiger-Mueller (G-M) tube, ratemeter and strip chart recorder. A waste filtration and ion exchange system preceded the water monitor system. The Picker license file also indicates that all liquids discharged from the stainless steel tanks sequence through a solenoid valve, the water monitoring system and a water meter. The normally closed water solenoid valve opens only when the monitoring system detects less than a pre-determined count rate. Since the water system is not operated continuously, a record of a disposal run was made by recording the watermeter reading on the strip chart of the recorder at the start and finish of the run. The chart record would then indicate the total volume of waste discharged and the counts per minute from the monitor. This information was then used to calculate average specific activity of the discharged waste and total activity discharged.

Although documentation from seven AEC inspections conducted at Picker Corporation in the 1960s are maintained in the terminated Picker license file maintained by the NRC and were reviewed during this inspection, none describe the liquid radwaste control mechanisms or monitoring system used at the time, or provide sanitary sewer effluent release data for other than 1965, as described further in Section 4(e).

In about 1974, Picker Corporation modified portions of the facility's liquid radwaste disposal system, switching to a batch system as discussed previously above. In a letter from Picker to the AEC dated January 25, 1974, the licensee submitted a manual entitled "Radiation Safety Procedures for the Picker Corporation, Isotope Operations." The 1974 manual was to supersede the manual, "Radiation Safety Procedures for the Picker X-Ray Corporation, Waite Manufacturing Division, Inc.," dated December 1959. The January 1974 manual was later revised by Picker in September 1976. However, neither the January 1974 manual, the January 25, 1974 letter or the revised September 1976 manual were incorporated by reference into Picker's AEC license (No. 34-07225-09). The Picker AEC/NRC license continued to reference the superseded Waite Manufacturing Division procedures through license termination in November 1979.

Section VII of both the January 1974 and September 1976 versions of the Picker radiation safety procedures manual required that liquid waste be "pumped off the top of the holding tanks, passed through a cloth filter to remove any non-suspendible solids, and temporarily stored in a 55-gallon batch tank." Notwithstanding these procedures, of the five Picker Corp. interviewees involved in batch tank discharges to the sewer system from 1974-1979, four stated that wastewater pumped from the holding tanks was not filtered to remove non-suspendible solids. One interviewee could not recall if filters were used or not. The interviewees stated they were unaware that the procedure required filtering. Failure to filter waste water pumped from the WHUT room tanks into the 55-gallon batch tank appears contrary to the aforementioned procedures. However, as noted above, compliance with these procedures were not required by Picker's NRC license.

Condition 16 and 19 of AMS License No. 34-19089-01, original license dated November 2, 1979 through Amendment No. 9 dated September 5, 1986, requires that the licensee possess and use licensed material in accordance with the statements, representations, and procedures contained in an application received July 16, 1979 and various letters including a letter dated October 19, 1979. In addition, License Condition 16, 18 and 19, beginning with Amendment No. 2

dated November 25, 1983 to the present, reference either the "Radiation Safety Procedures Manual ISP-1" dated July 1983 or the "Revised ISP-1 Manual, Appendices A and B," respectively. The letter dated October 19, 1979, Radiation Safety Procedures Manual ISP-1 and Revised Manual ISP-1, all include the procedures for liquid waste storage and disposal. These procedures all state that "waste is pumped off the top of the holding tanks, passed through a cloth filter to remove any non-suspendible solids and temporarily stored in a 55 gallon batch tank."

Contrary to the AMS procedure requirements described above, waste pumped from the holding tanks was not filtered to remove non-suspendible solids, according to four of the five interviewees involved in 55-gallon batch tank discharges to the sewer system from November 1979 through April 16, 1986. These interviewees stated they were unaware of the filtering requirement. Failure to filter wastewater pumped from the WHUTs to the batch tank is an apparent violation of AMS procedures referenced in License Conditions 16, 18 and 19.

One interviewee involved in AMS batch tank releases in 1985 and 1986 stated that wastewater pumped from the WHUTs was occasionally filtered using nylon stockings.

Failure to filter liquid radwaste pumped from the WHUTs could have allowed cobalt-60 particulate and sediment likely contained in the holdup tanks to be transferred to the batch tank and possibly released to the sewer system. Since the cobalt-60 used at the London Road facility was not water soluble, holdup tank sediment contained much greater concentrations of cobalt-60 than its filtrate. The quantity of sediment transferred to the batch tank would have depended on the amount of sediment buildup in the holding tanks and the depth at which the hose lines were inserted into the two tanks. It is unknown how or if hose insertion into the WHUTs was controlled. Furthermore, had the hot cell drain not been equipped with a screen mesh or similar particulate trap, which could not be definitively determined, it is possible that whole cobalt-60 pellets could have been discharged into the 100-gallon WHUT and subsequently transferred to the batch tank or possibly directly into the sewer system prior to implementation of the batching system in 1974.

(2) Batch Tank Mixing, Sampling and Analysis

Interviewees indicated that the contents of the 55-gallon batch tank were mixed (agitated) for about five minutes using the electric motor/impeller system previously described and depicted in Figure-III. After mixing, a 5-50 ml sample was withdrawn from the batch tank using the

tank's sample spigot and analyzed for cobalt-60 content using a well counter system. The well counter system's efficiency was determined using a cobalt-60 liquid standard of known concentration. If the batch tank's radioactive content divided by the average daily water usage for the facility was within regulatory daily concentration limits, and if annual gross quantity discharge limits would not be exceeded, the batch tank's contents would be discharged to the sanitary sewer system. All interviewees agreed that the contents of each batch tank was mixed, sampled and analyzed prior to sewer release. Although facility water dilution used in the discharge calculation was reportedly based on actual water bill data, interviewees could not recall if the dilution information was updated annually, quarterly, or based on facility historical data accumulated over more than one year. Water dilution considerations are discussed further in Section 5.

The 200-gallon blue tank was also equipped with an electric driven motor/impeller system to mix its contents, similar to the 55-gallon batch tank. Samples, however, were withdrawn from the blue tank using a 2-3 foot long water column sampling probe, which was submerged into the tank to extract an approximate 50-100 ml sample. Although liquids from the blue tank were also not filtered prior to discharge to the sewer system, the blue tank, unlike the 55-gallon batch tank, only received liquid radwaste from the change area decontamination showers, sinks and washing machine and not potentially higher activity radioactive wastes from hot cell/decontamination room related operations.

(3) Uncertainties and Related Concerns

As previously described, cobalt-60 pellets would readily oxidize and release microscopic or dust-like particulates, contaminating interior hot cell surfaces and migrate to other areas. Also, whole pellets would occasionally disperse into the cell during source manufacturing activities. In many instances, some of these dispersed pellets could not be retrieved magnetically using the cell's remote manipulators and were scattered around the cell. If the hot cell drain was not equipped with a screen to trap the pellets, they may have been deposited in the 100-gallon WHUT. Radiation levels in excess of 1000 R/hour measured in the WHUT room in 1988 indicate that pellet oxides and possibly whole pellets were discharged into the tank.

The interviews disclosed that the liquid radwaste pumped from the WHUTs to the batch tank was not filtered as required; consequently, it is possible that sediment and/or discrete particles of relatively high cobalt-60 content could have been released to the sanitary sewer system and

not captured and analyzed in the sample withdrawn from the batch tank. This could have occurred beginning in 1974 and continued until 55-gallon batch tank releases ceased in April 1986. Since only 5-50 ml of each 55-gallon batch tank was sampled prior to discharge and the cobalt-60 was not water soluble, the relatively small sample may not have been representative of the batch tank's contents. On the other hand, if the batch tank's contents were mixed and allowed to settle prior to sampling and the sample was withdrawn using the spigot at the bottom of the batch tank, the sample may have contained sediment or discrete particles of relatively high cobalt-60 content. Similarly, since little information could be obtained regarding the in-line (G-M probe) liquid radwaste monitoring system used by Picker Corporation prior to 1974, the adequacy of this system to detect relatively high activity sediment or discrete cobalt-60 particulates is also unknown. Therefore, the possible release of high activity particulates also cannot be discounted prior to 1974.

In summary, due to: (1) the unknowns associated with the existence of hot cell/decontamination room floor drain screens; (2) the apparent failure to filter wastewater pumped from the holding tanks; (3) the cobalt-60 insolubility; (4) the unknown adequacy of the in-line G-M probe monitoring system used prior to 1974; and (5) the relatively small size of the sample withdrawn from the batch tank, the precise quantity of cobalt-60 discharged into the sanitary sewer system is uncertain.

D. Unmonitored Releases

The interviewees were questioned regarding liquid radwaste discharges to the sanitary sewer system that may have been unmonitored, either intentionally or accidentally, were not monitored properly, or were monitored and not recorded in the discharge log. The interviewees were also questioned regarding the accuracy of the information documented in discharge logs and records.

(1) Details

According to the interviewees, all discharges to the sanitary sewer system from either the 55-gallon batch tank or the 200-gallon blue tank were mixed, sampled and analyzed for cobalt-60 content prior to release. An accurate log entry was made to account for each of these releases. However, of the nine interviewees, four recalled that on one or more occasions, unmonitored releases of liquid radwaste occurred from other than the batch or blue tanks. A summary of these events is provided below.

Interviewee No. 1: A sewer backup occurred during off hours on one occasion in the late 1960s, flooding the front and back basement areas of the facility. The floodwater presumably entered through the basement floor drains and drained back into the sewer system before employees reported to work the following morning. The front basement was clean (not radioactively contaminated) prior to the flood but found to be contaminated afterward. Floodwater apparently became contaminated with cobalt-60 as the water back flowed through the sewer discharge pipe beneath the floor of the facility and into the back basement, washing contamination off the interior surfaces of the pipe and also the back basement floor and walls.

The interviewee could not recall if an evaluation of the radioactivity released to the sanitary sewer system and a discharge log entry were made to account for this event. The individual indicated, however, that the incident was discussed with an AEC inspector and documented in an AEC inspection report later that year. However, a review of the available Picker Corp. AEC inspection reports from the 1960s and early 1970s did not reveal any information about the event. According to the interviewee, the basement floor drains were plugged shortly after the flood, in order to prevent similar incidents from recurring.

Interviewee No. 2: On two or three occasions in the mid to late 1980s, sewer backups flooded the basement and floodwater drained back into the sewer system. No evaluation was conducted to estimate the amount of radioactivity in the discharged flood waters. The interviewee indicated that plugs were not inserted into the basement floor drains to prevent sewer water backup until about 1988 or 1989.

Interviewee No. 3: During a major facility decontamination project in 1988, conducted pursuant to NRC's 1987 Decontamination Order, elevated radiation levels were discovered in the sewer manhole area just outside the building on AMS property. The elevated levels apparently resulted from cobalt-60 contamination which had accumulated in the sewer discharge piping from years of liquid radwaste discharges. Shortly after discovery of this problem in about January or February 1988, the manhole and sewer discharge piping leading to the municipal sewer system was flushed with clean water in an effort to decontaminate them. The interviewee indicated that the flush water was probably not collected and analyzed for its radioactive content.

Interviewee No. 4: This interviewee indicated that there were "several" occasions throughout the 1970s and early 1980s, when sewer backups flooded the basement and

floodwaters were allowed to drain back into the municipal sewer system. No evaluation was conducted to determine the amount of radioactivity in the discharged floodwater. Additionally, the interviewee recalled a few occasions in the 1970s when equipment removed from the hot cell was decontaminated (hosed off) in the isotope shop, not the decontamination room as normally done, and the resultant contaminated wash water was not collected or diverted into the isotope shop floor trench which drains to a WHUT. Rather, the wash water was allowed to flow down into the back basement, through the basement floor drain and into the sewer system. According to the interviewee, employees made no real effort to divert the contaminated wash water to the floor trench or to collect and analyze it, because its radioactive content was presumed to be low and of little consequence.

(2) Conclusion - Unmonitored Releases

Based on interviewee statements, it appears that several unmonitored releases to the sanitary sewer system occurred during the 1960s, 1970s and 1980s. Although the precise volume and radioactivity content of these apparent unmonitored releases is unknown, it is unlikely that the cumulative total quantity of cobalt-60 released to the sewer system from these events exceeded a few hundred millicuries. This conclusion is based on: (1) the relatively low contamination levels which typically existed on the floor and walls in the back basement (less than 50,000 dpm/100cm^2); (2) the quantity of cobalt-60 known to have been discharged after a basement flood in 1989 (see Section 5); and (3) the equipment decontamination activities that took place in the isotope shop likely only involved relatively low levels of contamination. However, given the unknown magnitude of the facility floods, the contamination levels that existed at the facility at any given time and the extent of decontamination activities, uncertainty also exists in the quantity of cobalt-60 discharged to the sewer system during these unmonitored releases.

10 CFR 20.201(b) requires that each licensee make such surveys as may be necessary to comply with the requirements of Part 20 and which are reasonable under the circumstances to evaluate the extent of radiation hazards that may be present. As defined in 10 CFR 20.201(a), "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions.

Based on statements from the interviewees, it appears that on one or more occasions, both Picker Corp. in the 1960s and

1970s and AMS in the 1980s, did not make surveys to assure compliance with 10 CFR 20.303, which limits the disposal of licensed material by release to a sanitary sewerage system. Specifically, both licensees failed to evaluate the concentrations and total gross quantities of cobalt-60 released to the sewer system resulting from facility floods and certain decontamination activities. The failure to evaluate, in all instances, the quantity of licensed material released to the sewer system is an apparent violation of 10 CFR 20.201(b).

However, the interviewees could not recall the details regarding the apparent unmonitored discharges into the sanitary sewer system. For example, dates, approximate water volumes, radioactivity content and other details or circumstances are unknown. Similarly, extensive NRC review of the AMS and Picker license files and analysis of the information provided by the interviewees disclosed no specific information. Details and circumstances regarding these unmonitored release events cannot be ascertained from any of the available documentation.

E. Sanitary Sewer Discharge Logs/Records

Records of liquid radwaste discharges to the sewer system are maintained by AMS from 1980 to the present. These records were reviewed during the May 1993 inspection, as reported in Inspection Report No. 030-16055/93002(DRSS), and were reviewed with those interviewees employed by AMS. Records show that a total of 122 discharges containing a total of 209 millicuries of cobalt-60 was released into the sewer system between May 15, 1980 and May 26, 1989. AMS reportedly did not discharge radioactive material to the sewer system from the date of licensee issuance on November 2, 1979 through May 14, 1980, or after May 26, 1989. Of those 122 monitored and recorded AMS releases, 85 were via the 55 gallon batch tank, 36 were from the blue tank and one resulted from a flood in 1989. AMS records show that the maximum activity released on a given day was 10.46 millicuries in 1984. The maximum reported to have been released in a year occurred in 1983, when a cumulative quantity of 59.1 millicuries was discharged.

Blue tank releases, which were initiated in April 1986, have accounted for only 5.53 millicuries of the total reported 209 millicuries released from the AMS facility. This relatively small quantity of cobalt-60 discharged from the blue tank is not unusual since the sources of liquid radwaste into this tank were reportedly only from the locker room change area decontamination sinks, showers and washing machine. These sources should not contain significant quantities of cobalt-60 as would be expected from hot cell and decontaminations room sources.

Records of sanitary sewer radwaste discharges from the London Road facility made by Picker Corp. from the date of license issuance in 1959 to its termination in November 1979, are not maintained by Picker (currently Picker International, Inc., Cleveland, Ohio). Interviewees employed by Picker claim that all sanitary sewer radwaste disposal information was maintained in log books, which were left at the London Road facility upon its sale to AMS in 1979. In a letter dated January 13, 1984, Picker International requested from NRC information on the disposal of records related to its NRC licenses which were terminated prior to 1980. NRC responded to Picker International in letter dated January 24, 1984 (enclosure 4) by advising them to transfer to AMS any radiation records related to employees or facilities which were transferred from Picker to AMS.

A search for the Picker log books at the AMS facility in late 1993 by AMS representatives was unsuccessful. Consequently, the quantity of cobalt-60 recorded as discharged from the London Road facility to the sewer system by Picker Corp. is unknown, except for the time periods 1965, 1973 and part of 1974, as described below.

The report from a February 1966, AEC inspection at the Picker London Road facility documented that 230 millicuries of cobalt-60 was discharged to the sewer system in 1965. The report from an April 1974 inspection documents that 104 millicuries was discharged in 1973 and 62 millicuries in 1974 through April 1, 1974.

Interviewees indicated that the largest quantities of cobalt-60 discharged to the sewer system in the 1960s - 1970s, likely occurred in 1975 or 1976, during peak source manufacturing periods, and in 1968 or 1969, following a major hot cell decontamination project. Picker interviewees stated that the one curie per year annual gross quantity disposal limit was never exceeded during their respective tenures.

5. Status of Previously Unresolved Issues

Inspection Report No. 030-16055/93002(DRSS), issued August 2, 1993, documents several unresolved or unconfirmed issues regarding the liquid radwaste management and control program implemented at the London Road facility since the 1960s. As a result of the interviews conducted during this inspection, many of the unresolved issues were clarified and are considered closed. These previously unknown and unresolved issues are outlined below.

Issue: When did the use of 55-gallon batch tank cease and use of the 200-gallon plastic (blue) tank begin?

Status (Closed): As discussed in Section 4(b), in 1986, wastewater discharge lines from the locker room change area showers, sinks, washing machine and isotope shop sink were re-routed to discharge into the 200-gallon tank rather than the WHUTs. Use of the 200-gallon tank for batch release to the sewer system began in April 1986. Although the 55-gallon batch tank remained physically positioned in the back basement until 1988, it was not used to release liquid radwastes to the sewer system after April 1986.

Issue: Was the WHUT room floor treated with a sealant during the room's isolation project? Was water present in the WHUT room upon its isolation?

Status (Closed): Three interviewees involved in the isolation project indicated that the floor of the WHUT room was not treated with a sealant to prevent possible migration of contaminated waste water from seeping into the floor. One of the three interviewees indicated that no water or sludge remained on the WHUT room floor upon isolation of the room in 1988. However, according to the interviewee, the floor was covered with approximately one inch of dry sediment. The other two interviewees could not recall the condition of the floor upon room isolation.

Although the information provided by the interviewees was inconclusive regarding the presence of liquids on the WHUT room floor, this issue is considered closed. The radiological and physical condition of the WHUT room is required to be evaluated by the licensee in order to develop an appropriate Decommissioning Funding Plan (DFP) pursuant to 10 CFR 30.35. The DFP is required to be submitted to the NRC upon license renewal on December 31, 1994.

Issue: Were liquids pumped from the WHUTs to the 55-gallon batch tank filtered?

Status (Closed): As discussed in Section 4(c), seven of nine interviewees indicated that the liquids pumped from the WHUTs or WHUT room floor into the 55-gallon batch tank were not filtered. One interviewee indicated that the liquids were occasionally filtered with nylon stockings. One interviewee could not recall if filters were used. Based on the consensus of information obtained during the interviews, an apparent violation was identified for failure to pass the liquids pumped from the WHUTs through a cloth filter to remove non-suspendible solids.

Issue: Were the liquids in the batch tank sampled using the tank's sample drain valve (spigot) or a water column sampling probe?

Status (Closed): A 5-50 ml sample (volume varied with interviewees) was withdrawn from the 55-gallon batch tank using the sample valve (spigot) near the bottom of the tank, as depicted in Figure-III. A 50-100 ml sample was withdrawn from the 200-gallon (blue) tank using a water column sample probe. Use of the sample column probe began in April 1986.

Picker Corp. procedures entitled "Radiation Safety Procedures For the Picker Corporation Isotope Operation," specify in January 1974 and

September 1976 versions that the 55-gallon batch tank incorporates a "sample draw-off valve." The procedure, however, does not specify the volume to be sampled.

AMS procedure ISP-12, 1979 and 1983 versions, requires that a sample be obtained from the batch tank through the sample valve. The 1987 version (Revision B) of ISP-12 specifies that "water discharged from the liquid waste holdup tanks located in the basement liquid waste storage room is first pumped into a batch tank as described on pages 41 and 42 of the ISP-1." The 1987 version further states that "water discharged from the liquid waste holdup tank located in the clean side of the basement is sampled directly from the holdup tank." Interviewees clarified that the holdup tanks located in the basement liquid waste storage room as the WHUTs, the batch tank as the 55-gallon batch tank, and the holdup tank in the clean side of the basement as the 200-gallon blue tank. Based on the interviewees' statements, samples were collected from the 55-gallon batch tank and 200-gallon blue tank as required by ISP-12.

The 1987 version of ISP-12 requires that a sample be drawn off using a standard water column sampling probe, the probe be discharged into a beaker and a 5 ml subsample obtained from the beaker. The procedure did not specify if this sampling method pertained to the 55-gallon batch tank or 200-gallon blue tank. According to the interviewees, only the blue tank was sampled using the water column. Although ISP-12 was not revised to specify use of a water column probe until August 1987, use of the probe began in April 1986 and coincided with liquid radwaste discharges from the blue tank. Despite the vagueness of the 1987 version of ISP-12, the licensee appeared to follow the procedure as intended.

Issue: What were the batch tank mixing, filtering and sampling practices actually implemented by both Picker Corp. and AMS? Did these practices introduce significant uncertainty into the quantity of licensed material reportedly released to the sanitary sewer system?

Status (Closed): Batch tank mixing and sampling practices implemented by Picker and AMS employees, and the apparent failure to filter liquids pumped from the WHUTs into the batch tank are described in Section 4(c). The potential uncertainties in liquid radwaste quantification resulting from these practices is also described in Section 4(c).

Issue: Was facility water usage information obtained from actual water bill records? At what frequency was the dilution data updated?

Status (Closed): Interviewees agreed that liquid radwaste discharge concentrations were calculated by dividing the batch tank cobalt-60 content, as determined from sampling, by the average daily facility water usage. The water usage data was obtained from facility water bills. However, the interviewees could not recall if water usage information was obtained from quarterly, annual or other historical water bill data. As reported in Inspection Report No. 03016055/93002 (DRSS), had quarterly water usage data been used to determine average

daily use rates for the facility as required by the 1987 version of ISP-12, the concentrations of cobalt-60 reported as released to the sewer system may have been underestimated during certain low water use periods.

Although the specific application of facility water usage data could not be determined, any underestimate of cobalt-60 concentrations that quarterly updates may have produced would not be radiologically significant because the total cumulative quantity released to the sewer system in a given year was, according to interviewees, below the regulatory one curie annual limit. Consequently, this matter is considered closed.

Issue: Did considerable uncertainty exist in the quantification of cobalt-60 released to the sewer system from a facility flood in May 1989?

Status (Closed): As documented in Inspection Report No. 03016055/93002(DRSS), AMS records show that 3.2 mCi of cobalt-60 in a volume of about 5300 gallons of liquid was released to the sewer system in May 1989, when a sewer backup flooded the basement of the facility.

According to those involved, the floodwater entered the facility through the back basement standpipe and was retained in the basement by plugs previously inserted in the floor drains. About eight inches of water flooded both the front and back basement floors. The volume of floodwater was determined by the measured water depth and surface area affected. The cobalt-60 concentration was determined from three 20 ml flood water samples, collected from the front and back basement, and analyzed using the well counter system. Independent NRC calculation showed the floodwater volume determination to be accurate.

Based on the actual methods used by those involved in analyzing the floodwater, it appears that the wastewater volume and cobalt-60 quantification was reasonably accurate.

6. Independent Measurements and Calculations

A. Radiation Surveys

A 55-gallon drum nearly identical to that shown in Figure-III is currently stored in the basement of the London Road facility. The drum is stenciled "New February 1986" and consequently it does not appear that this particular drum was used for batch discharges to the sanitary sewer system for more than two or three months. (As discussed in Section 4(b), 55-gallon drum batch tank discharges were discontinued in April 1986.)

During the initial phases of this inspection in August 1993, the inspector conducted direct radiation surveys of the above noted batch tank and its contents. According to the license, the tank contained several feet of tank tubing, an electric motor/impeller

and a manifold and pump likely used in the past to pump liquids from the WHUTs into the batch tank. The tank's contents were removed from the tank and bagged in plastic by the licensee prior to the inspector's arrival. Inspector measured maximum surface radiation levels on the empty tank and its bagged contents were 30 mrem/hr and 200 mrem/hr, respectively. These radiation levels are not unexpected.

B. Liquid Effluent Discharge Calculation

Since at least 1983, AMS used a "Nucell" computer program to calculate the allowable cobalt-60 activity (in microcuries/day) that could be released to the sanitary sewer system on a daily basis. The program calculates the maximum daily release limit based on 10 CFR 20.303 cobalt-60 concentration limits, the average daily facility water dilution data, and the batch tank cobalt-60 activity content.

During the inspection, a sample calculation was generated by the computer program and compared with the NRC inspector's independent hand calculation. No problem was noted with the computer generated result. The program alerts the user if the batch tank content exceeds the maximum daily permissible limit.

7. Summary/Conclusion

The interviewees provided valuable historical insight into the liquid radwaste effluent management and control program implemented at the London Road facility since the 1960s. As a result of these interviews and NRC review of procedures and available records, two apparent violations of regulatory requirements were identified.

Based on interviewee statements, it appears that both Picker Corp. and AMS failed to filter wastewater pumped from the WHUTs to the 55-gallon batch tank and both licensees had one or more unmonitored releases of licensed material into the sanitary sewer system.

As described in Section 4(c), the failure to filter liquid radwastes transferred from the WHUTs to the batch tank coupled with a lack of screen traps in the hot cell/decontamination room drains, could have allowed discrete particles of relatively high cobalt-60 content and possibly whole pellets to be transferred into the batch tank. Depending on batch tank mixing and sampling practices during a given discharge, these discrete particles could have been released to the sanitary sewer system and not accurately accounted for during sampling/analysis. If high activity particulates were released into the sanitary sewer system and not measured by the in-line G.M. monitoring system used prior to 1974 or accounted for in batch tank sampling/analysis, the quantity of cobalt-60 reported to have been released to the sanitary sewer system could have been significantly underestimated.

According to interviewees, unmonitored discharges occurred as a result of basement flooding and other activities as described in Section 4(d). Nevertheless, the cobalt-60 activity released to the sanitary sewer system from these activities likely only contributed a cumulative total of less than one curie during the 1960s, 1970s and 1980s. This conclusion is based on: (1) the relatively low contamination levels typically present on the basement floor and walls; (2) the quantity of cobalt-60 determined to be discharged after a basement flood in 1989; and (3) the scope and magnitude of decontamination work in the isotope shop. However, since the extent and magnitude of facility floods and decontamination activities is not definitively known, the total quantity of cobalt-60 discharged from the facility during all unmonitored releases is also uncertain.

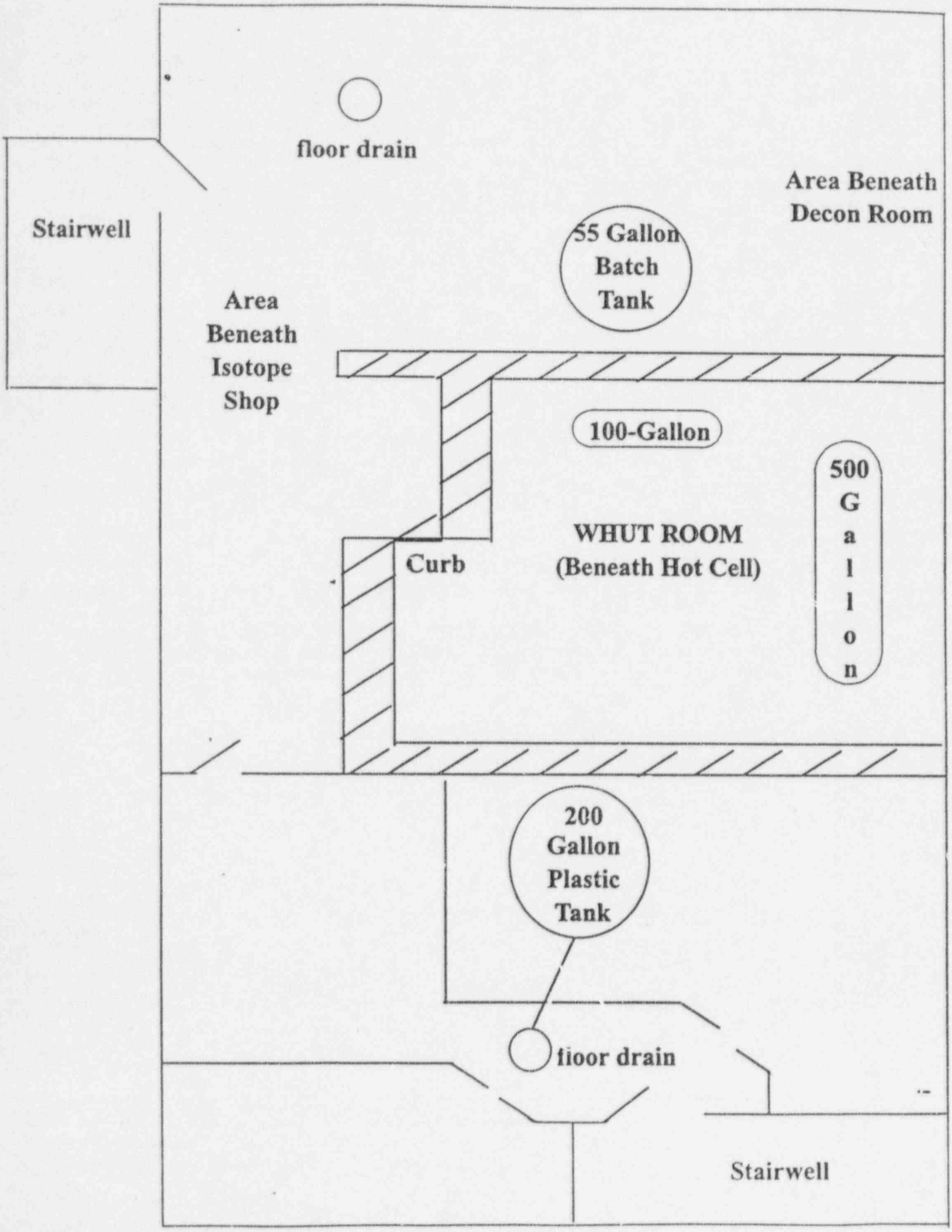
Based on interviewee statements, it appears that in all instances, both Picker Corp. and AMS employees sampled and analyzed the contents of each batch tank (and blue tank) prior to its release to the sanitary sewer system. The interviewees also stated that an accurate discharge log entry was made for each batch tank release.

In conclusion, as a result of the: (1) failure to filter wastewater pumped from the WHUTs; (2) unknowns associated with the existence of hot cell/decontamination room floor drain screen traps; (3) insolubility of the cobalt-60 used at the facility; (4) technical uncertainties associated with the in-line monitoring system and batch tank sampling/analysis methods; and (5) failure to evaluate, in all instances, the quantity of radwaste discharged to the sewer system, the precise quantity of cobalt-60 discharged to the sanitary sewer system from the London Road facility over a near 30-year period beginning in about 1960 is unknown. However, we cannot conclude from the available records or interviews that the 10 CFR 20 one curie per year sanitary sewer discharge limit for cobalt-60 was exceeded in any year.

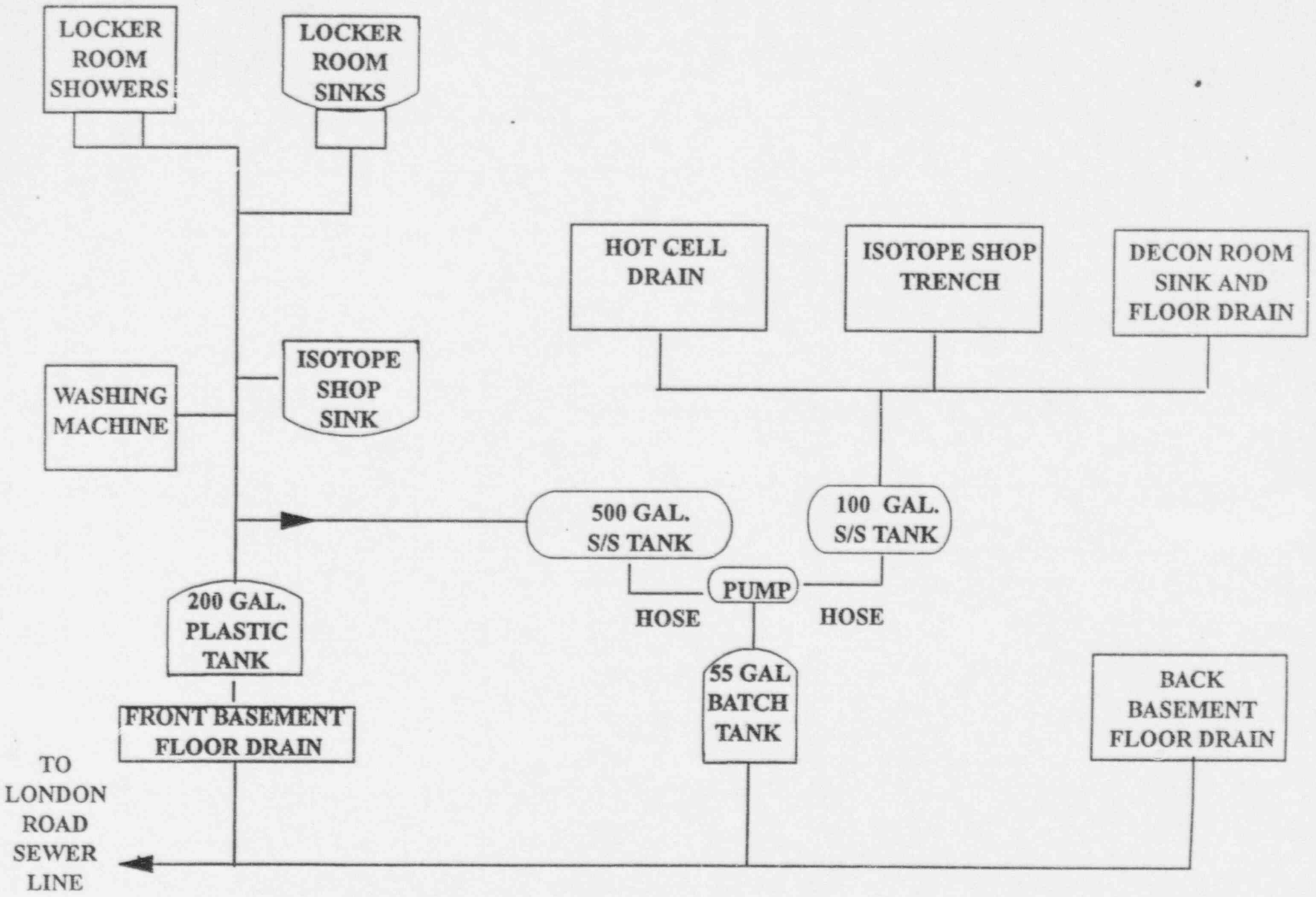
Enclosures: Figure-I (Plan View of Facility Basement)
Figure-II (Contaminated Wastewater Sources)
Figure-III (55-gallon Batch Tank)
NRC Letter dated January 24, 1984.

BASEMENT PLAN VIEW
FIGURE I

NOT TO SCALE



CONTAMINATED WASTEWATER SOURCES
FIGURE II



55-GALLON BATCH TANK
FIGURE III