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IN-SITU NON-DESTRUCTIVE RADIOLOGICAL CHARACTERIZATION OF SELECTED 202-S REDUCTION OXIDATION (REDOX) FACILITY SAMPLE GALLERY PIPES AND VESSELS

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Prepared for the U.S. Department of Energy
Office of Environmental Restoration

Bechtel Hanford, Inc.
Richland, Washington

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In-Situ Non-Destructive Radiological Characterization of Selected 202-S Reduction Oxidation (REDOX) Facility Sample Gallery Pipes and Vessels

Revision 1

Prepared for:
Bechtel Hanford, Inc.

Prepared by:
Scientific Ecology Group
February 3, 1997
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SEG
Scientific Ecology Group, Inc.

REDOX NDC REPORT

In-Situ Non-Destructive Radiological Characterization of Selected 202-S Reduction Oxidation (REDOX) facility Sample Gallery Pipes and Vessels

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SUMMARY

A non-intrusive radiological characterization was performed in the 202-S (REDOX) North and South Sample Galleries during the period from November 1996 through January 1997. The purpose of this study was to determine plutonium-239 (Pu-239) inventories in selected pipes and components. This study was performed during Phase 3 of the REDOX Sample Box Unusual Occurrence Recovery Plan.

Over 300 measurements were performed, including pipe, tank, valve, calibration, and source check measurements. Characterized components included the H-4 Transfer Line, the E-3 to L-12 Transfer Line, the 233-S Floor Drain Line (4" Drain Line), the 233-S Pipe Trench Drain Line (1" Drain Line), the Product Removal Cage (PR Cage) Sump, the E-16 Pre-Concentrator, and the E-17 Concentrator. The length or size of some components (i.e., the H-4 waste line) made contiguous adjacent measurements impractical. Instead, a number of representative measurements were performed on each component. An upper bound on the quantity of material held up in the component was then derived, based on the few available data points.

Very small quantities of plutonium were measured in each of the transfer and drain lines. These quantities are indicative of residue left in the pipes after system flushing. As expected, higher quantities of material were identified in elbows, valves, and flanges. The PR Cage Sump appears (visually) to contain a large amount of material. However, measurements indicate that less than 5 g of Pu-239 is present in the accumulated debris. The E-16 Pre-Concentrator and the E-17 Concentrator may contain up to 1500g and 700g of Pu-239, respectively. These estimates were based on the available measurement data, and the assumption that the measured concentration of Pu-239 is uniformly distributed over the entire interior surface of each tank.

ESTIMATED TOTAL PU-239 QUANTITY	
COMPONENT	PU-239 (GRAMS)
H-4 Transfer Line	< 50
E-3 to L-12 Transfer Line	< 2.5
233-S Floor Drain Line	< 2.5
233-S Pipe Trench Drain Line	< 5
PR Cage Sump	< 5
E-16 Pre-Concentrator	< 1500
E-17 Concentrator	< 700

Most measurement interferences identified during earlier characterization efforts were either minimized or eliminated, increasing measurement accuracy and precision. These included minimizing the contribution to Pu-239 activity observed by the detector from sources other than the component under analysis, the reduction of dead time due to the Am-241 59.54 keV gamma ray, and the use of lead blankets and highly directional, narrow solid angle collimators.

BACKGROUND

The Reduction Oxidation (REDOX) Facility is located in the 200 West Area, directly south of the U Plant facility on the Hanford Site. The facility was constructed between 1950 to 1952 and became the first large-scale continuous-flow solvent extraction process plant built in the United States for the recovery of plutonium from irradiated uranium fuel. This process, which replaced the batch precipitation method first used at the Hanford Site, was designed to separate uranium, plutonium, and neptunium as individual product streams from the fission products with which they are associated in the irradiated fuel. This separation was accomplished by controlling the relative distribution of the activated components between aluminum nitrate-salted aqueous solutions, and an immiscible organic extractant, hexone (methyl isobutyl ketone).

From 1966 to 1967, the facility underwent an orderly shutdown and decontamination process that drastically reduced the radiological and hazardous material inventories. In 1969, the REDOX complex was declared abandoned and placed in a surplus status. REDOX is presently a Hanford Site surplus facility managed under the ERO program, and scheduled to begin decommissioning in 2005.

During routine decontamination activities in March 1996, a valve above Sample Box No. 146, in the REDOX North Sample Gallery, was thought to be leaking a solution containing plutonium and americium. Questions regarding the quantity of solution inside the Sample Box led to an Unusual Occurance declaration and Recovery Plan. The Plan required that the quantity of plutonium be determined in the pipes, valves, and vessels associated with the "leaking" valve. This data will help determine the eventual disposition of the pipes and vessels.

During late March through May 1996, a non-intrusive radiological characterization study was performed to determine the Pu-239 inventory in selected pipes and components in the REDOX North Sample Gallery. This study was performed during Phase 3 of the REDOX Sample Box Unusual Occurance Recovery Plan. The characterized pipes and components are all associated with a valve directly above Sample Box No. 146, which was the subject of the Unusual Occurance investigation.

The current nondestructive assay and characterization program was undertaken to determine the total quantity of fissile material contained within additional pipes and PR Cage vessels associated with the leaking valve. An additional effort was made to apply advanced analytical techniques to determine the source and strength of the measured radiation.

MEASUREMENT METHODS

Sodium Iodide (NaI) and High Purity Germanium (HPGe) detector based gamma spectroscopy systems were used to identify and quantify Pu-239 in the components of interest. These are commercially available detector systems, modified with custom designed and fabricated shielding and collimators. The electronics package used to supply power to the detectors and process incoming signals was an EG&G Ortec Nomad Plus (92X) portable system, coupled to a notebook computer. The multichannel analyzer and spectra analysis software used was EG&G Ortec GammaVision version 2.23.

Each measured facility component and geometry are documented in the Field Notes. The field notes are created by the NDA Technician in the contamination area, while measurements are being performed. Often these notes cannot be free released, and must be transcribed by the notes' author onto clean paper in the Contamination Area air lock. These notes are finally transcribed by a typist. The field technician who originally wrote the notes will check the transcribed notes for accuracy, then sign an accurately transcribed set of notes. The cognizant engineer will also review and sign all field notes. The transcribed November, 1996, through January, 1997, field notes can be found in Attachment A.

Sodium Iodide (NaI) Spectroscopy Systems

The NaI based system consists of a standard 2" x 2" NaI detector, photomultiplier tube, and tube base. The detector fits snuggly into a cylindrical shield consisting of 3/4" lead encased in aluminum. The front end of the detector is recessed into the shield by two inches. The shield, therefore, effectively forms a collimator with a 90° field of view. The cylindrical shield was further modified with lead field of view limiter. The limiter attaches directly to the front of the cylindrical shield. It was designed to wrap around a section 2" or 4" sch 40 pipe, shielding gamma rays originating above, below, or beyond the pipe. Further, it limits the detector field of view to 6" of pipe length. Therefore, each REDOX pipe measurement accounted for only those gamma rays originating in the 6" segment of the pipe under investigation.

This configuration was calibrated using one of Pacific Northwest National Laboratory's (PNNL) National Transuranic Program Office (DOE-NTPO) Performance Demonstration Program (PDP) weapons grade plutonium standards. The 10 inch long cylindrical standard was centered inside a section of 2" sch 40 steel pipe. The field of view limited NaI detector system was then centered on the pipe section to perform the calibration. Data from the calibration can be found in Attachment B. A region of interest was established around the Pu-239 375/413 keV gamma ray peaks. All net counts within the region of interest were used to determine a Pu-239 counts per second per gram (cps/g Pu-239) calibration factor for this geometry. This factor was then used to correct all REDOX pipe measurement spectra region of interest net count rates. The background count rate under the Pu-239 375/413 keV gamma ray peaks was used to determine the minimum detectable activity (MDA) for each measurement, using the 2-sigma MDA equation.

Component geometry sometimes precluded use of the Field of View Limiter attachment to the NaI cylindrical lead shield (i.e., valves, elbows). The cylindrical lead shield alone acts as a collimator and provides the detector a 90° field of view. This geometry was calibrated against a small (less than 1" diameter) PNNL weapons grade plutonium standard. The standard was counted at one foot increments from the front of the cylindrical lead shield. A region of interest was established around the Pu-239 375/413 keV gamma ray peaks. All net counts within the region of interest were used to determine a Pu-239 counts per second per gram (cps/g Pu-239) calibration factor, versus distance from the detector, for this geometry. An equation was then found which closely fit the curve which describes the calibration factor versus distance data points. This equation was then used to determine a specific calibration factor for each given measurement distance. This calibration factor was then used to correct all REDOX pipe measurement spectra region of interest net count rates. A correction for attenuation due to valve or pipe wall material and thickness was also made. The background count rate under the Pu-239 375/413 keV gamma ray peaks was used to determine the minimum detectable activity (MDA) for each measurement, using the 2-sigma MDA equation.

High Purity Germanium (HPGe) Spectroscopy Systems

The HPGe based system consists of a 30 percent efficient (relative to NaI) HPGe detector, preamplifier, 48 hour liquid nitrogen dewar, and cryostat. The detector and dewar are mounted onto a custom designed and fabricated shield/collimator system. The HPGe detector fits snuggly into a cylindrical shield consisting of 1" lead encased in aluminum. The front end of the detector is recessed into the shield by three inches. The outer diameter of the detector is three inches, therefore, the shield forms a collimator with a 90° field of view. The entire assembly fits onto a custom designed and fabricated multi-axis positioner. The positioner slides onto the front tynes of a portable Genie-Lift for ease of transport and height adjustment.

The front of the cylindrical shield assembly contains a pair of fixtures which allow the addition of pin-hole or "snout" type collimators. The pin-hole collimators are ½" thick lead disks with a 0.25", 0.5" or 1" diameter centered hole. The "snout" type collimator consists of a 6" length of one inch diameter steel pipe, centered in a ½" thick lead disk. A pipe adapter forms the connection between the pipe and the disk. The total length of the snout, adapter, and disk when assembled is 7 inches. This collimator provides the detector with a 5.7° field of view. The skewed angle thickness through the side wall of the pipe is great enough to minimize the contribution of Pu-239 gamma rays incident on the detector face from sources outside the 5.7° angle. The set of pin-hole and "snout" collimators provide a wide range of capability to accurately evaluate activity in the component of interest while screening out gamma rays from outside sources. Collimator use was determined by component geometry requirements.

Seven inches was chosen as the standard distance between the front of the open cylindrical (90°) collimator and the front of a section of pipe. This geometry was calibrated using a Eu-152/154 sheet standard inserted into a short section of 2" sch 40 steel pipe. The Eu-152/154 calibration spectra was used to determine Energy versus Channel Number and Efficiency versus Energy curves for the region from 100 to 720 keV. These calibration curves were used only for those REDOX pipe measurements made on 2" pipe, or 4" pipe corrected for additional distance and attenuation due to the additional pipe wall thickness. The GammaVision software was used to determine Pu-239 activity, examining the 345, 375, 380, and 413 keV gamma peaks.

When use of the open cylinder collimator or snout collimator was required (in measurement geometries other than described in the preceding paragraph), the net activity in Pu-239 375 keV gamma peak was evaluated. The Eu-152/154 sheet standard in pipe configuration was counted at one foot increments from the front of the open cylindrical lead shield out to a distance of 6 feet. The individual spectra were then used to develop distance dependent Efficiency versus Energy curves for the spectra region from 100 to 720 keV. This data was then used to develop an Efficiency versus Distance curve for the Pu-239 375 keV gamma. An equation was then found which closely fit the curve which describes the efficiency versus distance data points. This equation was then used to determine a specific efficiency calibration factor for each given measurement distance. This efficiency calibration factor was used to correct the net 375 keV peak activity determined by the GammaVision software for all REDOX measurements made using this geometry. A correction for attenuation due to valve, pipe, or vessel wall material and thickness was also made, when required. The background count rate under the Pu-239 375 keV gamma ray peak was used to determine the minimum detectable activity (MDA) for each measurement, using the 2-sigma MDA equation. This process was repeated to develop an efficiency calibration factor equation for the snout type collimator.

When component geometry required the use of a pin-hole collimator, the measurement specific collimator to component distance was first determined. This distance was then used to perform a distance and collimator specific detector calibration. The Eu-152/154 sheet standard was folded into a 4" x 4" square which was placed at the appropriate distance from the required collimator. The detector efficiency at 375 keV was determined. This efficiency factor was then used to correct the net 375 keV peak activity determined by the GammaVision software for all REDOX measurements made using this geometry. A correction for attenuation due to valve or vessel wall material and thickness was also made, when required. The background count rate under the Pu-239 375 keV gamma ray peak was used to determine the minimum detectable activity (MDA) for each measurement, using the 2-sigma MDA equation.

System Calibration

The NaI system was calibrated using PNNL PDP Standard NTP-0124 and PNNL plutonium standard #27. The PDP standard is constructed of a seamless stainless steel canister inside of a similar canister. The outer diameter is 1.95", and the active length is 10". The source material is PuO_2 mixed homogeneously into diatomaceous earth. The standard contains 2.9507g of plutonium, of which 93.7614% is Pu-239. Only 6" of the 10" active length is observed by the NaI field of view limiter. The PDP source Content and Traceability Certificate can be found in Attachment B. PNNL plutonium standard #27 was fabricated on April 19, 1990, using 12 grams of plutonium, of which 93.7% is Pu-239. This standard currently contains 11.24g of Pu-239. The source is constructed of a 1" diameter vial of PuO_2 centered within a 4" diameter by 5" high aluminum can.

The HPGe system was calibrated using a Eu-152/154 sheet standard. The standard was fabricated on June 5, 1995, at the 222-S Laboratory. The standard originally contained 27.0 uCi Eu-152 (with trace quantities of Eu-154). The source consists of twelve 2" diameter filter papers containing equal quantities of a dried Eu-152 standard solution. The filter papers are sandwiched between two layers of thin plastic sheet. The Standard Traceability Sheet is found in Attachment B.

Both systems were calibrated prior to performing field measurements, per the descriptions provided in the previous section of this report. The HPGe system was fully decontaminated and removed from REDOX twice during the characterization effort and checked against the Eu-152 sheet standard in a previously measured geometry. Upon completion of all measurements, both systems were again checked against their original calibration standards. Both systems maintained calibration during the duration of the characterization activities.

Due to contamination control constraints, it was not possible to remove the detector systems from REDOX for a daily source check. Therefore, an elbow on the H-4 Transfer Line, close to the line's entry point into the 233-S Pipe Trench, inside the North Sample Gallery, was used to perform a daily source check for system stability.

Sources of Error

The measurement error reported in this document refers to the statistical counting error associated with each measurement and is not indicative of the total error associated with the measurement. There are many sources of possible error when performing in situ measurements,

many of which are non-quantifiable. Every effort was made to minimize or eliminate interferences and sources of error during the recent REDOX Sample Gallery measurements. However, some interferences and sources of error exist which may influence the results of this study.

(1) A sophisticated set of collimators and field of view limiters were used to minimize the contribution of gamma rays impinging upon the face of the detector from sources above, below, or beyond the detector. Measurements made during the Spring 1996 characterization study were heavily influenced by activity observed within the collimator solid angle field of view, but not originating within the component of interest. This provided an upper bound on the activity within the component of interest, but not an evaluation of material held up in the component itself. In addition to the collimators and view limiters used during this study, lead blankets and thin pieces of lead sheet were used to further reduce the activity from other nearby sources. It is neither possible, nor practical, to entirely eliminate the contribution to total activity from outside sources, however. During this study only a very small fraction of the total Pu-239 activity observed in each measurement can be attributed to other nearby sources.

(2) An effort was made to eliminate the contribution of activity originating behind the detector systems, using lead blankets. The fraction of activity originating behind the detector can be estimated by using a lead brick in front of the detector as a shadow shield while performing a background count in the required measurement geometry. During this study only a very small fraction of the total Pu-239 activity observed in each measurement can be attributed to sources behind the detector. Measurements made in the PR Cage precluded the use of a brick as a shadow shield, and a thin sheet of lead was used instead. The thin lead sheet failed to eliminate the incident gamma rays originating in front of the detector to allow an adequate evaluation of activity originating behind the detector. These background measurements were disregarded.

(3) An assumption was made that the only gamma rays contributing counts to the net area in the PU-239 375/413 keV region of interest when using the NaI system were due to actual 375 and 413 keV Pu-239 gamma rays. It was assumed that no other radionuclide was present in the source material which would provide gamma rays within the specified region of interest. A small number of gamma rays from Am-241 and other intermediate Pu-239 energy lines are present within this region, but their contribution is negligible.

(4) In some cases, the measurement geometry required the use of an open (90°) collimator. Lead blankets were placed beyond the measurement location, when possible. However, it was not possible to minimize the contribution of gamma rays from other nearby sources during most of these measurements. All sources of activity within the collimator field of view were observed by the detector.

(5) The highly abundant Am-241 59.54 keV gamma ray significantly increased the detector dead time. Therefore, a combination of 0.021" thick cadmium and 0.011" thick copper sheets were added to the front of the detector to attenuate the Am-241 gamma ray from the spectra, while providing the least attenuation of the plutonium 375 and 413 keV gamma rays. All measurements and calibrations were performed using these filters.

(6) It was assumed that the self-attenuation occurring in the plutonium residue inside the pipes and vessels was negligible. The quantities of plutonium measured are indicative of a widely disbursed, very thin layer of residue inside of the components of interest. Therefore, no correction was made for plutonium self-attenuation.

(7) It was assumed that the plutonium is distributed within a widely disbursed, very thin layer of residue inside of the components of interest. It is possible, however, that the plutonium is actually contained within small hot spots, pockets, or fine fragments. If so, the calibration and analytical methods used during this study may underestimate the activity found within these hotspots.

(8) The assumption that the plutonium is distributed within a widely disbursed, very thin layer of residue inside of the components of interest was extrapolated to apply to the entire component of interest. It is probable that the plutonium is not uniformly distributed throughout the entire length of pipe or interior of the vessel. The measured quantity of plutonium may represent a hot spot within the component. Therefore, the derived total quantity within the vessel, assuming uniform distribution, would greatly over estimate the actual total quantity of plutonium . Conversely, the measured quantity of plutonium may represent a "clean" area within the component. Therefore, the derived total quantity within the vessel, assuming uniform distribution, would greatly under estimate the actual total quantity of plutonium. More measurements distributed over the outer surface of a vessel are necessary to accurately determine the actual quantity of material within the vessel.

(9) The thickness of the attenuating material (tank, valve, or pipe wall thickness) and material composition are not accurately known. Assumptions were made based upon pipe diameter and schedule. Tank wall thicknesses were taken off of facility construction drawings. Wall thinning due to extended use and corrosion, however, cannot be accurately estimated.

(10) The HPGe detector was used during a one week period of near 0°F temperatures. The spectra showed signs of significant drifting during long duration measurements (62,000 seconds). After a few days at these temperatures, the detector electronics failed to respond to an input signal. The detector and electronics were released from the contamination area and were brought to a warm area for evaluation. No permanent damage was observed, and when fully warm, the calibration was still valid when compared against the calibration standard. The spectra taken during this period were analyzed, even though they exceed shape and fit parameters. The activity indicated by these spectra agree well with spectra taken before and after this incident.

(11) The actual REDOX source term is not well known. The isotopic composition of the plutonium, americium, neptunium, and curium must be carefully evaluated before the measured Pu-239 quantities can be used to derive the relative quantities of the other isotopes and nuclides. Further, it appears that the isotopic composition is highly variable within the PR Cage and the components of interest in this study. The relative ratio of Am-241 activity to Pu-239 activity varies between 1 and 65. Indications of curium and neptunium activity are also present in many of the PR Cage and 4" Drain Line spectra.

Not enough activity is present, however, to allow a positive identification, nor quantification. Therefore, only Pu-239 quantities are reported.

MEASUREMENT DESCRIPTIONS

H-4 Transfer Line (2" Sch 40)

The H-4 Transfer Line is constructed of 488 ft of 2" sch. 40 stainless steel pipe. Elbows and rolling offsets are welded to the pipe sections. The pipe originates at the North Sample Gallery north wall with a rolling offset. Immediately following the rolling offset is a 15" long north-to-south horizontal section. The pipe turns east for approximately 8 feet after a 90° elbow; then turns south for another 8 feet after a second 90° elbow. Immediately after a tee connecting a run of 1" tubing to the pipe is a 2" sch 40 valve. The tee and valve are approximately 7 ft above the Gallery floor. The pipe continues to the south wall of the North Sample Gallery, where it turns toward the east. The pipe continues down the length of the North Sample Gallery, then turns south, running along the west wall of the North-South Corridor connecting the two Sample Galleries. The pipe turns back toward the west and runs along the north wall of the South Sample Gallery, before terminating at a valve at the H-Cell. Another valve is found approximately half way down the North Sample Gallery. The line is approximately 7 feet high from the floor.

Along the North Sample Gallery north wall, the transfer line runs parallel to a number of other 233-S related pipes. Over the center of the gallery, the transfer line runs parallel to a pair of 3/4" cesium ion exchange column sluice lines. These lines are known to contain Cs-137 contamination and have associated higher than background exposure rates. The pipe parallels one of the lines approximately half way down the North Sample Gallery. Interferences from these lines were minimized through the use of a collimators, a field of view limiter, and extensive use of lead blankets.

QUANTITY OF PU-239 IN THE H-4 TRANSFER LINE			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
PIPE:			
South Gallery	3	100	3
North-South Corridor	7	3	0.21
North Gallery			
East Section	26	3.5	0.91
West Section	7	45	3.2
VALVES:			
South Gallery at H-Cell	0.2	1.8	0.003
Middle of North Gallery	0.3	100	0.3
Near PR Cage (2")	1.5	1.8	0.03
Near PR Cage (1")	0.06	1.9	0.001

QUANTITY OF PU-239 IN THE H-4 TRANSFER LINE			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
BENDS:			
Southeast Corner	0.01	9.9	0.01
Northeast Corner	0.1	2.7	0.005
Corner over Sample Boxes	2.5	0.7	0.18
Near north wall	0.5	3	0.02
Across from PR Cage	5.0	1.7	0.09
TOTAL Pu-239	52.8	14	7

Most measurements were made using the NaI detector system coupled with the field of view limiter. All pipe to pipe welds were analyzed. All valves and elbows were measured separately using a combination of NaI and HPGe detector systems and collimators. It was assumed that the plutonium residue was uniformly distributed between measurement locations. Actually, it is more probable that a variable plutonium quantity gradient exists within the pipe. Measurement data can be found in Attachments C and D. The following table describes the distribution of Pu-239 along the length of the H-4 Transfer Line.

H-4 TRANSFER LINE Pu-239 DISTRIBUTION	
DESCRIPTION	Pu-239 (g/ft)
South Sample Gallery:	
First 12" long horizontal section out of valve at H-Cell in the South Sample Gallery	0.217
138" from elbow weld (toward east)	0.110
169" from elbow weld (toward east)	0.114
393" from elbow weld (toward east)	0.034
630" from elbow weld (toward east)	0.013
860" from elbow weld (toward east)	0.008
1079" from elbow weld (toward east)	0.004
1199" from elbow weld (toward east)	0.002
1295" from elbow weld (toward east)	0.023
1403" from elbow weld (toward east)	0.125
112" from SE elbow weld (toward west)	0.076

H-4 TRANSFER LINE Pu-239 DISTRIBUTION	
94" from SE elbow weld (toward west)	0.034
35" from SE elbow weld (toward west)	0.024
Southeast Elbow	0.034
North-South Corridor:	
84" from SE elbow weld (toward north)	0.122
216" from SE elbow weld (toward north)	0.014
320" from SE elbow weld (toward north)	0.164
553" from SE elbow weld (toward north)	0.316
North Sample Gallery:	
Northeast Elbow	0.225
80" from NE elbow weld (toward west)	0.020
128" from NE elbow weld (toward west)	0.220
225" from NE elbow weld (toward west)	0.254
357" from NE elbow weld (toward west)	0.413
411" from NE elbow weld (toward west)	0.264
591" from NE elbow weld (toward west)	0.234
823" from NE elbow weld (toward west)	0.166
1056" from NE elbow weld (toward west)	0.150
1289" from NE elbow weld (toward west)	0.055
1522" from NE elbow weld (toward west)	0.125
1755" from NE elbow weld (toward west)	0.214
1995" from NE elbow weld (toward west)	0.131
2218" from NE elbow weld (toward west)	0.071
2224" from NE elbow weld (toward west)	0.032
2414" from NE elbow weld (toward west)	0.019
2526" from NE elbow weld (toward west)	0.003
2870" from NE elbow weld (toward west)	0.091

H-4 TRANSFER LINE Pu-239 DISTRIBUTION	
3174" from NE elbow weld (toward west)	0.165
Elbow at south wall of North Sample Gallery (line turns toward north)	0.051
Elbow at north wall of North Sample Gallery (line turns toward west)	2.57
Elbow at south wall of North Sample Gallery (Line turns toward north - check source elbow)	4.81
Rolling offset at north wall of North Sample Gallery (just before entering the wall)	2.38

Cesium-137 generated Compton had little effected on the NaI detector's response, due to shielding, collimation, and view limitation. High Cs-137 activity was observed in the valve situated half way down the North Sample Gallery. Indications of neptunium activity were observed in the South Sample Gallery valve, and the valve next to the 1" tee in the North Sample Gallery. Not enough activity was present for positive identification, nor quantification, however.

E-3 to L-12 Transfer Line (2" Sch 40)

The E-3 to L-12 Transfer Line is constructed of approximately 22 ft of 2" sch. 40 stainless steel pipe, prior to entering a reducer connected to approximately 7 ft of 1" stainless steel tubing. Elbows and the reducer are welded to the pipe sections. The pipe originates at the North Sample Gallery north wall and makes an immediate 90° turn toward the west. The pipe continues west until across from the exit stairwell, where it makes another 90° turn toward the south. The pipe continues for another 7 ft before entering a reducer. The 1" tubing extends south from the reducer approximately 7 feet before entering the southwest corner of the PR Cage, and eventually the canyon wall. The pipe is approximately 7 ft above the Gallery floor.

Along the North Sample Gallery north wall, the transfer line runs parallel to a number of other 233-S related pipes, including the 233-S Floor Drain Line (4" Drain Line). Care was taken to shield any gamma rays originating in the adjacent pipes.

Most measurements were made using the NaI detector system in both open cylindrical collimator and limited field of view configurations. Elbows were measured separately using a combination of NaI and HPGe detector systems and collimators. It was assumed that the plutonium residue was uniformly distributed between measurement locations. Actually, it is more probable that a variable plutonium quantity gradient exists within the pipe. Measurement data can be found in Attachments C and D.

It is believed that the contribution from all other nearby sources was minimized. Indications of neptunium activity were observed the elbow closest to the stairwell door. Not enough activity was present for positive identification, nor quantification, however.

QUANTITY OF PU-239 IN THE E-3 to L-12 TRANSFER LINE			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
PIPE:			
Parallel to Gallery	0.2	14	0.03
Along side of PR Cage	0.5	37	0.19
BENDS:			
At north wall	0.04	3	0.001
At stairwell	0.02	13.5	0.003
At PR Cage	0.03	45.6	0.014
Reducer	0.03	100	0.03
TOTAL Pu-239	0.8	30	0.24

Note: Measurements less than MDA are reported with 100% error.

233-S Floor Drain Line (4" Drain Line) (4" Sch 40)
The 233-S Floor Drain Line (4" Drain Line) is constructed of approximately 26 ft of 4" sch. 40 stainless steel pipe. Elbows are welded to the pipe sections. The pipe originates at the North Sample Gallery north wall and makes an immediate 90° turn toward the west. The pipe continues west until across from the exit stairwell, where it makes another 90° turn toward the south. The pipe continues for another 11 ft before entering the southwest corner of the PR Cage, and eventually the canyon wall. The pipe is approximately 7 ft above the Gallery floor.

Along the North Sample Gallery north wall, the 4" Drain Line parallels a number of other 233-S related pipes, including the E-3 to L-12 Transfer Line. Care was taken to shield any gamma rays originating in the adjacent pipes.

Most measurements were made using the NaI detector system in both open cylindrical collimator and limited field of view configurations. Elbows were measured separately using a combination of NaI and HPGe detector systems and collimators. Attenuation corrections were made to the calculated activity for the increased wall thickness of the 4" pipe. It was assumed that the plutonium residue was uniformly distributed between measurement locations. Actually, it is more probable that a variable plutonium quantity gradient exists within the pipe. Measurement data can be found in Attachments C and D.

It is believed that the contribution from all other nearby sources was minimized. Indications of neptunium activity were observed the elbow closest to the stairwell door. Not enough activity was present for positive identification, nor quantification, however.

QUANTITY OF PU-239 IN THE 233-S FLOOR DRAIN LINE			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
PIPE:			
Parallel to Gallery	0.6	43	0.26
Along side of PR Cage	1.0	45	0.45
BENDS:			
At north wall	0.05	100	0.05
At stairwell	0.02	100	0.02
At PR Cage	0.03	100	0.03
TOTAL Pu-239	2.0	45	0.9

Note: Measurements less than MDA are reported with 100% error.

233-S Pipe Trench Drain Line (1" Drain Line)

The 233-S Pipe Trench Drain Line (1" Drain Line) is constructed of approximately 10 ft of 1" stainless steel tubing. The tubing enters the north wall at two points (drains from the bottom of both 233-S pipe trenches), and connects to a 6ft long horizontal tube section via a tee and 90° elbow. A 90° bend down is found at the west end of the horizontal section. The tubing continues to the Gallery floor for another 4 ft. Elbows and tees are welded to the pipe sections. The horizontal tubing section is approximately 4 ft above the Gallery floor.

The 1" Drain Line is directly below the point where the H-4 and E-3 to L-12 Transfer Lines, and the 4" 233-S Floor Drain Line, enter the Gallery from the 233-S Pipe Trench. This includes the hot spot check source elbow used to confirm detector system stability. Care was taken to shield any gamma rays originating in these adjacent pipes and hot elbow. However, some contribution to the measured Pu-239 activity is likely.

The 1" Drain Line measurements were made using the NaI detector system in an open cylindrical collimator configuration. The eastern most elbow was measured separately, again using the open collimator geometry. Attenuation corrections were made to the calculated activity for the reduced diameter and wall thickness of the 1" tubing. It was assumed that the plutonium residue was uniformly distributed throughout the 10 ft length of tubing. Further, it was assumed that the two elbows and one tee each contained the same quantity of plutonium as was measured in the eastern most elbow. Given the very low measured concentrations of plutonium in the tubing and elbow, these assumptions are valid. Measurement data can be found in Attachment C.

QUANTITY OF PU-239 IN THE 233-S PIPE TRENCH DRAIN LINE			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
PIPE [1]	0.4	33	0.13
BENDS:			
At north wall	0.06	34	0.02
Tee [2]	0.06	34	0.02
At west end of horizontal section [2]	0.06	34	0.02
TOTAL Pu-239	0.6	34	0.2

Notes: (1) Only one measurement was performed (on the horizontal section) on this line.
(2) Only the eastern most elbow was measured. It was assumed that the other elbow and tee contained the same quantity of Pu-239.

Product Removal Cage Sump

The PR Cage Concentrator Pit Sump is located in the Northwest corner of the Concentrator Pit. The Concentrator Pit is located in the Northwest corner of the PR Cage. The bottom of the Pit is 4.5 ft below floor level. The sump is square, measuring 6" x 6" x 6", extending down to 5 ft below floor level. One 2" diameter pipe and one 1.5" diameter pipe enter the sump, complicating measurements. A number of additional pipes and pipe supports over the sump further complicate measurements. Photographs of the sump indicate the presence of debris in the sump, filling it to level with the Pit bottom. A small hole is visible in the debris, but actual diameter and depth are not known.

A number of measurements were performed on the sump with the NaI in the open cylindrical collimator configuration. This configuration required lowering the detector and collimator to within 6" of the top of the sump. The detector's 90° field of view permitted measurement of the entire sump, without the contribution of surrounding sources of Pu-239 activity. Plutonium-239 activity decreased with distance away from the sump, as the detector was moved toward the E-16 Tank. A pile of unidentifiable residue, perhaps an old rag, directly west of the E-16 Tank on the Pit floor, and a white residue mark on the side of the E-16 Tank were also measured. Measurement data can be found in Attachment C.

An analysis was performed using the MicroShield version 4.0 computer code to determine the effects of attenuation due to the debris found in the sump, as well as the effects of plutonium self-attenuation. The debris was modeled as having the material composition of concrete, with an adjusted density of 1.6 g/cm^3. It is not realistic to assume that the debris material is packed into the sump such that the density would be much higher (set structural concrete has a density of 2.35 g/cm^3. At worst case, the plutonium would be located in the bottom of the sump. The

MicroShield analysis revealed that attenuation corrections would only increase the total quantity of plutonium by a factor of approximately 2. Therefore, at worst case, approximately 5g of Pu-239 was measured in the Concentrator Pit Sump.

QUANTITY OF PU-239 IN THE PR CAGE CONCENTRATOR PIT SUMP AND ASSOCIATED COMPONENTS			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
SUMP	2.5	1.6	0.04
PIT FLOOR, half way between the sump and E-16 Tank	0.36	2.7	0.01
BENDS: 2" line entering sump 1.5" line entering sump	 0.74 0.96	 2.1 1.8	 0.02 0.02
Pile of debris (rag)	0.34	4.0	0.01
Mark on side of E-16 Tank	0.42	1.1	0.004
Bottom horizontal section of 2" pipe entering the lower Northwest side of the E-16 Tank	0.47	2.6	0.01
West end cap of large pipe immediately below floor level inside of pit, running east-west	0.14	1.7	0.002

E-16 Pre-Concentrator

The E-16 Pre-Concentrator is located in the PR Cage Concentrator Pit. The Pre-Concentrator consists of two sections, a lower tank, assumed to be empty, and an upper column section, assumed to be full of Raschig Rings. The Tank section contains a heating coil situated on the inside bottom of the tank. The Tank is 33" inner diameter, with 0.25" steel walls. The Tank is 60" tall. The bottom of the Tank sits on four legs and is 8 in above the bottom of the Concentrator Pit. The upper Tower section is 12" inner diameter and 102" tall. The Tower walls are 0.25" steel. The Tower is centered on the top of the tank section. The axial center line of the tank/tower combination is situated 28.5" south of the PR Cage plexiglass panel walls.

Measurements were performed on the bottom, middle, and top of the tank, and on the middle of the tower. All measurements were performed with the HPGe detector using the snout collimator configuration. The snout collimator provides the detector with a 5.7° field of view. All measurements were performed either looking down into the pit at the side of the tank, or looking

up at the side of the tower. Estimates of activity were performed assuming (1) all of the measured Pu-239 activity is on the outside of the tank (or tower), (2) all of the measured Pu-239 activity is on the inside wall of the tank, or (3) all of the measured Pu-239 activity is at a spot in the bottom of the tank. The third geometry was only used when the angle of the measurement intersected the bottom of the tank. Corrections were made for distance and attenuation due to the skewed tank wall thickness.

The total quantity of Pu-239 estimated for the E-16 Pre-Concentrator is based on the assumption that the quantity of Pu-239 is constant over the entire surface of the measured section. The value used for the Pu-239 concentration in the bottom of the tank was taken from the tank bottom measurement. The tank side activity was derived from the activity estimated on the inside wall of the tank from the tank middle measurement. The activity in the top of the tank was estimated over the area of the disk described by the bottom of the tower section and used the Tank top measurement data. The tower activity was derived from the total surface area of the inside of the tower section and the tower measurement. Measurement data can be found in Attachment E.

QUANTITY OF PU-239 IN THE E-16 PRE-CONCENTRATOR TANK			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
Tower	220	15	33
Top	15	11	1.7
Middle	870 (1)	10	87
Bottom	160	3	5
Floor	170	1	2
TOTAL Pu-239	1450	10	145

Notes: (1) This value is based on an assumed concentration of 0.14 g/in^2 rather than the measured value of 0.35 g/in^2.

The assumption that the concentration of plutonium is constant over the entire surface area of each section of each component is not valid. However, it provides a first approximation of the total quantity of plutonium located inside of the vessel. More likely, the plutonium is concentrated toward the bottom of the vessel, and a significant concentration gradient exists on the vessel walls. It was originally planned that the outside of the tank be decontaminated prior to making these measurements. However, health and safety concerns precluded this action. Therefore, it is likely that a fraction of the activity is located on the outside of the vessel, rather than inside of the vessel. The activity on the outside of the vessel is uncorrected for vessel wall attenuation, and, therefore, would indicate a significantly lower total Pu-239 inventory.

The inside wall Pu-239 concentration derived from the tank middle measurement (0.35 g/in^2) appears unusually high. The plutonium concentration is more likely closer to the concentration found in the top (0.135 g/in^2) and bottom (0.183 g/in^2) of the tank. Therefore, a value of 0.14 g/in^2 was assumed, and used in the total quantity derivation.

The activity measured on the floor beneath the tank was assumed to be uniformly distributed over the E-16 Tank's half of the Concentrator Pit floor. This value was added to the E-16 Tank inventory.

The snout collimator provides a very narrow field of view which effectively eliminates gamma rays from all other nearby sources not the subject of the measurement. Therefore, each measurement accurately identifies and quantifies isotopes of interest, attributing their activity to only the subject component. The problem with this approach, however, is that the area analyzed during each measurement is very small compared to the entire component. This small area may not be representative of the entire component, but may represent significantly higher or lower activity than may be found in the remainder of the component. This problem must be considered when evaluating total quantity data derived from snout collimator measurements.

E-17 Concentrator

The E-17 Concentrator is located in the PR Cage Concentrator Pit, east of the E-16 Pre-Concentrator. The Concentrator consists of two sections, a lower tank, assumed to be empty, and an upper column section, assumed to be full of Raschig Rings. The Tank section contains a heating coil situated on the inside bottom of the tank. The Tank is 18" inner diameter, with 0.25" steel walls. The Tank is 48" tall. The bottom of the Tank sits on four legs and is 42 in above the bottom of the Concentrator Pit. The upper Tower section is 6" inner diameter and 78" tall. The Tower walls are 0.25" steel. The Tower is centered on the top of the tank section. The axial center line of the tank/tower combination is situated 28.5" south of the PR Cage plexiglass panel walls.

Measurements were performed on the bottom, middle, and top of the tank. Time constraints precluded a measurement on the tower section. All measurements were performed with the HPGe detector using the snout collimator configuration. The snout collimator provides the detector with a 5.7° field of view. All measurements were performed either looking down into the pit at the side of the tank, or looking up at the side of the tower. Estimates of activity were performed assuming (1) all of the measured Pu-239 activity is on the outside of the tank (or tower), (2) all of the measured Pu-239 activity is on the inside wall of the tank, or (3) all of the measured Pu-239 activity is at a spot in the bottom of the tank. The third geometry was only used when the angle of the measurement intersected the bottom of the tank. Corrections were made for distance and attenuation due to the skewed tank wall thickness.

The total quantity of Pu-239 estimated for the E-17 Concentrator is based on the assumption that the quantity of Pu-239 is constant over the entire surface of the measured section. The value used for the Pu-239 concentration in the bottom of the tank was taken from the tank bottom measurement. The tank side activity was derived from the activity estimated on the inside wall of the tank from the tank middle measurement. The activity in the top of the tank was estimated over the area of the disk described by the bottom of the tower section and used the Tank top measurement data. Measurement data can be found in Attachment E.

QUANTITY OF PU-239 IN THE E-17 CONCENTRATOR TANK			
COMPONENT	Pu-239 (grams)	1 sigma error (percent)	1 sigma error (grams)
Tower	90 (1)	6.6	6
Top	4	6.8	0.3
Middle	200	8.8	18
Bottom	30	3.8	1
Floor	320	0.47	1.5
TOTAL Pu-239	650	4	27

Notes: (1) No measurement was made on the E-17 Tower section. Therefore, a value of 0.06 g/in^2 was assumed (measured value from the E-16 Tower section).

The assumption that the concentration of plutonium is constant over the entire surface area of each section of each component is not valid. However, it provides a first approximation of the total quantity of plutonium located inside of the vessel. More likely, the plutonium is concentrated toward the bottom of the vessel, and a significant concentration gradient exists on the vessel walls. It was originally planned that the outside of the tank be decontaminated prior to making these measurements. However, health and safety concerns precluded this action. Therefore, it is likely that a fraction of the activity is located on the outside of the vessel, rather than inside of the vessel. The activity on the outside of the vessel is uncorrected for vessel wall attenuation, and, therefore, would indicate a significantly lower total Pu-239 inventory.

No measurement was made on the E-17 Tower Section. Therefore, the Pu-239 concentration measured in the E-16 Tower (0.06 g/in^2) was used to develop a first approximation of E-17 Tower inventory.

The activity measured on the floor beneath the tank was assumed to be uniformly distributed over the E-17 Tank's half of the Concentrator Pit floor. This value was added to the E-17 Tank inventory.

The snout collimator provides a very narrow field of view which effectively eliminates gamma rays from all other nearby sources not the subject of the measurement. Therefore, each measurement accurately identifies and quantifies isotopes of interest, attributing their activity to only the subject component. The problem with this approach, however, is that the area analyzed during each measurement is very small compared to the entire component. This small area may not be representative of the entire component, but may represent significantly higher or lower activity than may be found in the remainder of the component. This problem must be considered when evaluating total quantity data derived from snout collimator measurements.

RECOMMENDATIONS FOR FURTHER MEASUREMENTS

Ten samples were taken of debris and contamination from inside the PR Cage Concentrator Pit. These samples should be analyzed by a qualified laboratory, capable of transuranic separations and analyses. The analyses of interest include, gamma spectrum, gross alpha, gross beta, plutonium isotopics, neptunium isotopics, curium isotopics, and americium isotopics. This data can then be used to confirm or deny the presence of curium and neptunium in the contamination. Further, the data available from the current characterization effort can be re-analyzed to determine curium and neptunium concentrations in pipes and vessels.

A set of samples should be withdrawn from the H-4 Transfer Line. These should also be analyzed for gamma spectrum, gross alpha, gross beta, plutonium isotopics, neptunium isotopics, curium isotopics, and americium isotopics. Further, it would be of significant interest to determine the concentration of low atomic numbered materials present in the samples which could act as neutron moderators. These samples will once again help fine tune the current measurements, as well as provide valuable information regarding the contents of the 233-S L-16 Recycle Tank.

A number of measurement should be performed on the E-16 and E-17 vessels once they can be cleaned of exterior contamination. The single data point acquired at each elevation during the current study is not adequate to fully characterize each tank. Further, there are a number of pipes, valves, and flanges inside the PR Cage attached to the E-16 and E-17 vessels which should also be analyzed. The 3/4" Ion Exchange Column sluice lines which run parallel to the H-4 Line should also be analyzed to determine whether they are currently full of material, or if the activity observed as an interference in the H-4 Line measurements is merely residual on the inside of the pipes.

REFERENCES

1. Los Alamos National Laboratory, 1991, Passive Nondestructive Assay Of Nuclear Materials, NUREG/CR-5550, Los Alamos, New Mexico.

2. Los Alamos National Laboratory, 1974, Fundamentals of Passive Nondestructive Assay of Fissionable Material, LA-5651-M, Los Alamos, New Mexico.

3. Wick, O.J., et al., 1967, Plutonium Handbook, a Guide to the Technology, United States Atomic Energy Commission, Pacific Northwest Laboratories, Richland, Washington.

4. SEG, 1995, Non-Destructive Assay and Characterization Operations Manual, Scientific Ecology Group, Inc., October 1995, Richland, Washington.

5. SEG, 1995,. Calibration and Test Requirements for Radiation Protection Instrumentation, Scientific Ecology Group, Inc., August 1995, Oak Ridge, Tennessee.

6. SEG, 1995, Quality Assurance of Counting Systems and Portable Counters, Scientific Ecology Group, Inc., September 1995, Oak Ridge, Tennessee.

7. SEG, 1994, Quality Assurance Manual, Scientific Ecology Group, Inc., September 1994, Oak Ridge, Tennessee.

8. Radiological Health Handbook, PB-23-846, U.S. Department of Health, Education, and Welfare, January 1970, Rockville, Maryland.

9. Radioactive Decay Tables, DOE-TIC-11026, D.C. Kocher, U.S. Department of Energy, Technical Information Center, 1981.

10. "GammaVision - Gamma-ray Spectrum Analysis and MCA Emulation Software," Code Package A66-BI, Version 2.23, EG&G Ortec, Oak Ridge, Tennessee, 1995.

11. Hanford Drawing No. H-2-7324, "Product Recycle Piping Arrangement and Details"

12. Hanford Drawing No. H-2-39742, "Piping - General Arrangement Plan & Sections - 202-S to 233-S Trench"

13. Hanford Drawing No. H-2-8439, "Archetectural - Plans and Details of Product Removal Cage"

14. Hanford Drawing No. H-2-8755, "Piping - General Arrangement Elevations and Sections - P.R. Room"

15. Hanford Drawing No. H-2-7957, "Piping - General Arrangement Plans - P.R. Room"

16. Hanford Drawing No. H-2-18034, "Piping - General Arrangement Building 202-S to 233-S Trench Air Sampling and Wash Down - Plans, Sections, and Details"

17. Hanford Drawing No. H-2-8569, "Structural Concrete - Plans, Details, and Sections - Sump, Canyon Area"

Attachment A

REDOX In-Situ NDAC Field Notes

NDAC Field Log **November 1, 1996**

Note: Calibration of the NaI detector with PNNL at 324 building.

N-96-306-01 300 second count with filters with Am-241 and Cs-137 button source with sources on contact with shield. Gain setting at (0.8688 x 20).

N-96-306-02 300 second count with filters with Am-241 and Cs-137 button source with sources on contact with shield. Gain setting at (0.8688 x 20).

N-96-306-03 300 second count without filters with Am-241 and Cs-137 button source with sources on contact with shield. Gain setting at (0.8688 x 20).

N-96-306-04 300 second count without filters with Am-241 and Cs-137 button source with sources on contact with shield. Gain setting at (0.8688 x 20).

N-96-306-05 100 second count with filters with Pu-239 source standard #27 with source on contact with shield. Gain setting at (0.8688 x 20).

N-96-306-06 100 second count with filters with Pu-239 source standard #27 with source on contact with shield. Gain setting at (0.8688 x 20).

N-96-306-07 100 second background count with filters without source without brick. Gain setting at (0.8688 x 20).

N-96-306-08 100 second background count with filters without source without brick. Gain setting at (0.8688 x 20).

N-96-306-09 100 second background count with filters without source with brick. Gain setting at (0.8688 x 20).

N-96-306-10 100 second background count with filters without source with brick. Gain setting at (0.8688 x 20).

N-96-306-19 100 second count with filters with Pu-239 source standard #27 with source 2" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-20 100 second count with filters with Pu-239 source standard #27 with source 2" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-21 300 second count with filters with Pu-239 source standard #27 with source 4" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-22 300 second count with filters with Pu-239 source standard #27 with source 4" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-23 300 second count with filters with Pu-239 source standard #27 with source 6" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-24 300 second count with filters with Pu-239 source standard #27 with source 6" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-25 300 second count with filters with Pu-239 source standard #27 with source 8" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-26 300 second count with filters with Pu-239 source standard #27 with source 8" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-27 300 second count with filters with Pu-239 source standard #27 with source 10" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-28 300 second count with filters with Pu-239 source standard #27 with source 10" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-29 300 second count with filters with Pu-239 source standard #27 with source 12" from front of shield to front of source. Gain setting at (0.8688 x 20).

N-96-306-30 300 second count with filters with Pu-239 source standard #27 with source 12" from front of shield to front of source. Gain setting at (0.8688 x 20).

NDAC Technician	1-31-97 Date
Transcriptionist	1-31-97 Date
NDAC Engineer	01-31-97 Date

Note: Calibration of the NaI detector with PNNL at 324 building.

N-96-306-11 300 second background count with filters, without source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-12 300 second background count with filters, without source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-13 300 second background count with filters, without source, with jaws, without back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-14 300 second background count with filters, without source, with jaws, without back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-15 300 second background count with filters, without source, with jaws, without back plate, without pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-16 300 second background count with filters, without source, with jaws, without back plate, without pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-17 300 second background count with filters, without source, with jaws, with back plate, without pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-18 300 second background count with filters, without source, with jaws, with back plate, without pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-31 1000 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-32 1000 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-33 1000 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-34 1000 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-35 1000 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. With source sitting bare on top of jaws. Gain setting at (0.8688 x 20).

N-96-306-36 1000 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. With source bare sitting on top of jaws. Gain setting at (0.8688 x 20).

N-96-306-37 300 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-306-38 300 second count with PDP source #NTP-0124 with filters, with source, with jaws, with back plate, with pipe inserted. Gain setting at (0.8688 x 20).

N-96-311-01 300 second count with Am-241/Cs-137 source centered on open collimation with filters.

N-96-311-02 300 second count with Am-241/Cs-137 source centered on open collimation with filters.

N-96-311-03 300 second count with Am-241/Cs-137 source centered on open collimation without filters.

N-96-311-04 300 second count with Am-241/Cs-137 source centered on open collimation with out filters.

N-96-311-05 300 second bkg count without filters.

N-96-311-06 300 second count with Am-241/Cs-137 source centered on open collimation without filters.

Dan Moder 1-31-97
NDAC Technician Date

Chris L. Shelton 1-31-97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log November 7, 1996

Note: Shots on the H-4 xfer pipe - 2" sch 40, beginning in the South Sample Gallery.

N-96-312-00 Background on floor, center of South Sample Gallery, detector horizontal, with JAWS, facing west, back of JAWS closed, JAWS empty, sitting on silver paper, FG = 0.8991, CG = 20, LT = 300s

N-96-312-01 South Sample Gallery, where H-4 enters the wall through a herky valve, first North-South horizontal section outside plexiglass box, running toward North. 300s count with JAWS, FG = 0.8639

N-96-312-02 Same as N9631201 but for 1000s count time.

Dan Zgoda 1-31-97
NDAC Technician Date

Linda J. Hilton 1-31-97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **November 8, 1996**

N-96-313-00 Background count, 300 second, center of south sample gallery passage, facing west. Amplifier gain 0.8639 (Cs-137 peak was at ~ channel 415)

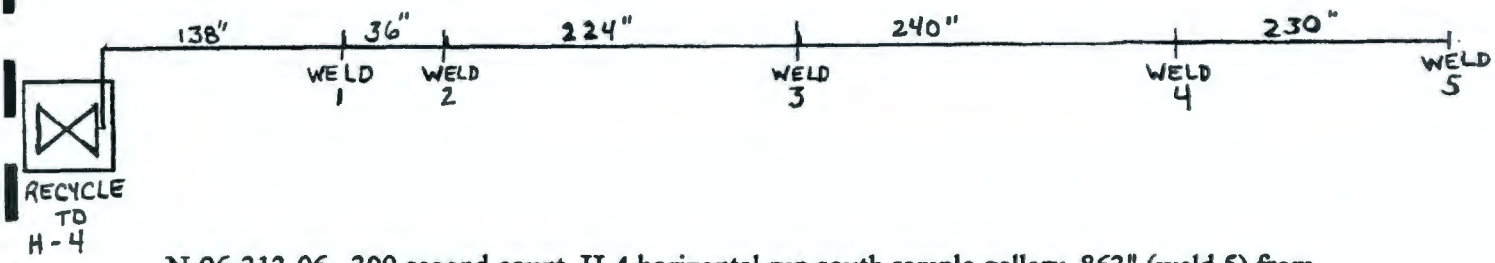
N-96-313-01 Background count, same parameters as N9631301. Amplifier gain 0.8454.

N-96-313-02 1000 second count, H-4 horizontal run south sample gallery, 138" from second bend of Recycle to H-4 valve. JAWS used, back flap raised. Am-241 peak at Marker 40, Cs-137 peak at Marker 404.

N-96-313-03 1000 second count, H-4 horizontal run south sample gallery, 169" (weld 2) from second bend of Recycle to H-4 valve. JAWS used, back flap raised. Am-241 peak at Marker 39, Cs-137 peak at Marker 397.

N-96-313-04 300 second count, H-4 horizontal run south sample gallery, 393" (weld 3) from second bend of Recycle to H-4 valve. JAWS used, back flap raised. Cs-137 peak at Marker 404. Gain approximately 0.8610.

N-96-313-05 300 second count, H-4 horizontal run south sample gallery, 633" (weld 4) from second bend of Recycle to H-4 valve. JAWS used, back flap raised. Cs-137 peak at Marker 404.



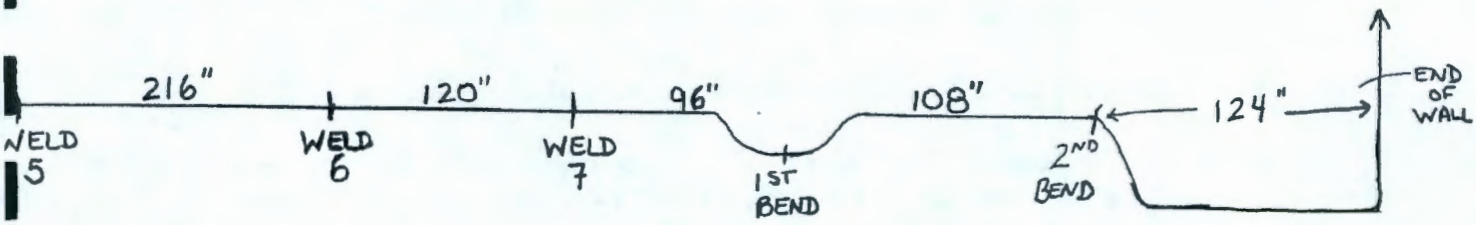
N-96-313-06 300 second count, H-4 horizontal run south sample gallery, 863" (weld 5) from second bend of Recycle to H-4 valve, JAWS used, back flap raised, Cs-137 peak at Marker 402.

N-96-313-07 300 second count, H-4 horizontal run south sample gallery, 1079" (weld 6) from second bend of Recycle to H-4 valve, JAWS used, back flap raised, Cs-137 peak at 402, gain at 0.8639.

N-96-313-08 300 second count, 1199" from second bend (weld 7), JAWS used, back flap raised. Cs-137 peak at Marker 404.

N-96-313-09 300 second count, 1295" from second bend (first pipe bend), JAWS used, back flap raised. Cs-137 peak at Marker 402.

N-96-313-10 1000 second count, 1403" from second bend (second pipe bend), JAWS used, back flap raised. Cs-137 peak at 404, Am-241 peak at Marker 40.



Dan Moder 1·31·97
NDAC Technician Date

Michael J. Hatton 1·31·97
Transcriptionist Date

John P. Sanford 01-31-97
NDAC Engineer Date

NDAC Field Log **November 11, 1996**

N-96-316-00 Background count, 300 seconds, east end of south sample gallery, detector facing west, positioned in center of passageway, JAWS installed, back shielding plate off, gain setting 0.8639, Cs-137 peak at marker 407 (back shield fell off).

N-96-316-01 1000 second count, pipe bend 94" from east interior wall corner. JAWS installed, back plate set over opening, detector hanging vertically, gain setting 0.8639.

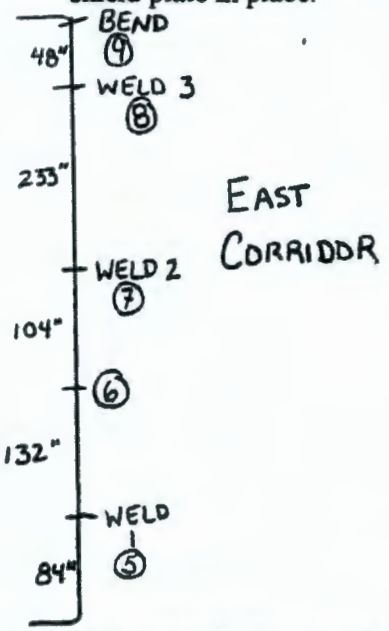
N-96-316-02 1000 second count, middle of pipe, 112" from east end of wall in south sample gallery, JAWS used, back plate in place.

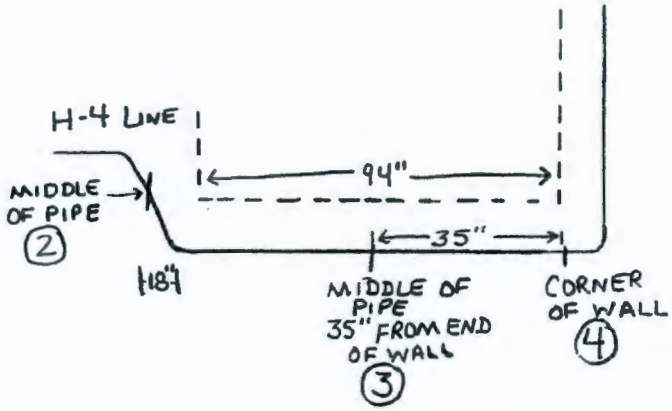
N-96-316-03 1000 second count, middle of pipe, 35" from end of wall, JAWS used, back plate in place.

N-96-316-04 1000 second count, bend (west side of bend) at wall corner (SE corner) of south sample gallery, JAWS used, back shield in place.

N-96-316-05 1000 second count, first weld H-4 in east corridor, 84" from SE corner of wall, JAWS used, back shield plate in place.

N-96-316-06 second count, 216" from SE corner, H-4 pipe in east corridor, JAWS used, back shield plate in place.





N-96-316-07 1000 second count, (weld 2), 320" from SE corner, JAWS used, back shield installed.

N-96-316-08 1000 second count, (weld 3), 553" from SE corner, JAWS used, back shield plate.

N-96-316-09 1000 second count, bend at NE corner, H-4 line, JAWS used, back shield plate installed.

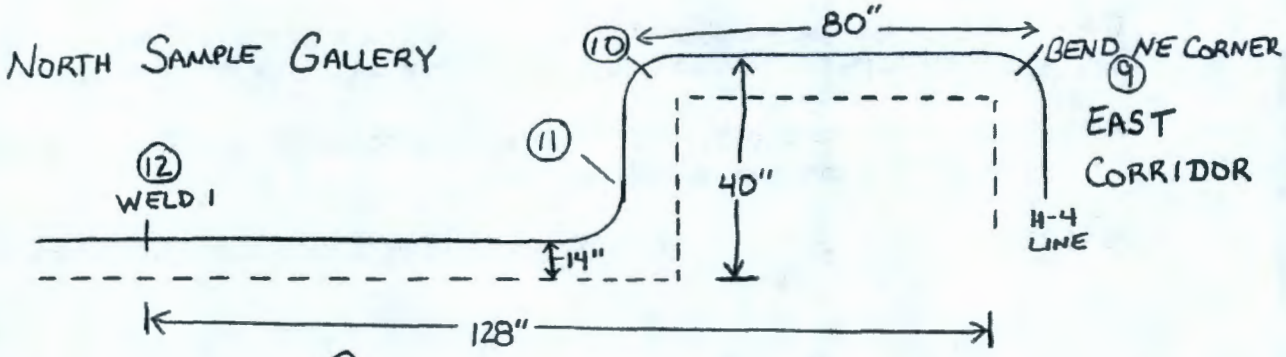
N-96-316-10 300 second count, bend 80" from NE corner and 40" out from canyon wall, JAWS used, back shield plate installed.

N-96-316-11 300 second count, bend 80" from NE corner and 14" out from canyon wall, JAWS used, back shield plate in place.

N-96-316-12 1000 second count on weld, 128" from NE corner, H-4 line, JAWS used, back shield plate installed.

N-96-316-13 Background count, 300 second, North sample gallery, east end, detector facing west, centered in passageway, JAWS used, back shield plate down.

N-96-316-14 Background count, east corridor, 300 seconds, detector facing south, located at NE corner, JAWS used, back shield plate down.



Dan Yates 1·31·97
NDAC Technician Date

Catherine L. Hutton 1·31·97
Transcriptionist Date

John R. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **November 12, 1996**

N-96-317-00 300 second background count, NE end of North sample gallery, detector facing east, JAWS installed, back shield down. Detector centered in corridor.

N-96-317-01 300 second count, 225" from NE corner, measurement taken between welds, area of higher surface contamination and then internal readings, JAWS used, back shield NOT used.

N-96-317-02 300 second count on weld, 357" from NE corner, H-4 line, North sample gallery, JAWS used, back shield plate installed.

N-96-317-03 300 second count, between welds 411" from NE corner, JAWS used, back shield installed, detector pointing toward floor.

N-96-317-04 1000 second count, weld 591" from NE corner, JAWS used, back shield installed. Large Cs-137 peak with resulting Compton region. May have to do this shot over again with the HPGe or NaI (significant shielding). Shot taken in vicinity of B-2 sample box.

N-96-317-05 300 second count 823" from NE corner on a weld, JAWS used, back shield plated installed.

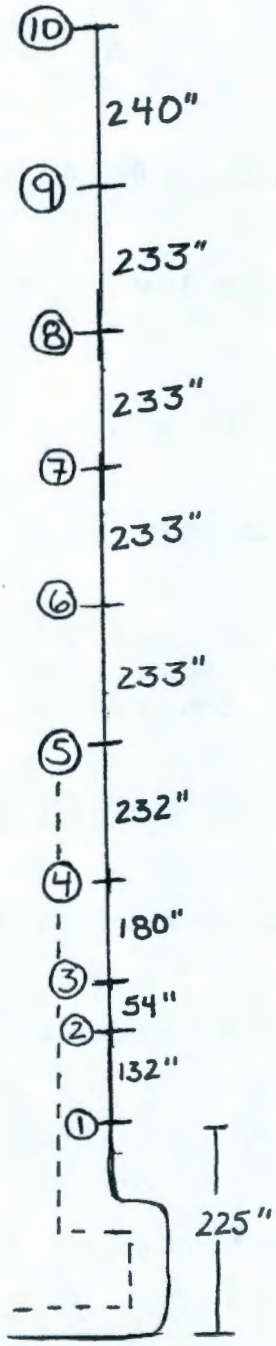
N-96-317-06 300 second count, 1056" from NE corner on weld, JAWS used, back shield plate installed.

N-96-317-07 300 second count, 1289" from NE corner on weld, JAWS used, back shield plate installed.

N-96-317-08 1000 second count, 1522" from NE corner on weld, JAWS used, back shield plate installed.

N-96-317-09 300 second count, 1755" from NE corner on weld, JAWS used, back shield plate installed.

N-96-317-10 300 second count, 1995" from NE corner on weld, JAWS used, back shield plate installed.



1·31·97
NDAC Technician Date

1·31·97
Transcriptionist Date

01-31-97
NDAC Engineer Date

NDAC Field Log **November 13, 1996**

N-96-318-00 300 second count, background count, north sample gallery, detector centered in passageway on west side of false wall, (~20 feet east of stairs), JAWS on, back shield plate installed and lowered.

N-96-318-01 1000 second count, weld, 1992" from NE corner, first weld on west side of false wall, JAWS used, back shield plate installed, lead blankets.

N-96-318-02 300 second count on bend in pipe, 2218" from NE corner, JAWS used, shield used, lead blanketing used around detector.

N-96-318-03 1000 second count, straight portion of bend measured above, 2224" from NE corner, JAWS used, shield used, lead blankets used.

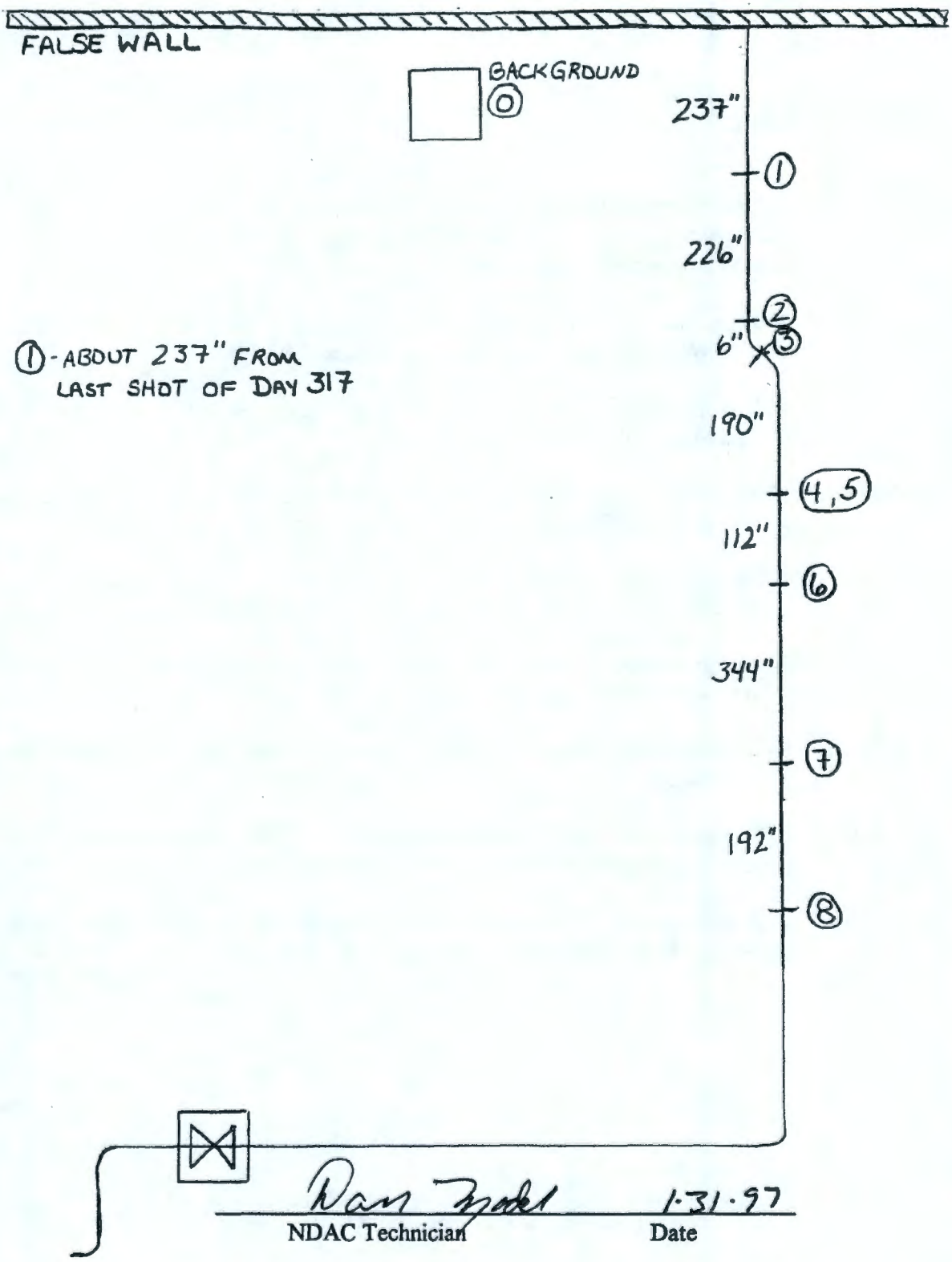
N-96-318-04 1000 second count, straight pipe run, located on H-4 above pipe trench, JAWS used, shield used, lead blankets used, 2414" from NE corner.

N-96-318-05 Same count as above with the large lead blankets in place to shield the contribution from IX line. (Shielding appears to have worked well)

N-96-318-06 1000 second count, next to weld, 2526" from NE corner, JAWS used, shield used, lead blankets used.

N-96-318-07 1000 second count, 2870" from NE corner, JAWS used, shield was not used but piece of lead was put in front of detectors, lead blankets used.

N-96-318-08 1000 second count, 3062" from NE corner, JAWS used, back shield not used but piece of lead placed in front of detector, lead blankets used.



1 - ABOUT 237" FROM LAST SHOT OF DAY 317

Dan Zodl 1·31·97
NDAC Technician Date

Michael J. Hutton 1·31·97
Transcriptionist Date

John P. Sanford 01-31-97
NDAC Engineer Date

N-96-319-00 300 second background count, north sample gallery, west end down by loadout hood, detector facing east, JAWS on, back shield plate installed and lowered.

N-96-319-01 1000 second count, bend on H-4 that turns pipe into the north sample gallery away from canyon wall, 3174" from NE corner, JAWS used, no back shield plate, lead blankets around detector.

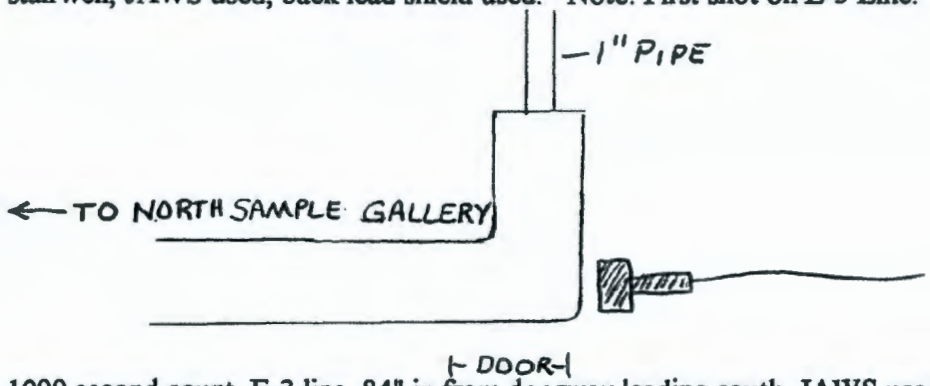
N-96-319-02 300 second count, north bend, JAWS used, lead shield used, lead blankets used.

N-96-319-03 300 second count, bend that turns H-4 line toward the north wall adjacent to stairs leading out of REDOX to Greenhouse, JAWS used, back lead shield used, lead blankets used.

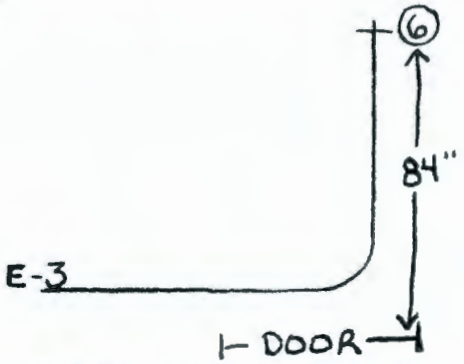
N-96-319-04 1000 second count, bend taking H-4 line vertical along wall adjacent to stairwell leading to greenhouse, JAWS used, lead blankets used.

----------(THIS COMPLETES THE H-4 LINE)----------

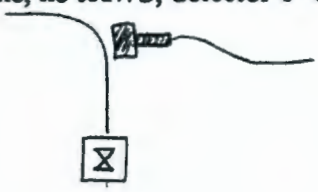
N-96-319-05 1000 second count E-3 to L-12 line, bend centered on doorway leading to stairwell, JAWS used, back lead shield used. Note: First shot on E-3 Line.

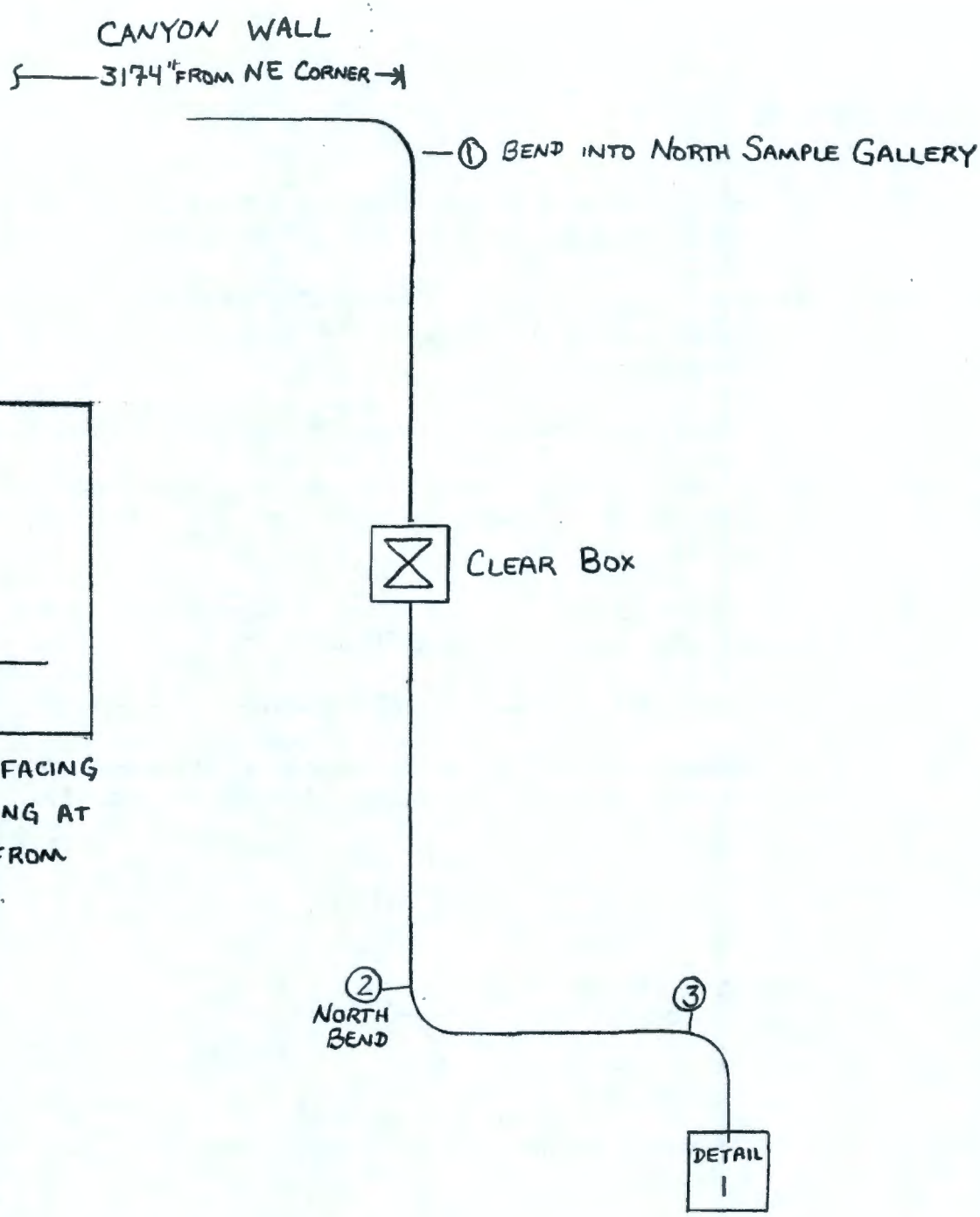


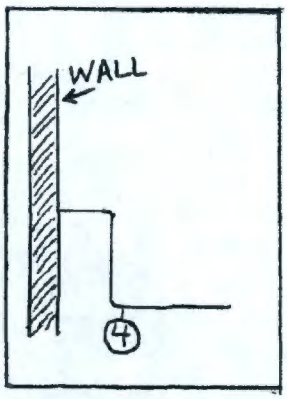
N-96-319-06 1000 second count, E-3 line, 84" in from doorway leading south, JAWS used, back shield used.



N-96-319-07 1000 second count on elbow of H-4 line, no JAWS, detector 6" away from pipe (6" elbow to shielding)





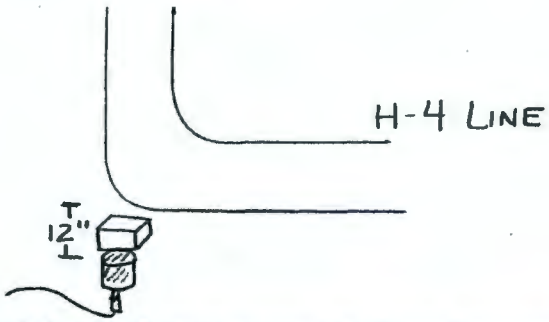


DETAIL 1: FACING EAST, LOOKING AT H-4 LINE FROM THE SIDE.

[signature]	1·31·97
NDAC Technician	Date
[signature]	1·31·97
Transcriptionist	Date
[signature]	01-31-97
NDAC Engineer	Date

NDAC Field Log **November 15, 1996**

N-96-320-00 1000 second background count, detector hanging vertically pointing at the H-4 elbow used as check source, lead brick covering the detector face, distance from detector face to elbow is 12".



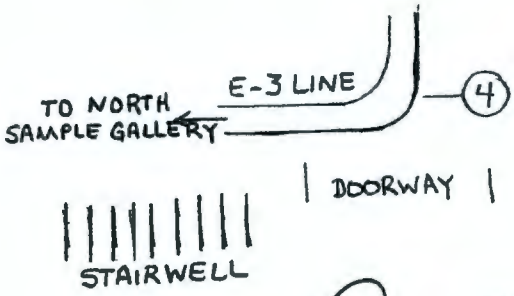
N-96-320-01 1000 second count exactly as above, however, brick is removed.

Note: Changed 9 volt battery.

N-96-320-02 1000 second count exactly as described in N9632000. However, a new 9V battery was installed prior to this count.

N-96-320-03 1000 second count as described in N9632001 except with new 9V battery.

N-96-320-04 1000 second count on elbow of E-3 line just inside doorway to stairwell. Elbow that makes the bend from west to south direction, JAWS used, lead back plate used.



Dan Mobel 1·31·97
NDAC Technician Date

Richard L Hatton 1·31·97
Transcriptionist Date

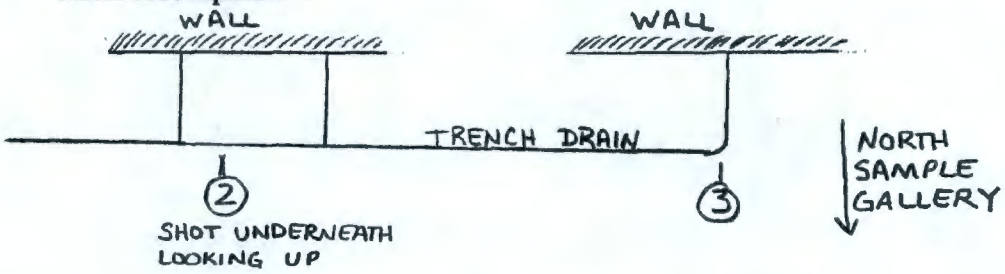
John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **November 18, 1996**

N-96-323-00 300 second source check on H-4 line, brick on detector, distance equals 12".

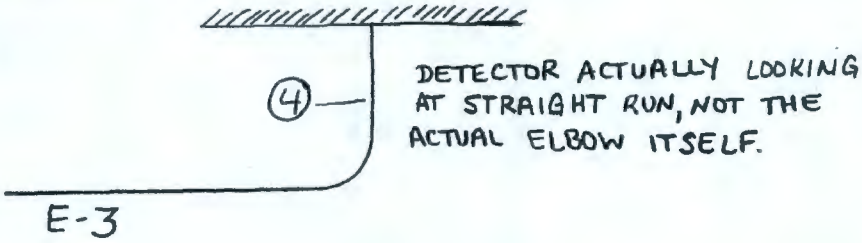
N-96-323-01 300 second source check on H-4 line, brick removed, distance equals 12".

N-96-323-02 300 second count of trench drain line where both lines come into the single line (H-connection). Lead blankets in place to shield background. Distance of pipe to shield face equals 6".



N-96-323-03 1000 second count on elbow where single trench drain comes out of wall, shot taken from below, looking up. Lead blanket in place to shield down background. Distance from pipe to shield face equals 6".

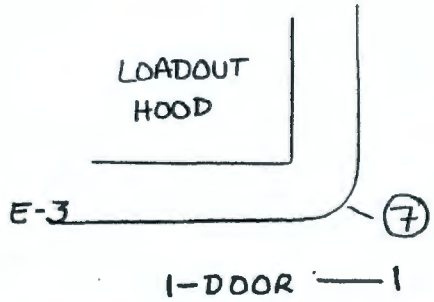
N-96-323-04 1000 second count on first elbow of E-3 line just as it comes out of the wall. JAWS installed to fit around 2" pipe. Lead blankets used to shield down background from Cs-137 influence of other piping.



N-96-323-05 100 second source check on H-4 elbow due to out of the ordinary peak at Marker 40 in shot N9632304. This is just to verification source check. Detector shield 12" from pipe.

N-96-323-06 300 second count, 38" from first elbow in E-3 line (heading west), ⅛" lead sheeting placed trying to simulate JAWS and knock down background. Detector shield is about 5 ½" from pipe. Detector hanging vertical looking straight up.

N-96-323-07 1000 second count directly below E-3 elbow just inside doorway to stairwell. Lead sheets used to simulate JAWS. Detector 6" below pipe (6" pipe to shield).



N-96-323-08 300 second end of the day source check on H-4 elbow. Detector shield 12" from pipe, lead brick on.

N-96-323-09 300 second end of the day source check on H-4 elbow. Detector shield 12" from pipe, lead brick off.

Dan Mydel 1·31·97
NDAC Technician Date

Michael L. Hatton 1·31·97
Transcriptionist Date

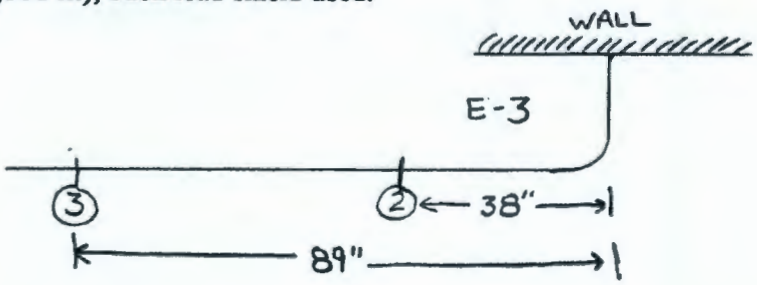
John P. Smith 01-31-97
NDAC Engineer Date

NDAC Field Log **November 19, 1996**

N-96-324-00 300 second source check, H-4 elbow, with brick, 12" distance pipe to detector shield.

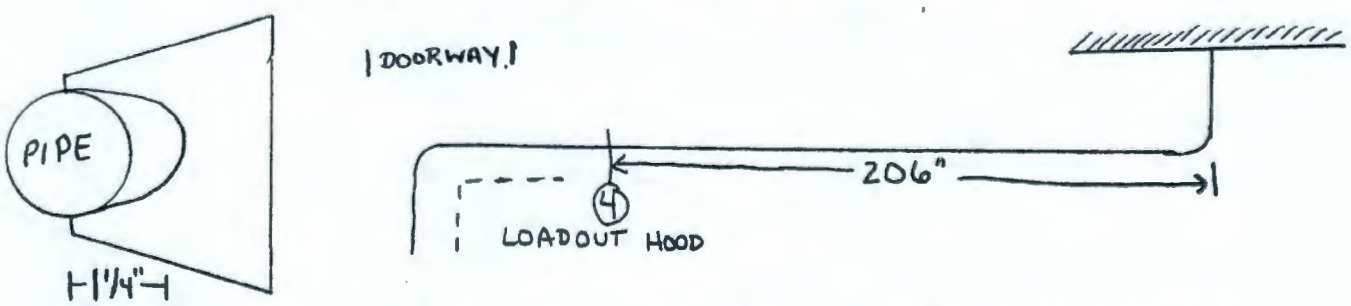
N-96-324-01 300 second source check, H-4 elbow, without brick, 12" distance pipe to detector shield.

N-96-324-02 300 second count on E-3 line, 38" downstream of wall penetration, JAWS used (good fit), back lead shield used.



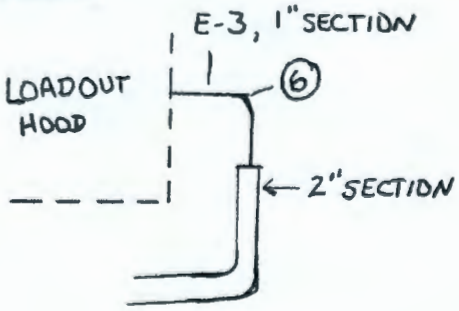
N-96-324-03 300 second count on E-3 line, 89" downstream of wall penetration, JAWS used (good fit), no back lead shield plate.

N-96-324-04 1000 second count on E-3 line, 206" downstream of wall penetration, JAWS used but pipe offset out of JAW 1 ¼" (see below), lead shielding placed around detector to compensate for lack of shielding form JAWS.



N-96-324-05 1000 second count on E-3 line at 2" to 1" reduction site. Lead blankets used to knock down background from loadout hood. Detector shield 6" from pipe.

N-96-324-06 600 second count on E-3 line (1" section) on elbow as it turns toward loadout hood. Detector shield 6" from pipe. No lead shielding due to difficulty in hanging the blankets.



N-96-324-07 300 second source check with brick, H-4 line.

N-96-324-08 300 second source check without brick, H-4 line.

Dan Moder 1·31·97
NDAC Technician Date

Cedric L Hutton 1·31·97
Transcriptionist Date

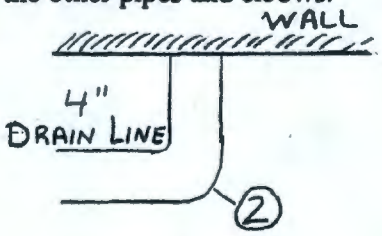
John P. Lenz 01-31-97
NDAC Engineer Date

NDAC Field Log **November 20, 1996**

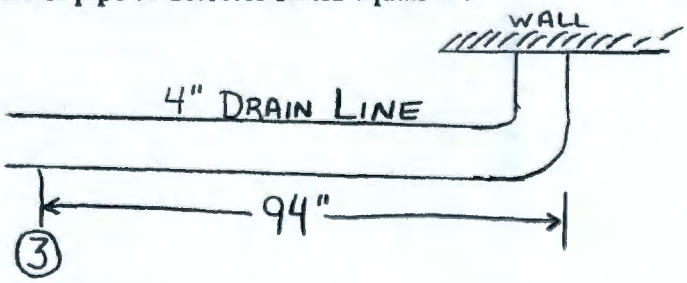
N-96-325-00 Source check, 300 second, H-4 elbow, with brick, 12" distance to pipe.

N-96-325-01 Source check, 300 second, H-4 elbow, without brick, 12" distance to pipe.

N-96-325-02 300 second count on 4" drain line elbow as it comes out of the wall. Detector shield is 6" from pipe. Lead blankets and heavy shielding used to knock out the contribution from the other pipes and elbows.

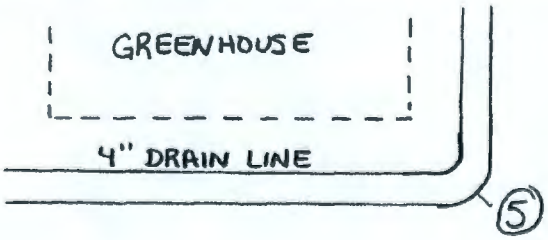


N-96-325-03 300 second count on 4" drain line, 94" downstream of elbow mentioned above. Lead blankets used over other bends (as above) and lead shielding placed around detector. Distance of pipe to detector shield equals 6".

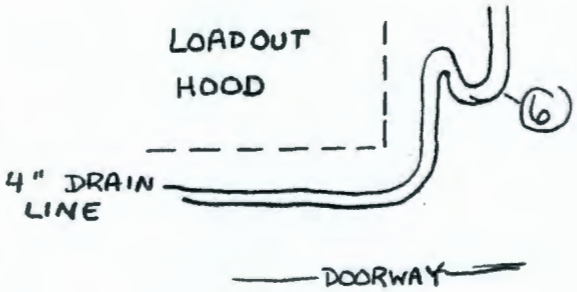


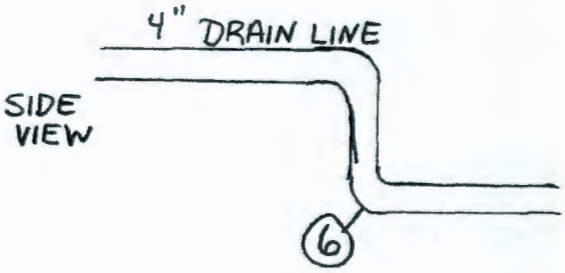
N-96-325-04 300 second count on 4" drain line, 198" from elbow (downstream of elbow). Shielding is the same as described above. Distance from pipe to detector shield equals 6".

N-96-325-05 600 second count on 4" drain line, on elbow as it makes the bend around the loadout hood. Elbow is down by doorway to stairwell. Heavy lead shielding used to knock down peak seen at this junction on the E-3 line.



N-96-325-06 600 second count on 4" drain line, lower elbow located 152" in from doorway to stairwell. 6" distance, detector shield to pipe.





N-96-325-07 Same exact shot as N9632506 except that another lead blanket was added for more shielding. Saw a hint of what might turn out to be a Np peak. Didn't make sense in drain line.

N-96-325-08 300 second count on E-4 to L-2 line at the valve station located near NW corner of the loadout hood and 120" in from the doorway. Lead blankets used to shield the detector. Distance pipe to detector shield equals 6".

N-96-325-09 300 second source check, H-4 elbow, with brick, at 12".

N-96-325-10 300 second source check, H-4 elbow, without brick, at 12".

NDAC Technician	1·31·97 Date
Transcriptionist	1·31·97 Date
NDAC Engineer	01-31-97 Date

NDAC Field Log **November 22, 1996**

Note: Calibration check with HPGe at RCT's trailer outside the fence at 233-S.

H-96-327-00 500 second background count with brick gain setting at 0.7001 x 40.

H-96-327-01 500 second background count with brick gain setting at 0.7001 x 40.

H-96-327-02 500 second count with Eu-152/154 source rolled up inside 2" schedule 40 pipe. 7" from front of pipe to front of shield. Gain setting at 0.7001 x 40.

H-96-327-03 500 second count with Eu-152/154 source rolled up inside 2" schedule 40 pipe. 7" from front of pipe to front of shield. Gain setting at 0.7001 x 100.

Dan Zyodel 1·31·97
NDAC Technician Date

Melinda L. Hatton 1·31·97
Transcriptionist Date

John P. Shelf 01-31-97
NDAC Engineer Date

NDAC Field Log **November 26, 1996**

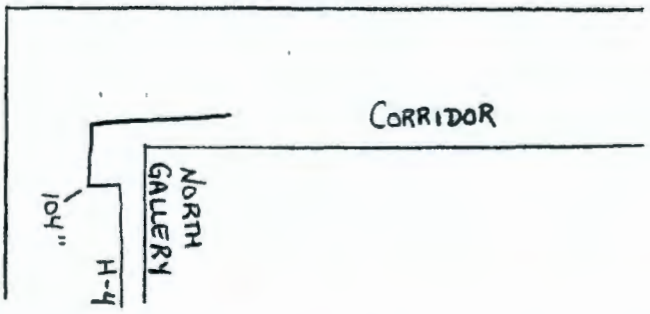
N-96-331-00 300 second count on hot spot elbow H-4 line gain approximately 0.8600 x 20 12" from elbow to front of shield.

N-96-331-01 300 second count with brick on hot spot elbow H-4 line. 12" from front of shield to elbow.

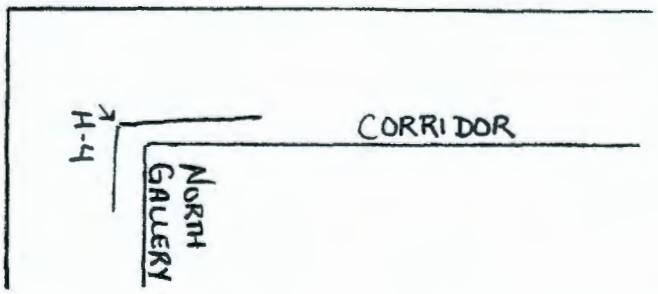
N-96-331-02 1800 second count on H-4 valve in north sample gallery close to the hood detector is underneath the valve pointed at an angle toward the hood. There is 4" from front of plexi-glass panel to front of shield. There are lead blankets around the resin line, approximately 7" from valve to front of shield.

N-96-331-03 1800 second count on H-4 valve wrapped in plastic on the side of the false wall in the middle of the north sample gallery. Count canceled 98% dead time. Detector was 6" from front of shield to front of valve.

N-96-331-04 1000 second count on H-4 elbow, 104" from the North-South corridor on the North Sample Gallery. 6" from front of pipe to front of shield.



N-96-331-05 1000 second count on H-4 elbow in the north sample gallery. Where the H-4 line run along the corridor between the north and south gallery. 6" from pipe to front of shield.



N-96-331-06 1000 second count on H-4 elbow in south gallery on bend at corridor. 6" from pipe to front of shield.

N-96-331-07 1000 second count on H-4 valve in south gallery where it comes out of H-cell. 66" from the floor to center of detector and 2" from front of shield to front of plexi-glass panel. Approximately another 14" to the valve.

N-96-331-08 300 second count on H-4 hot spot with brick for source check near hood. 12" from pipe to front of shield.

N-96-331-09 300 second count on H-4 hot spot without brick. 12" from pipe to front of shield.

Dan Moder 1.31.97
NDAC Technician Date

1.31.97
Transcriptionist Date

01-31-97
NDAC Engineer Date

NDAC Field Log **November 27, 1996**

H-96-332-00 600 second background count on hot spot elbow of H-4 with HPGe with brick. 7" from front of shield to front of pipe. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector.

H-96-332-01 600 second background count on hot spot elbow of H-4 with HPGe without brick. 7" from front of shield to front of pipe. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector.

H-96-332-02 2000 second background count on E-3 to L-12 line on elbow near the stairwell door in north sample gallery. 49" from the floor to the center of the back of the detector. 71" from the floor to the center of the front of the detector. 7" from front of shield to front of elbow. Detector is completely vertical with brick with ⅛" lead sheet wrapped around the gaps.

H-96-332-03 2000 second count on E-3 to L-12 elbow near the stairwell door in north sample gallery 49" from the floor to the center of the back of the detector. 71" from the floor to the center of the front of the detector. 7" from front of shield to front of elbow. Detector is completely vertical.

H-96-332-04 300 second background count with brick on H-4 hot spot elbow. 7" from front of shield to front of elbow. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector with ⅛" lead sheets covering the gaps.

H-96-332-05 300 second background count without brick on H-4 hot spot elbow. 7" from front of shield to front of elbow. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector.

Dan Models 1·31·97
NDAC Technician Date

1·31·97
Transcriptionist Date

01-31-97
NDAC Engineer Date

NDAC Field Log **December 2, 1996**

H-96-337-00 300 second background count on hot spot elbow of H-4 line in north sample gallery. 54" from the floor to the back center of the detector. 72" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

H-96-337-01 300 second background count on hot spot with brick elbow of H-4 line in north sample gallery. 54" from the floor to the back center of the detector. 72" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

H-96-337-02 2000 second count on elbow at north sample gallery at north and south corridor with brick. 57" from the floor to the center of the back of the detector. 74" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

H-96-337-03 2000 second count on elbow at north sample gallery at north and south corridor without brick. 57" from the floor to the center of the back of the detector. 74" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

H-96-337-04 2000 second count on elbow at south sample gallery at north and south corridor without brick. 57" from the floor to the center of the back of the detector. 74" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

H-96-337-05 2000 second count on elbow at south sample gallery at north and south corridor with brick. 57" from the floor to the center of the back of the detector. 74" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

H-96-337-06 2000 second count with brick on H-4 valve in south sample gallery. 69" from the floor to the center of the detector. Detector is centered on handle of the valve at about 5" from the front of the shield.

Ron Model 1·31·97
NDAC Technician Date

Cecilia J. Hutton 1.31.97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **December 3, 1996**

H-96-337-07 68,000 (20 hours) overnight count on H-4 valve in south sample gallery. 69" from the floor to the center of the back and front of the detector. Detector is centered on handle of the valve at about 5" from the front of the shield.

H-96-337-08 3600 second count with brick on H-4 valve in south sample gallery. 69" from the floor to the center of the back and front of the detector. Detector is centered on handle of the valve at about 5" from the front of the shield.

H-96-337-09 300 second count with brick on hot spot elbow H-4 in north sample gallery. 54" from the floor to the back center of the detector. 72" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

H-96-337-10 300 second count without brick on hot spot elbow of H-4 line in north sample gallery. 54" from the floor to the back center of the detector. 72" from the floor to the center of the shield. 7" from the front of the pipe to the front of the shield.

Dan Yoder 1·31·97
NDAC Technician Date

Cheryl L. Hutton 1·31·97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **December 5, 1996**

H-96-340-00 1000 second count with smear sample #15 from 1" valve on H-4 line near process hood. Smear is sealed in a planchet centered on face of the detector with lead brick covering the shield, no filter.

H-96-340-01 1800 second count with smear sample #15. Smear is sealed in a planchet centered on face.

H-96-340-02 1800 second background count with brick, with filters in RBA Redox.

H-96-340-03 1300 second background count with brick, without filters in RBA Redox.

Dan Yoder 1·31·97
NDAC Technician Date

Debbie L. Hilton 1·31·97
Transcriptionist Date

[illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **December 6, 1996**

H-96-341-00 300 second count on hot spot elbow on H-4 line near hood without brick. 54" from the center of the back of the detector to the floor. 74" from the floor to the center of the front of the detector. 7" from front of elbow to front of shield.

H-96-341-01 300 second count on hot spot elbow on H-4 line near hood without brick. 54" from the center of the back of the detector to the floor. 74" from the floor to the center of the front of the detector. 7" from front of elbow to front of shield.

H-96-341-02 2000 second count on bigger H-4 valve in north sample gallery. 54" from the center of the back of the detector to the floor. 74" from the floor to the center of the front of the detector. 7" from the front of the elbow to front of the shield with brick in front. Detector front is facing the hood.

H-96-341-03 2000 second count on bigger H-4 valve in north sample gallery . 54" from the center of the back of the detector to the floor. 74" from the floor to the center of the front of the detector. 7" from the front of the elbow to front of the shield with brick in front. Detector front is facing the hood.

H-96-341-04 2000 second count on small valve on 1" line going toward the process hood. The detector is vertically positioned underneath the valve. 7" from front of valve to front of shield.

H-96-341-05 2000 second count on small valve on 1" line going toward the process hood. The detector is positioned vertically underneath the valve. 7" from the front of valve to front of shield with brick.

H-96-341-06 300 second count on hot spot elbow on H-4 line near the process hood with brick. 54" from the center of the back of the detector to the floor. 74" form the floor to the center of the front of the detector. 7" from the front of the elbow to the front of the shield.

H-96-341-07 300 second count on hot spot elbow on H-4 line near the process hood without brick. 54" from the center of the back of the detector to the floor. 74" form the floor to the center of the front of the detector. 7" from the front of the elbow to the front of the shield.

Dan Yoder 1·31·97
NDAC Technician Date

Ulrike G. Hatton 1·31·97
Transcriptionist Date

John P. [illegible] 01-21-97
NDAC Engineer Date

NDAC Field Log **December 9, 1996**

Note: Gain at 0.7001 x 100 HPGe

H-96-344-00 300 second count on hot spot elbow on H-4 line near hood without brick. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector. 7" from the front of the pipe to the front of the shield.

H-96-344-01 300 second count on hot spot elbow on H-4 line near hood with brick. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector. 7" from the front of the pipe to the front of the shield.

H-96-344-02 2000 second count centered on valve on H-4 line in the middle of the north sample gallery. 95" from the floor to center of the detector. 35" from the center of the valve to the front of the shield.

H-96-344-03 2000 second count centered on valve on H-4 line in the middle of the north sample gallery with brick. 95" from the floor to center of the detector. 35" from the center of the valve to the front of the shield.

H-96-344-04 300 second count on hot spot elbow on H-4 line near hood without brick. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector. 7" from the front of the pipe to the front of the shield.

H-96-344-05 300 second count on hot spot elbow on H-4 line near hood with brick. 54" from the floor to the center of the back of the detector. 72" from the floor to the center of the front of the detector. 7" from the front of the pipe to the front of the shield.

Note: Gain at 0.8498 x 20

N-96-344-00 300 second count on hot spot elbow on H-4 line near hood 12" from front of pipe to front of shield without brick.

N-96-344-01 300 second count on hot spot elbow on H-4 line near hood 12" from front of pipe to front of shield with brick.

N-96-344-02 1000 second count on smaller valve on L-16 to E-3 line header toward process hood, branching off the H-4 line. 6" from front of detector to front of shield.

N-96-344-03 300 second count on hot spot elbow on H-4 line near hood. 12" from front of pipe to front of shield without brick.

N-96-344-04 300 second count on hot spot elbow on H-4 line near hood. 12" from front of pipe to front of shield with brick.

Note: The glovebag to cover the opening in the Hood is expected on or about December 16. The HPGe appears ready.

Dan Moder 1·31·97

NDAC Technician Date

1·31·97

Transcriptionist Date

01-31-97

NDAC Engineer Date

NDAC Field Log **December 10, 1996**

H-96-345-00 1000 background count with brick inside RCT's trailer outside fence at 233-S.

H-96-345-01 2000 second count with Eu-152/154 source. 35" from center of pipe to front of shield.

Dan Moder 1·31·97
NDAC Technician Date

Michael L. Hatton 1·31·97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **December 12, 1996**

N-96-347-00 62000 second count inside 233-S on sump in the Loadout room. The detector is placed vertically on top with shield over the sump with open collimation.

N-96-347-01 1000 second bkg count inside 233-S inside the Loadout room. The detector is facing away from the Loadout Hood into the change room. Detector is horizontal with open collimation and with brick over the front of the shield.

N-96-347-02 1000 second bkg count with brick in RCT's trailer outside fence at 233-S.

N-96-347-03 2000 second count with Eu-152 source 12" from front of shield to front of source in RCT's trailer outside the fence.

N-96-347-04 60 second count with Eu-152 source folded up and detector and shield placed on top shooting down on the source.

N-96-347-05 60 second count with Eu-152 source folded up and detector and shield placed on top shooting down on the source with gain tweaked down.

Ron Goodel 1·31·97
NDAC Technician Date

Melissa L. Nutter 1·31·97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **December 16, 1996**

Note: Glovebag not expected until Friday, to be installed on Monday, December 23. Would not be able to get much done over XMAS anyway. Re-shoot valves and other pipes.

H-96-351-00 300 second count on hot spot elbow H-4 line without brick. 54" from floor to center of back of the detector. 74" from floor to center of front of the detector. 7" from front of pipe to front of shield.

H-96-351-01 300 second count on hot spot elbow H-4 line with brick. 54" from floor to center of back of detector. 74" from floor to center of front of the detector. 7" from front of pipe to front of shield.

H-96-351-02 1000 background count with brick on bigger valve on H-4 line near hood. 7" from the front of valve to front of shield. Detector is vertical underneath the Spm valve.

H-96-351-03 62000 second count on bigger H-4 valve on H-4 line near hood. 7" from the front of valve to front of shield. Detector is vertical underneath the valve.

H-96-351-04 1000 second count with brick on bigger valve on H-4 line near hood. 7" from the front of valve to front of shield. Detector is vertical underneath the valve.

H-96-351-05 300 second count on hot spot elbow H-4 line with brick 54" from floor to center of the back of the detector. 74" from the floor to the center of the front of the detector. 7" from front of the pipe to front of shield.

H-96-351-06 300 second count on hot spot elbow H-4 line without brick 54" from floor to center of the back of the detector. 74" from the floor to the center of the front of the detector. 7" from front of the pipe to front of shield.

1·31·97
NDAC Technician Date

1·31·97
Transcriptionist Date

01-31-97
NDAC Engineer Date

NDAC Field Log **December 17, 1996**

H-96-352-00 300 second count on hot spot elbow H-4 line without brick 54" from floor to center of the back of the detector. 74" from the floor to the center of the front of the detector. 7" from front of the pipe to front of shield.

H-96-352-01 300 second count on hot spot elbow H-4 line with brick 54" from floor to center of the back of the detector. 74" from the floor to the center of the front of the detector. 7" from front of the pipe to front of shield.

H-96-352-02 300 second count on 1" line west of the E-14 tank inside process hood the line runs into the E tank, the line is about 8" in front he plexiglass panel and is reading about 8 mR/hr on contact with plexiglass. The detector is positioned horizontally 46" from the floor to the center of the detector. 6" from the front of the detector to the front of the panel.

H-96-352-03 62000 second count E-3 to L-12 line at elbow near stairwell. 7" from front of elbow to face of shield.

H-96-352-04 1000 background count on E-3 to L-12 line at elbow near stairwell with brick. 7" from front of elbow to face of shield.

H-96-352-05 300 second count with brick on hot spot elbow. 7" from front of shield to front of pipe.

H-96-352-06 300 second count without brick on hot spot elbow. 7" from front of shield to front of pipe.

Dan Zadel 1·31·97
NDAC Technician Date

Velma L. Hutton 1·31·97
Transcriptionist Date

John P. [illegible] Jr. 01-31-97
NDAC Engineer Date

NDAC Field Log **December 18, 1996**

H-96-353-00 300 second count without brick on hot spot elbow H-4 line. 7" from front of shield to front of pipe.

H-96-353-01 300 second count with brick on hot spot elbow H-4 line. 7" from front of shield to front of pipe.

H-96-353-02 43000 second count of 4" drain line in between the west wall and the process hood. Dose rate on contact 11 mR/hr. The floor drain line is 53" from the floor to center of pipe. From the floor to center of the front of the detector is 47". 28" from the floor to center of the back of the detector. 5 ½ from front of pipe to front of 1" collimator.

H-96-353-03 1000 second background count with brick on 4" drain line in between the west wall and the process hood.

H-96-353-04 300 second count without brick on hot spot elbow H-4 line. 7" from front of shield to front of pipe.

H-96-353-05 300 second count with brick on hot spot elbow H-4 Line. 7" from front of shield to front of pipe.

Dan Moder 1·31·97
NDAC Technician Date

Lakisha Y. Hutton 1·31·97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **December 19, 1996**

H-96-354-00 300 second count with brick on hot spot elbow H-4 line. 7" from front of shield to front of pipe.

H-96-354-01 300 second count without brick on hot spot elbow H-4 line. 7" from front of shield to front of pipe.

H-96-354-02 62000 second count on 4" drain line on elbow near stairwell door. 4" from front of pipe to front of shield with detector under the elbow vertically.

H-96-354-03 1000 second count with brick on 4" drain line elbow near stairwell door. 4" from front of pipe to front of shield with detector under the elbow vertically.

H-96-354-04 300 second count with brick on hot spot elbow H-4 line. 7" from front of shield to front of pipe.

H-96-354-05 300 second count without brick on hot spot elbow H-4 line. 7" from front of shield to front of pipe.

Dan Yoder 1·31·97
NDAC Technician Date

Debbie J. Helton 1·31·97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **December 26, 1996**

H-96-361-00 1000 second background count with brick inside RCT's Trailer at 233-S.

H-96-361-01 1000 second background count with brick, with 1" collimator inside RTC's Trailer at 233-S. #1

H-96-361-02 1000 second background count with brick, with 1" collimator inside RCT's Trailer at 233-S. #2

1·31·97
NDAC Technician Date

1·31·97
Transcriptionist Date

01·31-97
NDAC Engineer Date

NDAC Field Log **December 31, 1996**

H-96-366-00 1000 second background count with brick inside RCT's Trailer at 233-S.

H-96-366-01 1000 second background count with brick, with 1" collimator inside RCT's Trailer at 233-S.

Note: Source is folded and centered inside. 4" schedule 40 pipe source is Eu-152/154, 5" long, 2 ½" wide. Pipe is 3' long.

H-96-366-02 1000 second count with 1" collimator. Eu-152 centered inside 4" schedule 40 pipe source on table. 5 ½" from front of pipe to front of collimator.

H-96-366-03 600 second count. Eu-152 source centered inside 4" schedule 40 pipe source on table. 4" from front of pipe to front of shield.

H-96-366-04 300 second count Eu-152 source centered inside 4" schedule 40 pipe. Center of source centered on middle of can. 4" from front of pipe to front of shield.

H-96-366-05 1000 second count with 1" collimator. Eu-152 source centered inside 4" schedule 40 pipe. Center of source centered on middle of collimator. 5 ½" from front of pipe to front of collimator.

Dan Yoder 1·31·97
NDAC Technician Date

Leslie G. Shelton 1·31·97
Transcriptionist Date

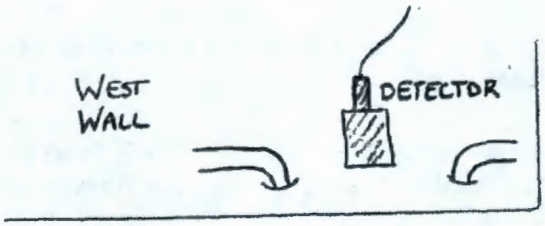
John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **January 7, 1997**

N-97-007-00 300 second count on hot spot elbow H-4 line. 6" from front of pipe to front of shield.

N-97-007-01 300 second count on hot spot elbow H-4 line with brick. 6" from front of pipe to front of shield.

N-97-007-02 300 second count inside hood 202-S approximately 6" from sump to front of shield.



N-97-007-03 Same

Dan Zodel 1·31·97
NDAC Technician Date

Richard L. Hatton 1·31·97
Transcriptionist Date

John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **January 8, 1997**

N-97-008-00 300 second background count with detector sitting on ledge inside hood detector facing east.

N-97-008-01 300 second count on pile of stuff on floor 6" away from floor to front of detector.

N-97-008-02 300 second count on pile of material sitting on ledge of the E-16 tank 6" from material to front of shield.

N-97-008-03 300 second background count 4' from floor to front of detector. Detector hanging off toward the west wall hanging over the E-16 tank approximately 3'. Decontaminated the shield and tape measure re-shot background. (N9700804)

N-97-008-04 Same.

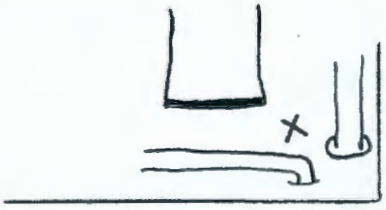
N-97-008-05 300 second count on sump inside the hood with detector positioned over 1½" line. 6" from floor to front of shield.

N-97-008-06 300 second count on sump inside the hood with detector positioned in the corner where the walls come together. 6" from floor to front of shield.

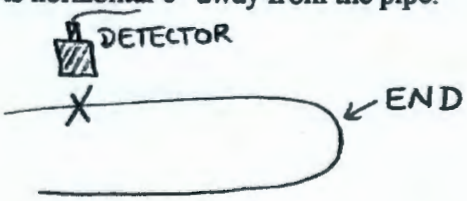
N-97-008-07 300 second count on sump inside the good with detector positioned over the 2" pipe elbow. 6" from floor to front of shield.

N-97-008-08 300 second count on sump inside the hood with detector positioned in between the 2" and the 1½" pipes.

N-97-008-09 300 second count on sump inside the hood with detector positioned in between the two pipes closer to the E-16 tank.



N-97-008-10 300 second count of pipe paralleling the North wall of pit 12" from the end of the pipe. Detector is horizontal 6" away from the pipe.



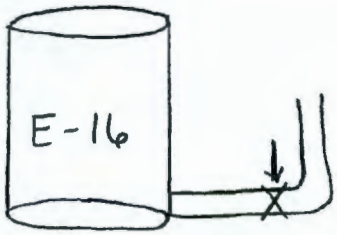
N-97-008-11 Calibration check on sump. 300 second count.

[signature]	1·31·97
NDAC Technician	Date
[signature]	1·31·97
Transcriptionist	Date
[signature]	01-31-97
NDAC Engineer	Date

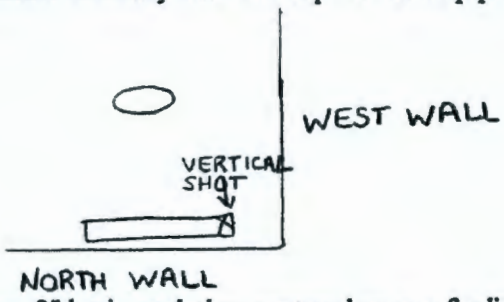
NDAC Field Log **January 10, 1997**

N-97-010-00 300 second count on sump inside process hood 202-S. 6" from floor to front of shield.

N-97-010-01 300 second count on 2" line going into the E-16 tank on elbow 6" from front of pipe to front of shield.



N-97-010-02 300 second count on 2" horizontal pipe, centered on cap for line going into E-16 tank. Detector is positioned vertically over the cap. 6" from pipe to front of shield.



N-97-010-03 300 second count on 2" horizontal pipe, centered on cap for line going into E-16 tank. Detector is positioned horizontally over the cap. 6" from pipe to front of shield.

Dan Zgodet 1·31·97
NDAC Technician Date

1·31·97
Transcriptionist Date

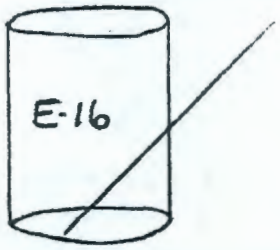
01-31-97
NDAC Engineer Date

NDAC Field Log **January 13, 1997**

H-97-013-00 300 second count on hot spot elbow H-4 line 23" from front of shield to front of elbow. (7" from base plate to end of snout.)

H-97-013-01 300 second background count with brick (lead sheet) on hot spot elbow H-4 line. 23" from front of shield to front of elbow.

H-97-013-02 2000 second count of E-16 tank. 19" from floor to center of snout. 4' from floor to back of detector. 3" from plexiglass panel to center of snout middle/bottom of tank.



H-97-013-03 1000 second background count with lead blanket and lead sheets.

H-97-013-04 62000 second count on floor inside hood. 18" floor to center of detector. 35" to back center of fill cap of detector snout is about 2" past the panel.

H-97-013-05 2000 second background count with 2 lead sheets in front of the snout. Same conditions as above.

H-97-013-06 1000 second background count redone for shot H9701303 with lead sheet covering the snout.

H-97-013-07 1000 second background count on the top portion of the E-16 tank. 5" from the plexiglass panel opening to the front of the snout. 15½" from the floor to the center of the snout. 17" from the floor to the back center of the detector.

H-97-013-08 2000 second count on the top portion of the E-16 tank. Conditions same as above.

H-97-013-09 2000 second count of the flange between the tower and the tank of the E-16. 5" from the plexiglass panel opening to the front of the snout. 17" from the floor to the front of the center of the snout. 19" from the floor to the front of the center of the snout.

H-97-013-10 1000 second background count with lead sheeting. Sam conditions as before (above).

H-97-013-11 2000 second count on bottom of E-17 tank. Snout is flush with panel opening. 16" from the floor to the center of the snout. 33" from the floor to the center of the back of the detector.

H-97-013-12 300 second background count on hot spot elbow H-4 line.

Note: Must finish all shots this week. Only take necessary shots. GJC has committment to produce report by January 31.

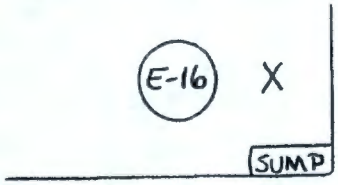
Dan Zyoch 1·31·97
NDAC Technician Date

Linda L. Nelson 1·31·97
Transcriptionist Date

John P [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **January 15, 1997**

H-97-015-00 60000 second count on floor inside of hood. 3" from plexiglass panel opening to front of snout. 18" from floor to center of snout. 46" from floor to back center of dewar.



H-97-015-01 1000 second background count with lead sheet. Same conditions as above.

NDAC Technician 1·31·97 Date

Transcriptionist 1·31·97 Date

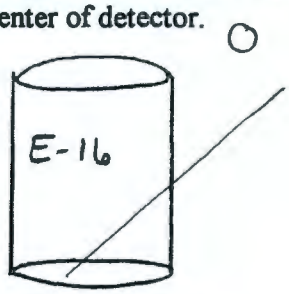
NDAC Engineer 01-31-97 Date

NDAC Field Log **January 16, 1997**

H-97-016-00 300 second count on hot spot elbow H-4 line with snout collimator on 12" from front of shield to front of elbow. 52" from floor to back center on dewar. 72" from floor to front center of the shield.

H-97-016-01 300 second background count on hot spot elbow H-4 line. Same conditions as above.

H-97-016-02 2000 second count on E-16 tank at the center of the bottom with snout 2" from plexi-panel opening to front of snout. 20½" from floor to center of snout. 49" from floor to back center of detector.



H-97-016-03 1000 second count on E-16 tank with lead sheets in front of snout. Same conditions as above.

H-97-016-04 2000 second count on E-16 tank at the center of the middle with snout 2" from the plexi-glass opening to the snout.
15" from the floor to the center of the snout.
35" from the floor to the back center of the snout.

H-97-016-05 1000 second background count with lead sheets. Same conditions as above.

H-97-016-06 2000 second count on the E-16 tank where the tower and the tank sections come together. 3" inside the hood from the plexiglass panel opening. 19" from center on both front and back of the dewar and snout to the floor.

H-97-016-07 1000 second background count with lead sheets. Same conditions as above.

H-97-016-08 2000 second count on the E-16 tower about 1' up from the letters "E-16".
4" from the plexiglass opening to the front of the snout.
33" from the floor to the back center of the dewar.
53" from the floor to the front center of the detector.

H-97-016-09 1000 second background count with lead sheet on E-16 tower about 1' up from the letters "E-16". Same conditions as above.

H-97-016-10 300 second count on hot spot elbow H-4 line with snout collimator on 12" from front of shield to front of elbow. 52" from the floor to the back center of the dewar.
72" from the floor to the front center of the detector.

H-97-016-11 300 second background count on hot spot elbow H-4 line. Same conditions as above.

Note: Detector (HPGe) may be having problems. Probably due to the extremely cold temperatures. When warm, detector appears to function properly. Pre-Amp cable 9-pin connector replaced as a precaution.

Dan Zgodes 1·31·97
NDAC Technician Date

Michael L. Hatton 1·31·97
Transcriptionist Date

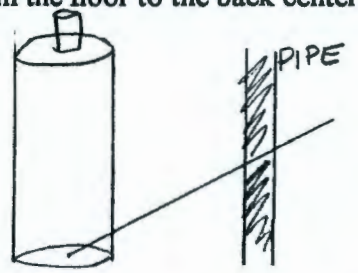
John P. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **January 17, 1997**

H-97-017-00 300 second background count with snout on hot spot elbow H-4 line. 12" from front of shield to front of pipe. 51" from floor to center of back of detector. 71" from floor to center of front of shield.

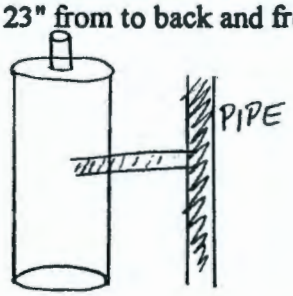
H-97-017-01 300 second background count with lead sheets over snout. Same conditions as above.

H-97-017-02 2000 second count on E-17 tank bottom with snout collimator. 3" from front of snout to front of plexiglass opening. 14½" from the floor to the center of the snout. 30" from the floor to the back center of the dewar.



H-97-017-03 1000 second background count with lead sheets on E-17 tank bottom. Same conditions as above

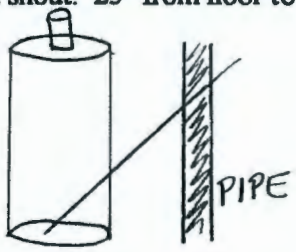
H-97-017-04 600 second count on E-17 tank middle. 2" from plexiglass panel opening to front of snout. 23" from to back and front center of detector.



H-97-017-05 600 second background count with lead sheet on E-17 tank middle. Conditions same as above.

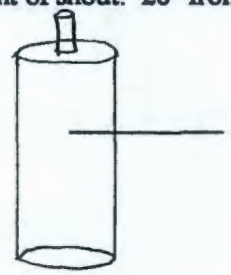
H-97-017-06 Count of hot spot elbow H-4.

H-97-017-07 1000 second count on E-17 tank bottom. 4" from front of plexiglass panel opening to front snout. 25" from floor to center of snout. 47" from floor to center of dewar.



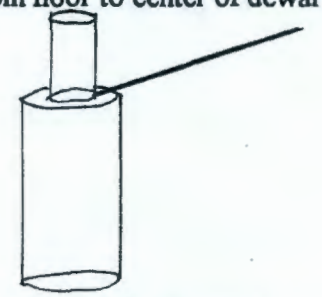
H-97-017-08 500 second background count on E-17 tank bottom with lead sheet in front of snout. Same conditions as above.

H-97-017-09 1000 second count on E-17 tank middle 5" from front of plexiglass panel opening to front of snout. 28" from floor to center of snout. 28" from floor to center of dewar.



H-97-017-10 500 second background count with lead sheet on E-17 tank middle. Same conditions as above.

H-97-017-11 1000 second count on E-17 interface between tower and tank. 4" from front of plexiglass panel opening to front of snout. 47" from floor to center of snout. 54" from floor to center of dewar.



H-97-017-12 500 second background count with lead sheet on E-17 tank interface. Same conditions as above.

H-97-017-13 300 second count on hot spot elbow H-4 line, 12" from front of shield to front of pipe. 72" from the floor to front of the shield. 52" from the floor to back of the dewar.

H-97-017-14 300 second background count on hot spot elbow H-4 line with lead sheet over the pipe. Same conditions as above.

Dan Yoder 1·31·97
NDAC Technician Date

Edwin L. Hetter 1·31·97
Transcriptionist Date

John R. [illegible] 01-31-97
NDAC Engineer Date

NDAC Field Log **January 23, 1997**

Note: Calibration with HPGe with Eu-152 source inside RCT's trailer at 233-S. Source is folded and is 5" long, 2" wide 1½" deep.

H-97-023-00 600 second count with snout with Eu-152 source centered inside 2" pipe. 23" from front of shield to front of pipe. Count #1.

H-97-023-01 600 second count with snout with Eu-152 source centered inside 2" pipe. 23" from front of shield to front of pipe. Count #2.

H-97-023-02 600 second count with snout with bare Eu-152 source centered 2' from front of snout to front of source. Count #1.

H-97-023-03 600 second count with snout with bare Eu-152 source centered 2' from front of snout to front of source. Count #2.

H-97-023-04 600 second count with snout with bare Eu-152 source centered 3' from front of snout to front of source. Count #1.

H-97-023-05 600 second count with snout with bare Eu-152 source centered 3' from front of snout to front of source. Count #2.

H-97-023-06 1000 second count with snout with bare Eu-152 source centered 4' from front of snout to front of source. Count #1.

H-97-023-07 4000 second count with snout with bare Eu-152 source centered 4' from front of snout to front of source.

H-97-023-08 4000 second count with snout with bare Eu-152 source centered 5' from front of snout to front of source.

H-97-023-09 6000 second count with snout with bare Eu-152 source centered 6' from front of snout to front of source.

H-97-023-10 300 second count open collimation with Eu-152 source 15" from front of shield to front of 2" pipe. Count #1.

H-97-023-11 300 second count open collimation with Eu-152 source 15" from front of shield to front of 2" pipe. Count #1.

Dan Moody 1·31·97

NDAC Technician Date

Deborah L. Hutton 1·31·97

Transcriptionist Date

John P. [illegible] 01-31-97

NDAC Engineer Date

Attachment B

Calibration Certificates and Data

Los Alamos National Laboratory

Certificate of Content and Traceability

Department of Energy Carlsbad Area Office
Working Reference Material # NTP-0124

PuO_2-Diatomaceous Earth

This Working Reference Material (WRM) contains high purity plutonium dioxide dispersed in diatomaceous earth. Quantitative information and uncertainties on the nuclear content of this WRM are listed below. Complete information regarding the Pu and Am content, Pu isotopic ratios, chemical composition, elemental impurities, containment, and WRM fabrication procedure is described in the NDA PDP WRM Phase 1 Production Plan, CST-8-PLA-STD-104, and in files retained at the Idaho National Engineering Laboratory by the Lockheed Martin Idaho Technology Co. Transuranic Waste Department and at the Los Alamos National Laboratory Inorganic Elemental Analysis Group.

NUCLEAR MATERIAL CONTENT

The nuclear material content and total alpha activity for this WRM are listed below. Also listed are overall uncertainty estimates at 95% confidence intervals (CI) for each component.

Component	Quantity or Value	95 % CI
PuO_2 in WRM	3.3597 grams	± 0.0028 grams [a]
Pu Assay	87.827 % of PuO_2	± 0.072 % [b]
Pu in WRM	2.9507 grams	± 0.0025 grams [c]
^{241}Am Assay	766.7 µg/g PuO_2*	± 2.2 µg/g [d]
^{241}Am in WRM	2.576 mg*	± 0.0072 mg [e]
Isotopic Weight Fraction		
^{238}Pu	0.000145	± 0.000008 [f]
^{239}Pu	0.937614	± 0.000013 [f]
^{240}Pu	0.059445	± 0.000005 [f]
^{241}Pu	0.002237*	± 0.000008 [f]
^{242}Pu	0.000559	± 0.000004 [f]
Total Alpha Activity in WRM	227.5 mCi** 8.419E+09 Bq	± 0.8 mCi [g] ± 3E+07 Bq [g]

*Measured value on 7/15/95 ** Effective 7/15/95

Bill J. McKerley, Group Leader
Inorganic Elemental Analysis

Robert S. Marshall, Project Manager
NDA PDP WRM Production

Standards Laboratory
Radiation Source Certificate

Identification: 84B53

Description: Type Sheet Standard

Prepared by: D. J. Eirich on June 5, 1995

Cut 15 2-in. squares from Whatman QNA quartz microfiber filter paper and placed them on a sheet of tacky Mylar (DuPont). Dispensed 19.5588 g of 118B42, characterized europium-152 stock material. Allowed to air dry. Then, placed another piece of tacky Mylar on top for containment and sealing. The sheet was wrapped around a 1-gal plastic container and placed inside a metal carrier.

The given value is obtained by theoretical calculation based on the characterized value of the stock material.

Intended Use: Source

Calibration Values
t_0 = 6/05/95

Isotope	μCi source^{-1}
^{152}Eu	27.0

SPECIAL NOTE: Consult HSRCM-1, *Hanford Site Radiological Control Manual*, regarding the control of a radiation source. This source is certified for one year, however, it should be replaced on an eight month cycle. The user is responsible for proper control and disposal.

Signature: D. J. Eirich Date: 6/15/95
Senior Chemical Technologist

Signature: Leanna D. Carlum Date: 6-15-95
Responsible Chemist

Signature: Wayne W. Baird Jr Date: 6-15-95
W. W. Baird, Manager, AS Standards Laboratory

DON'T SAY IT --- *Write It!*

DATE: September 28, 1995

TO: G. Carter

FROM: LH Rodgers
T5-54

Telephone: 373-2185

CC: S. Hurlbut, G. Westsik, C Kronvall

SUBJECT: Sheet Standard accuracy estimate

The sheet standards were prepared a number of years ago by two methods. The first was to weigh out NBS Standard Pu metal on an analytical balance, dissolve the metal in acid and then apply all of the solution to the filter paper. The paper was allowed to dry and then encased in a plastic sheet for contamination control purposes. The second method was to assay Pu nitrate solution against NBS standard solutions and apply a precise amount to the filter paper. The rest of the process is the same as the metal produced standard. In conversations with the scientist involved in the standards preparation he felt comfortable that the accuracy of the standards is at least 0.5%.

Efficiency Calculation for NaI Detector
with the 90° Open Faced Collimator with Filters

Data from EG&G Ortec .SPC files from a Nomad Plus data acquisition system using combined 375 and 413 keV peaks from Pu-239, as observed on a 2" x 2" NaI detector.

JAWS field of view limiter not used.

PNNL 12 g Pu-239 standard in a 4" diameter can was used. Standard was approximately centered in the can. therefore, the distance to the effective center of the standard is 2".

The detector is recessed into the outer gamma shield by 2".

The distance from the face of the detector to the center of the standard, when the can is on contact with the front of the shield, is 4". Therefore, 4" was added to each of the distance measurements.

Steel pipe, 2" sch 40, has a 0.154" wall thickness. The transmission through to 0.154" Fe at 400 keV = 0.749. Efficiency data in the bottom table was corrected for transmission through this pipe.

Filename	BKG	ROI Gross area	ROI Net area	Uncertainty 1 sigma	Live Time (sec)	Corrected cps	1 sigma cps	Efficiency cps/g	Uncertainty cps/g	Uncertainty (percent)	MDA (cps)	Description
N96-306-05		483700	40000	387	100	400.000	3.870	33.333	0.323	0.968	0.566	100 sec cnt with standard #27 Pu-239 on contact
N96-306-06		482831	41957	368	100	419.570	3.680	34.964	0.307	0.877	0.538	100 sec cnt with standard #27 Pu-239 on contact
N96-306-19		218768	42755	323	100	427.550	3.230	35.629	0.269	0.755	0.334	100 sec cnt with standard #27 Pu-239 2in front to front shield
N96-306-20		218936	39404	284	100	394.040	2.840	32.837	0.237	0.721	0.366	100 sec cnt with standard #27 Pu-239 2in front to front shield
N96-306-21		330192	87741	566	300	292.470	1.887	24.373	0.157	0.645	0.191	300 sec cnt with standard #27 Pu-239 4in front to front shield
N96-306-22		328759	89062	575	300	296.873	1.917	24.739	0.160	0.646	0.187	300 sec cnt with standard #27 Pu-239 4in front to front shield
N96-306-23						ERR	ERR	ERR	ERR	ERR	ERR	300 sec cnt with standard #27 Pu-239 6in front to front shield
N96-306-24		207977	61421	495	300	204.737	1.650	17.061	0.138	0.806	0.212	300 sec cnt with standard #27 Pu-239 6in front to front shield
N96-306-25		153856	46567	434	300	155.223	1.447	12.935	0.121	0.932	0.239	300 sec cnt with standard #27 Pu-239 8in front to front shield
N96-306-26		154509	47679	443	300	158.930	1.477	13.244	0.123	0.929	0.233	300 sec cnt with standard #27 Pu-239 8in front to front shield
N96-306-27		114887	35102	378	300	117.007	1.260	9.751	0.105	1.077	0.274	300 sec cnt with standard #27 Pu-239 10in front to front shiel
N96-306-28		114359	36041	388	300	120.137	1.293	10.011	0.108	1.077	0.264	300 sec cnt with standard #27 Pu-239 10in front to front shiel
N96-306-29		88915	29182	353	300	97.273	1.177	8.106	0.098	1.210	0.285	300 sec cnt with standard #27 Pu-239 12in front to front shiel
N96-306-30		89086	28921	351	300	96.403	1.170	8.034	0.098	1.214	0.289	300 sec cnt with standard #27 Pu-239 12in front to front shiel

Distance	Corrected Distance	Corrected cps	Efficiency cps/g	Calc'd Efficiency cps/g	Shielded by 2" sch 40 pipe cps/g
0	4	409.8	34.1	44.0	25.6
2	6	394.0	32.8	32.9	24.6
4	8	294.7	24.6	24.2	18.4
6	10	204.7	17.1	17.6	12.8
8	12	157.1	13.1	12.9	9.8
10	14	118.6	9.9	9.8	7.4
12	16	96.8	8.1	8.1	6.0

3rd degree Polynomial Fit: y=a+bx+cx^2+dx^3...

Coefficient Data:

a =	74.4833
b =	-9.10866
c =	0.39534
d =	-0.005324

Efficiency Calculation for NaI Detector
with JAWS Field of View Limiter

Data from EG&G Ortec .SPC files from a Nomad Plus data acquisition system using combined 375 and 413 keV peaks from Pu-239, as observed on a 2" x 2" NaI detector.

JAWS field of view limiter used, therefore, only 6" of the active length is seen by the detector.

Calibration standard No. NTP-0124 (PNNL PDP standard) with a total activity of 2.9507 g Pu (93.7% is Pu-239) distributed along an active length of 10 inches.

The calibration standard was slipped snuggly into a 2-inch sch 40 section of pipe for calibration.

JAWS was centered on the pipe/source combination.

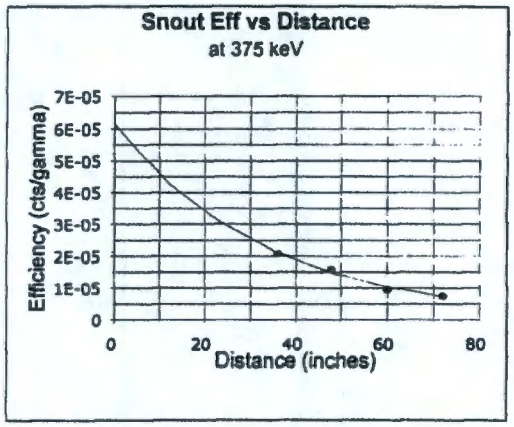
g-(Pu-239) = (2.9507 g) * (0.937614) * (6-in/10-in) 1.6600 g Pu-239

Filename	BKG	ROI Gross area	ROI Net area	Uncertainty 1 sigma	Live Time (sec)	Corrected cps	1 sigma cps	Efficiency cps/g	Uncertainty cps/g	(percent)	Description
N96-311-31		317335	85945	565	1000	85.945	0.565	51.775	0.340	0.657	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-32		315820	83503	551	1000	83.503	0.551	50.304	0.332	0.660	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-33		20054	4232	108	1000	4.232	0.108	2.549	0.065	2.552	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-34		20035	4600	119	1000	4.600	0.119	2.771	0.072	2.587	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-35		28223	7451	164	1000	7.451	0.164	4.489	0.099	2.201	1000 sec cnt w/ PDP source #Ntp-0124 bare on jaw
N96-311-36		27431	6470	144	1000	6.470	0.144	3.898	0.087	2.226	1000 sec cnt w/ PDP source #Ntp-0124 bare on jaw
N96-311-37		93142	22492	273	300	74.973	0.910	45.165	0.548	1.214	300 sec cnt w/ PDP source #Ntp-0124
N96-311-38		93632	25223	305	300	84.077	1.017	50.649	0.612	1.209	300 sec cnt w/ PDP source #Ntp-0124

avg = 50.9095 for 3 of the 4 data points, throwing out the low point
51.0395 for the 2 data points taken for 1000 s.

6" SNOUT EFFICIENCY at 375 keV

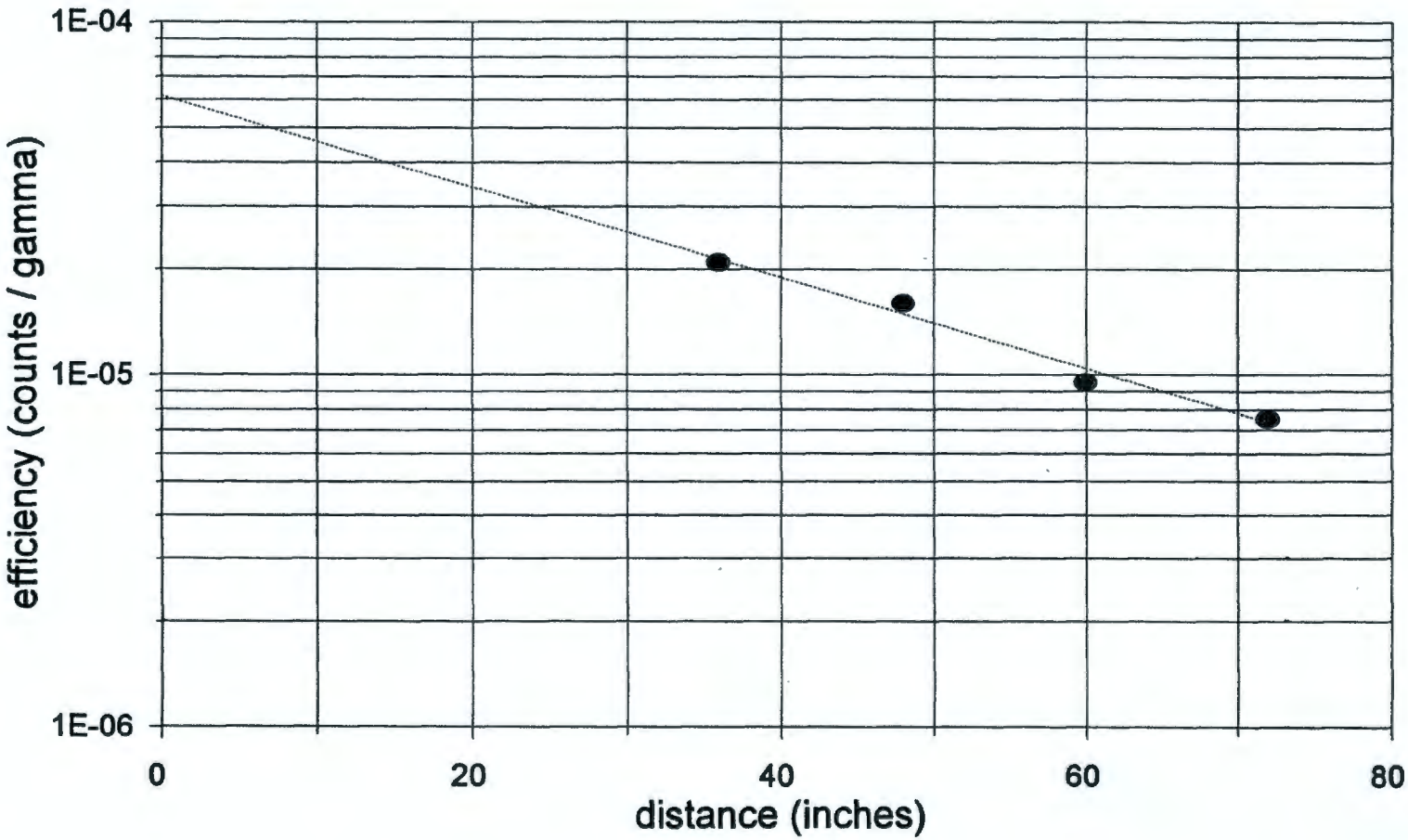
Distance (ft)	Distance (in)	Eff at 375 keV (counts per gamma)	Eff at 375 keV (Calc'd)
0	0		6.15E-05
1	12		4.31E-05
2	24		3.03E-05
3	36	2.09E-05	2.12E-05
4	48	1.60E-05	1.49E-05
5	60	9.50E-06	1.04E-05
6	72	7.48E-06	7.32E-06



Exponential Fit: y=ae^(bx)
Coefficient Data:
a = 6.152E-05
b = -0.029557

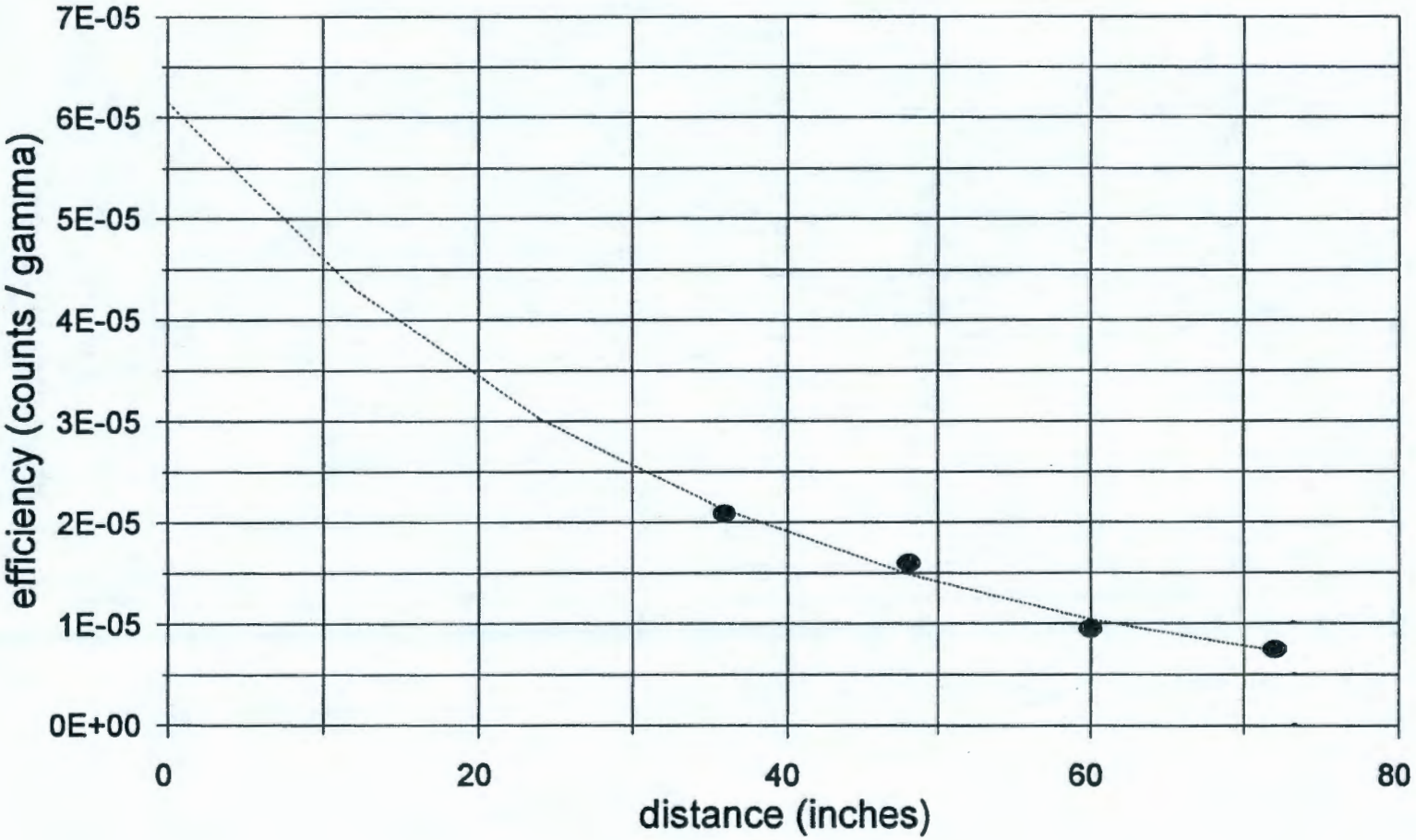
Snout Efficiency @ 375 keV vs distance

EQN: y = a*e^(bx)



Snout Efficiency @ 375 keV vs distance

EQN: y = a*e^(bx)



Attachment C

REDOX NaI Data

REDOX NaI DATA - November 1996 through January 1997

Filename	BKG	ROI Gross area (counts)	ROI Net area (counts)	Uncertainty 1 sigma (counts)	Live Time (sec)	Corrected ROI Activity (cps)	Uncertainty 1 sigma (cps)	Center Line Distance (inches)	Efficiency Type	Efficiency (cps/g)	Pu-239 (grams)	Uncertainty (1 sigma) (grams)	Uncertainty (1 sigma) (percent)	MDA (grams)	Shot Information Length (inches)	Shot Information Pu per 12" (grams)	Shot Information Filename	Description
*** 01-NOV-96 ***																	*** 01-NOV-96 ***	
N96-306-01		19355	-202	136	300	-0.673	0.453	2.5	OPEN	54.1	< MDA	—	—	0.024	N/A	N/A	N96-306-01	amcs 300 sec with filters
N96-306-02		19557	-405	142	300	-1.350	0.473	2.5	OPEN	54.1	< MDA	—	—	0.025	N/A	N/A	N96-306-02	amcs 300 sec with filters
N96-306-03		24433	-119	150	300	-0.397	0.500	2.5	OPEN	54.1	< MDA	—	—	0.027	N/A	N/A	N96-306-03	amcs 300 sec with filters
N96-306-04		24754	-509	159	300	-1.697	0.530	2.5	OPEN	54.1	< MDA	—	—	0.028	N/A	N/A	N96-306-04	amcs 300 sec without filters
N96-306-05		483700	40000	387	100	400.000	3.870	4	OPEN	44.0	9.084	0.088	0.968	0.426	N/A	N/A	N96-306-05	100 sec cnt with standard #27 Pu-239
N96-306-06		482831	41957	368	100	419.570	3.680	4	OPEN	44.0	9.528	0.084	0.877	0.427	N/A	N/A	N96-306-06	100 sec cnt with standard #27 Pu-239
N96-306-07	X	931	-131	41	300	-0.437	0.137	2	OPEN	57.8	< MDA	—	—	0.005	N/A	N/A	N96-306-07	300 bkg 300 sec no brick
N96-306-08	X	893	11	28	300	0.037	0.087	2	OPEN	57.8	0.001	0.001	236.364	0.005	N/A	N/A	N96-306-08	300 bkg 300 sec no brick
N96-306-09	X	819	-117	39	300	-0.390	0.130	2	OPEN	57.8	< MDA	—	—	0.005	N/A	N/A	N96-306-09	300 bkg 300 sec no brick
N96-306-10	X	771	159	20	300	0.530	0.067	2	OPEN	57.8	0.009	0.001	12.579	0.004	N/A	N/A	N96-306-10	bkg 300 sec with brick
N96-306-19		218788	42755	323	100	427.550	3.230	8	OPEN	32.9	12.990	0.098	0.755	0.361	N/A	N/A	N96-306-19	100 sec cnt with standard #27 Pu-239 2in front to front shield
N96-306-20		218936	39404	284	100	394.040	2.840	6	OPEN	32.9	11.972	0.086	0.721	0.365	N/A	N/A	N96-306-20	100 sec cnt with standard #27 Pu-239 2in front to front shield
N96-306-21		330192	87741	566	300	292.470	1.887	8	OPEN	24.2	12.091	0.078	0.645	0.192	N/A	N/A	N96-306-21	300 sec cnt with standard #27 Pu-239 4in front to front shield
N96-306-22		328759	89062	575	300	296.873	1.917	8	OPEN	24.2	12.273	0.079	0.646	0.191	N/A	N/A	N96-306-22	300 sec cnt with standard #27 Pu-239 4in front to front shield
N96-306-23		328759	89062	575	300	296.873	1.917	8	OPEN	24.2	12.273	0.079	0.646	0.191	N/A	N/A	N96-306-23	300 sec cnt with standard #27 Pu-239 6in front to front shield
N96-306-24		207977	61421	495	300	204.737	1.650	10	OPEN	17.6	11.629	0.094	0.808	0.205	N/A	N/A	N96-306-24	300 sec cnt with standard #27 Pu-239 6in front to front shield
N96-306-25		153856	48567	434	300	155.223	1.447	12	OPEN	12.9	12.025	0.112	0.932	0.240	N/A	N/A	N96-306-25	300 sec cnt with standard #27 Pu-239 8in front to front shield
N96-306-26		154509	47879	443	300	158.930	1.477	12	OPEN	12.9	12.313	0.114	0.929	0.239	N/A	N/A	N96-306-26	300 sec cnt with standard #27 Pu-239 8in front to front shield
N96-306-27		114887	35102	378	300	117.007	1.260	14	OPEN	9.8	11.892	0.128	1.077	0.271	N/A	N/A	N96-306-27	300 sec cnt with standard #27 Pu-239 10in front to front shield
N96-306-28		114359	36041	388	300	120.137	1.293	14	OPEN	9.8	12.210	0.131	1.077	0.269	N/A	N/A	N96-306-28	300 sec cnt with standard #27 Pu-239 10in front to front shield
N96-306-29		88915	29182	353	300	97.273	1.177	16	OPEN	8.1	11.945	0.144	1.210	0.284	N/A	N/A	N96-306-29	300 sec cnt with standard #27 Pu-239 12in front to front shield
N96-306-30		89086	28921	351	300	96.403	1.170	16	OPEN	8.1	11.838	0.144	1.214	0.285	N/A	N/A	N96-306-30	300 sec cnt with standard #27 Pu-239 12in front to front shield
*** 06-NOV-96 ***																	*** 06-NOV-96 ***	
N96-311-11	X	930	-159	44	300	-0.530	0.147	6	JAWS	51	< MDA	—	—	0.006	6	< 0.012	N96-311-11	300 sec bkg cnt with Jaws with Pipe with filters
N96-311-12	X	870	87	12	300	0.290	0.040	6	JAWS	51	0.006	0.001	13.793	0.005	6	0.011	N96-311-12	300 sec bkg cnt with Jaws with Pipe with filters
N96-311-13	X	934	-146	43	300	-0.487	0.143	6	JAWS	51	< MDA	—	—	0.006	6	< 0.012	N96-311-13	300 sec bkg cnt with Jaws with Pipe with filters no back shield
N96-311-14	X	837	-81	36	300	-0.270	0.120	6	JAWS	51	< MDA	—	—	0.005	6	< 0.011	N96-311-14	300 sec bkg cnt with Jaws with Pipe with filters no back shield
N96-311-15	X	875	101	8	300	0.337	0.027	6	JAWS	51	0.007	0.001	7.921	0.005	6	0.013	N96-311-15	300 sec bkg cnt w/ Jaws w/out Pipe w/ filters no back shield
N96-311-16	X	947	47	22	300	0.157	0.073	6	JAWS	51	0.003	0.001	46.809	0.006	6	0.006	N96-311-16	300 sec bkg cnt w/ Jaws w/out Pipe w/ filters no back shield
N96-311-17	X	878	156	17	300	0.520	0.057	6	JAWS	51	0.010	0.001	10.897	0.005	6	0.020	N96-311-17	300 sec bkg cnt w/ Jaws w/out Pipe w/ filters w/ back shield
N96-311-18	X	870	33	23	300	0.110	0.077	6	JAWS	51	0.002	0.002	69.697	0.005	6	0.004	N96-311-18	300 sec bkg cnt w/ Jaws w/out Pipe w/ filters w/ back shield
N96-311-31		317335	85945	565	1000	85.945	0.565	6	JAWS	51	1.685	0.011	0.657	0.027	6	3.370	N96-311-31	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-32		315820	83503	551	1000	83.503	0.551	6	JAWS	51	1.637	0.011	0.660	0.027	6	3.275	N96-311-32	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-33		20054	4232	108	1000	4.232	0.108	6	JAWS	51	0.083	0.002	2.552	0.007	6	0.166	N96-311-33	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-34		20035	4600	119	1000	4.600	0.119	6	JAWS	51	0.090	0.002	2.587	0.007	6	0.180	N96-311-34	1000 sec cnt w/ PDP source #Ntp-0124
N96-311-35		28223	7451	164	1000	7.451	0.164	6	JAWS	51	0.146	0.003	2.201	0.008	6	0.292	N96-311-35	1000 sec cnt w/ PDP source #Ntp-0124 bare on jaws
N96-311-36		27431	6470	144	1000	6.470	0.144	6	JAWS	51	0.127	0.003	2.226	0.008	6	0.254	N96-311-36	1000 sec cnt w/ PDP source #Ntp-0124 bare on jaws
N96-311-37		93142	22492	273	300	74.973	0.910	6	JAWS	51	1.470	0.018	1.214	0.049	6	2.940	N96-311-37	300 sec cnt w/ PDP source #Ntp-0124
N96-311-38		93632	25223	305	300	84.077	1.017	6	JAWS	51	1.649	0.020	1.209	0.048	6	3.297	N96-311-38	300 sec cnt w/ PDP source #Ntp-0124
N96-311-01		21211	16	136	300	0.053	0.453	6	JAWS	51	0.001	0.009	850.000	0.027	6	N/A	N96-311-01	300 sec cnt with amcs sources
N96-311-02		20921	815	113	300	2.717	0.377	6	JAWS	51	0.053	0.007	13.865	0.026	6	N/A	N96-311-02	300 sec cnt with amcs sources with filters
N96-311-03		25247	1082	121	300	3.607	0.403	6	JAWS	51	0.071	0.008	11.183	0.029	6	N/A	N96-311-03	300 sec cnt with amcs sources w/out filters
N96-311-04		25414	1285	116	300	4.283	0.387	6	JAWS	51	0.084	0.008	9.027	0.029	6	N/A	N96-311-04	300 sec cnt with amcs sources w/out filters
N96-311-05	X	220	-5	15	300	-0.017	0.050	6	JAWS	51	< MDA	—	—	0.003	6	< 0.006	N96-311-05	300 sec bkg cnt without filters
N96-311-06		23071	-500	154	300	-1.667	0.513	6	JAWS	51	< MDA	—	—	0.028	6	< 0.056	N96-311-06	300 sec cnt with amcs w/out filters
*** 07-NOV-96 ***																	*** 07-NOV-96 ***	
N96-312-00	X	13089	-51	109	300	-0.170	0.363	6	JAWS	51	< MDA	—	—	0.021	6	< 0.043	N96-312-00	300 sec bkg cnt in s sample gallery facing west in middle of gal

REDOX NaI DATA - November 1996 through January 1997

Filename	BKG	ROI Gross area (counts)	ROI Net area (counts)	Uncertainty 1 sigma (counts)	Live Time (sec)	Corrected ROI Activity (cps)	Uncertainty 1 sigma (cps)	Center Line Distance (inches)	Efficiency Type	Efficiency (cps/g)	Pu-239 (grams)	Uncertainty (1 sigma) (grams)	Uncertainty (1 sigma) (percent)	MDA (grams)	Shot Information Length (inches)	Shot Information Pu per 12" (grams)	Shot Information Filename	Description
N96-312-01		29391	1221	132	300	4.070	0.440	6	JAWS	51	0.080	0.009	10.811	0.031	6	0.160	N96-312-01	300 sec cnt on first horiz short section
N96-312-02		98011	5545	219	1000	5.545	0.219	6	JAWS	51	0.109	0.004	3.950	0.017	6	0.217	N96-312-02	1000 sec cnt on first horiz short section
*** 08-NOV-96 ***																	*** 08-NOV-96 ***	
N96-313-00	X	20664	-1386	167	300	-4.620	0.557	6	JAWS	51	< MDA	—	—	0.027	6 <	0.053	N96-313-00	300 sec bkg cnt south end redox.
N96-313-01	X	20026	-206	138	300	-0.687	0.460	6	JAWS	51	< MDA	—	—	0.028	6 <	0.053	N96-313-01	300 sec bkg cnt south end redox.
N96-313-02		36967	2803	115	1000	2.803	0.115	6	JAWS	51	0.055	0.002	4.103	0.010	6	0.110	N96-313-02	1000 sec cnt south weld 138" frm h-4 elbow.
N96-313-03		61135	2905	184	1000	2.905	0.184	6	JAWS	51	0.057	0.004	6.334	0.013	6	0.114	N96-313-03	1000 sec cnt south weld 169" frm h-4 elbow.
N96-313-04		8522	-190	94	300	-0.633	0.313	6	JAWS	51	< MDA	—	—	0.017	6 <	0.034	N96-313-04	300 sec cnt south weld 393" frm h-4 elbow.
N96-313-05		3899	101	52	300	0.337	0.173	6	JAWS	51	0.007	0.003	51.485	0.012	6	0.013	N96-313-05	300 sec cnt south weld 630" frm h-4 elbow.
N96-313-06		2192	59	39	300	0.197	0.130	6	JAWS	51	0.004	0.003	66.102	0.009	6	0.008	N96-313-06	300 sec cnt south weld 860" frm h-4 elbow.
N96-313-07		1743	33	36	300	0.110	0.120	6	JAWS	51	0.002	0.002	109.091	0.008	6	0.004	N96-313-07	300 sec cnt south weld 1079" frm h-4 elbow.
N96-313-08		7539	15	81	300	0.050	0.270	6	JAWS	51	0.001	0.005	540.000	0.016	6	0.002	N96-313-08	300 sec cnt south weld 1199" frm h-4 elbow.
N96-313-09		3669	-219	69	300	-0.730	0.230	6	JAWS	51	< MDA	—	—	0.011	6 <	0.023	N96-313-09	300 sec cnt south weld 1295" frm h-4 elbow.
N96-313-10		21168	3195	59	1000	3.195	0.059	6	JAWS	51	0.063	0.001	1.847	0.007	6	0.125	N96-313-10	1000 sec cnt south weld 1403" frm h-4 elbow.
*** 11-NOV-96 ***																	*** 11-NOV-96 ***	
N96-316-00	X	1321	-162	49	300	-0.607	0.163	6	JAWS	51	< MDA	—	—	0.007	6 <	0.014	N96-316-00	300 sec bkg cnt E end of S gallery facing W.
N96-316-01		8780	860	42	1000	0.860	0.042	6	JAWS	51	0.017	0.001	4.884	0.005	6	0.034	N96-316-01	1000 sec cnt 94" from E end of S gal bend h-4.
N96-316-02		14505	1941	26	1000	1.941	0.026	6	JAWS	51	0.038	0.001	1.340	0.006	6	0.076	N96-316-02	1000 sec cnt 112" from E end of S gal inbetween bends h-4.
N96-316-03		5372	620	20	1000	0.620	0.020	6	JAWS	51	0.012	0.000	3.226	0.004	6	0.024	N96-316-03	1000 sec cnt 35" from E end of S gal inbetween bends h-4.
N96-316-04		6375	876	21	1000	0.876	0.021	6	JAWS	51	0.017	0.000	2.397	0.004	6	0.034	N96-316-04	1000 sec cnt elbow at E end of S gallery on h-4 line.
N96-316-05		14645	3107	93	1000	3.107	0.093	6	JAWS	51	0.061	0.002	2.993	0.006	6	0.122	N96-316-05	1000 sec cnt 84" from elbow at E corridor between N&S gallery.
N96-316-06		2659	364	13	1000	0.364	0.013	6	JAWS	51	0.007	0.000	3.571	0.003	6	0.014	N96-316-06	1000 sec cnt 216" from elbow at E corridor between N&S gallery.
N96-316-07		15879	4179	123	1000	4.179	0.123	6	JAWS	51	0.082	0.002	2.943	0.006	6	0.164	N96-316-07	1000 sec cnt 320" from elbow at E corridor between N&S gallery.
N96-316-08		36397	8065	155	1000	8.065	0.155	6	JAWS	51	0.158	0.003	1.922	0.009	6	0.316	N96-316-08	1000 sec cnt 553" from elbow at E corridor between N&S gallery.
N96-316-09		24166	5743	136	1000	5.743	0.136	6	JAWS	51	0.113	0.003	2.368	0.008	6	0.225	N96-316-09	1000 sec cnt on elbow at NE corner at corridor between N&S ga
N96-316-10		664	151	21	300	0.503	0.070	6	JAWS	51	0.010	0.001	13.907	0.004	6	0.020	N96-316-10	300 sec cnt 80" from elbow at NE corner & 40" from canyon wal
N96-316-11		665	71	9	300	0.237	0.030	6	JAWS	51	0.005	0.001	12.676	0.005	6	0.009	N96-316-11	300 sec cnt 80" from elbow at NE corner & 14" from canyon wal
N96-316-12		24769	5617	131	1000	5.617	0.131	6	JAWS	51	0.110	0.003	2.332	0.008	6	0.220	N96-316-12	1000 sec cnt 128" from elbow to weld from NE corner.
N96-316-13	X	810	-9	27	300	-0.030	0.090	6	JAWS	51	< MDA	—	—	0.005	6 <	0.011	N96-316-13	300 sec bkg cnt NE end of N gallery.
N96-316-14	X	555	-66	30	300	-0.220	0.100	6	JAWS	51	< MDA	—	—	0.004	6 <	0.009	N96-316-14	300 sec bkg cnt in the NE corridor between N&S gallery.
*** 12-NOV-96 ***																	*** 12-NOV-96 ***	
N96-317-00	X	752	59	15	300	0.197	0.050	6	JAWS	51	0.004	0.001	25.424	0.005	6	0.008	N96-317-00	300 sec bkg cnt in the N end of N sample gallery facing W.
N96-317-01		17161	1942	40	300	6.473	0.133	6	JAWS	51	0.127	0.003	2.060	0.023	6	0.254	N96-317-01	300 sec cnt 225" from N end of N sample gallery facing on H-4.
N96-317-02		13859	3158	98	300	10.527	0.327	6	JAWS	51	0.206	0.006	3.103	0.019	6	0.413	N96-317-02	300 sec cnt 357" from N end of N sample gallery on H-4.
N96-317-03		10172	2018	71	300	6.727	0.237	6	JAWS	51	0.132	0.005	3.518	0.017	6	0.264	N96-317-03	300 sec cnt 411" from N end of N sample gallery on H-4.
N96-317-04		116018	5975	247	1000	5.975	0.247	6	JAWS	51	0.117	0.005	4.134	0.018	6	0.234	N96-317-04	1000 sec cnt 591" from N end of N sample gallery on H-4.
N96-317-05		7697	1271	45	300	4.237	0.150	6	JAWS	51	0.083	0.003	3.541	0.015	6	0.166	N96-317-05	300 sec cnt 823" from N end of N sample gallery on H-4.
N96-317-06		4801	1147	61	300	3.823	0.203	6	JAWS	51	0.075	0.004	5.318	0.011	6	0.150	N96-317-06	300 sec cnt 1056" from N end of N sample gallery on H-4.
N96-317-07		22042	-179	144	300	-0.597	0.480	6	JAWS	51	< MDA	—	—	0.028	6 <	0.055	N96-317-07	300 sec cnt 1289" from N end of N sample gallery on H-4.
N96-317-08		177882	3183	368	1000	3.183	0.368	6	JAWS	51	0.062	0.007	11.561	0.023	6	0.125	N96-317-08	1000 sec cnt 1522" from N end of N sample gallery on H-4.
N96-317-09		87529	1003	266	300	3.343	0.887	6	JAWS	51	0.066	0.017	26.520	0.055	6	0.131	N96-317-09	300 sec cnt 1995" from N end of N sample gallery on H-4.
N96-317-10		71953	1636	229	300	5.453	0.763	6	JAWS	51	0.107	0.015	13.998	0.049	6	0.214	N96-317-10	300 sec cnt 1755" from N end of N sample gallery on H-4.
*** 13-NOV-96 ***																	*** 13-NOV-96 ***	
N96-318-00	X	13933	-485	125	300	-1.617	0.417	6	JAWS	51	< MDA	—	—	0.022	6 <	0.044	N96-318-00	300 sec bkg cnt just inside the false wall N gallery.
N96-318-01		105280	3931	257	1000	3.931	0.257	6	JAWS	51	0.077	0.005	6.538	0.018	6	0.154	N96-318-01	1000 sec cnt 1992" on h-4 line N gallery S end inside false wall
N96-318-02		36363	-1311	203	300	-4.370	0.677	6	JAWS	51	< MDA	—	—	0.035	6 <	0.071	N96-318-02	300 sec cnt 2218" on h-4 line N gallery S end inside false wal
N96-318-03		148569	825	355	1000	0.825	0.355	6	JAWS	51	0.016	0.007	43.030	0.021	6	0.032	N96-318-03	1000 sec cnt 2224" around bend on h-4 line N gallery S end insid
N96-318-04		125279	476	328	1000	0.476	0.328	6	JAWS	51	0.009	0.006	68.908	0.020	6	0.019	N96-318-04	1000 sec cnt 2414" on h-4 line N gallery S end insi
N96-318-05		57663	378	220	1000	0.378	0.220	6	JAWS	51	0.007	0.004	58.201	0.013	6	0.015	N96-318-05	1000 sec cnt 2nd shot w/lead 2414" on h-4 line N gallery S end

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Filename	BKG	ROI Gross area (counts)	ROI Net area (counts)	Uncertainty 1 sigma (counts)	Live Time (sec)	Corrected ROI Activity (cps)	Uncertainty 1 sigma (cps)	Center Line Distance (inches)	Efficiency Type	Efficiency (cps/g)	Pu-239 (grams)	Uncertainty (1 sigma) (grams)	Uncertainty (1 sigma) (percent)	MDA (grams)	Shot Information Length (inches)	Shot Information Pu per 12" (grams)	Shot Information Filename	Description
N96-318-06		58447	82	226	1000	0.082	0.226	6	JAWS	51	0.002	0.004	275.810	0.013	6	0.003	N96-318-06	1000 sec cnt 2526" w/ lead blankets on h-4 line N gallery S end
N96-318-07		50425	2311	189	1000	2.311	0.189	6	JAWS	51	0.045	0.003	7.313	0.012	6	0.091	N96-318-07	1000 sec cnt 2870" w/ lead blankets on h-4 line N gallery S end
N96-318-08		47210	4206	111	1000	4.206	0.111	6	JAWS	51	0.083	0.002	2.638	0.012	6	0.165	N96-318-08	1000 sec cnt 3062" w/ lead blankets on h-4 line N gallery S end
*** 14-NOV-96 ***																	*** 14-NOV-96 ***	
N96-319-00	X	9790	-308	104	300	-1.027	0.347	6	JAWS	51	< MDA	—	—	0.018	6	< 0.037	N96-319-00	300 sec bkg cnt N sample gallery facing away from hood.
N96-319-01		77945	6854	145	1000	6.854	0.145	6	JAWS	51	0.134	0.003	2.116	0.015	6	0.269	N96-319-01	1000 sec cnt 3174" from N end N gallery, elbow on h-4 near hood
N96-319-02		19182	390	119	300	1.300	0.397	6	JAWS	51	0.025	0.008	30.513	0.025	6	0.051	N96-319-02	300 sec cnt on h-4 elbow N bend near hood.
N96-319-03		84984	19635	248	300	65.450	0.827	6	JAWS	51	1.283	0.016	1.263	0.047	6	2.567	N96-319-03	300 sec cnt on h-4 hot spot right of elbow near hood N gallery.
N96-319-04		289870	60685	408	1000	60.685	0.408	6	JAWS	51	1.190	0.008	0.672	0.027	6	2.380	N96-319-04	1000 sec cnt on h-4 comes out of wall near hood N gallery.
N96-319-05		9217	505	68	1000	0.505	0.068	6	JAWS	51	0.010	0.001	13.465	0.005	6	0.020	N96-319-05	1000 sec cnt on E-3 to L-12 elobow near stairway door.
N96-319-06		6284	911	28	1000	0.911	0.028	6	JAWS	51	0.018	0.001	3.074	0.004	6	0.036	N96-319-06	1000 sec cnt on E-3 to L-12 elbow 84" from stairway door.
N96-319-07		76234	5782	165	1000	5.782	0.165	8.2	OPEN	17.6	0.329	0.009	2.854	0.043	8	0.494	N96-319-07	1000 sec cnt on H-4 on first elbow along canyon wall near hood.
*** 15-NOV-96 ***																	*** 15-NOV-96 ***	
N96-320-00	X	12322	298	94	1000	0.298	0.094	12.2	OPEN	9.4	0.032	0.010	31.544	0.033	12	0.032	N96-320-00	1000 sec bkg cnt w/ brick on hot spot elbow.
N96-320-01	X	167139	39906	361	1000	39.906	0.361	12.2	OPEN	9.4	4.251	0.038	0.905	0.108	12	4.251	N96-320-01	1000 sec bkg cnt w/out brick on hot spot elbow.
N96-320-02	X	12127	-518	120	1000	-0.518	0.120	14.2	OPEN	7.2	< MDA	—	—	0.044	14	< 0.037	N96-320-02	1000 sec bkg cnt w/ brick on hot spot elbow new battery.
N96-320-03	X	145888	36014	350	1000	36.014	0.350	14.2	OPEN	7.2	5.002	0.049	0.972	0.130	14	4.288	N96-320-03	1000 sec bkg cnt w/out brick on hot spot elbow new battery.
N96-320-04		12571	1015	63	1000	1.015	0.063	6	JAWS	51	0.020	0.001	6.207	0.006	6	0.040	N96-320-04	1000 sec cnt E-3 to L-12 on elbow next to stairway door.
*** 18-NOV-96 ***																	*** 18-NOV-96 ***	
N96-323-00	X	3540	-249	69	300	-0.830	0.230	14.2	OPEN	7.2	< MDA	—	—	0.079	14	< 0.066	N96-323-00	300 sec bkg cnt w/brick on source check h-4 elbow.
N96-323-01	X	44201	10926	192	300	36.427	0.640	14.2	OPEN	7.2	5.060	0.089	1.757	0.240	14	4.337	N96-323-01	300 sec bkg cnt w/out brick on source check h-4 elbow.
N96-323-02		3602	148	48	300	0.493	0.160	8.2	OPEN	17.6	0.028	0.009	32.432	0.033	8	0.042	N96-323-02	300 sec cnt on 1" trench drain line on h section in pipe.
N96-323-03		62824	661	226	1000	0.661	0.226	8.2	OPEN	17.6	0.038	0.013	34.191	0.040	8	0.056	N96-323-03	1000 sec cnt on 1" trench drain line on elbow from wall.
N96-323-04		11948	338	90	1000	0.338	0.090	6	JAWS	51	0.007	0.002	26.627	0.008	6	0.013	N96-323-04	1000 sec cnt on E-3 to L-12 on line before elbow from wall.
N96-323-05		17865	4032	111	100	40.320	1.110	14.2	OPEN	7.2	5.601	0.154	2.753	0.465	14	4.801	N96-323-05	100 sec cnt on on hot spot elbow on h-4 line.
N96-323-06		3373	124	46	300	0.413	0.153	7.7	OPEN	19.0	0.022	0.008	37.097	0.029	7.5	0.035	N96-323-06	300 sec cnt on E-3 to L-12 line 38" from elbow where it comes ou
N96-323-07		8921	380	72	1000	0.380	0.072	8.2	OPEN	17.6	0.022	0.004	18.947	0.015	8	0.032	N96-323-07	1000 sec cnt on E-3 to L-12 elbow 40" from stairway door.
N96-323-08	X	3247	-119	60	302.96	-0.393	0.198	14.2	OPEN	7.2	< MDA	—	—	0.075	14	< 0.064	N96-323-08	300 sec bkg cnt w/brick on hot spot elbow h-4.
N96-323-09	X	50766	12318	202	300	41.060	0.673	14.2	OPEN	7.2	5.703	0.094	1.640	0.258	14	4.889	N96-323-09	300 sec bkg cnt w/out brick on hot spot elbow h-4.
*** 19-NOV-96 ***																	*** 19-NOV-96 ***	
N96-324-00	X	3377	119	46	300	0.397	0.153	14.2	OPEN	7.2	0.055	0.021	38.655	0.076	14	0.047	N96-324-00	300 sec bkg cnt w/ brick on hot spot elbow h-4.
N96-324-01	X	56428	11320	170	300	37.733	0.567	14.2	OPEN	7.2	5.241	0.079	1.502	0.279	14	4.493	N96-324-01	300 sec bkg cnt w/ brick on hot spot elbow h-4.
N96-324-02		3151	-161	62	300	-0.537	0.207	6	JAWS	51	< MDA	—	—	0.011	6	< 0.021	N96-324-02	300 sec cnt on E-3 to L-12 38' from where pipe comes out of the
N96-324-03		2175	186	25	300	0.620	0.083	6	JAWS	51	0.012	0.002	13.441	0.006	6	0.024	N96-324-03	300 sec cnt on E-3 to L-12 89" from where pipe comes out of the
N96-324-04		6978	336	62	1000	0.336	0.062	5.4	OPEN	27.0	0.012	0.002	18.452	0.009	5	0.030	N96-324-04	1000 sec cnt on E-3 to L-12 208" from where pipe comes out of th
N96-324-05		20156	-760	152	1000	-0.760	0.152	8.2	OPEN	17.6	< MDA	—	—	0.023	8	< 0.034	N96-324-05	1000 sec cnt on E-3 to L-12 at reducer from 2" to 1".
N96-324-06		63972	504	230	600	0.840	0.383	8.2	OPEN	17.6	0.048	0.022	45.635	0.068	8	0.072	N96-324-06	600 sec cnt on E-3 to L-12 at 1" elbow coming out of the hood.
N96-324-07	X	3291	285	30	300	0.950	0.100	14.2	OPEN	7.2	0.132	0.014	10.526	0.073	14	0.113	N96-324-07	300 sec bkg cnt w/ brickon hot spot elbow h-4.
N96-324-08		51563	11252	181	300	37.507	0.603	14.2	OPEN	7.2	5.210	0.084	1.609	0.264	14	4.466	N96-324-08	300 sec bkg cnt w/out brickon hot spot elbow h-4.
*** 20-NOV-96 ***																	*** 20-NOV-96 ***	
N96-325-00		3026	-16	52	300	-0.053	0.173	14.2	OPEN	7.2	MDA	—	—	0.073	14	< 0.063	N96-325-00	300 sec bkg cnt w/out brick on hot spot elbow h-4.
N96-325-01		53129	14060	226	300	46.867	0.753	14.2	OPEN	7.2	6.510	0.105	1.607	0.260	14	5.580	N96-325-01	300 sec bkg cnt w/out brick on hot spot elbow h-4.
N96-325-02		4022	-145	67	300	-0.483	0.223	8.2	OPEN	17.2	< MDA	—	—	0.035	8	< 0.053	N96-325-02	300 sec cnt on 4" drain line at elbow near where it comes out o
N96-325-03		2179	-152	54	300	-0.507	0.180	8.2	OPEN	17.2	< MDA	—	—	0.026	8	< 0.039	N96-325-03	300 sec cnt on 4" drain line 94" from elbow near where it comes
N96-325-04		1598	104	26	300	0.347	0.087	8.2	OPEN	17.2	0.020	0.005	25.000	0.022	8	0.030	N96-325-04	300 sec cnt on 4" drain line 198" from elbow near where it come
N96-325-05		3414	-357	74	600	-0.595	0.123	8.2	OPEN	17.2	< MDA	—	—	0.016	8	< 0.024	N96-325-05	600 sec cnt on 4" drain line on elbow near stairway door.
N96-325-06		15955	259	111	600	0.432	0.185	8.2	OPEN	17.2	0.025	0.011	42.857	0.035	8	0.038	N96-325-06	600 sec cnt on 4" drain line 152" from stairway door.
N96-325-07		14323	-266	120	600	-0.443	0.200	8.2	OPEN	17.6	< MDA	—	—	0.032	8	< 0.048	N96-325-07	300 sec cnt on E-4 to L-2 at 120" from stairway door.

REDOX NaI DATA - November 1996 through January 1997

Filename	BKG	ROI Gross area (counts)	ROI Net area (counts)	Uncertainty 1 sigma (counts)	Live Time (sec)	Corrected ROI Activity (cps)	Uncertainty 1 sigma (cps)	Center Line Distance (inches)	Efficiency Type	Efficiency (cps/g)	Pu-239 (grams)	Uncertainty (1 sigma) (grams)	Uncertainty (1 sigma) (percent)	MDA (grams)	Shot Information Length (inches)	Shot Information Pu per 12" (grams)	Shot Information Filename	Description
N96-325-08		4712	-94	89	300	-0.313	0.230	8.2	OPEN	17.6	< MDA	—	—	0.037	8	< 0.056	N96-325-08	300 sec bkg cnt w/brick on h-4 hot spot.
N96-325-09		3230	107	46	300	0.357	0.153	14.2	OPEN	7.2	0.050	0.021	42.991	0.074	14	0.042	N96-325-09	300 sec bkg cnt w/brick on h-4 hot spot.
N96-325-10		52220	12044	194	300	40.147	0.647	14.2	OPEN	7.2	5.577	0.090	1.611	0.263	14	4.780	N96-325-10	300 sec bkg cnt w/brick on h-4 hot spot.
*** 26-NOV-96 ***																	*** 26-NOV-96 ***	
N96-331-00		55722	12765	199	300	42.550	0.663	14.2	OPEN	7.2	5.910	0.092	1.559	0.272	14	5.068	N96-331-00	300 cnt on source check elbow H-4.
N96-331-01		3636	270	36	300	0.900	0.120	14.2	OPEN	7.2	0.125	0.017	13.333	0.077	14	0.107	N96-331-01	300 cnt w/ brick on source check elbow H-4.
N96-331-02		377604	40833	223	1800	22.685	0.124	10	OPEN	12.2	1.863	0.010	0.546	0.075	N/A	N/A	N96-331-02	1800 cnt H-4 valve in N gallery near hood.
N96-331-03		103499	863	293	9.54	90.461	30.713	9	OPEN	14.3	6.334	2.151	33.951	6.665	N/A	N/A	N96-331-03	1800 cnt H-4 valve in N gallery on wrapped valve past false wall
N96-331-04		2878	59	44	1000	0.059	0.044	8.2	OPEN	17.6	0.003	0.003	74.576	0.006	8	0.005	N96-331-04	1000 cnt H-4 elbow in N gallery 104" from bend at corridor.
N96-331-05		14805	2952	86	1000	2.952	0.088	8.2	OPEN	17.6	0.168	0.005	2.913	0.018	8	0.252	N96-331-05	1000 cnt H-4 elbow in N gallery on bend at corridor.
N96-331-06		5544	774	22	1000	0.774	0.022	8.2	OPEN	17.8	0.044	0.001	2.842	0.011	8	0.066	N96-331-06	1000 cnt H-4 elbow in S gallery on bend at corridor.
N96-331-07		65331	3600	161	1800	2.000	0.101	18	OPEN	5.2	0.382	0.019	5.028	0.075	N/A	N/A	N96-331-07	1800 cnt H-4 valve in S gallery where it comes out of h-cell.
N96-331-08		3289	-89	59	300	-0.297	0.197	14.2	OPEN	7.2	< MDA	—	—	0.076	14	< 0.065	N96-331-08	300 cnt on hot spot elbow H-4 w/brick
N96-331-09		47095	12112	207	300	40.373	0.690	14.2	OPEN	7.2	5.608	0.096	1.709	0.246	14	4.807	N96-331-09	300 cnt on hot spot elbow H-4 w/ out brick
*** 09-DEC-96 ***																	*** 09-DEC-96 ***	
N96-344-00		50172	11211	184	300	37.370	0.613	14.2	OPEN	7.2	5.191	0.085	1.641	0.259	14	4.449	N96-344-00	300 sec cnt w/out brick on hot spot elbow h-4.
N96-344-01		3107	119	43	300	0.397	0.143	14.2	OPEN	7.2	0.055	0.020	36.134	0.073	14	0.047	N96-344-01	300 sec cnt w/t brick on hot spot elbow h-4.
N96-344-02		120663	13050	126	1000	13.050	0.126	9	OPEN	14.3	0.914	0.009	0.988	0.065	N/A	N/A	N96-344-02	1000 sec cnt on smaller valve L-16 to E-3 line closest to hood.
N96-344-03		52106	12416	201	300	41.387	0.670	14.2	OPEN	7.2	5.749	0.093	1.619	0.262	14	4.928	N96-344-03	300 sec cnt on hot spot elbow h-4 w/out brick.
N96-344-04		3367	116	46	300	0.393	0.153	14.2	OPEN	7.2	0.055	0.021	38.963	0.076	14	0.047	N96-344-04	300 sec cnt on hot spot elbow h-4 w/ brick.
*** 07-JAN-97 ***																	*** 07-JAN-97 ***	
N97-007-00		68387	15251	214	300	50.837	0.713	14.2	OPEN	7.2	7.061	0.099	1.403	0.303	14	6.053	N97-007-00	300 sec cnt w/out brick on hot spot elbow.
N97-007-01		3674	119	49	300	0.397	0.163	14.2	OPEN	7.2	0.055	0.023	41.176	0.079	14	0.047	N97-007-01	300 sec cnt w/ brick on hot spot elbow.
N97-007-02		61265	14690	219	300	48.967	0.730	11	OPEN	13.5	3.618	0.054	1.491	0.151	N/A	N/A	N97-007-02	300 sec cnt inside the hood 202-s on sump.
N97-007-03		49581	10053	162	300	33.510	0.540	11	OPEN	13.5	2.476	0.040	1.611	0.139	N/A	N/A	N97-007-03	300 sec cnt inside the hood 202-s on sump.
*** 08-JAN-97 ***																	*** 08-JAN-97 ***	
N97-008-00		3811	22	56	300	0.073	0.187	12	OPEN	12.9	0.006	0.014	254.545	0.045	N/A	N/A	N97-008-00	300 sec cnt inside the hood 202-s on ledge.
N97-008-01		8213	1778	71	300	5.927	0.237	10	OPEN	17.6	0.337	0.013	3.993	0.043	N/A	N/A	N97-008-01	300 sec cnt inside the hood 202-s on pile of stuff.
N97-008-02		16948	2242	25	300	7.473	0.083	10	OPEN	17.6	0.424	0.005	1.115	0.065	N/A	N/A	N97-008-02	300 sec cnt inside the hood 202-s on pile of material on tank.
N97-008-03		6732	1116	42	300	3.720	0.140	12	OPEN	12.9	0.288	0.011	3.763	0.055	N/A	N/A	N97-008-03	300 secbkg cnt inside the hood 202-s.
N97-008-04		5641	736	11	300	2.453	0.037	12	OPEN	12.9	0.190	0.003	1.495	0.052	N/A	N/A	N97-008-04	300 secbkg cnt inside the hood 202-s.
N97-008-05		43844	9905	174	300	33.017	0.580	5	OPEN	34.3	0.981	0.017	1.757	0.051	N/A	N/A	N97-008-05	300 sec cnt on sump inside the hood 202-s.
N97-008-06		37357	8269	157	300	27.563	0.523	10	OPEN	15.8	1.739	0.033	1.899	0.102	N/A	N/A	N97-008-06	300 sec cnt on sump inside the hood 202-s.
N97-008-07		30995	7649	161	300	25.497	0.537	5	OPEN	34.3	0.742	0.016	2.105	0.042	N/A	N/A	N97-008-07	300 sec cnt on sump inside the hood 202-s.
N97-008-08		46128	9804	166	300	32.680	0.553	10	OPEN	15.8	2.062	0.035	1.693	0.114	N/A	N/A	N97-008-08	300 sec cnt on sump inside the hood 202-s.
N97-008-09		16568	3239	89	300	10.797	0.297	8	OPEN	29.8	0.364	0.010	2.748	0.037	N/A	N/A	N97-008-09	300 sec cnt on sump inside the hood 202-s.
N97-008-10		7856	384	64	300	1.280	0.213	8.2	OPEN	17.8	0.073	0.012	16.667	0.046	8	0.109	N97-008-10	300 sec cnt on pipe along north wall inside the hood 202-s.
N97-008-11		56090	11171	168	300	37.237	0.560	10	OPEN	15.8	2.350	0.035	1.504	0.127	N/A	N/A	N97-008-11	300 sec cnt on sump calibration check.
*** 10-JAN-97 ***																	*** 10-JAN-97 ***	
N97-010-00		47513	12638	215	300	42.127	0.717	10	OPEN	15.8	2.659	0.045	1.701	0.112	N/A	N/A	N97-010-00	300 sec cnt on sump inside process hood 202-s.
N97-010-01		14681	2468	65	300	8.227	0.217	8.2	OPEN	17.8	0.469	0.012	2.634	0.060	8	0.703	N97-010-01	300 sec cnt on elbow on 2" going into e-16 tank.
N97-010-02		7609	625	48	300	2.083	0.160	9	OPEN	15.5	0.135	0.010	7.680	0.051	9	0.184	N97-010-02	300 sec cnt on horizontal pipe on cap on for line going to e -16
N97-010-03		5021	503	30	300	1.677	0.100	9	OPEN	15.5	0.108	0.006	5.984	0.041	9	0.148	N97-010-03	300 sec cnt on horizontal pipe on cap on for line going to e 16

Attachment D

REDOX HPGe Data - Open Collimator

REDOX HPGe DATA - OPEN COLLIMATOR

Filename	BKG	Live Time (sec)	Pu-239 Activity (uCi)	Uncertainty 1 sigma (uCi)	Center Line Distance (inches)	Geometry	Additional Correction	Note (see below)	Pu-239 (grams)	Uncertainty (1 sigma) (grams)	Uncertainty (1 sigma) (percent)	MDA (grams)	Pu-239 per ft of pipe (grams/ft)	Filename	Description
*** 27-NOV-96 ***														*** 27-NOV-96 ***	
H96-332-02	X	2000	353.2	152.5	11	EUHIGH07	—	—	0.0057	0.0025	43.17	0.0029	0.0062	H96-332-02	2000 sec cnt E-3 to L-12 Line elbow near stairwell door w/ brick
H96-332-03		2000	3947.3	137.8	11	EUHIGH07	—	—	0.0636	0.0022	3.49	0.0018	0.0694	H96-332-03	2000 sec cnt E-3 to L-12 Line elbow near stairwell door
*** 02-DEC-96 ***														*** 02-DEC-96 ***	
H96-337-02	X	2000	< MDA	—	11	EUHIGH07	—	—	< 0.0025	—	—	0.0025	< 0.0027	H96-337-02	2000 sec cnt on elbow at N gallery corridor w/ brick.
H96-337-03		2000	5753.3	157.6	11	EUHIGH07	—	—	0.0927	0.0025	2.74	0.0033	0.1012	H96-337-03	2000 sec cnt on elbow at N gallery corridor.
H96-337-04		2000	886.0	88.0	11	EUHIGH07	—	—	0.0143	0.0014	9.93	0.0012	0.0156	H96-337-04	2000 sec cnt on elbow at S gallery corridor.
H96-337-05	X	2000	< MDA	—	11	EUHIGH07	—	—	< 0.0022	—	—	0.0022	< 0.0024	H96-337-05	2000 sec cnt on elbow at S gallery corridor w/ brick.
H96-337-06		2000	1673.5	162.7	11	EUHIGH07	0.9235	(1)	0.0292	0.0028	9.72	0.0028	0.0319	H96-337-06	2000 sec cnt on elbow at S gallery H-4 Valve at H-Cell.
*** 03-DEC-96 ***														*** 03-DEC-96 ***	
H96-337-07		68000	9654.0	170.9	11	EUHIGH07	0.9235	(1)	0.1685	0.0030	1.77	0.0009	0.1838	H96-337-07	68000 sec cnt on valve in S gallery H-4 valve at H-Cell.
H96-337-08	X	3600	< MDA	—	11	EUHIGH07	0.9235	(1)	< 0.0055	—	—	0.0055	< 0.0060	H96-337-08	3600 sec cnt on valve in S gallery H-4 valve at H-Cell w/ brick.
*** 06-DEC-96 ***														*** 06-DEC-96 ***	
H96-341-02	X	2000	< MDA	—	11	EUHIGH07	0.9235	(1)	< 0.0164	—	—	0.0164	< 0.0179	H96-341-02	2000 sec cnt on big valve on H-4 near hood w/ brick.
H96-341-03		2000	68892.0	1260.7	11	EUHIGH07	0.9235	(1)	1.2624	0.0220	1.83	0.0096	1.3117	H96-341-03	2000 sec cnt on big valve on H-4 near hood.
H96-341-04		2000	32759.0	638.8	11	EUHIGH07	0.9235	(1)	0.5717	0.0111	1.95	0.0111	0.6237	H96-341-04	2000 sec cnt on small valve on H-4 closest to the hood.
H96-341-05	X	2000	< MDA	—	11	EUHIGH07	0.9235	(1)	< 0.0100	—	—	0.0100	< 0.0109	H96-341-05	2000 sec cnt on small valve on H-4 closest to the hood w/ brick.
*** 09-DEC-96 ***														*** 09-DEC-96 ***	
H96-344-02		2000	< MDA	—	38	EUHIGH35	0.9235	(1)	< 0.2740	—	—	0.2740	< 0.2989	H96-344-02	2000 sec cnt on valve on H-4 middle of N gallery.
H96-344-03	X	2000	< MDA	—	38	EUHIGH35	0.9235	(1)	< 0.0733	—	—	0.0733	< 0.0800	H96-344-03	2000 sec cnt on valve on H-4 middle of N gallery w/ brick.
*** 16-DEC-96 ***														*** 16-DEC-96 ***	
H96-351-02	X	1000	< MDA	—	11	EUHIGH07	0.9235	(1)	< 0.0269	—	—	0.0269	< 0.0293	H96-351-02	1000 sec cnt on bigger valve H-4 near hood w/ brick.
H96-351-03		62000	82265.0	1439.6	11	EUHIGH07	0.9235	(1)	1.4358	0.0251	1.75	0.0054	1.5663	H96-351-03	62000 sec cnt on bigger valve H-4 near hood.
*** 17-DEC-96 ***														*** 17-DEC-96 ***	
H96-351-04	X	1000	1754.2	758.3	11	EUHIGH07	0.9235	(1)	0.0306	0.0132	43.23	0.0160	0.0334	H96-351-04	1000 sec cnt on bigger valve H-4 near hood w/ brick.
H96-352-02		300	< MDA	—	15	EUHIGH07	—	—	< 0.1170	—	—	0.1170	< 0.1277	H96-352-02	300 sec cnt on 1" line W of E-14 tank inside hood.
H96-352-03		62000	2131.1	41.6	11	EUHIGH07	—	—	0.0343	0.0007	1.95	0.0018	0.0375	H96-352-03	62000 sec cnt on E-3 to L-12 Line on elbow.
*** 18-DEC-96 ***														*** 18-DEC-96 ***	
H96-352-04	X	1000	< MDA	—	11	EUHIGH07	—	—	< 0.0036	—	—	0.0036	< 0.0039	H96-352-04	1000 sec cnt on E-3 to L-12 Line on elbow.
*** 19-DEC-96 ***														*** 19-DEC-96 ***	
H96-353-02		43000	5132.6	2317.9	11	EUHIGH05	0.9800	(2)	0.0844	0.0381	45.16	0.0463	0.0921	H96-353-02	43000 sec cnt on 4" Drain Line W wall behind hood.
H96-353-03	X	1000	< MDA	—	11	EUHIGH05	0.9800	(2)	< 0.0803	—	—	0.0803	< 0.0876	H96-353-03	1000 sec cnt on 4" Drain Line W wall behind hood w/ brick.
H96-354-02		62000	< MDA	—	9	EUHIGH04	0.9800	(2)	< 0.0005	—	—	0.0005	< 0.0005	H96-354-02	62000 sec cnt on 4" Drain Line near stairwell door.
*** 20-DEC-96 ***														*** 20-DEC-96 ***	
H96-354-03	X	1000	< MDA	—	9	EUHIGH04	0.9800	(2)	< 0.0043	—	—	0.0043	< 0.0047	H96-354-03	1000 sec cnt on 4" Drain Line near stairwell door w/ brick.

Note: (1) Sch 40 valve is approximately 3/8" tk. Correction is due to additional attenuation due to greater thickness of valve. Calibration was performed with 0.15" tk steel.
(2) Correction is due to additional attenuation due to greater thickness of 4" sch 40 pipe. Calibration was performed with 0.15" tk 2" sch 40 steel pipe.

Attachment E

REDOX HPG Data - Snout Collimator

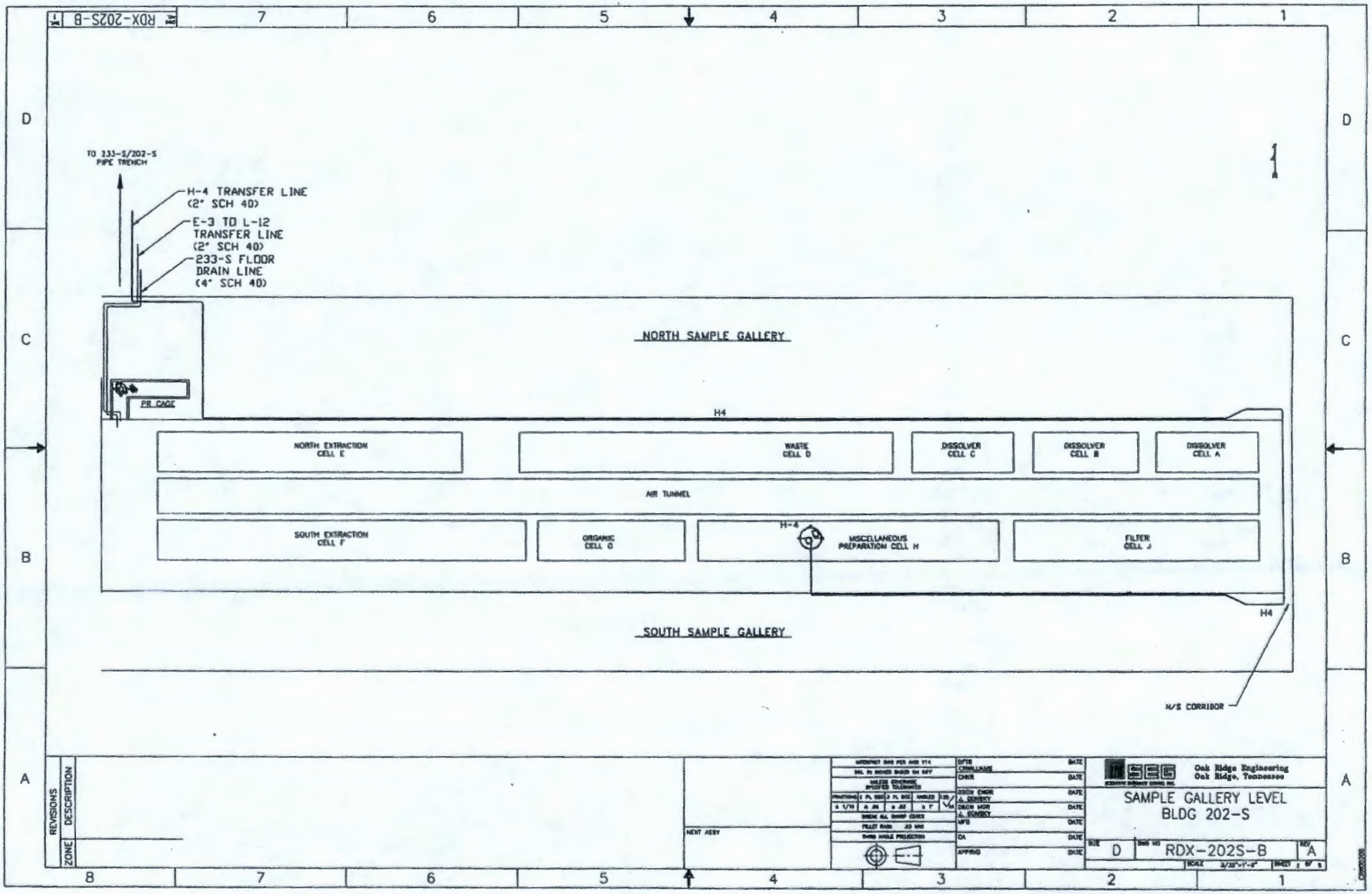
REDOX HPGe DATA - WITH SNOUT

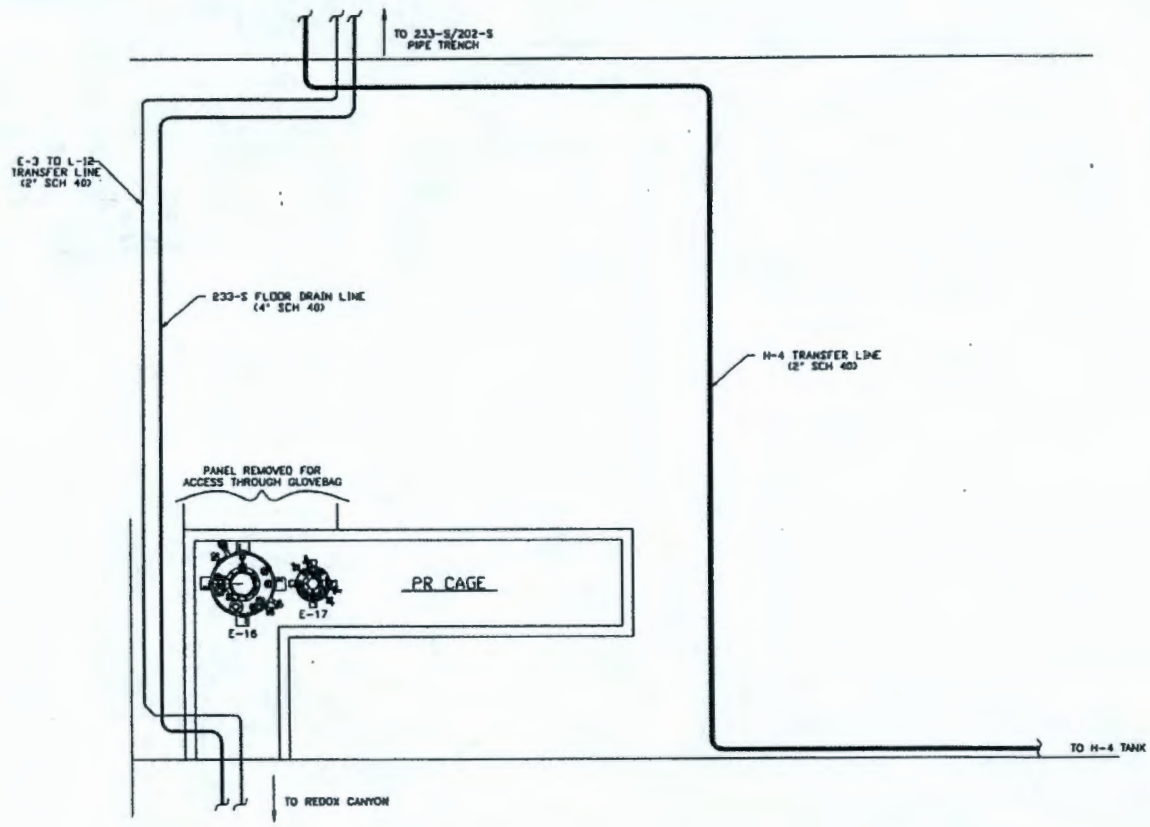
Filename	BKG	Live Time (sec)	375 keV ROI Bkg area (counts)	375 keV ROI Net area (counts)	Corrected ROI Activity (cps)	Uncertainty 1 sigma (cps)	Uncertainty 1 sigma (%)	Vessel Side Center Line Distance (inches)	Efficiency (cts/gamma)	Additional Correction	Note (see below)	Outside Vessel Wall: Pu-239 (grams)	Uncertainty (1 sigma) (grams)	Uncertainty (1 sigma) (percent)	MDA (grams)	Ellipse Area (in^2)	Pu-239 Conc. (g/in^2)	Wall Thickness (in)	Trans-mission Factor	Pu-239 (grams)	Uncertainty (1 (grams)
*** 13-JAN-97 ***																					
H97-013-02		2000	4408	3298	1.649	0.0551	3.34	32.5	2.35E-05	---	---	1.932	0.065	3.34	0.111	31.3	0.062	0.7075	6.22E-01	3.106	0.104
H97-013-03	X	1000	1127	173	0.173	0.0493	28.47	32.5	2.35E-05	---	---	0.203	0.058	28.47	0.114	31.3	0.006	0.7075	6.22E-01	0.326	0.093
H97-013-04		62000	160674	145484	2.347	0.0110	0.47	---	---	---	---	---	---	---	---	---	---	---	---	---	---
*** 14-JAN-97 ***																					
H97-013-05	X	2000	3469	2970	1.485	0.0497	3.35	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H97-013-06	X	1000	2372	1110	1.110	0.0765	6.89	32.5	2.35E-05	---	---	1.300	0.090	6.89	0.164	31.3	0.042	0.7075	6.22E-01	2.091	0.144
H97-013-07	X	1000	4022	408	0.408	0.0919	22.53	24	3.03E-05	---	---	0.372	0.084	22.53	0.165	9.1	0.041	0.5000	7.61E-01	0.489	0.110
H97-013-08		2000	9435	1459	0.730	0.0713	9.77	24	3.03E-05	---	---	0.665	0.065	9.77	0.126	9.1	0.073	0.5000	7.61E-01	0.874	0.085
H97-013-09		2000	9186	1854	0.927	0.0711	7.67	27.6	2.72E-05	---	---	0.940	0.072	7.67	0.138	11.1	0.085	0.5000	7.61E-01	1.235	0.095
H97-013-10	X	1000	4400	785	0.785	0.0979	12.47	27.6	2.72E-05	---	---	0.796	0.099	12.47	0.192	11.1	0.072	0.5000	7.61E-01	1.046	0.130
H97-013-11		2000	3927	2748	1.374	0.0515	3.75	23.3	3.09E-05	---	---	1.226	0.046	3.75	0.080	7.3	0.168	0.2990	8.85E-01	1.386	0.052
*** 15-JAN-97 ***																					
H97-015-00		60000	131090	74764	1.246	0.0097	0.78	---	---	---	---	---	---	---	---	---	---	---	---	---	---
H97-015-01	X	1000	1361	1078	1.078	0.0617	5.72	---	---	---	---	---	---	---	---	---	---	---	---	---	---
*** 16-JAN-97 ***																					
H97-016-02		2000	1819	3357	1.679	0.0774	4.61	29.2	2.59E-05	---	---	1.784	0.082	4.61	0.065	23.2	0.077	0.6354	6.70E-01	2.663	0.123
H97-016-03	X	1007	557	1236	1.227	0.0652	5.31	29.2	2.59E-05	---	---	1.304	0.069	5.31	0.073	23.2	0.056	0.6354	6.70E-01	1.947	0.103
H97-016-04		2000	1537	3395	1.698	0.0579	3.41	15.1	3.94E-05	---	---	1.189	0.041	3.41	0.040	3.9	0.305	0.3272	8.69E-01	1.368	0.047
H97-016-05	X	1000	622	1136	1.136	0.0642	5.65	15.1	3.94E-05	---	---	0.796	0.045	5.65	0.051	3.9	0.204	0.3272	8.69E-01	0.915	0.052
H97-016-06		1543	2486	1085	0.703	0.0852	12.11	19.5	3.46E-05	---	---	0.561	0.068	12.11	0.074	6.8	0.082	0.5000	7.61E-01	0.738	0.089
H97-016-07	X	1000	1573	878	0.878	0.0952	10.84	19.5	3.46E-05	---	---	0.700	0.076	10.84	0.091	6.8	0.102	0.5000	7.61E-01	0.921	0.100
H97-016-08		2000	1040	1248	0.624	0.0414	6.64	34.7	2.21E-05	---	---	0.780	0.052	6.64	0.058	15.7	0.050	0.3272	8.69E-01	0.897	0.060
H97-016-09	X	1000	563	497	0.497	0.0656	13.20	34.7	2.21E-05	---	---	0.621	0.082	13.2	0.086	15.7	0.040	0.3272	8.69E-01	0.715	0.094
*** 17-JAN-97 ***																					
H97-017-07		1000	482	1198	1.198	0.0658	5.49	27.7	2.71E-05	---	---	1.218	0.067	5.49	0.065	11.7	0.104	0.3548	8.53E-01	1.428	0.078
H97-017-08	X	500	170	401	0.802	0.0707	8.82	27.7	2.71E-05	---	---	0.815	0.072	8.82	0.079	11.7	0.070	0.3548	8.53E-01	0.956	0.084
H97-017-09		1000	465	704	0.704	0.0620	8.81	24.3	3.00E-05	---	---	0.646	0.057	8.81	0.058	9.2	0.070	0.2500	9.11E-01	0.709	0.062
H97-017-10	X	500	155	353	0.706	0.0811	11.49	24.3	3.00E-05	---	---	0.648	0.074	11.49	0.068	9.2	0.070	0.2500	9.11E-01	0.711	0.082
H97-017-11		1000	542	1094	1.094	0.0748	6.84	30.3	2.51E-05	---	---	1.200	0.082	6.84	0.074	12.7	0.094	0.5000	7.61E-01	1.578	0.108
H97-017-12	X	500	178	583	1.166	0.0921	7.90	30.3	2.51E-05	---	---	1.279	0.101	7.9	0.087	12.7	0.100	0.5000	7.61E-01	1.682	0.133

Inside Vessel Wall				Spot				Spot in Vessel							
(1 sigma) (percent)	MDA (grams)	Ellipse Area (in^2)	Pu-239 Conc. (g/in^2)	Center Line Distance (inches)	Efficiency (cts/gamma)	Additional Correction	Note (see below)	Pu-239 (grams)	Uncertainty (1 sigma) (grams)	Uncertainty (1 sigma) (percent)	MDA (grams)	Spot Area (in^2)	Pu-239 Conc. (g/in^2)	Filename	Description
														*** 13-JAN-97 ***	
3.34	0.179	31.3	0.099	63.1	9.53E-06	---	---	7.673	0.256	3.34	0.442	41.9	0.183	H97-013-02	2000 sec cnt on E-16 Tank MIDDLE/BOTTOM.
28.47	0.183	31.3	0.010	63.1	9.53E-06	---	---	0.805	0.229	28.47	0.451	41.9	0.019	H97-013-03	1000 sec cnt on E-16 Tank MIDDLE/BOTTOM w/bricks.
---	---	---	---	81.4	5.55E-06	---	---	11.665	0.055	0.47	0.091	65.6	0.178	H97-013-04	62000 sec cnt on FLOOR under E-17 Tank
														*** 14-JAN-97 ***	
---	---	---	---	81.4	5.55E-06	---	---	7.382	0.247	3.35	0.419	65.6	0.112	H97-013-05	2000 sec cnt on FLOOR under E-17 Tank with lead sheets
6.89	0.263	31.3	0.067	63.1	9.53E-06	---	---	5.165	0.356	6.89	0.650	41.9	0.123	H97-013-06	1000 sec cnt on E-16 Tank MIDDLE/BOTTOM w/bricks --> re-
22.53	0.217	9.1	0.054	---	---	---	---	---	---	---	---	---	---	H97-013-07	1000 sec bkg cnt on the TOP of the E-16 Tank w/brick.
9.77	0.166	9.1	0.096	---	---	---	---	---	---	---	---	---	---	H97-013-08	2000 sec bkg cnt on the TOP of the E-16 Tank.
7.67	0.182	11.1	0.111	---	---	---	---	---	---	---	---	---	---	H97-013-09	2000 sec cnt on TOP of the E-16 tower at the flange.
12.47	0.253	11.1	0.094	---	---	---	---	---	---	---	---	---	---	H97-013-10	1000 sec cnt on TOP of the E-16 tower at the flange w/lead sh
3.75	0.090	7.3	0.190	40.1	1.88E-05	---	---	2.277	0.085	3.75	0.149	19.7	0.116	H97-013-11	2000 sec cnt on BOTTOM of the E-17 Tank.
														*** 15-JAN-97 ***	
---	---	---	---	79.7	5.83E-06	---	---	5.891	0.046	0.78	0.081	63.2	0.093	H97-015-00	60000 sec cnt on pit FLOOR west of E-16 Tank
---	---	---	---	79.7	5.83E-06	---	---	5.096	0.292	5.72	0.503	63.2	0.081	H97-015-01	1000 sec bkg cnt w/lead on pit FLOOR west of E-16 Tank
														*** 16-JAN-97 ***	
4.61	0.097	23.2	0.115	65.8	8.80E-06	---	---	7.855	0.362	4.61	0.287	45.1	0.174	H97-016-02	2000 sec cnt on E-16 Tank BOTTOM.
5.31	0.108	23.2	0.084	65.8	8.80E-06	---	---	5.744	0.305	5.31	0.320	45.1	0.127	H97-016-03	2000 sec cnt on E-16 Tank BOTTOM, w/lead sheets
3.41	0.045	3.9	0.351	---	---	---	---	---	---	---	---	---	---	H97-016-04	2000 sec cnt on E-16 Tank MIDDLE.
5.65	0.058	3.9	0.235	---	---	---	---	---	---	---	---	---	---	H97-016-05	1000 sec cnt on E-16 Tank MIDDLE, w/ lead sheets
12.11	0.097	6.8	0.108	---	---	---	---	---	---	---	---	---	---	H97-016-06	2000 sec cnt on E-16 Tank between tower and tank sections.
10.84	0.120	6.8	0.135	---	---	---	---	---	---	---	---	---	---	H97-016-07	1000 sec cnt on E-16 Tank btwn tower and tank, with lead she
6.64	0.067	15.7	0.057	---	---	---	---	---	---	---	---	---	---	H97-016-08	2000 sec cnt on E-16 MIDDLE Tower.
13.2	0.099	15.7	0.046	---	---	---	---	---	---	---	---	---	---	H97-016-09	1000 sec cnt on E-16 MIDDLE Tower, w/ lead sheets
														*** 17-JAN-97 ***	
5.49	0.076	11.7	0.122	43.7	1.69E-05	---	---	2.291	0.126	5.49	0.123	22.6	0.101	H97-017-07	1000 sec cnt on E-17 Tank BOTTOM.
8.82	0.093	11.7	0.082	43.7	1.69E-05	---	---	1.534	0.135	8.82	0.149	22.6	0.068	H97-017-08	500 sec cnt on E-17 Tank BOTTOM, w/ lead sheets.
8.81	0.063	9.2	0.077	---	---	---	---	---	---	---	---	---	---	H97-017-09	1000 sec cnt on E-17 Tank MIDDLE.
11.49	0.075	9.2	0.077	---	---	---	---	---	---	---	---	---	---	H97-017-10	500 sec cnt on E-17 Tank MIDDLE, w/ lead sheets.
6.84	0.098	12.7	0.124	---	---	---	---	---	---	---	---	---	---	H97-017-11	1000 sec cnt on E-17 Tank INTERFACE btwn tower and tank.
7.9	0.115	12.7	0.132	---	---	---	---	---	---	---	---	---	---	H97-017-12	500 sec cnt on E-17 Tank INTERFACE btwn tower and tnk w/ le

Attachment F

REDOX Vessel Drawings


RDX-202S-B
TO 233-S/202-S PIPE TRENCH
H-4 TRANSFER LINE (2" SCH 40)
E-3 TO L-12 TRANSFER LINE (2" SCH 40)
233-S FLOOR DRAIN LINE (4" SCH 40)
NORTH SAMPLE GALLERY
PR CAGE
H4
NORTH EXTRACTION CELL E
WASTE CELL D
DISSOLVER CELL C
DISSOLVER CELL B
DISSOLVER CELL A
AIR TUNNEL
SOUTH EXTRACTION CELL F
ORGANIC CELL G
H-4
MISCELLANEOUS PREPARATION CELL H
FILTER CELL J
H4
SOUTH SAMPLE GALLERY
N/S CORRIDOR
REVISIONS
DESCRIPTION
ZONE
NEXT ASSY
DFTR
CHKR
DSGN ENGR
DSGN MGR
MFG
QA
APPRVG
DATE
Oak Ridge Engineering
Oak Ridge, Tennessee
SAMPLE GALLERY LEVEL
BLDG 202-S
SIZE D
DWG NO RDX-202S-B
REV A
SCALE 3/32"=1'-0"
SHEET 1 OF 5



REVISIONS

ZONE	DESCRIPTION

NEXT ASSY

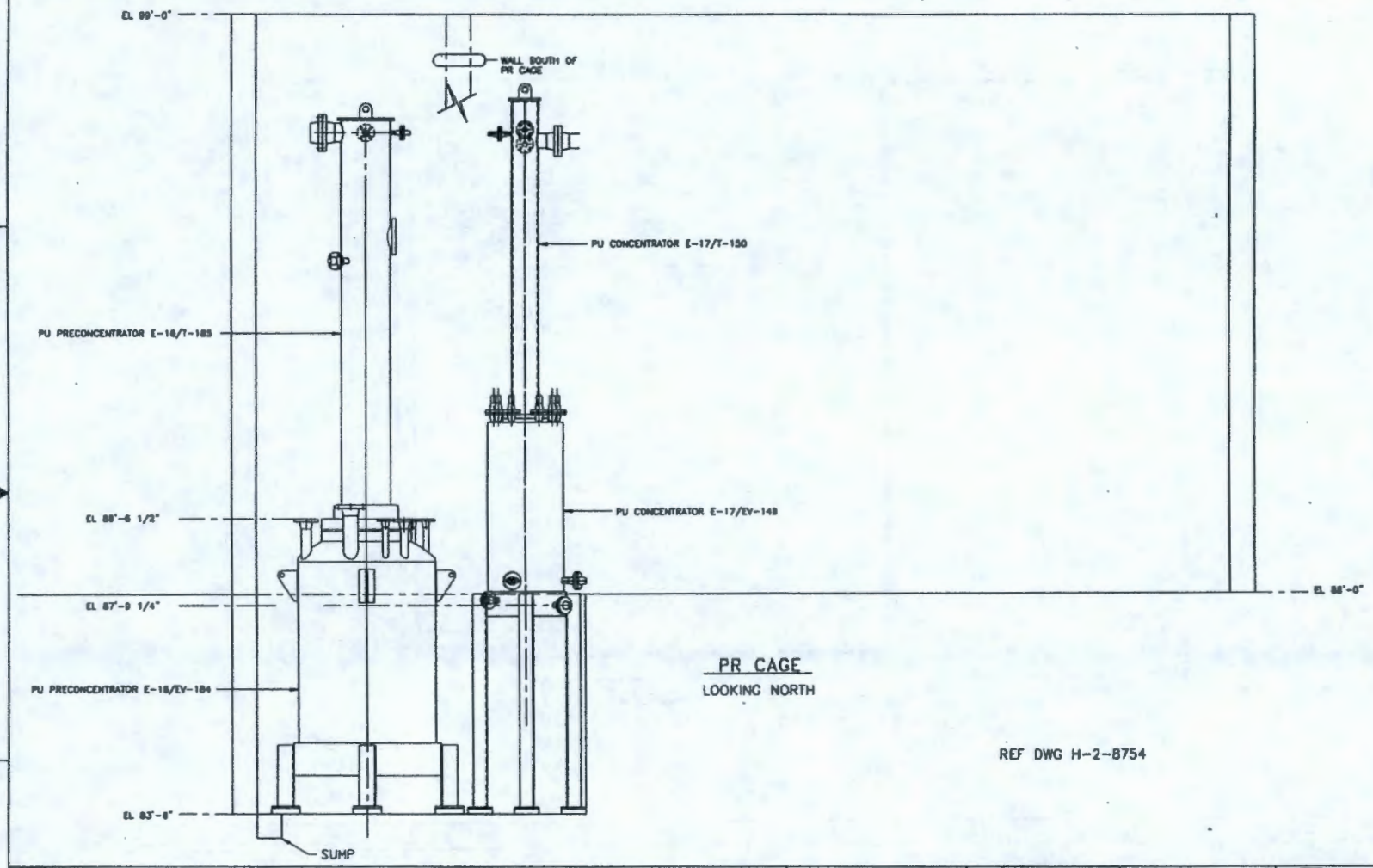
DFTR: DR WILLIAMS DATE 02/13/97
CHKR DATE
DSGN ENGR: J. GONDRY DATE
DSGN MGR: R. ROBERTS DATE
MFG DATE
QA DATE
APPRVD DATE

Oak Ridge Engineering
Oak Ridge, Tennessee

PR CAGE VICINITY

SIZE D | DWG NO RDX-202S-C | REV A

SCALE 3/8"=1'-0" | SHEET 1 OF 1



PR CAGE
LOOKING NORTH

REF DWG H-2-8754

REVISIONS
ZONE | DESCRIPTION

NEXT ASSY

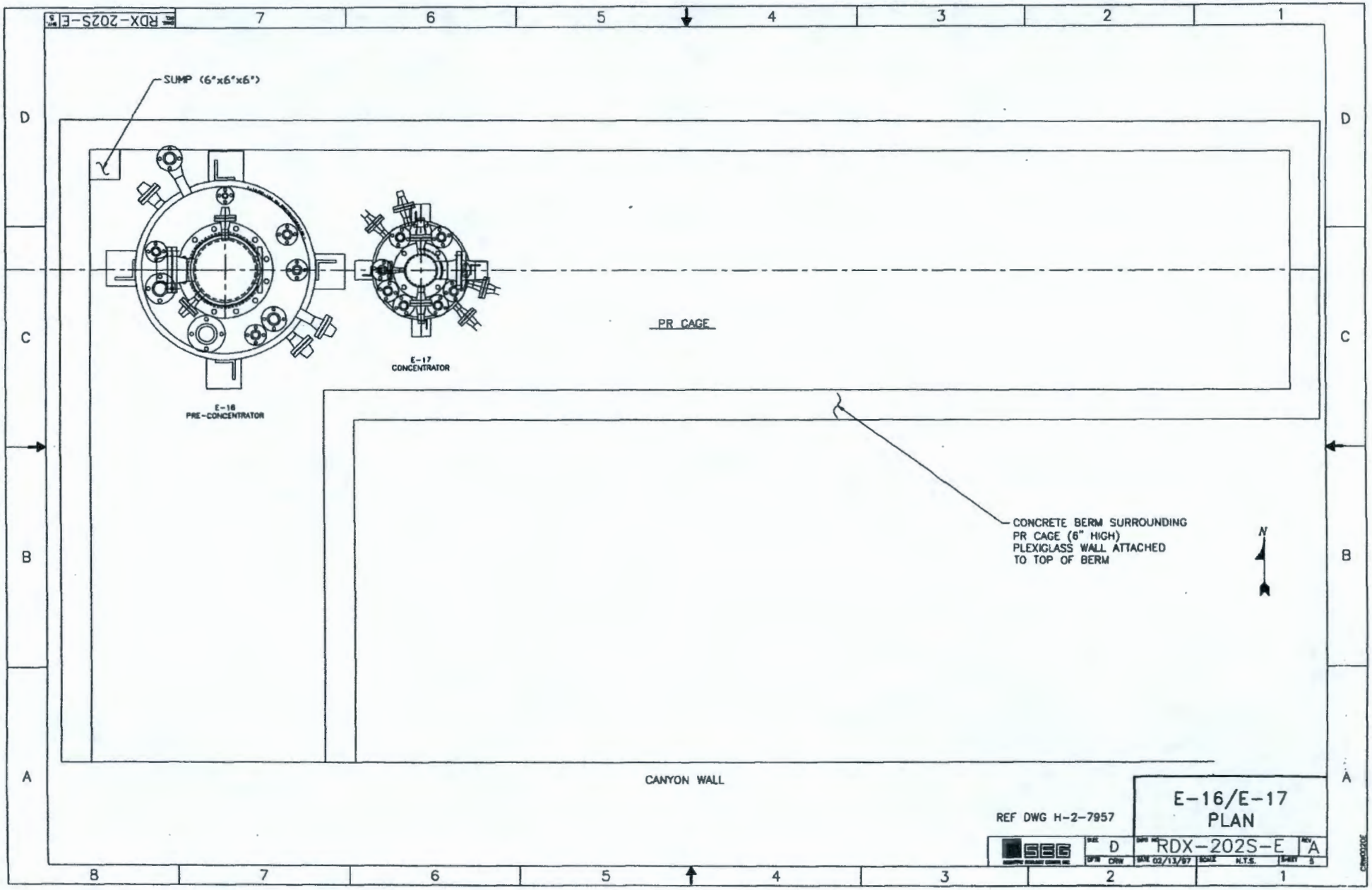
DFTR C.R. WILLIAMS DATE
CHKR DATE
DSGN ENGR J. SONSKY DATE
DSGN MGR J. SONSKY DATE
MFG DATE
QA DATE
APPRVD DATE

Oak Ridge Engineering
Oak Ridge, Tennessee

E-16/E-17
ELEVATIONS

SIZE D | DWG NO RDX-202S-D | REV A
SCALE 1"=1'-0" | SHEET 1 OF 1

RDX-202S-D

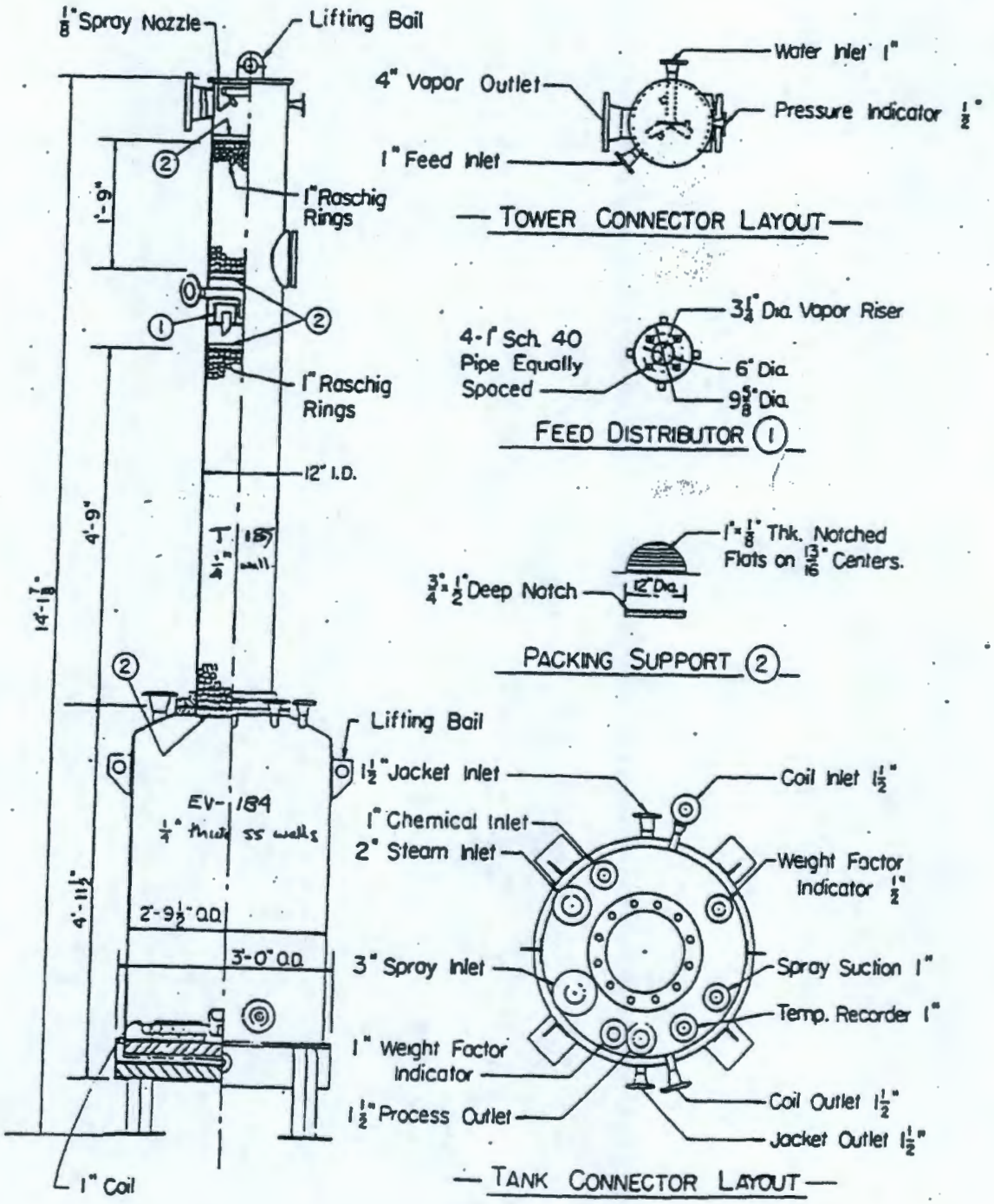

RDX-202S-E
SUMP (6"x6"x6")
E-16
PRE-CONCENTRATOR
E-17
CONCENTRATOR
PR CAGE
CONCRETE BERM SURROUNDING
PR CAGE (6" HIGH)
PLEXIGLASS WALL ATTACHED
TO TOP OF BERM
N
CANYON WALL
REF DWG H-2-7957
E-16/E-17
PLAN
SEG
D
RDX-202S-E
A
02/13/97
H.T.S.

DECLASSIFIED

[redacted]

FIGURE XV-4

PLUTONIUM PRECONCENTRATOR-E-16

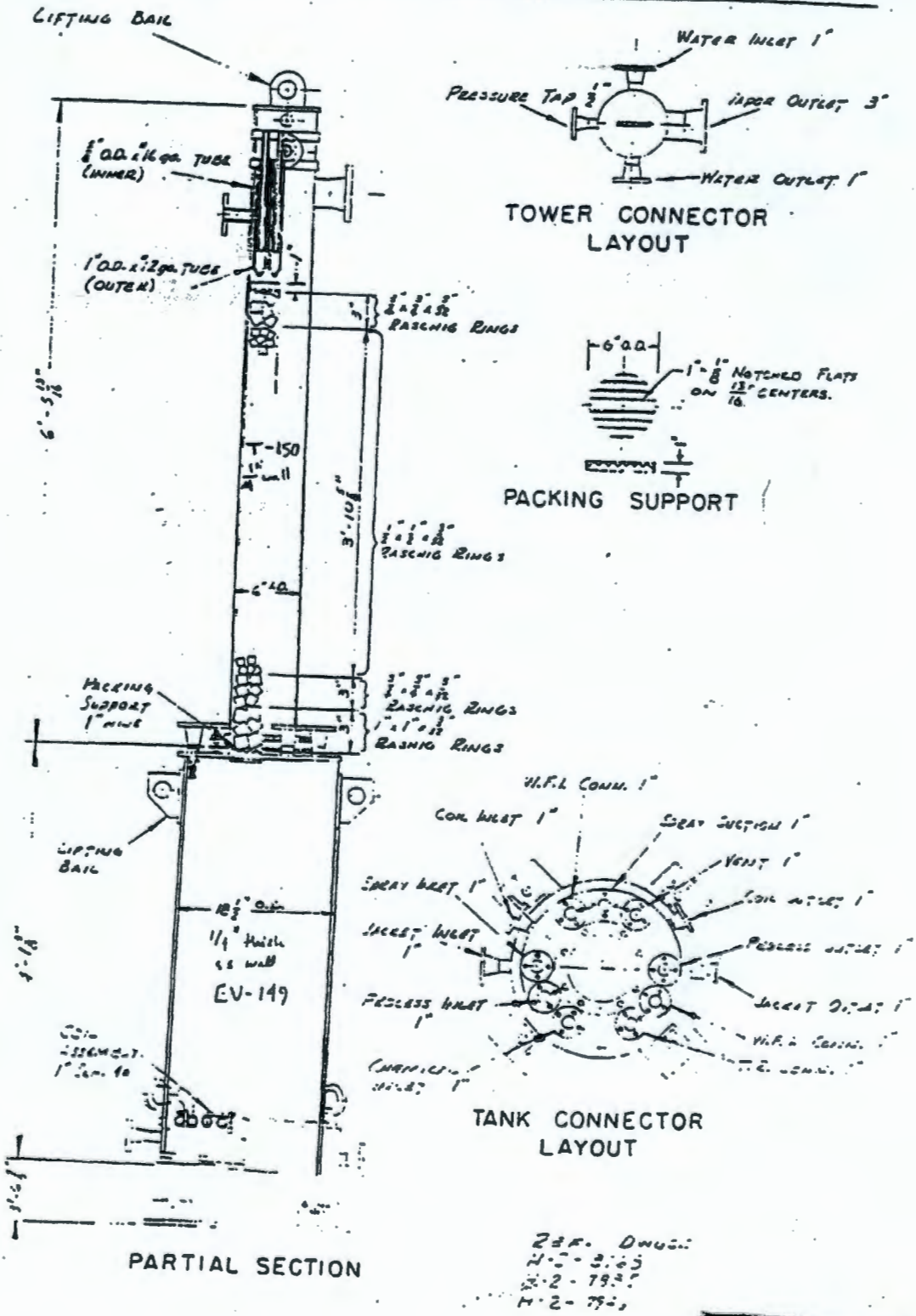


REFERENCE DWGS: H-2-8095
H-2-8169

[redacted]

[redacted] DECLASSIFIED

Figure XV-5
PLUTONIUM CONCENTRATOR E-17



REF. DWGS.

[redacted]

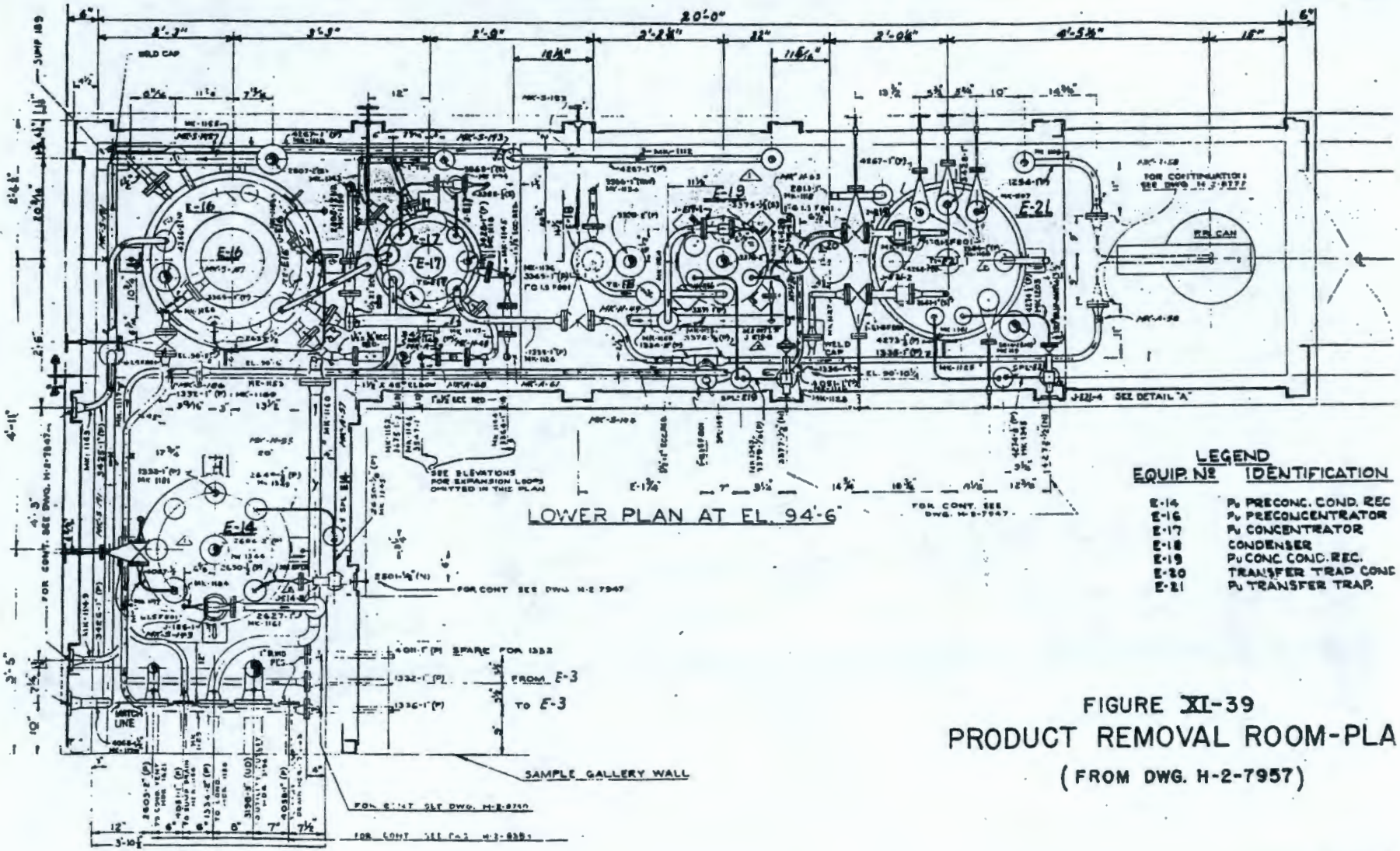


FIGURE XI-39
PRODUCT REMOVAL ROOM-PLA
(FROM DWG. H-2-7957)

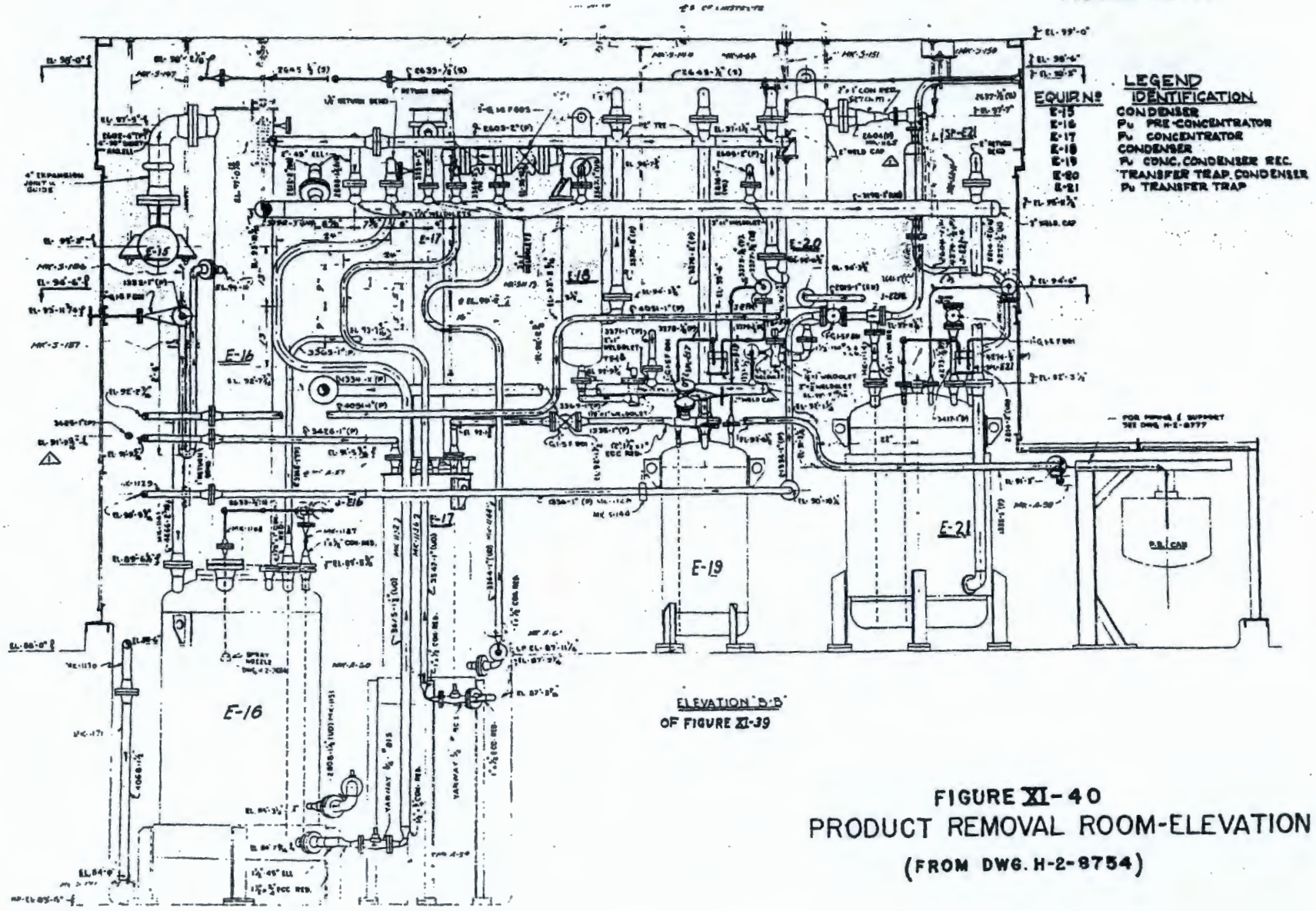


FIGURE XI-40
PRODUCT REMOVAL ROOM-ELEVATION
(FROM DWG. H-2-8754)

Attachment G

REDOX NaI Gamma Spectra

Please refer to separate attachment.

Attachment H

REDOX HPGe Gamma Spectra

Please refer to separate attachment.

Attachment I

Total Pu-239 Derivation

Included in this attachment are three spreadsheets intended to assist reviewers of this document with understanding the derivation of total Pu-239 quantity in each of the three major components, the E-16 Plutonium Pre-Concentrator, the E-17 Plutonium Concentrator, and the H-4 Transfer Line. Included is a reference to each measurement used in the derivation.

Estimate of total Pu-239 in the E-16 Pre-Concentrator

All vessel dimensions from Hanford Drawings H-2-7957 and H-2-8754.

Inside Dim.	Tank	Tower
diameter	33 in	12 in
height	60 in	102 in
end surf area	855.30 in^2	113.10 in^2
side surf area	6220.35 in^2	3845.31 in^2

Pu-239 concentration data (grams per square inch) from measurement data (Attachment E).

Location	Conc. (g/in^2)	Error (%)	Shot No.
mid-tower	0.057	6.64	H-97-016-08
top of tank	0.135	10.84	H-97-016-07
middle of tank	0.351	3.41	H-97-016-04
bottom of tank	0.183	3.34	H-97-013-02
floor under tank	0.093	0.78	H-97-015-00

Multiply the Pu-239 concentration by the appropriate surface area to get total Pu-239 on that surface.

Location	Surface Area (in^2)	Pu-239 (g)	Error (g)	
tower	3845.31	219.18	14.6	
top of tank	113.10	15.27	1.7	(1)
tank side walls	6220.35	870.85	87.1	(2)
tank bottom	855.30	156.52	5.2	
floor under tank	1800.00	167.40	1.3	(3)
TOTAL:		1429.22	109.8	

error 7.68 %

NOTES: (1) The surface area of the top of the tank was assumed to be equal to the surface area of the bottom end of the tower section (ie., 113.1 square inches).

(2) The measured value (0.37 g/in^2) was not used. It appears to be high compared to the top and bottom of tank measurement and measurements in similar locations in the adjacent E-17 Tank A better assumption is that the contamination is uniformly distribu inside the tank. Therefore, a value of 0.14 g/in^2 was used to approximate uniform distribution. Derivation of total Pu-239 cont based on the measured value (0.37 g/in^2) would yield an inappropriately high total Pu-239 quantity.

(3) The floor area beneath the tank is assumed to be approximately one half of the total PR Cage Pit floor area. The measured Pu-239 concentration is assumed to be uniformly distributed over this area. This will serve as a first approximation of total Pu-239 floor activity in this part of the pit.

Estimate of total Pu-239 in the E-17 Concentrator

All vessel dimensions from Hanford Drawings H-2-7957 and H-2-8754.

Inside Dim.	Tank	Tower
diameter	18 in	6 in
height	48 in	78 in
end surf area	254.47 in^2	28.27 in^2
side surf area	2714.34 in^2	1470.27 in^2

Pu-239 concentration data (grams per square inch) from measurement data (Attachment E).

Location	Conc. (g/in^2)	Error (%)	Shot No.
mid-tower	—	—	—
top of tank	0.124	6.84	H-97-017-11
middle of tank	0.077	8.81	H-97-017-09
bottom of tank	0.116	3.75	H-97-013-11
floor under tank	0.178	0.47	H-97-013-04

Multiply the Pu-239 concentration by the appropriate surface area to get total Pu-239 on that surface.

Location	Surface Area (in^2)	Pu-239 (g)	Error (g)	
tower	1470.27	88.22	5.9	(1)
top of tank	28.27	3.51	0.2	(2)
tank side walls	2714.34	209.00	18.4	
tank bottom	254.47	29.52	1.1	
floor under tank	1800.00	320.40	1.5	(3)
TOTAL:		650.64	27.1	

error 4.17 %

NOTES: (1) No measurements were performed on the tower section of the E-17 Pu Concentrator. The concentration of Pu-239 located in th section of the concentrator was assumed to be equal to that measured in the tower section of the E-16 Pre-Concentrator. Therefore, a value of 0.06 g/in^2 +/- 6.64% (1 sigma error) was used to derive an approximation of Pu-239 quantity.

(2) The surface area of the top of the tank was assumed to be equal to the surface area of the bottom end of the tower section (ie., 28.27 square inches).

(3) The floor area beneath the tank is assumed to be approximately one half of the total PR Cage Pit floor area. The measured Pu-239 concentration is assumed to be uniformly distributed over this area. This will serve as a first approximation of total Pu-239 floor activity in this part of the pit.

Estimate of total Pu-239 in the H-4 Transfer Line

All pipe dimensions from Hanford Drawings H-2-7324 and H-2-39742.

Pu-239 concentration data (grams per foot of pipe) from measurement data (Attachments C and D).

	Length (ft)	Avg Pu239 Conc. (g/ft)	Pu-239 (grams)	error (%)	error (grams)	Shot No.	Notes:
Pipe:							
South Gallery	126	0.023	2.898	100	2.898	N96-313-09	(1) (2)
N/S Corridor	53	0.122	6.466	2.993	0.194	N96-316-05	
North Gallery							
East Section	100	0.264	26.4	3.518	0.929	N96-317-03	(3)
West Section	210	0.032	6.72	43.03	2.892	N96-318-03	(4)
Valves:							
South Gallery			0.1685	1.77	0.003	H96-337-07	
enters wall							
Middle North			0.274	100	0.274	H96-344-02	(2)
Gallery							
Near Hood (2")			1.4358	1.75	0.025	H96-351-03	
Near Hood (1")			0.5717	1.95	0.011	H96-341-04	
Bends:							
SE Corner			0.0143	9.93	0.001	H96-337-04	
NE Corner			0.0927	2.74	0.003	H96-337-03	
Corner near Hood			2.38	0.672	0.016	N96-319-04	
N			0.494	2.854	0.014	N96-319-07	
Corner across			4.889	1.64	0.080	N96-323-09	(5)
from Hood							
TOTAL Pu-239			52.80	13.9	7		

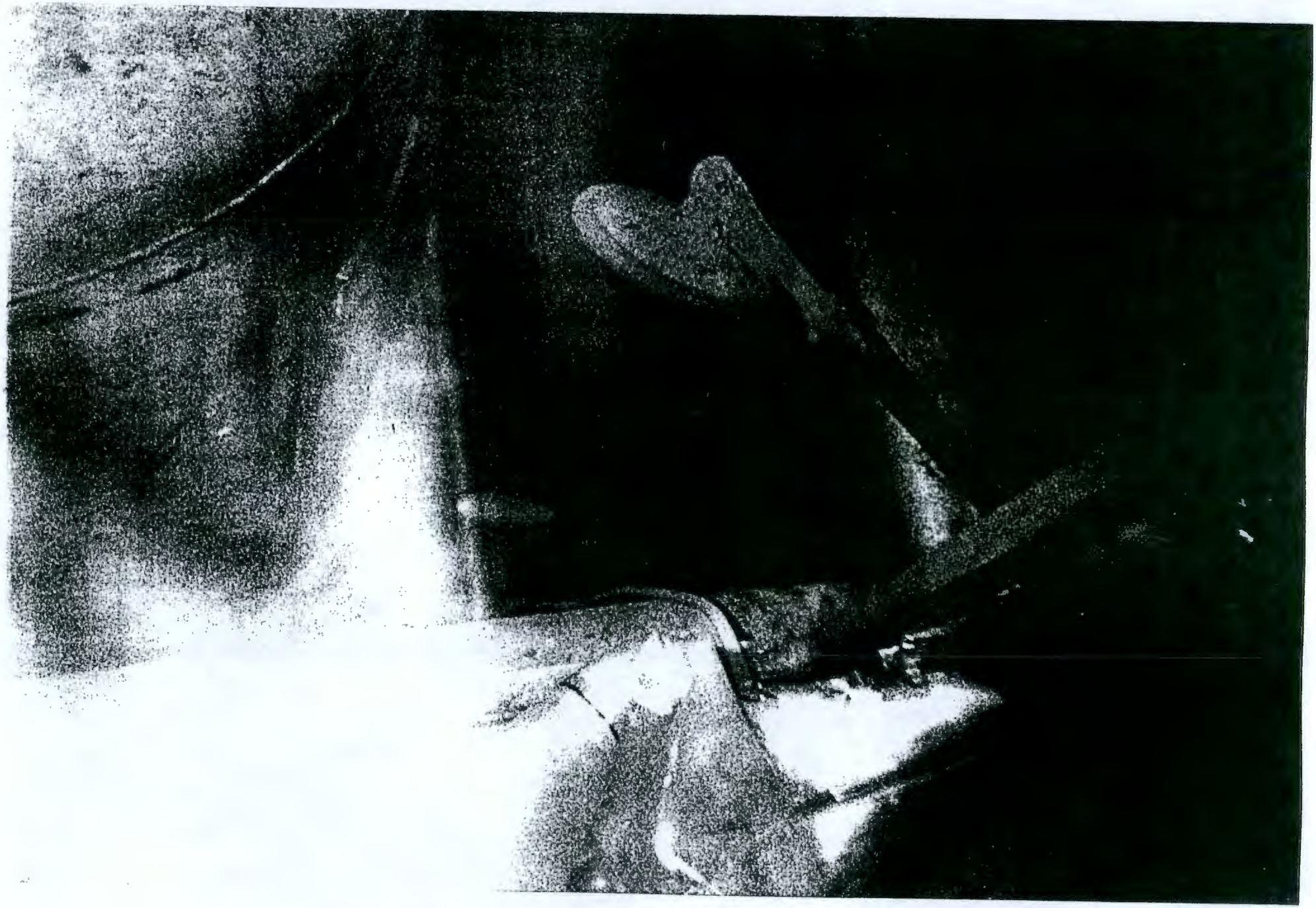
NOTES:
(1) The data point used to approximate total Pu-239 activity is representative of the specified section of pipe or valve. Along each length of pipe, a range of activity per length of pipe values exist. Pu-239 appears to be highest in elbows and valves, tap off with distance away from the elbow or valve. The data point chosen appears to average value for the selected object. Due to the simplicity of the model, the total P in the H-4 pipe is only a first approximation.
(2) All MDA values are reported with a 100% error (1 sigma).
(3) The "east" section of the H-4 Line in the North Sample Gallery was taken as approximately that length of pipe between a wrapped valve and the elbow at the N/ corridor. Measured Pu-239 in this section of pipe was higher than the remainder of pipe in the North Sample Gallery.
(4) The "west" section of pipe in the North Sample Gallery was taken as approximately that length of pipe between a wrapped valve on the east side of the false wall, and t point where the pipe enters the North Sample Gallery from the common wall with th 233-S Pipe Trench. The measured quantity of Pu-239 per length of pipe appeared lower throughout this section of pipe.
(5) This elbow was used as a daily check source, due to the easily reproducible geometry and Pu-239 actvity.

Attachment J

REDOX Sample Gallery and PR Cage Photographs

1. Side of E-17 Tank (left) and top of E-16 Tank (right)

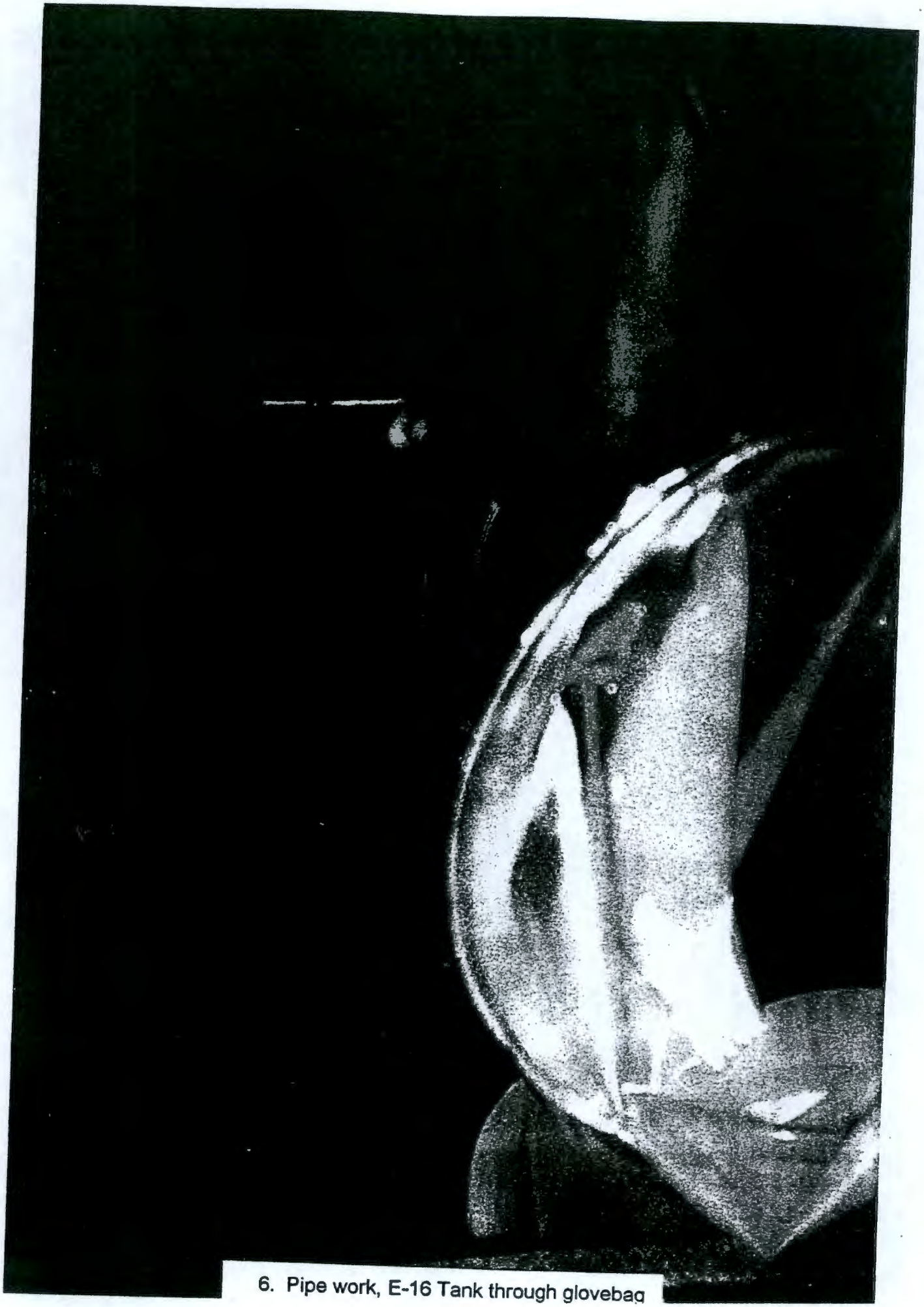
2. Top of E-16 Tank through glovebag



3. Northwest corner of the PR Cage pit - side of E-16 Tank

4. Top of E-16 Tank through PR Cage west side plexiglass panel

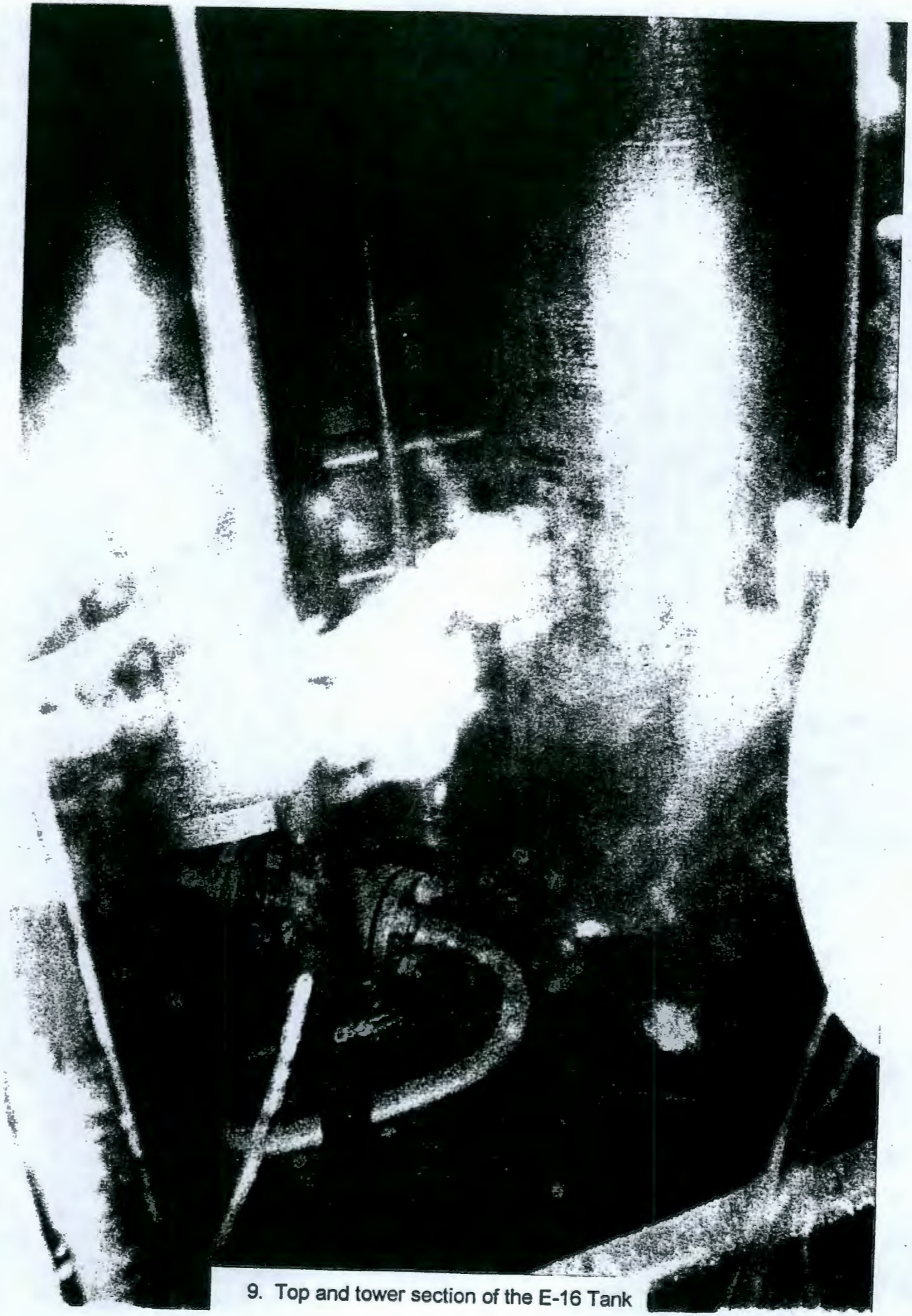
5. Side of E-16 Tank



6. Pipe work, E-16 Tank through glovebag

7. Pipe work, top of E-16 Tank through glovebag

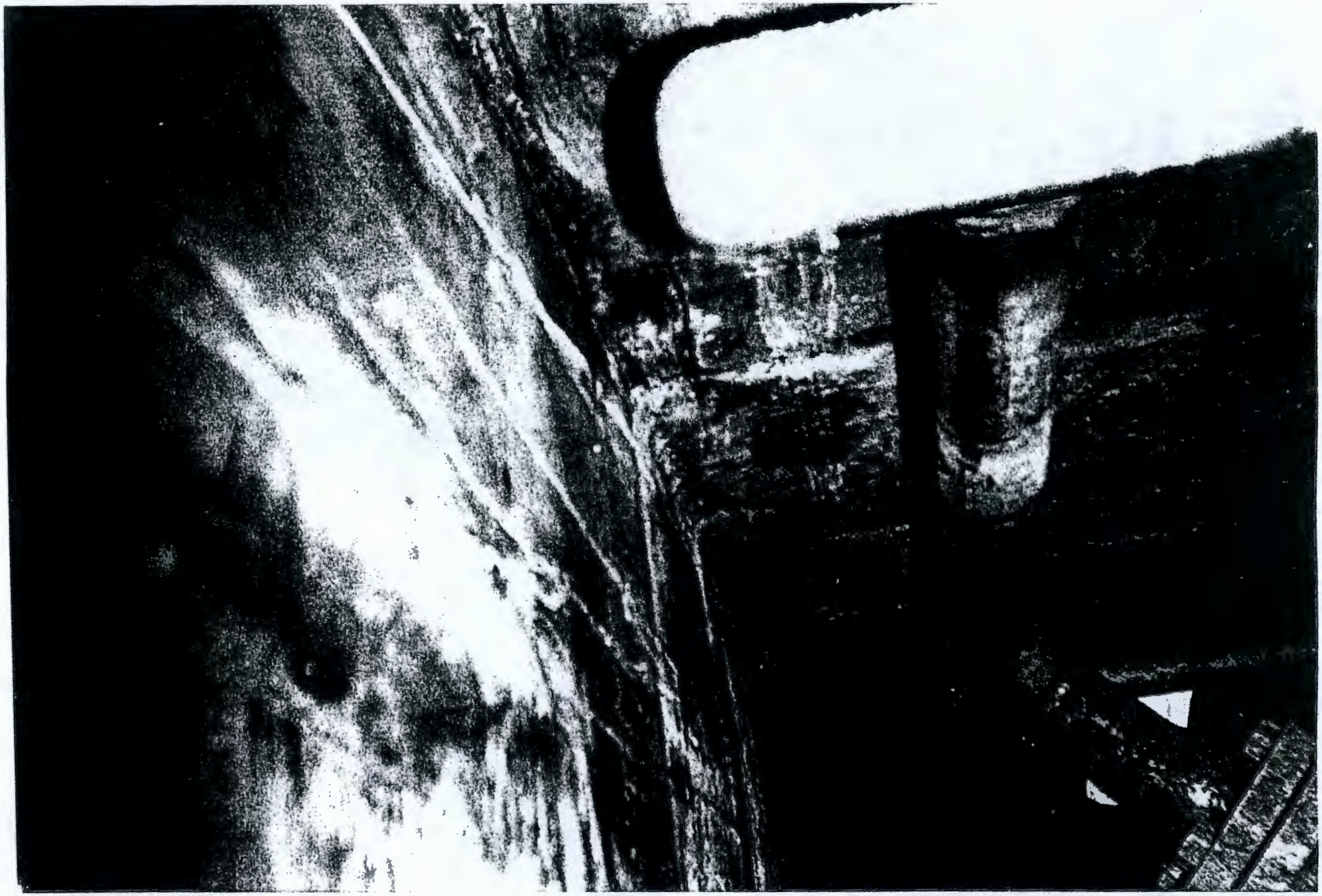
8. West side of E-16 Tank, west pit wall, and sump examination mirror



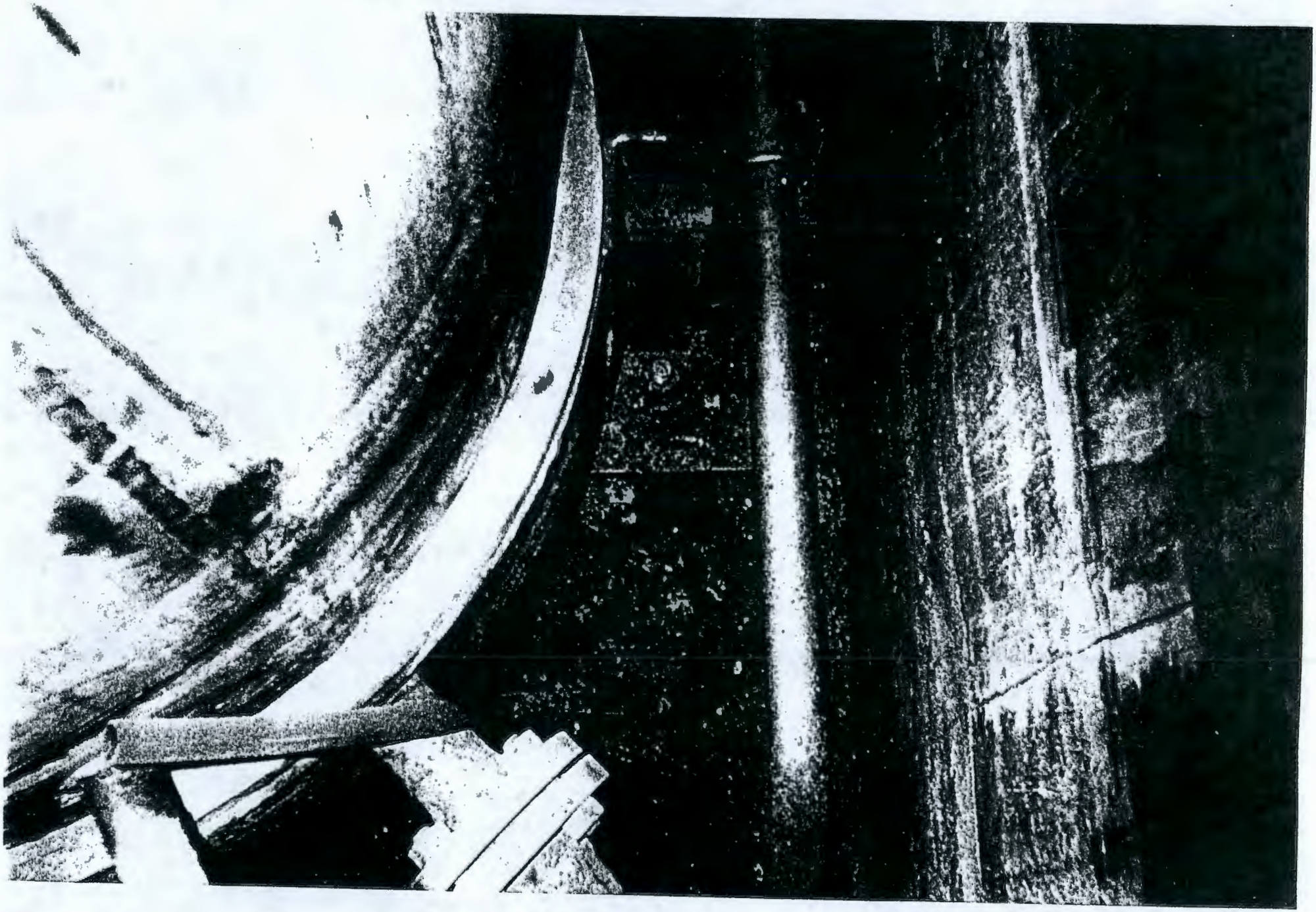
9. Top and tower section of the E-16 Tank

10. Pipe work and top of F-16 Tank

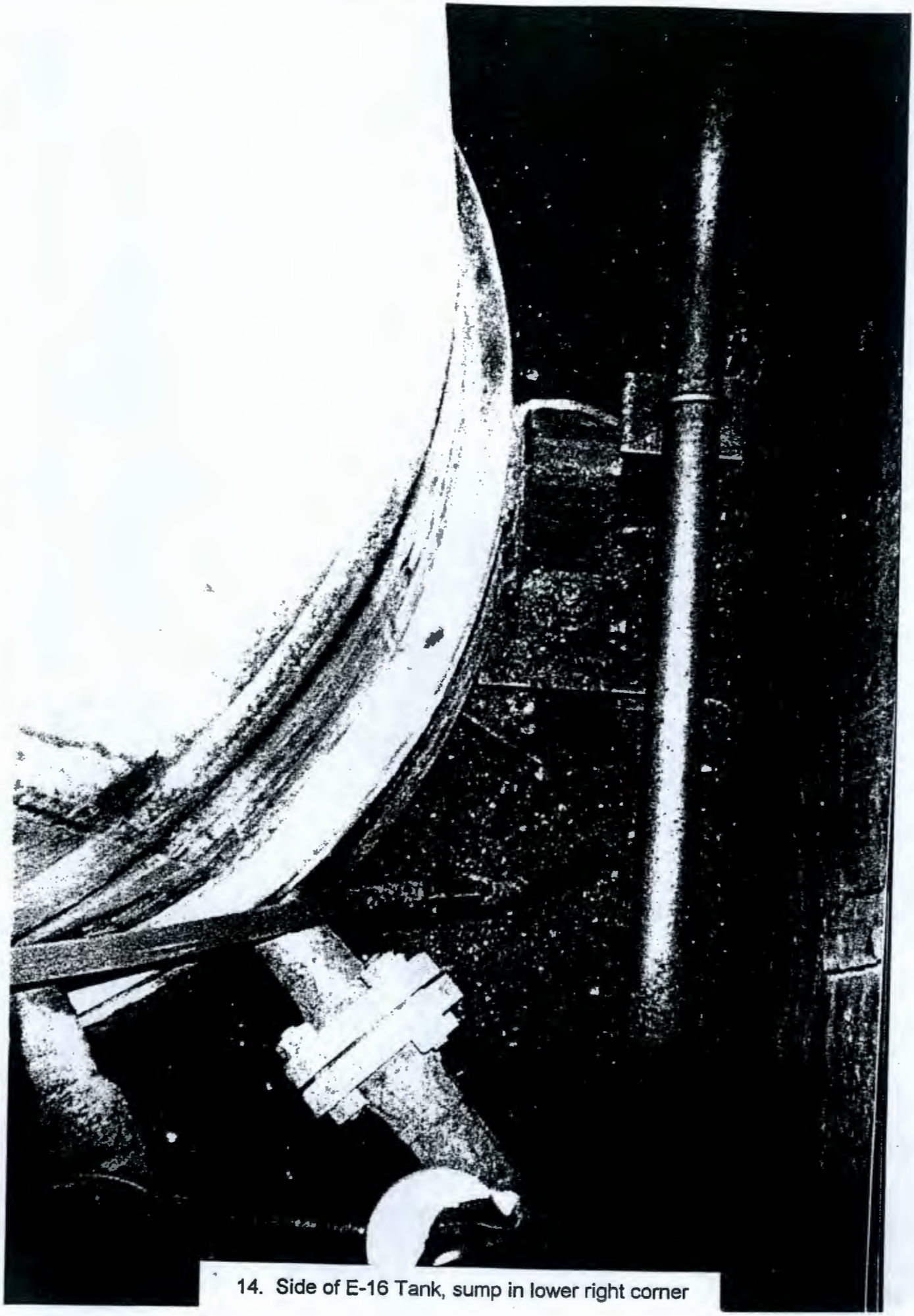
11. Top of E-17 Tank



12. PR Cage pit sump (note multiple bathtub rings)

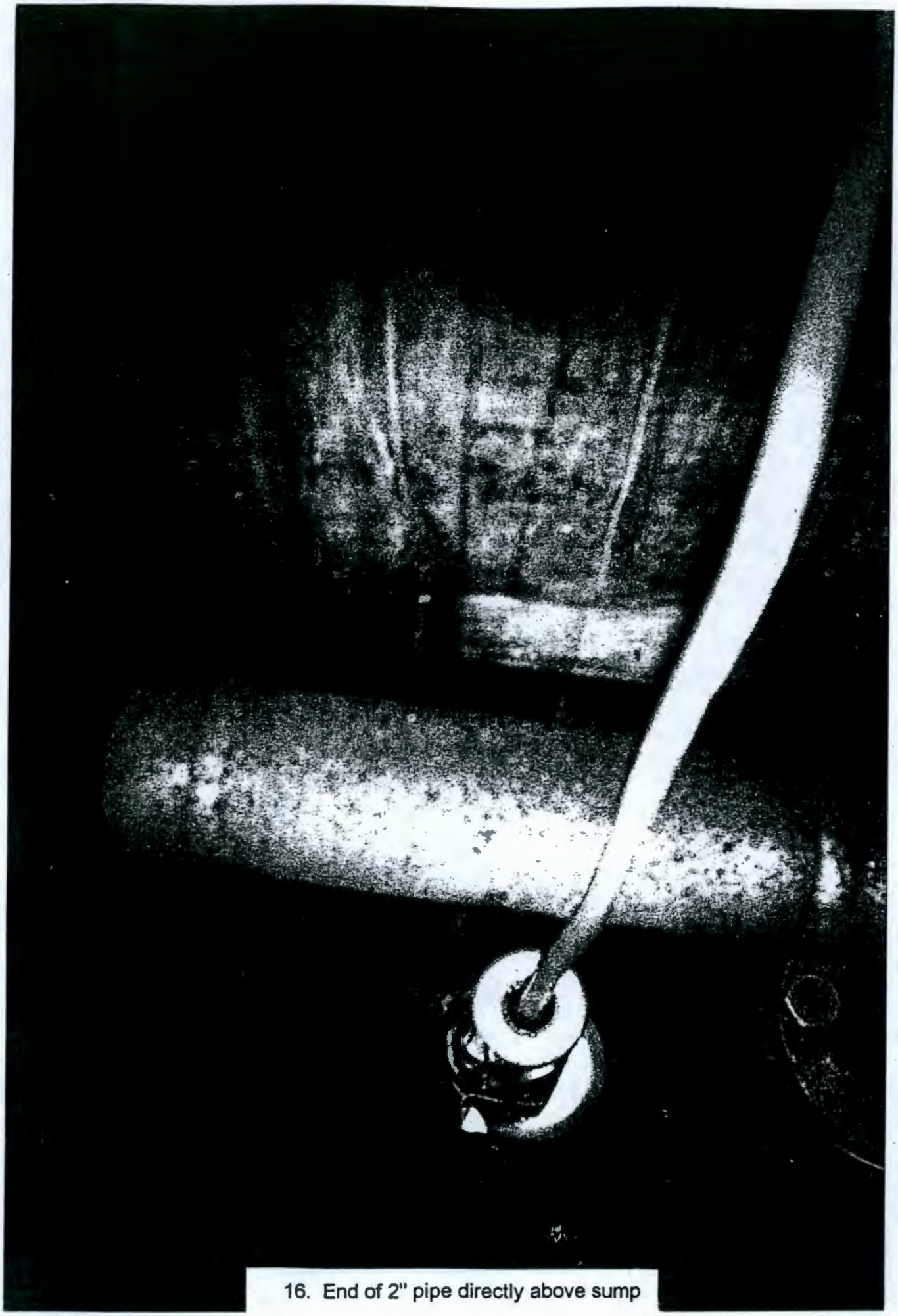


13. 2" pipe running along pit west wall to sump at bottom center

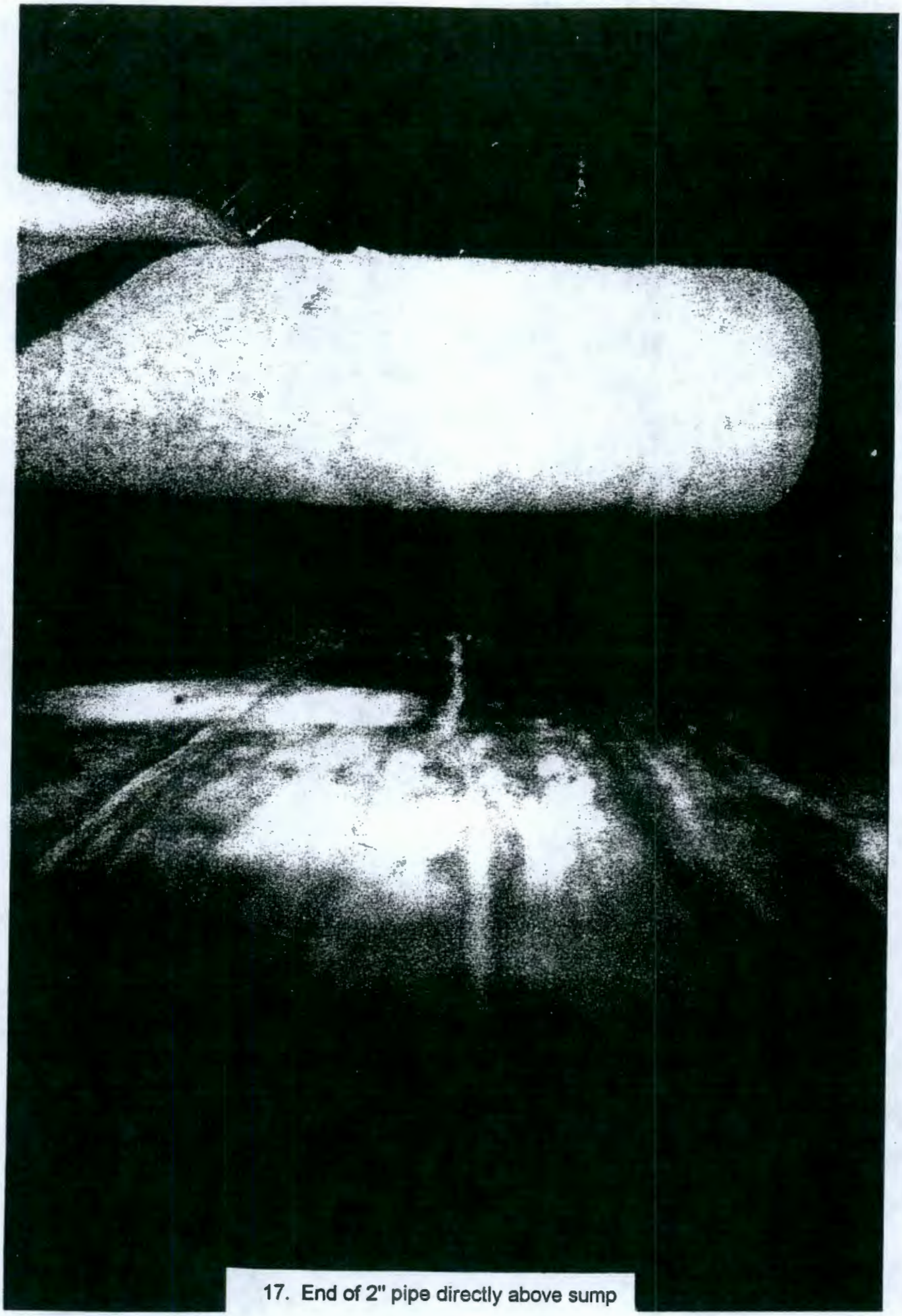


14. Side of E-16 Tank, sump in lower right corner

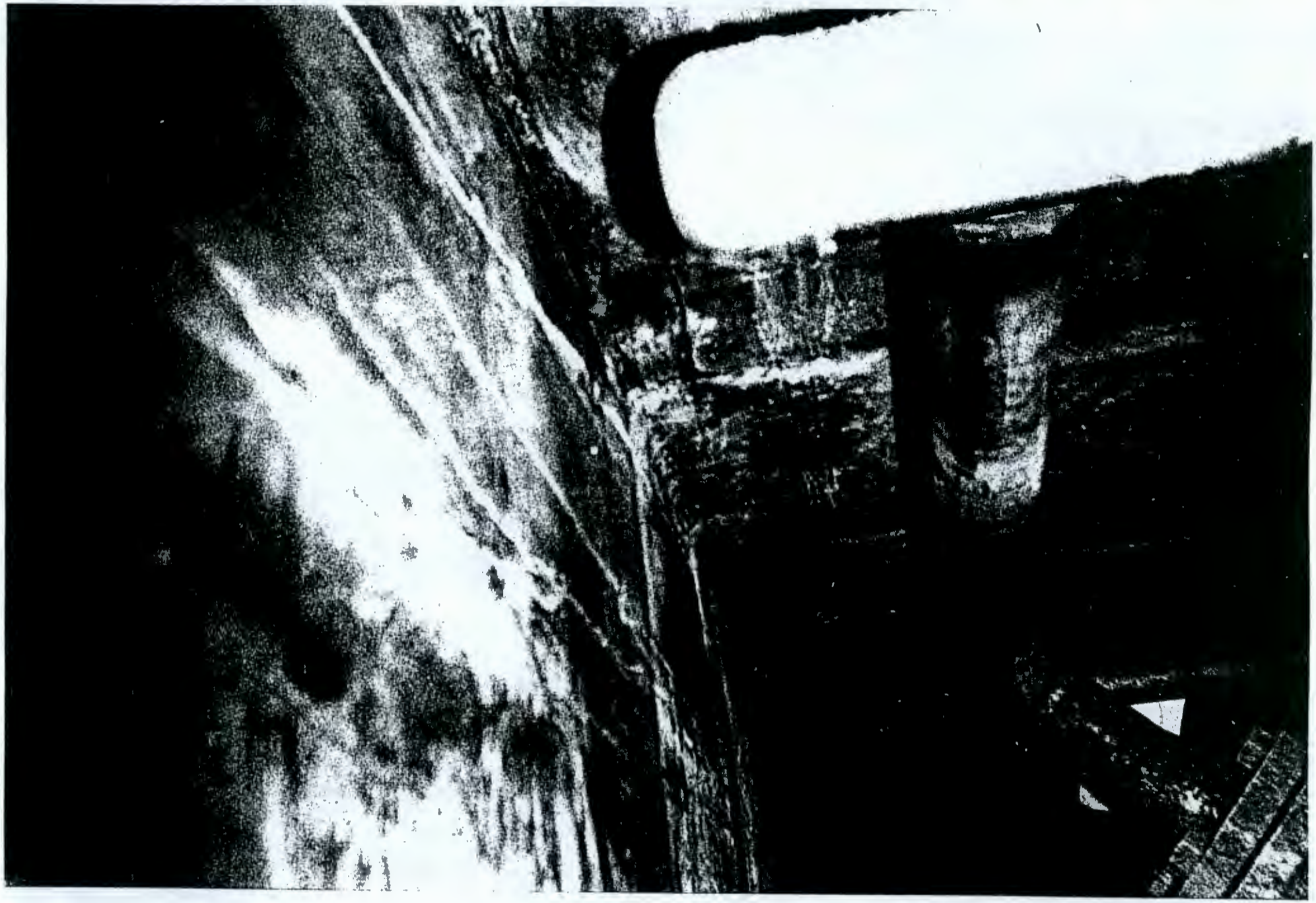
15. Southwest corner of PR Cage pit



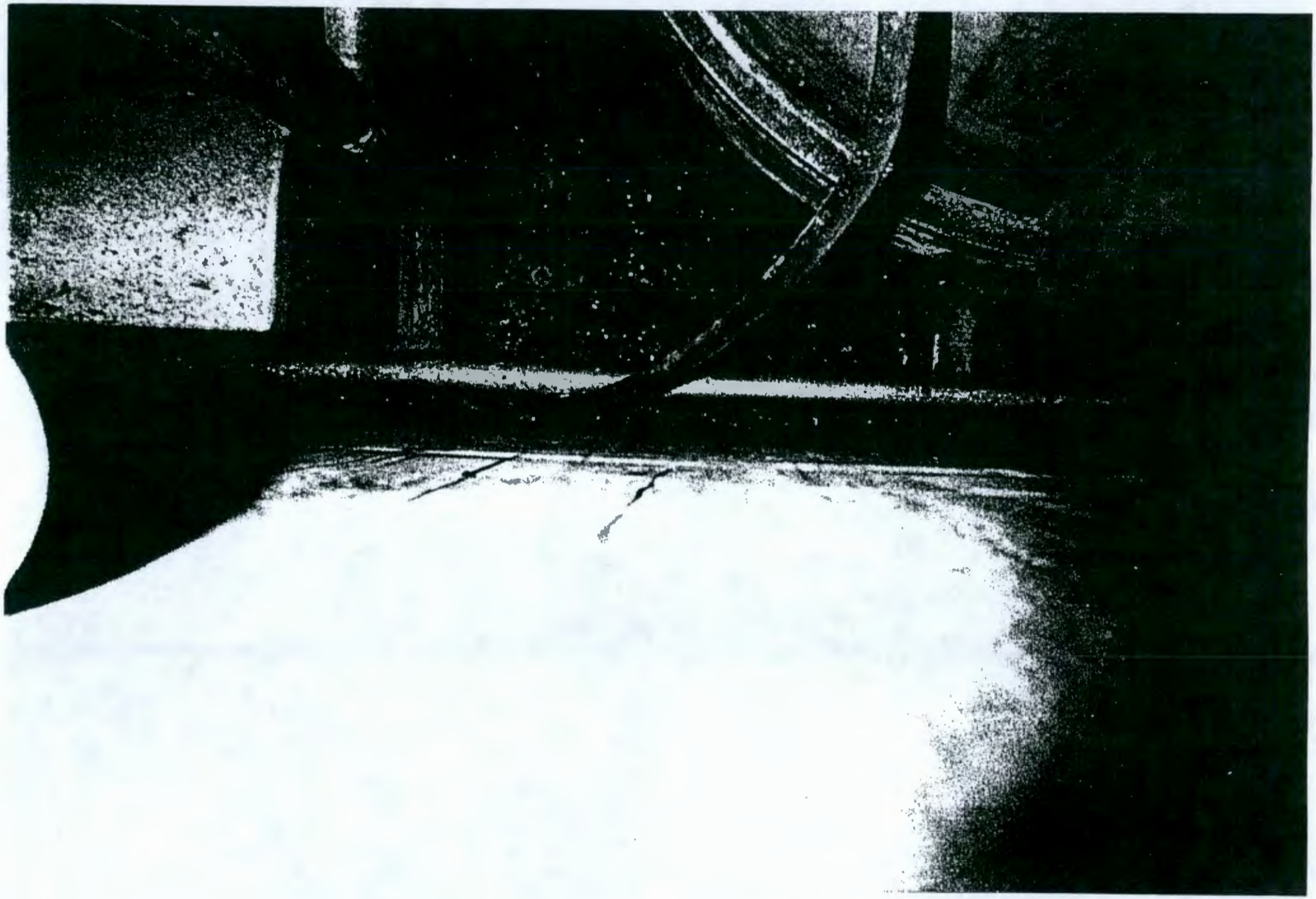
16. End of 2" pipe directly above sump



17. End of 2" pipe directly above sump

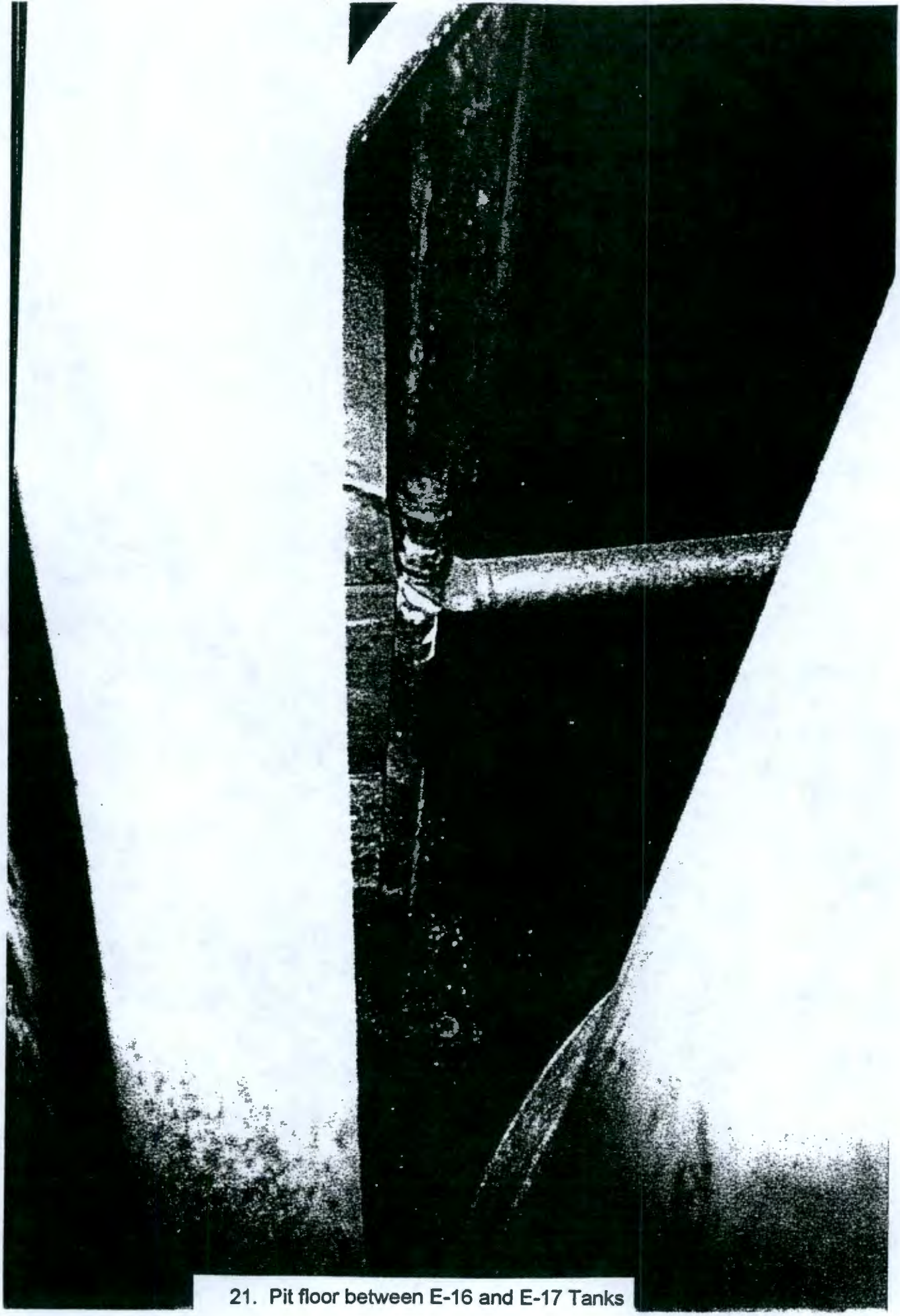


18. PR Cage pit sump (note multiple bathtub rings)



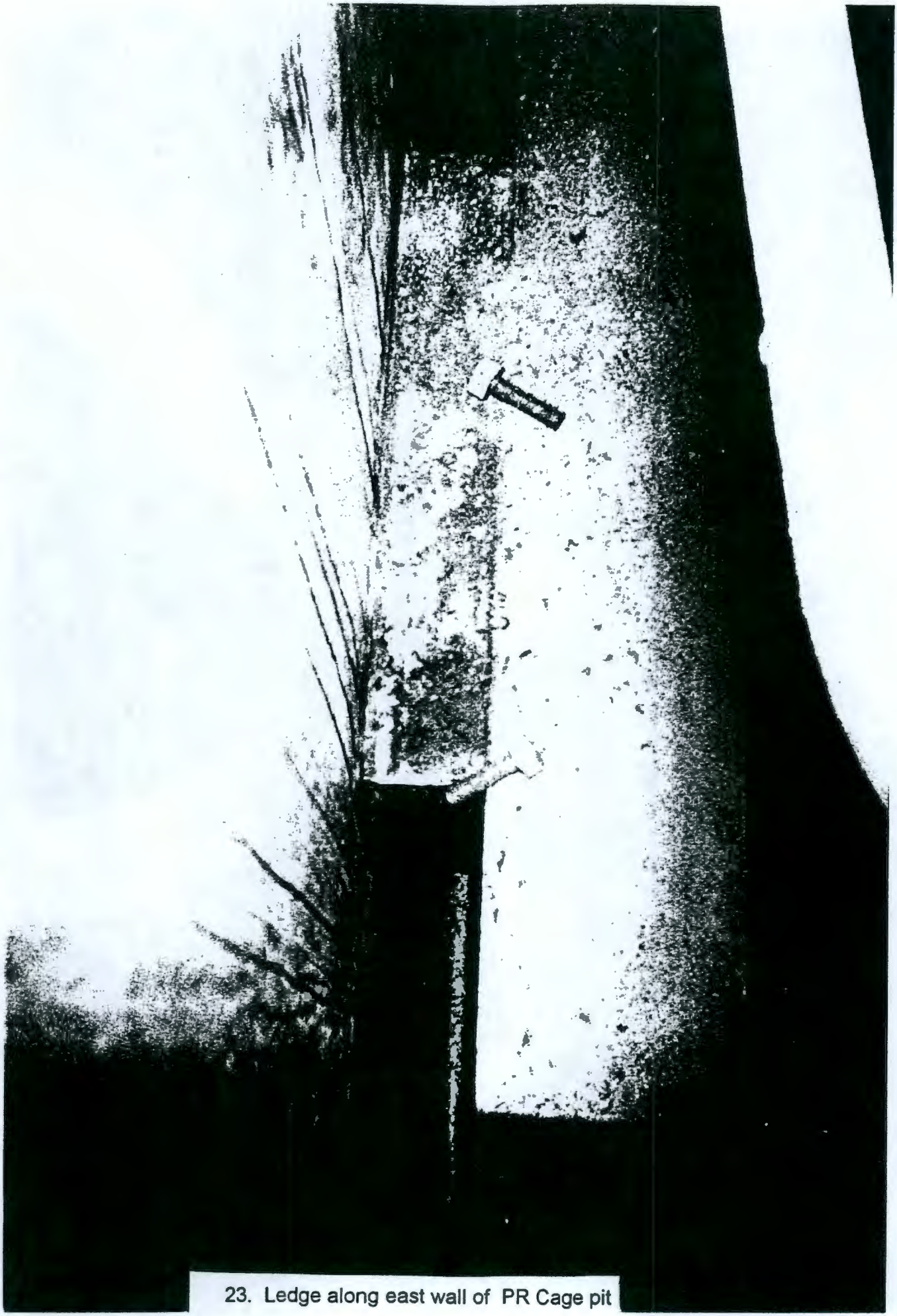
19. Looking down north wall of PR Cage pit

20. Floor area under the E-17 Tank (bottom of E-16 Tank in lower right corner)

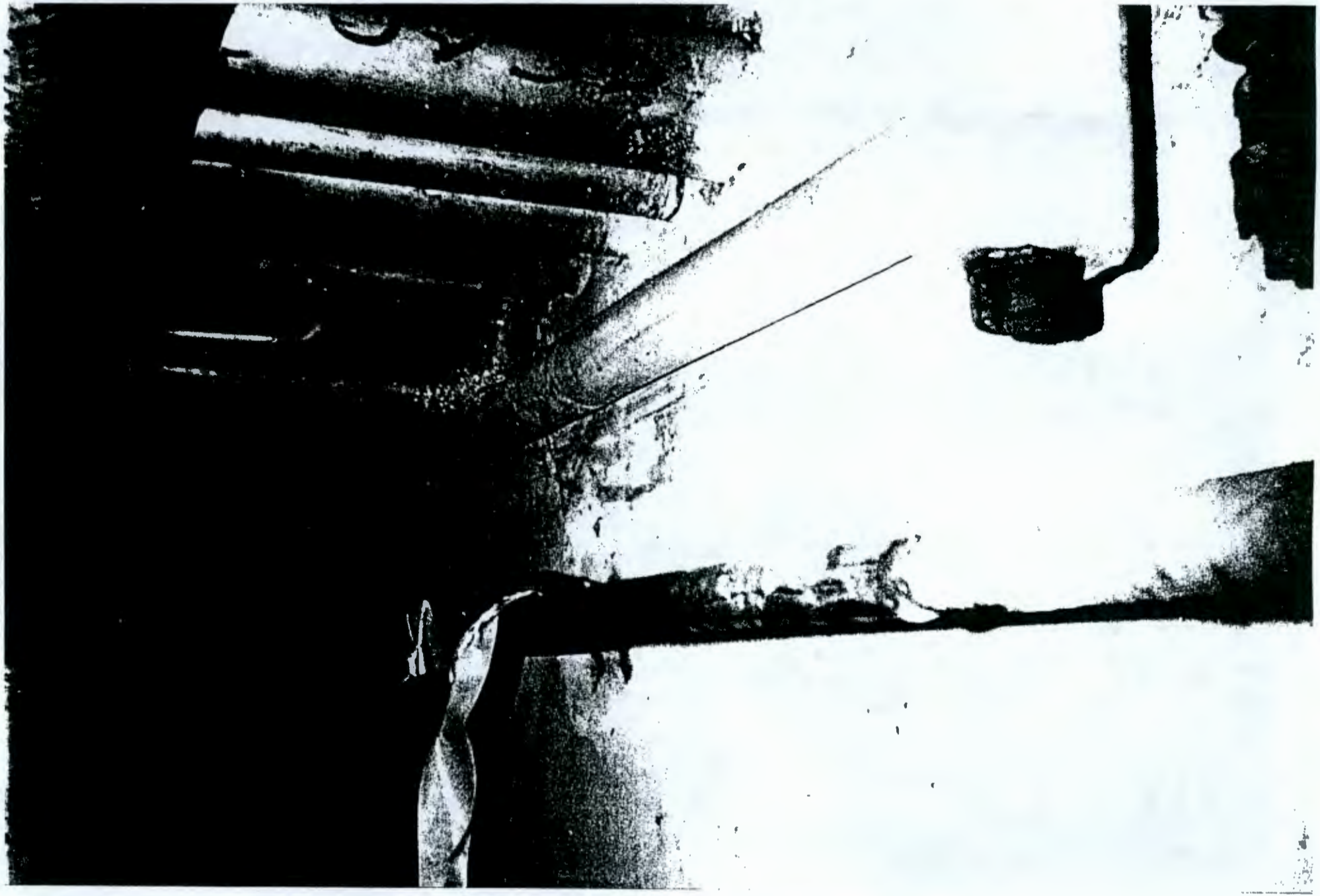


21. Pit floor between E-16 and E-17 Tanks

22. Ledge along east side of pit

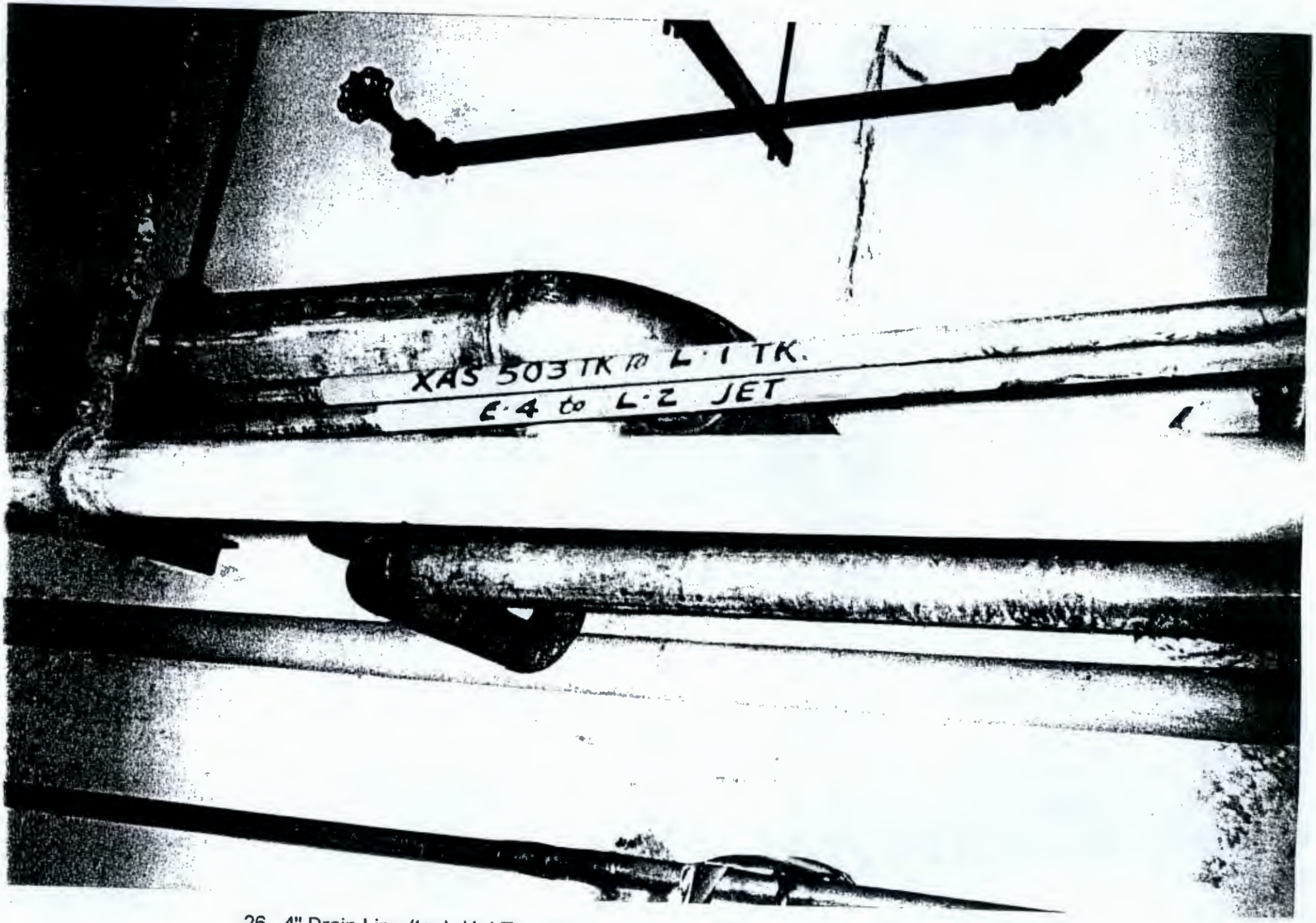


23. Ledge along east wall of PR Cage pit

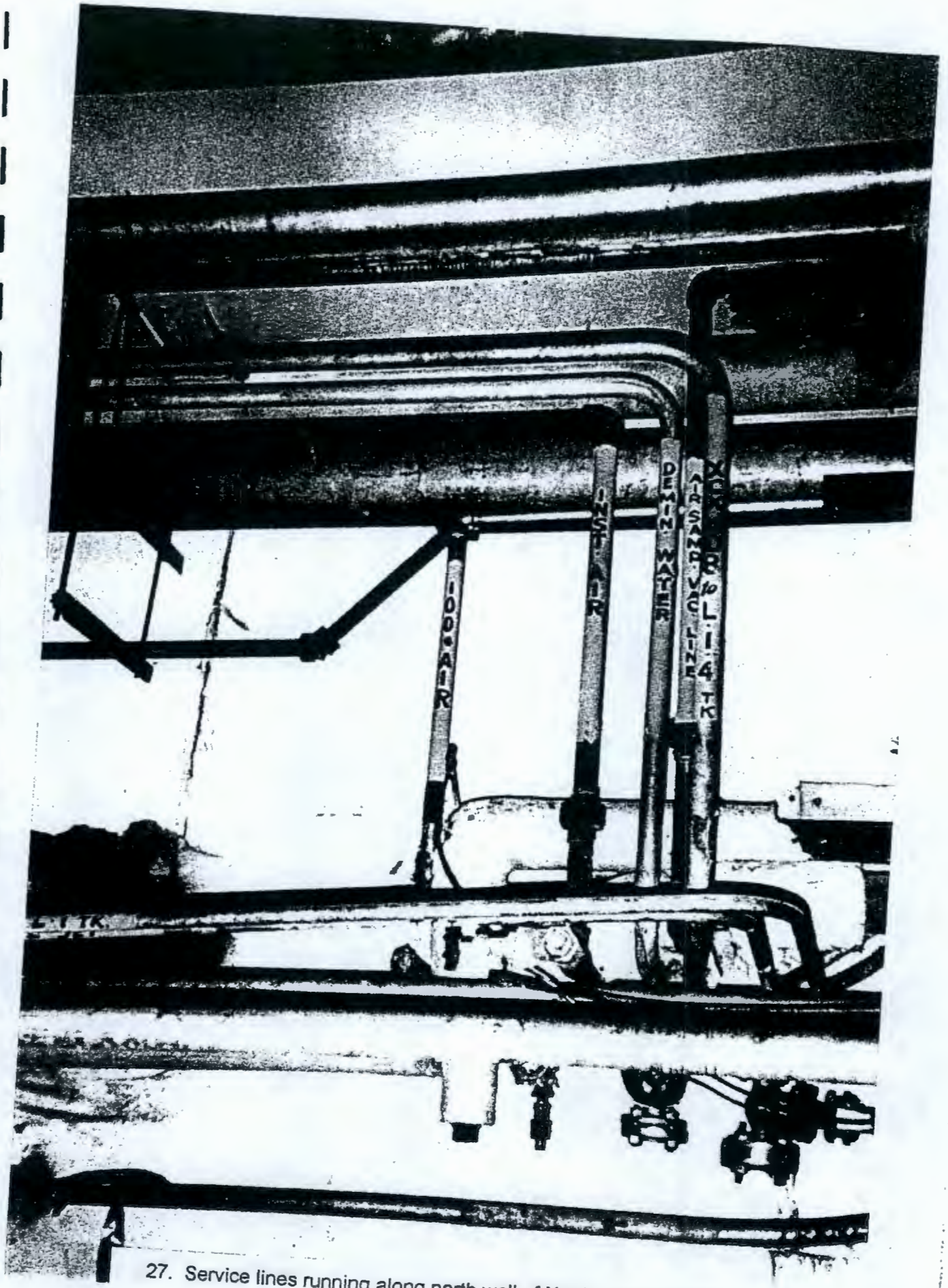


24. H-4 Transfer Line entering North Sample Gallery north wall (with rolling offset)

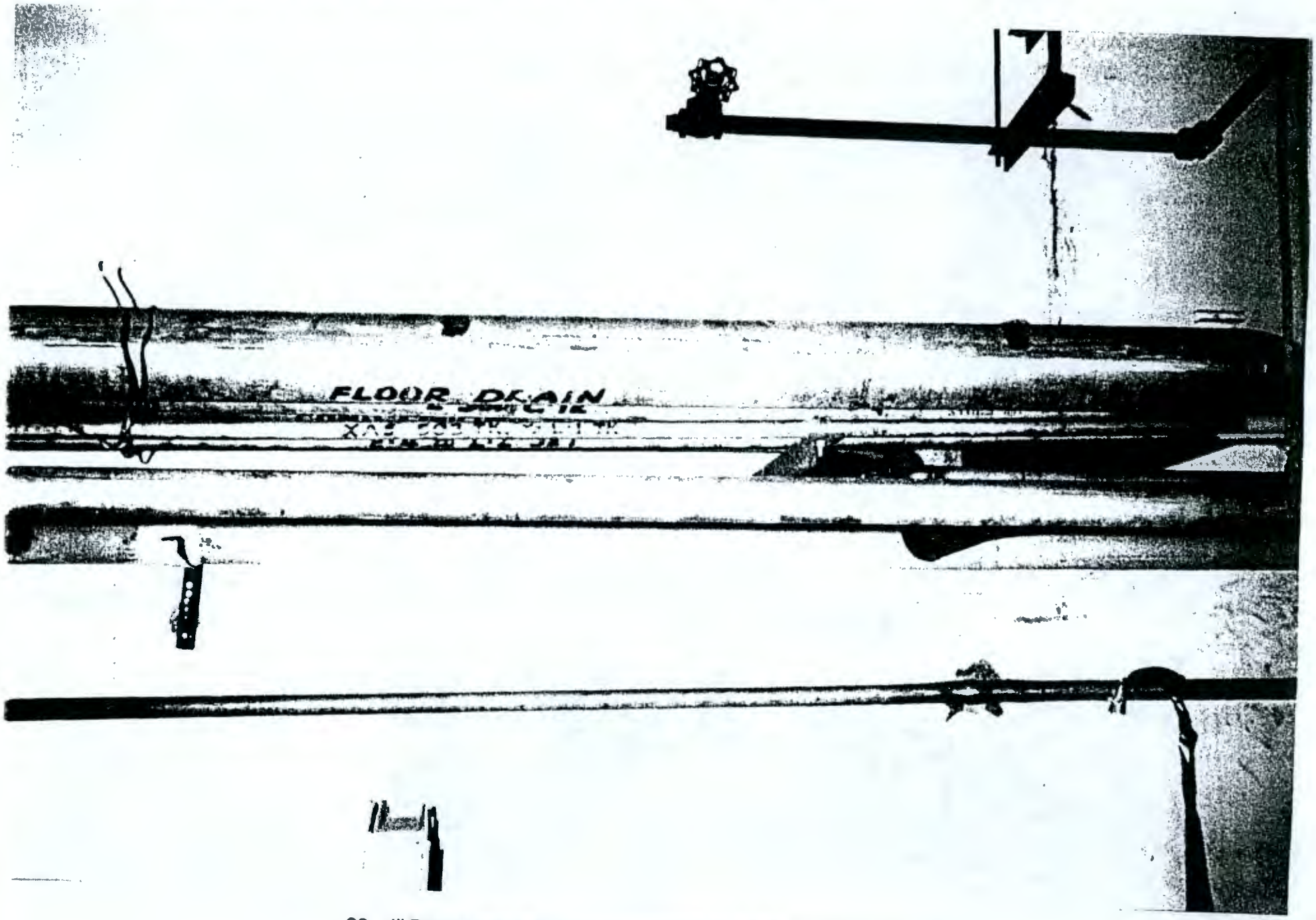
25. H-4, E-3 to L-12, and 4" Floor Drain Lines entering North Sample Gallery, north wall



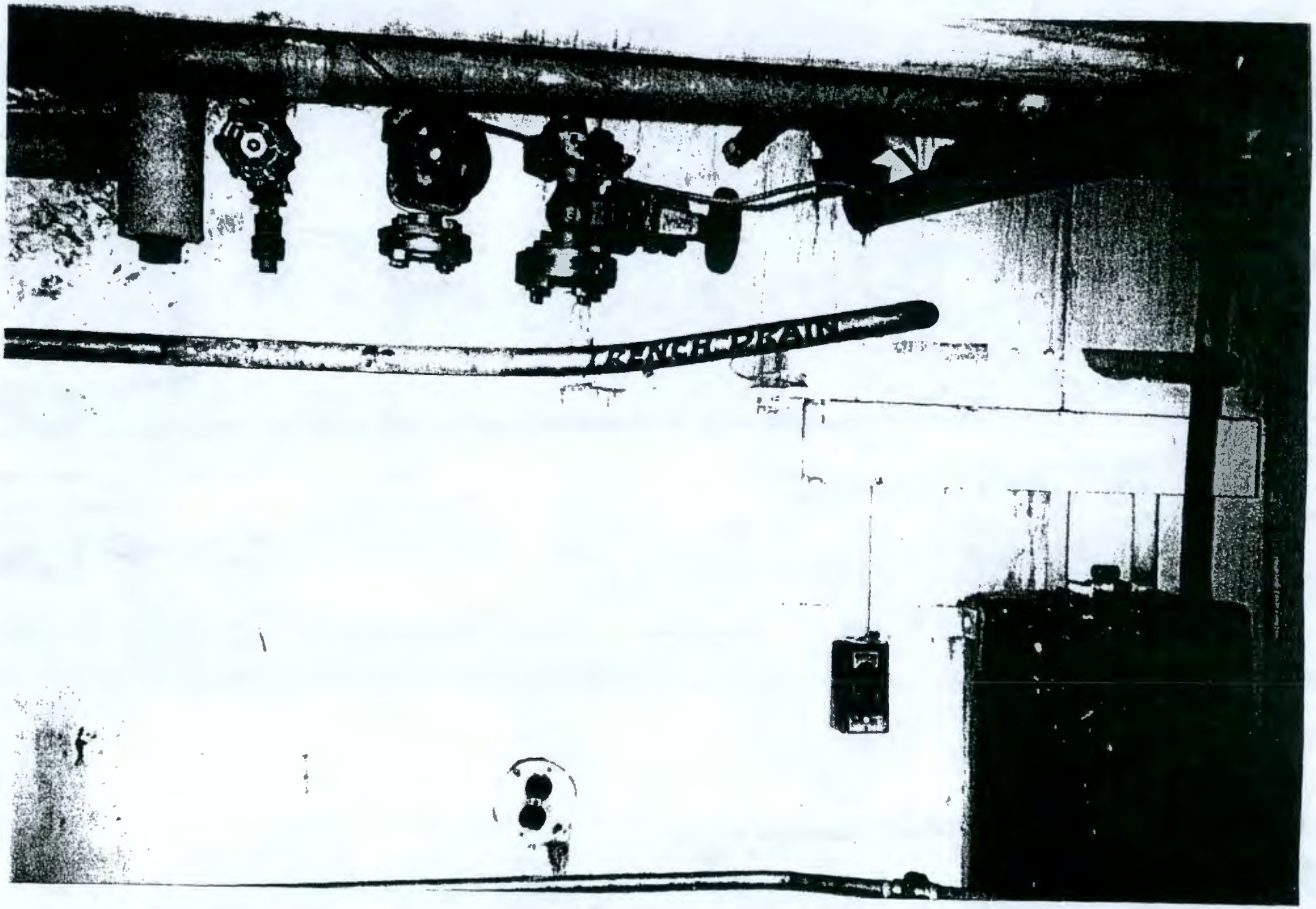
26. 4" Drain Line (top), H-4 Transfer Line (center), and 233-S Trench Drain Line (bottom)



27. Service lines running along north wall of North Sample Gallery



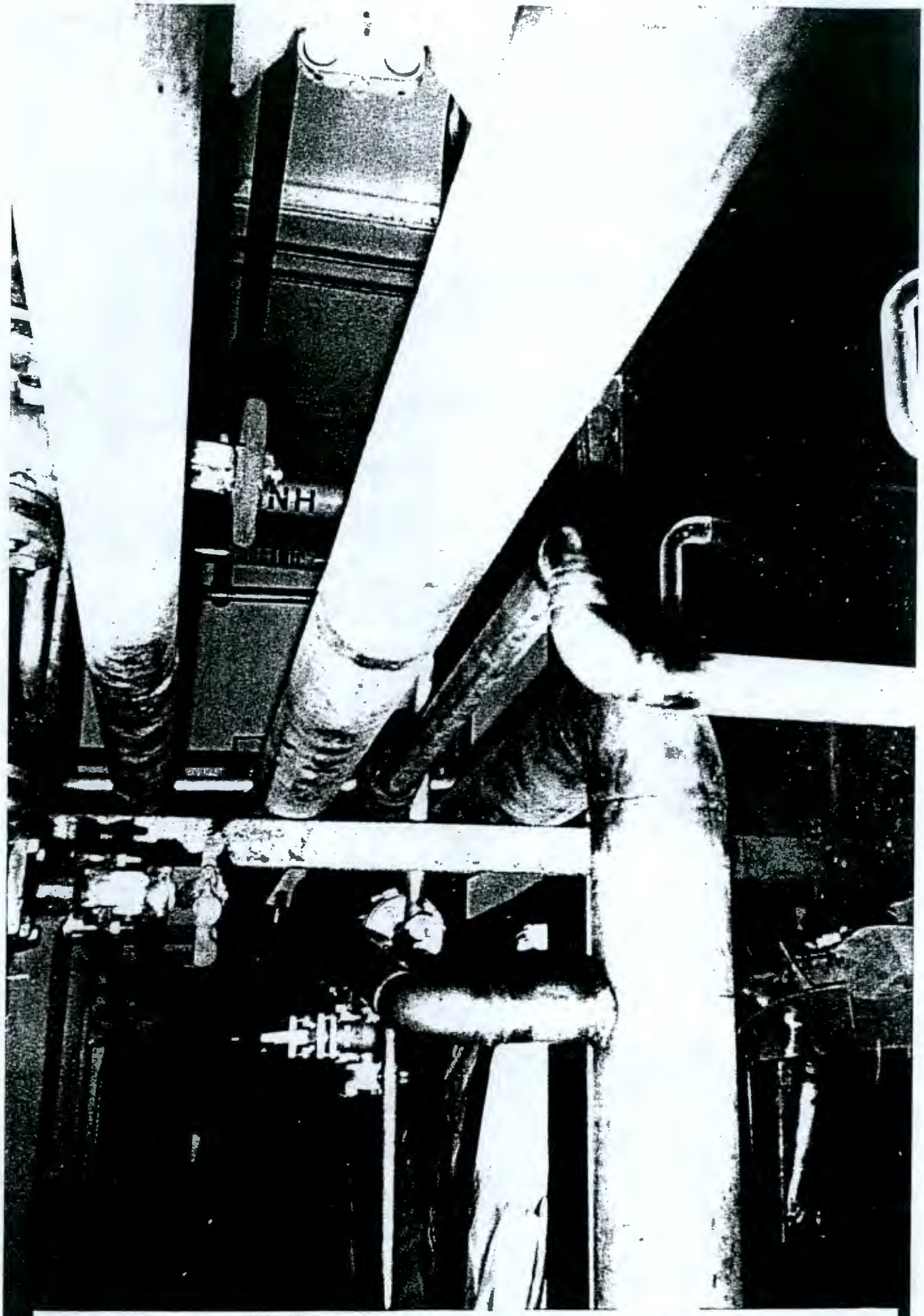
28. 4" Drain Line (top, foreground) and 233-S Trench Drain Line (bottom)



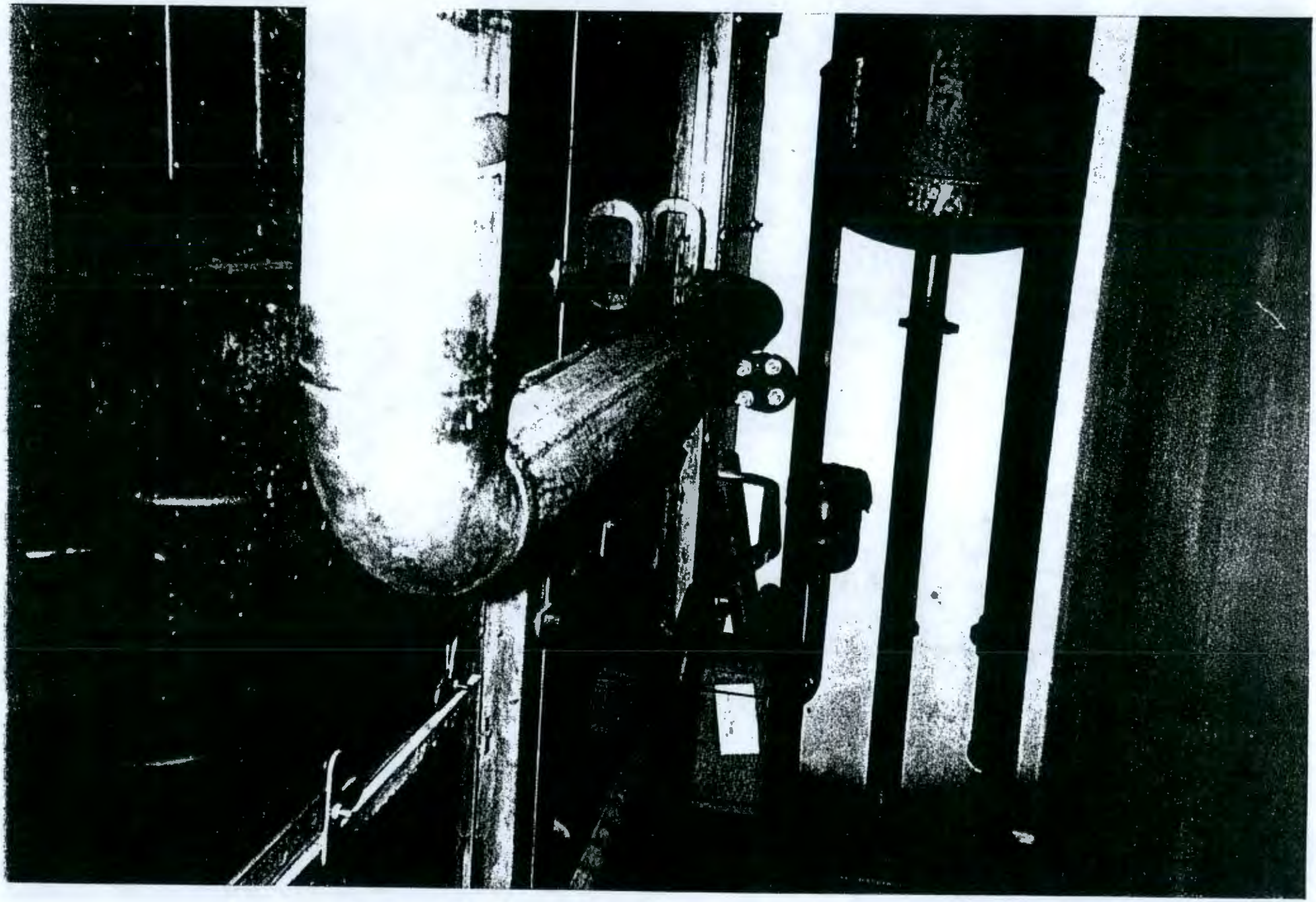
29. 233-S Trench Drain Line

30. H-4 Transfer Line and IX Column sluice lines crossing over North Sample Gallery

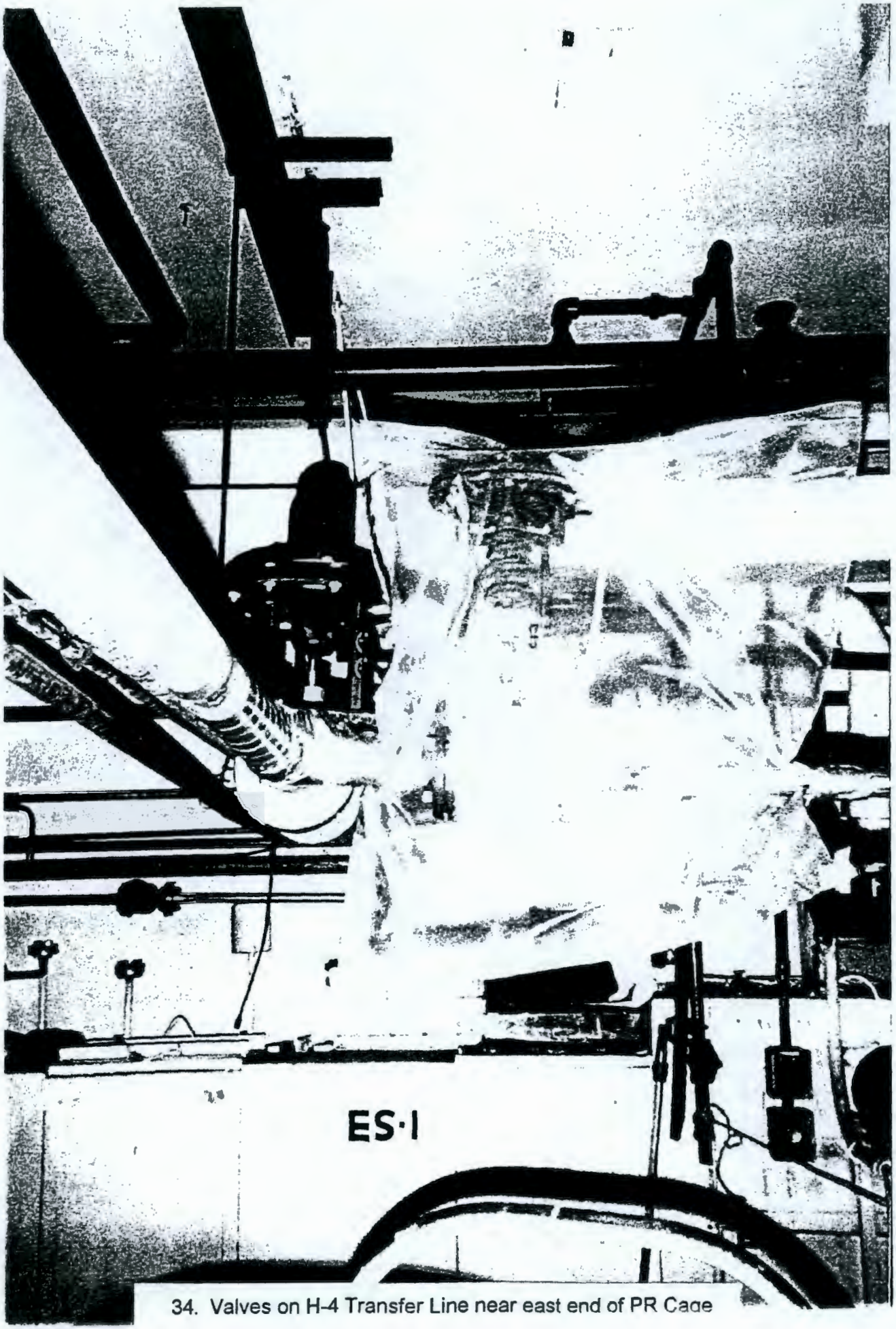
31. E-3 to L-12 and 4" Drain Lines (among others) turning south along west side of PR Cage



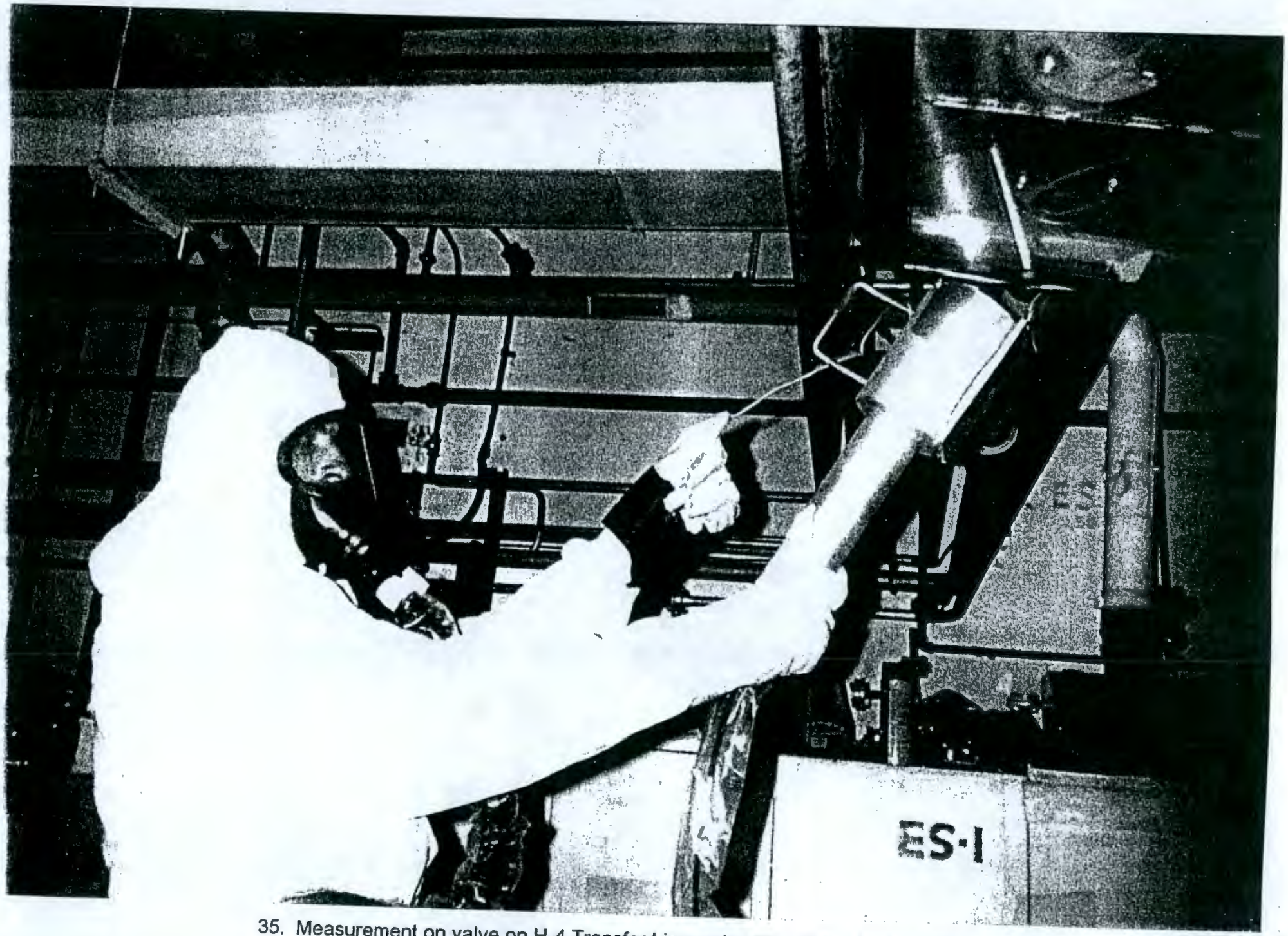
32 F-3 to L-12 and 4" Drain Line before entering the west side of the PR Cage (right)



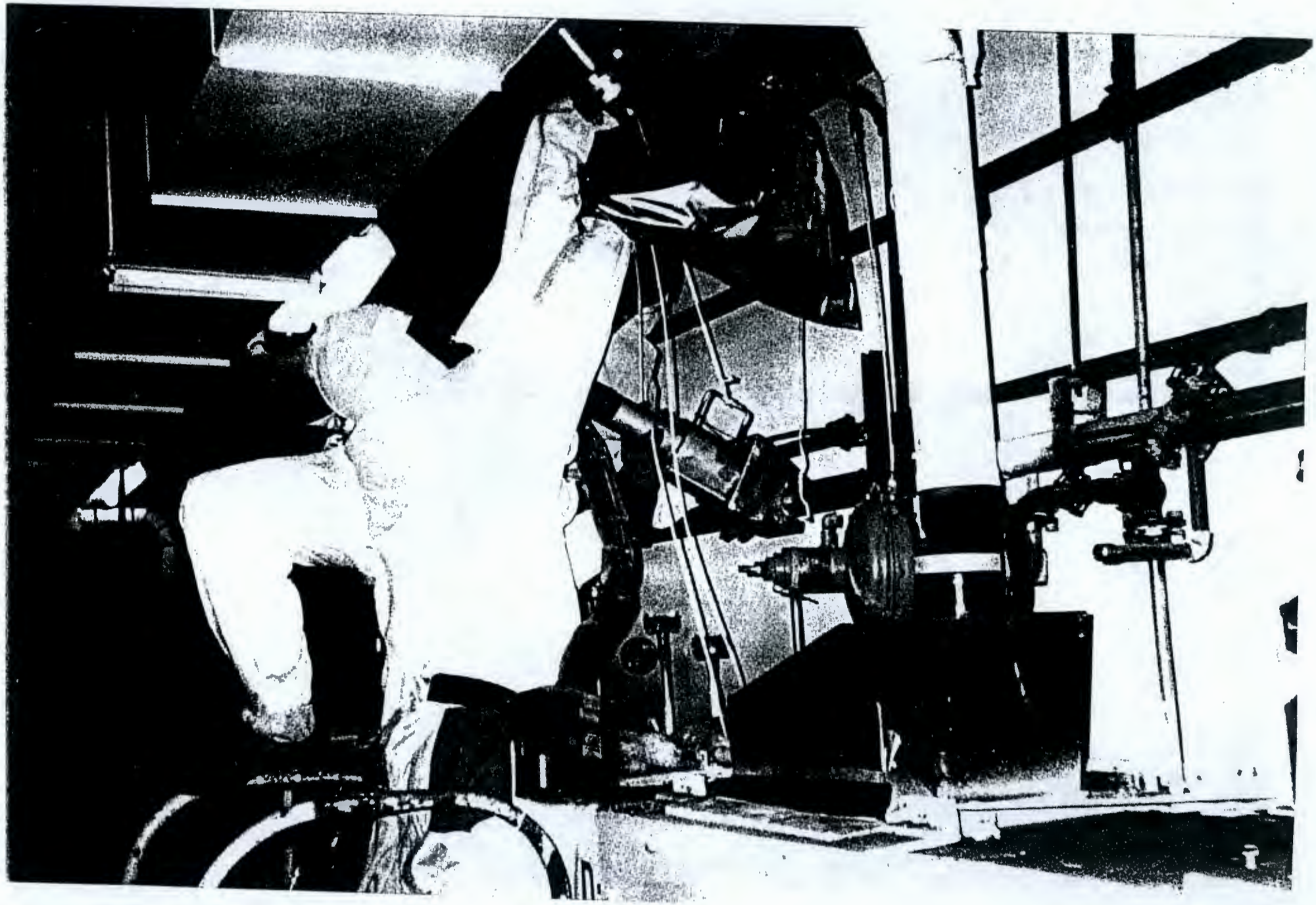
33. 4" Drain Line before entering the west side of the PR Cage (right)



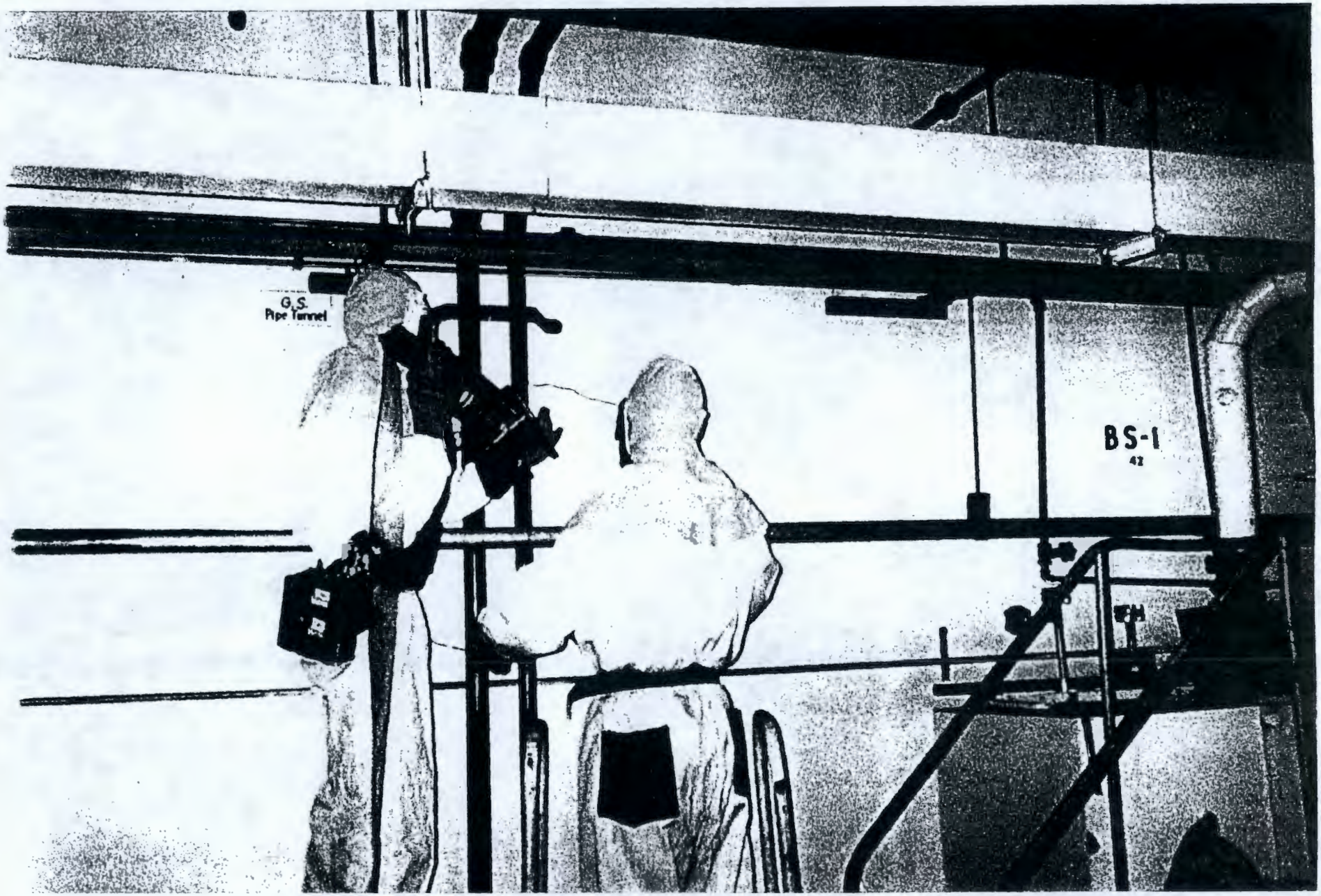
34. Valves on H-4 Transfer Line near east end of PR Cage



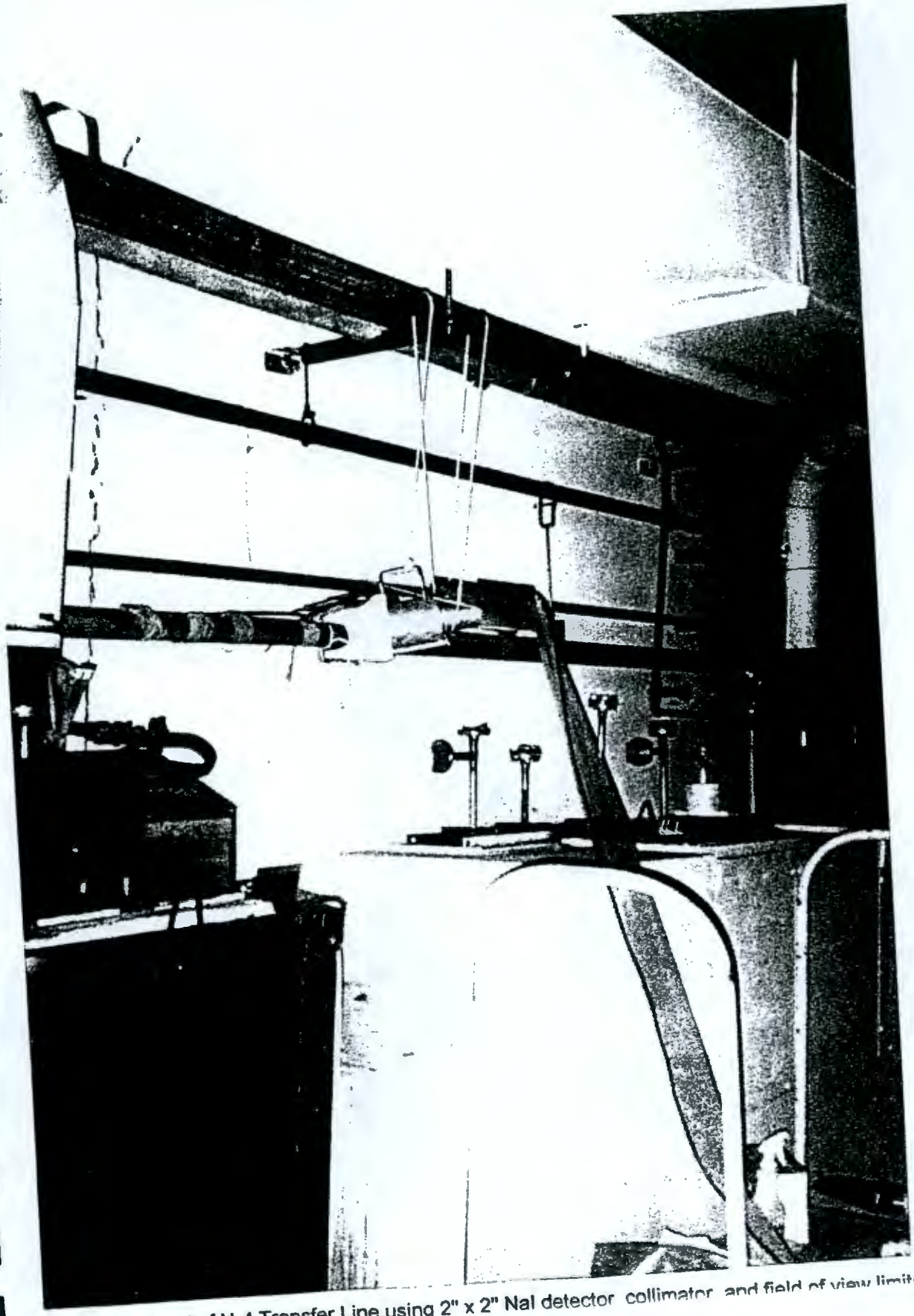
35. Measurement on valve on H-4 Transfer Line, using 2" x 2" NaI detector and collimator



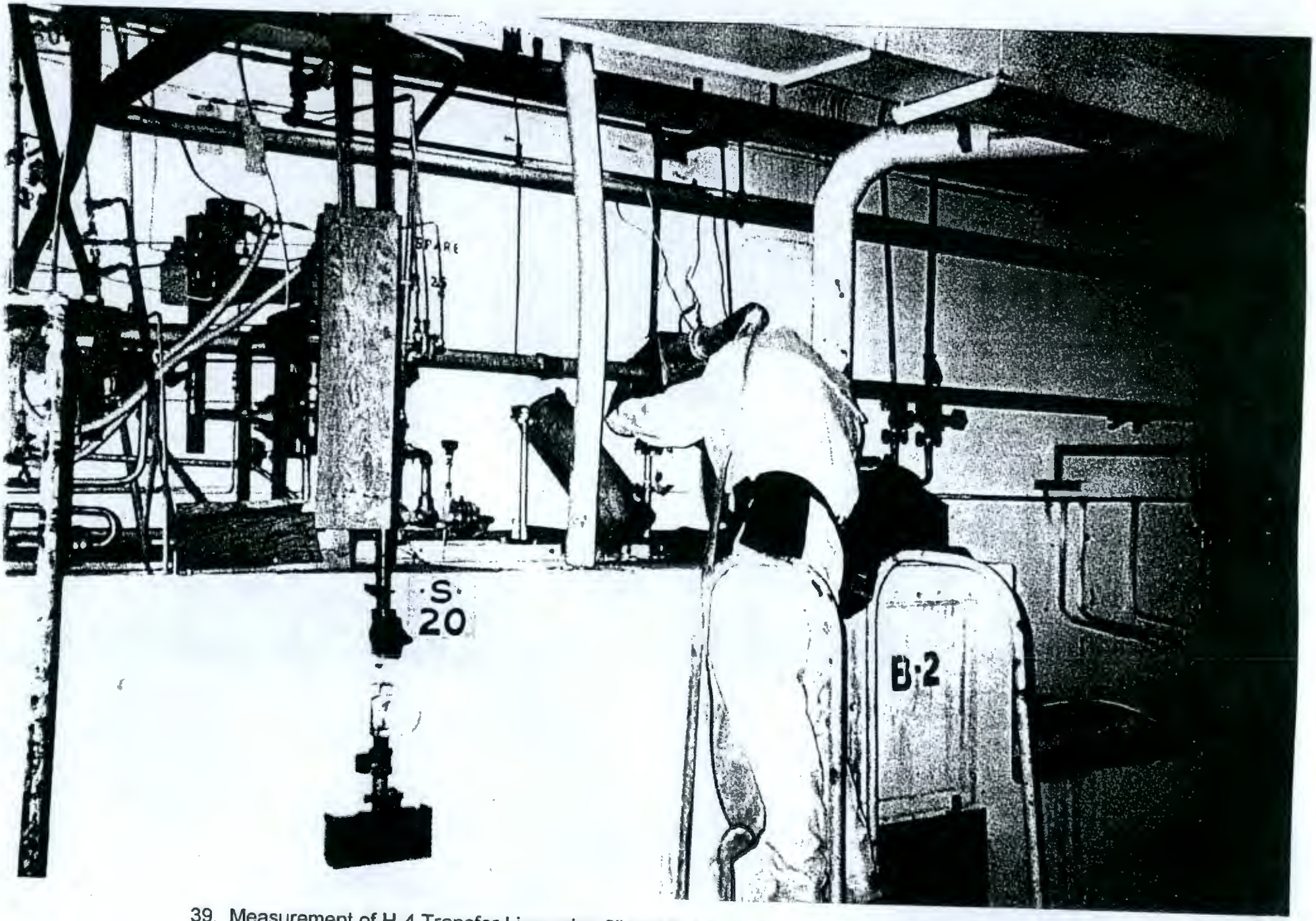
36. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



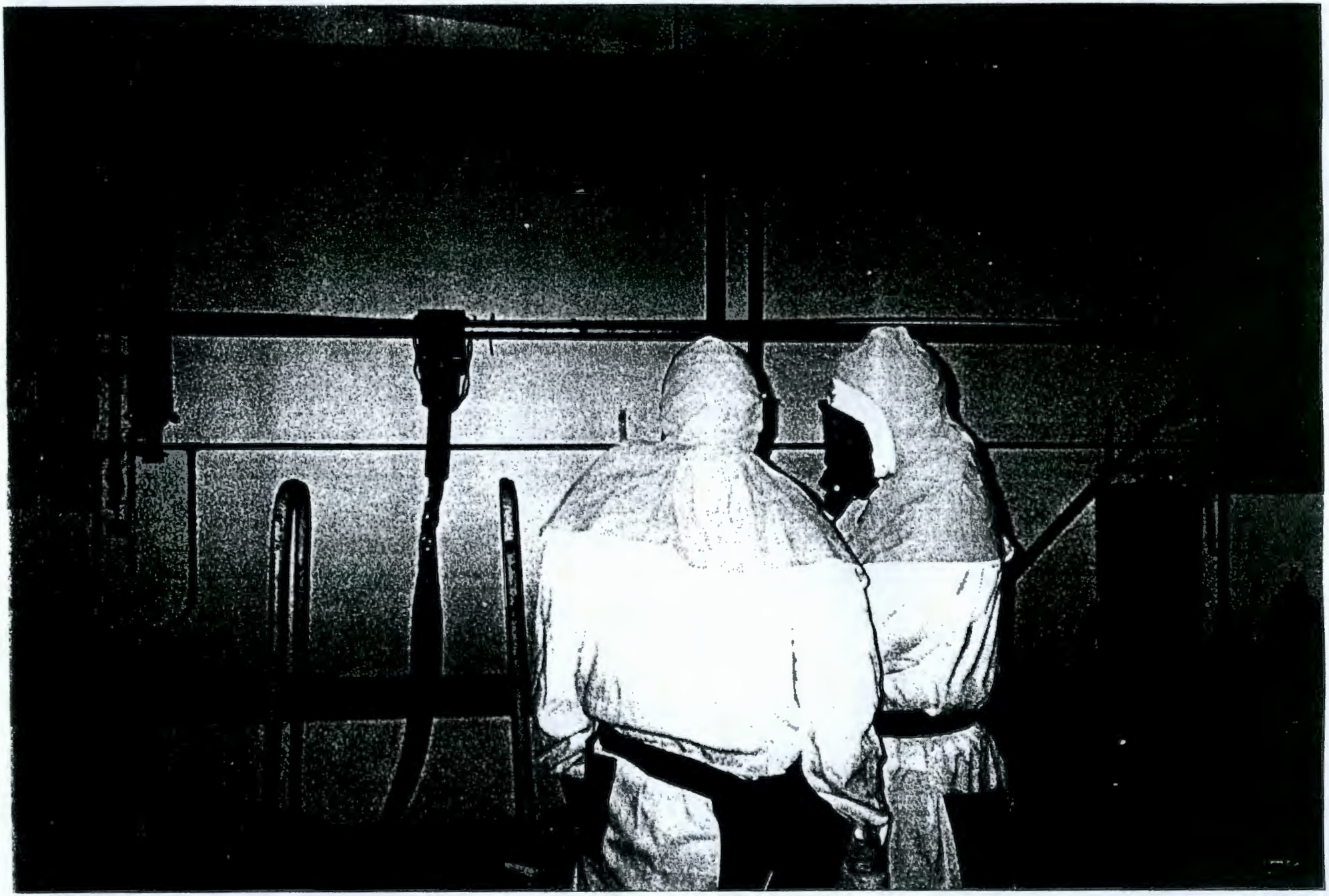
37. Preparing to use 2" x 2" NaI detector, collimator, and field of view limiter



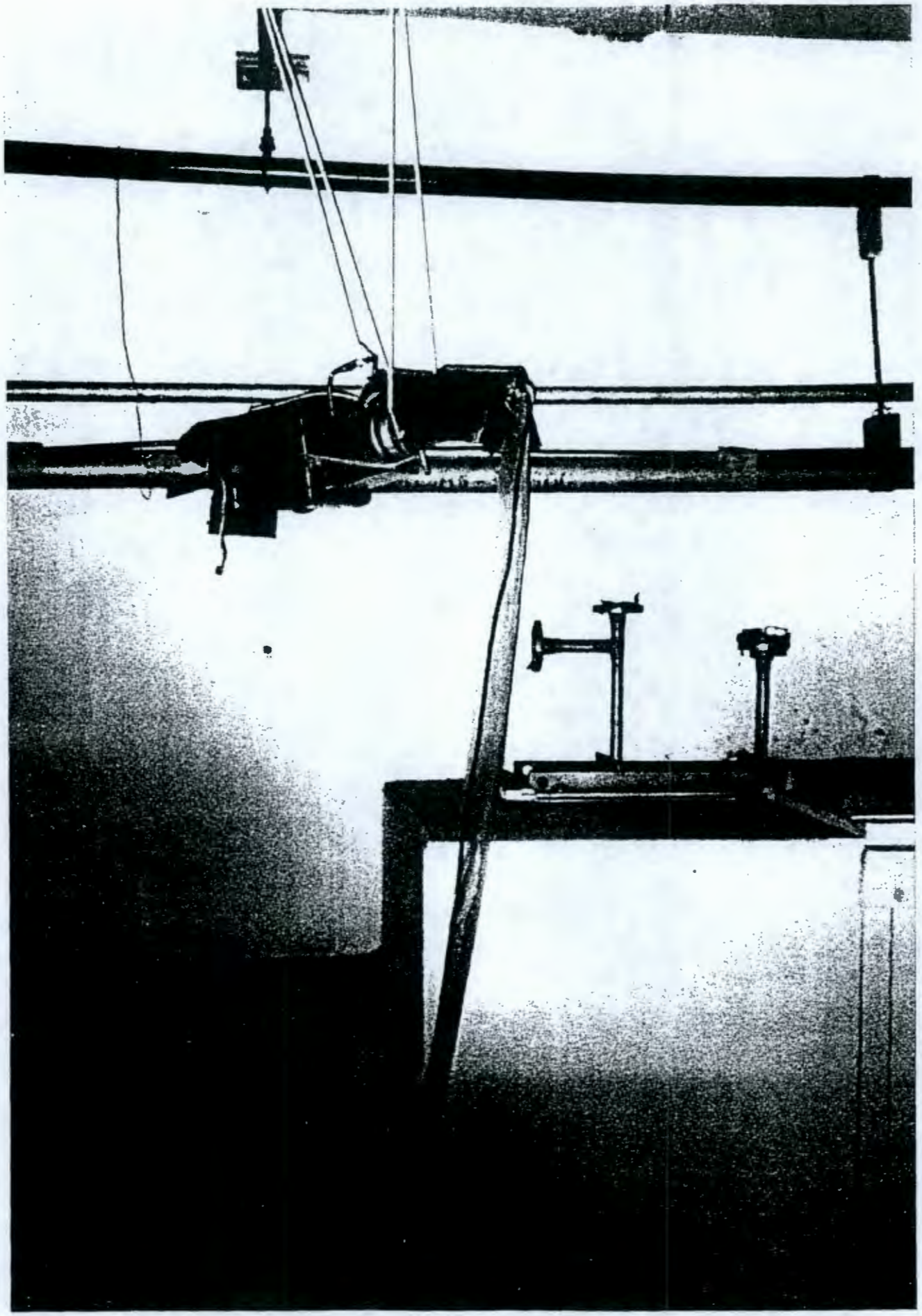
38. Measurement of H-4 Transfer Line using 2" x 2" NaI detector collimator and field of view limiter



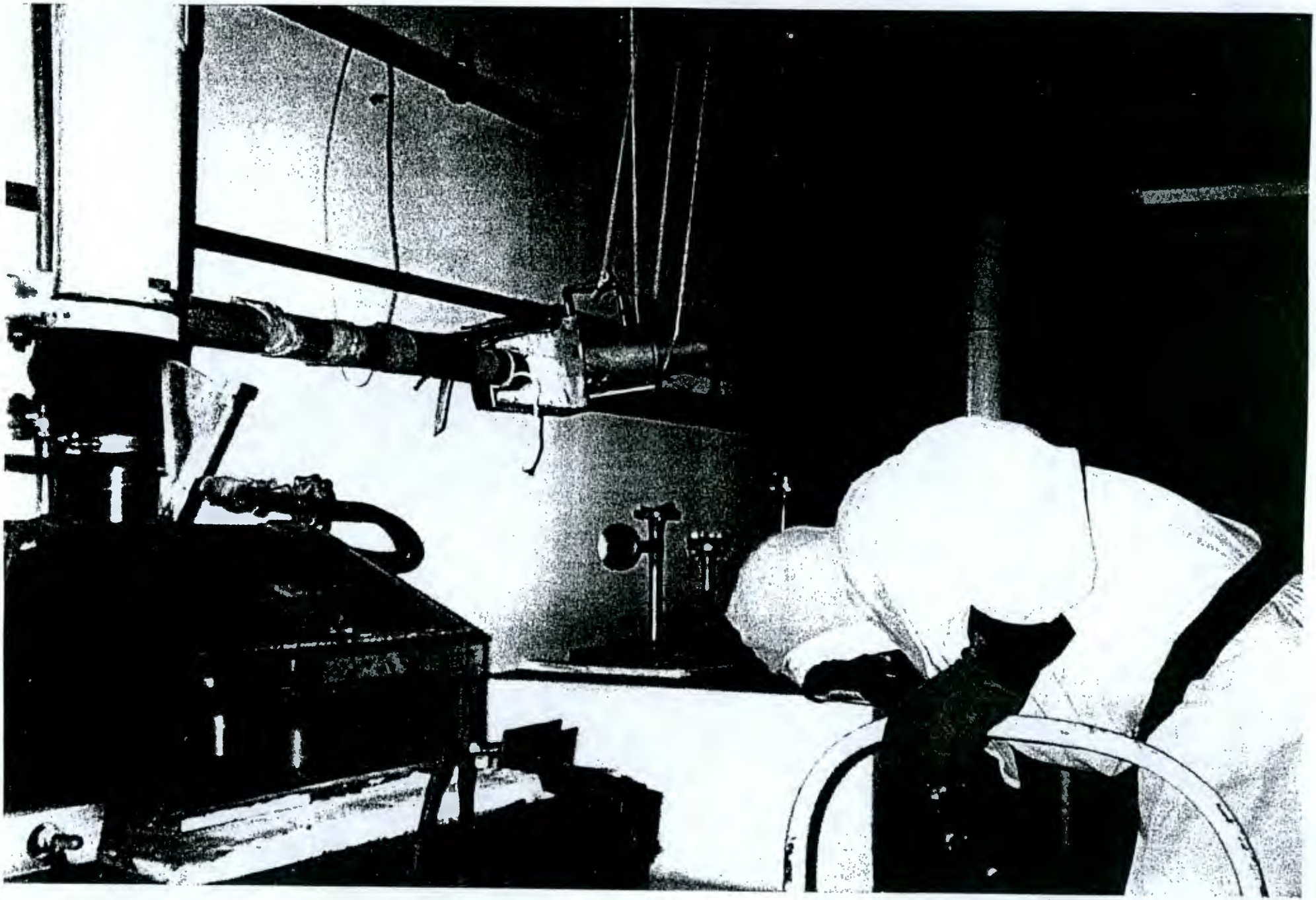
39. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



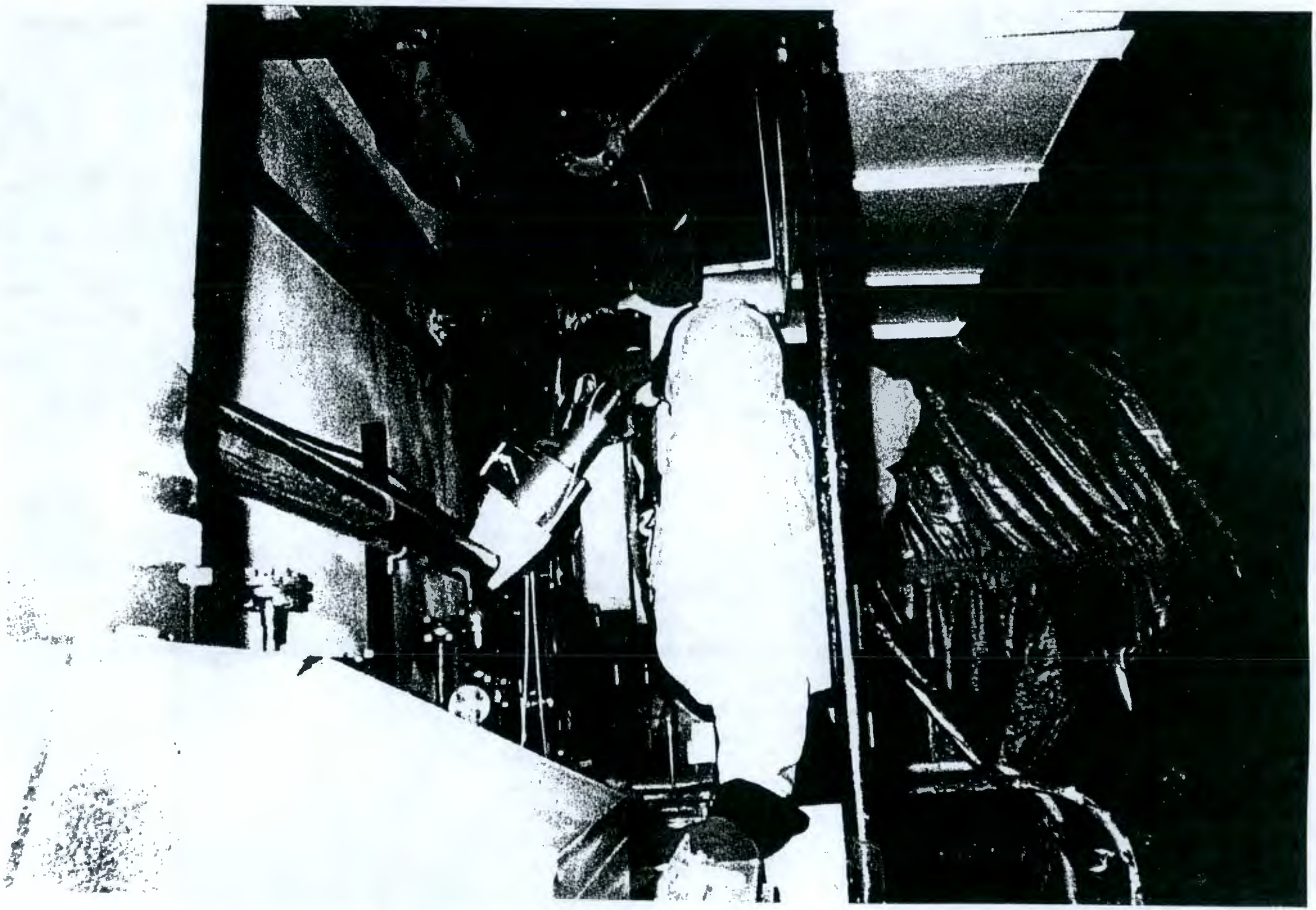
40. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



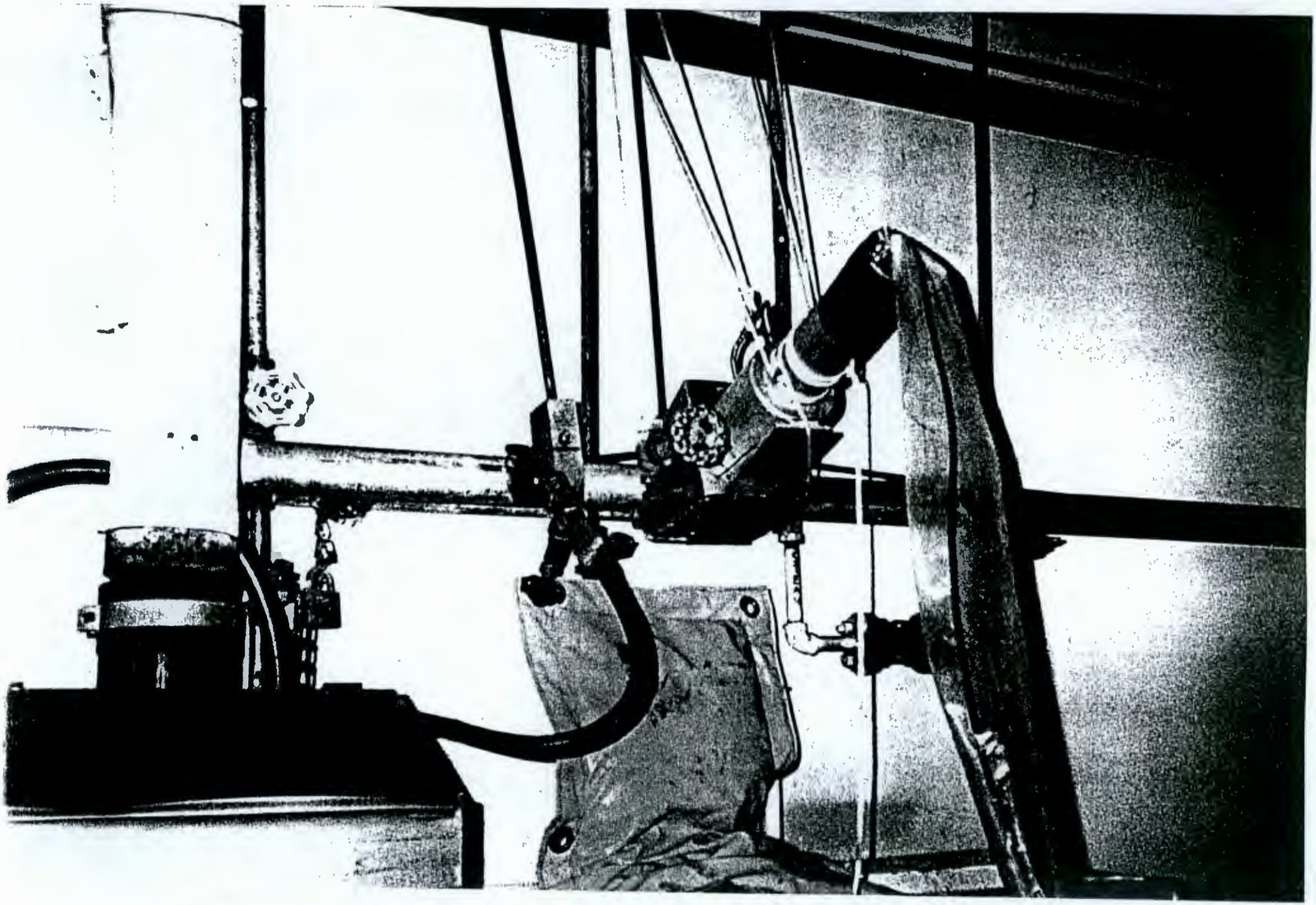
41. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



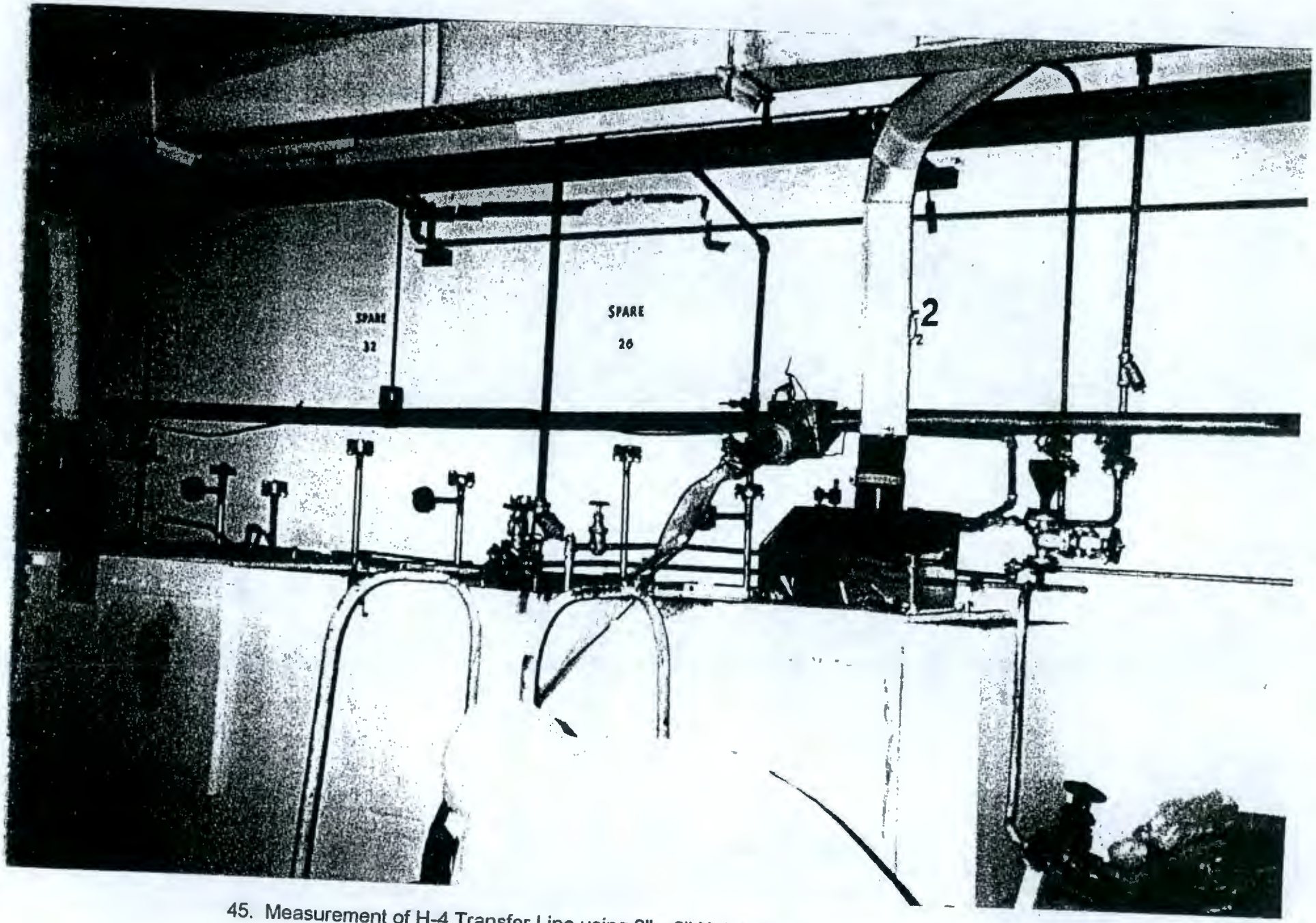
42. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



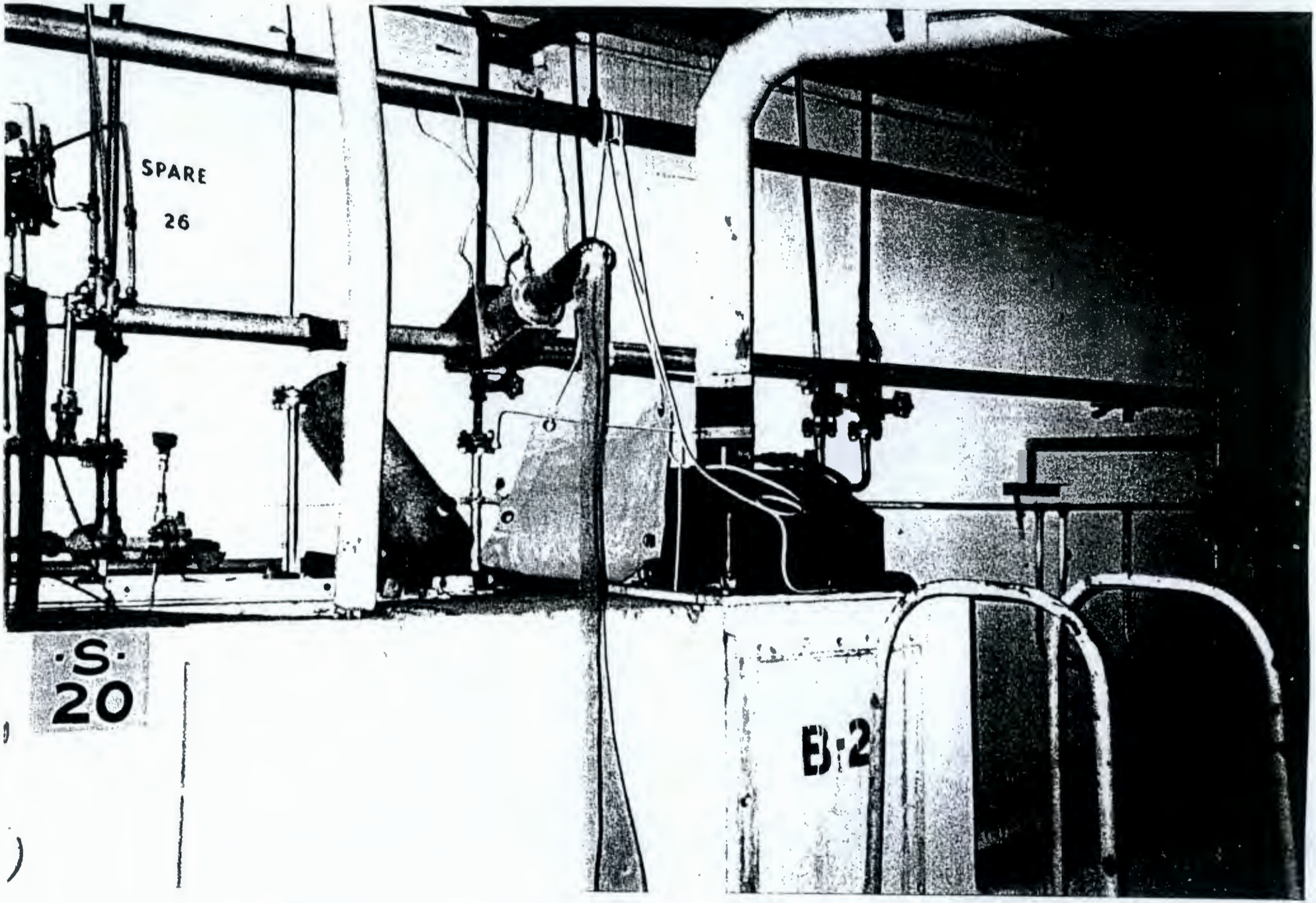
43. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



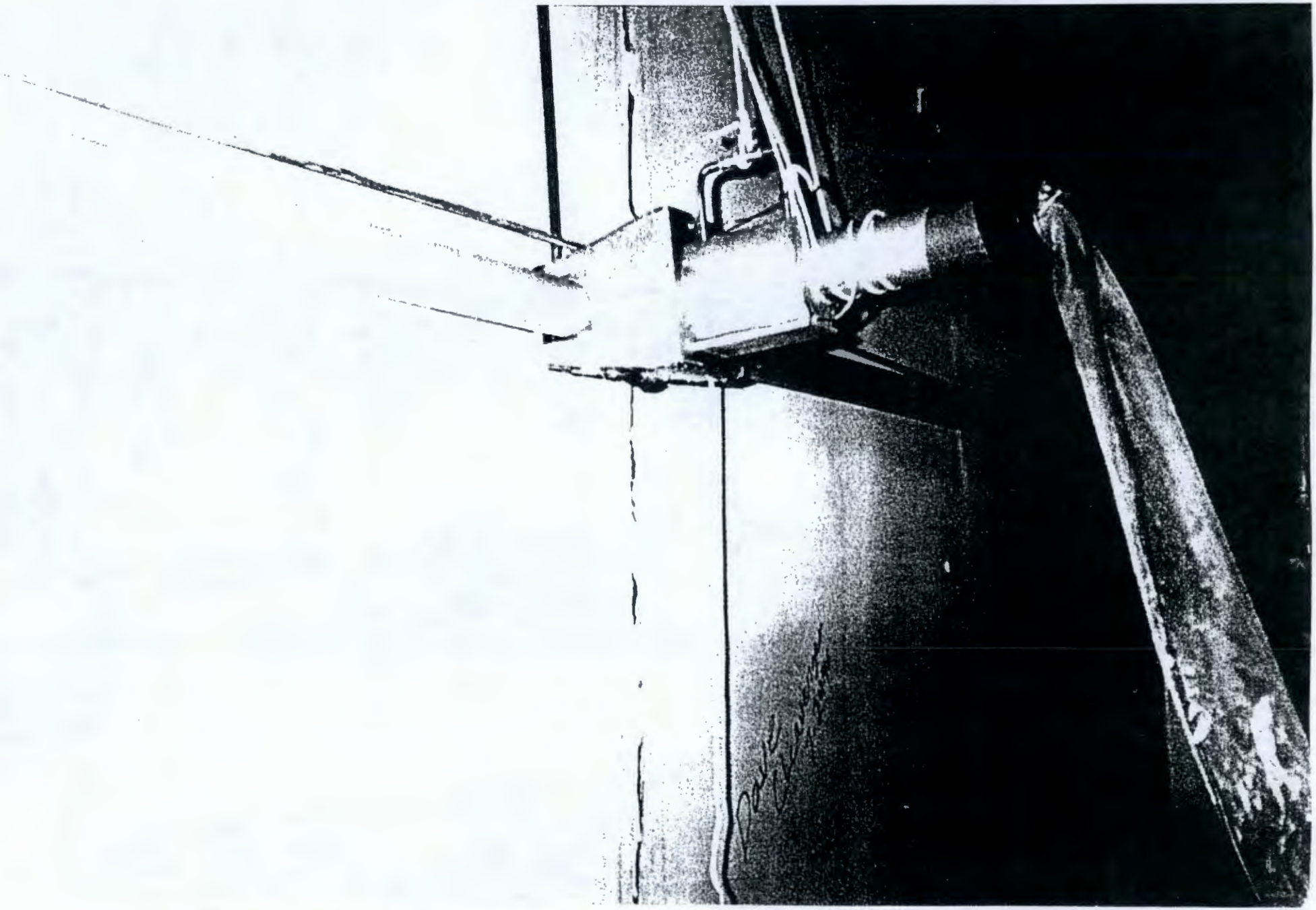
44. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



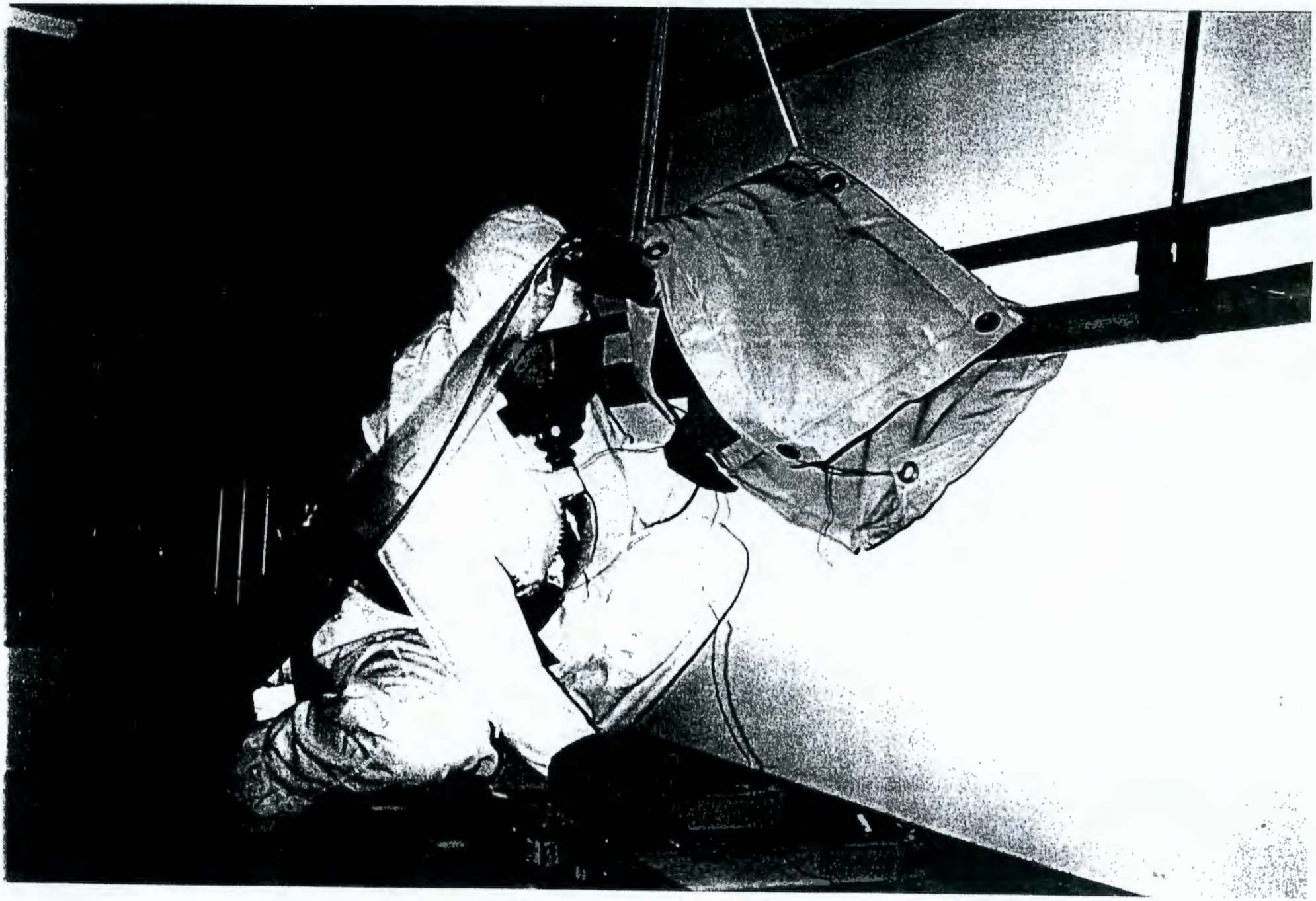
45. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



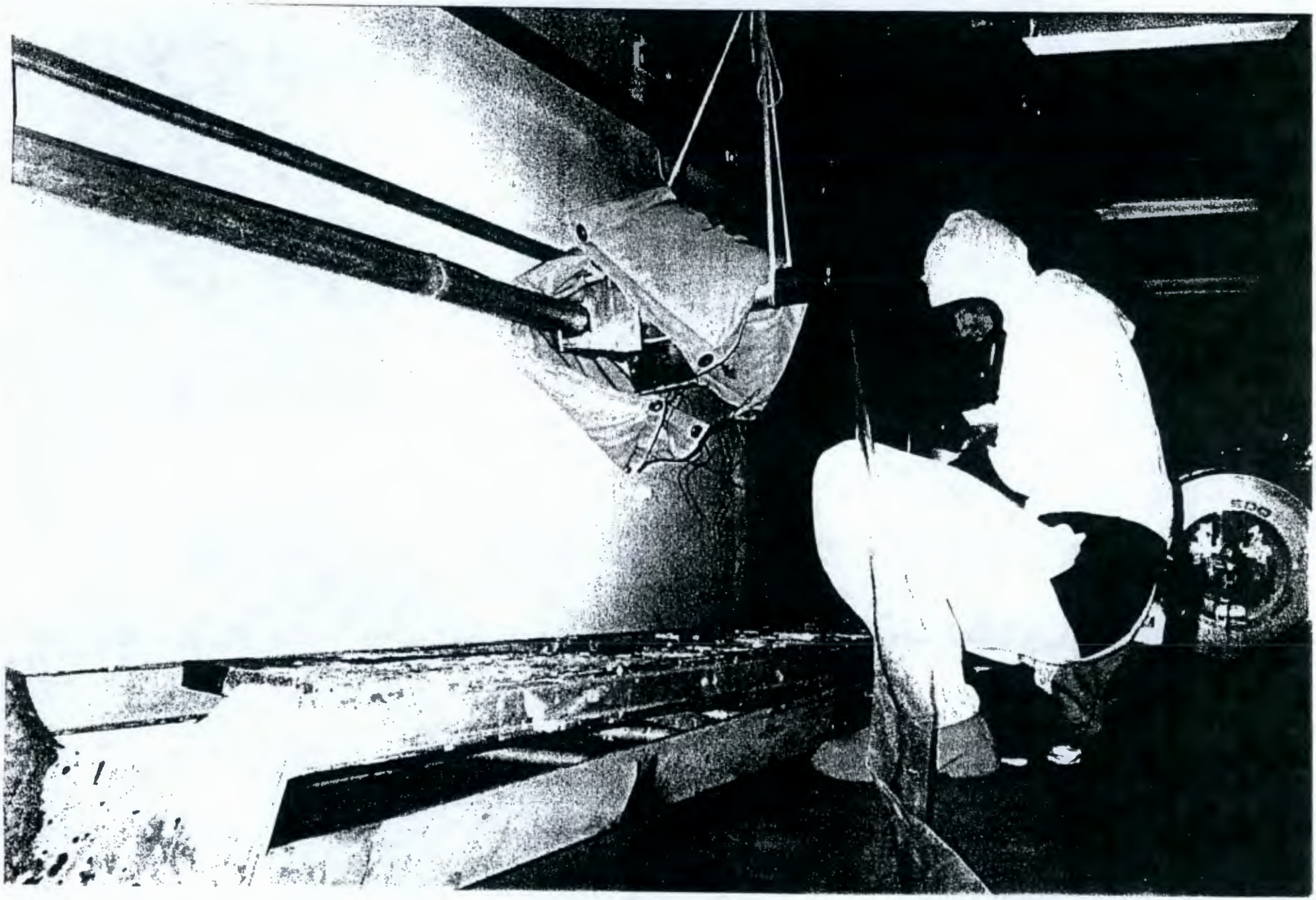
46. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter



47. Measurement of H-4 Transfer Line using 2" x 2" NaI detector, collimator, and field of view limiter

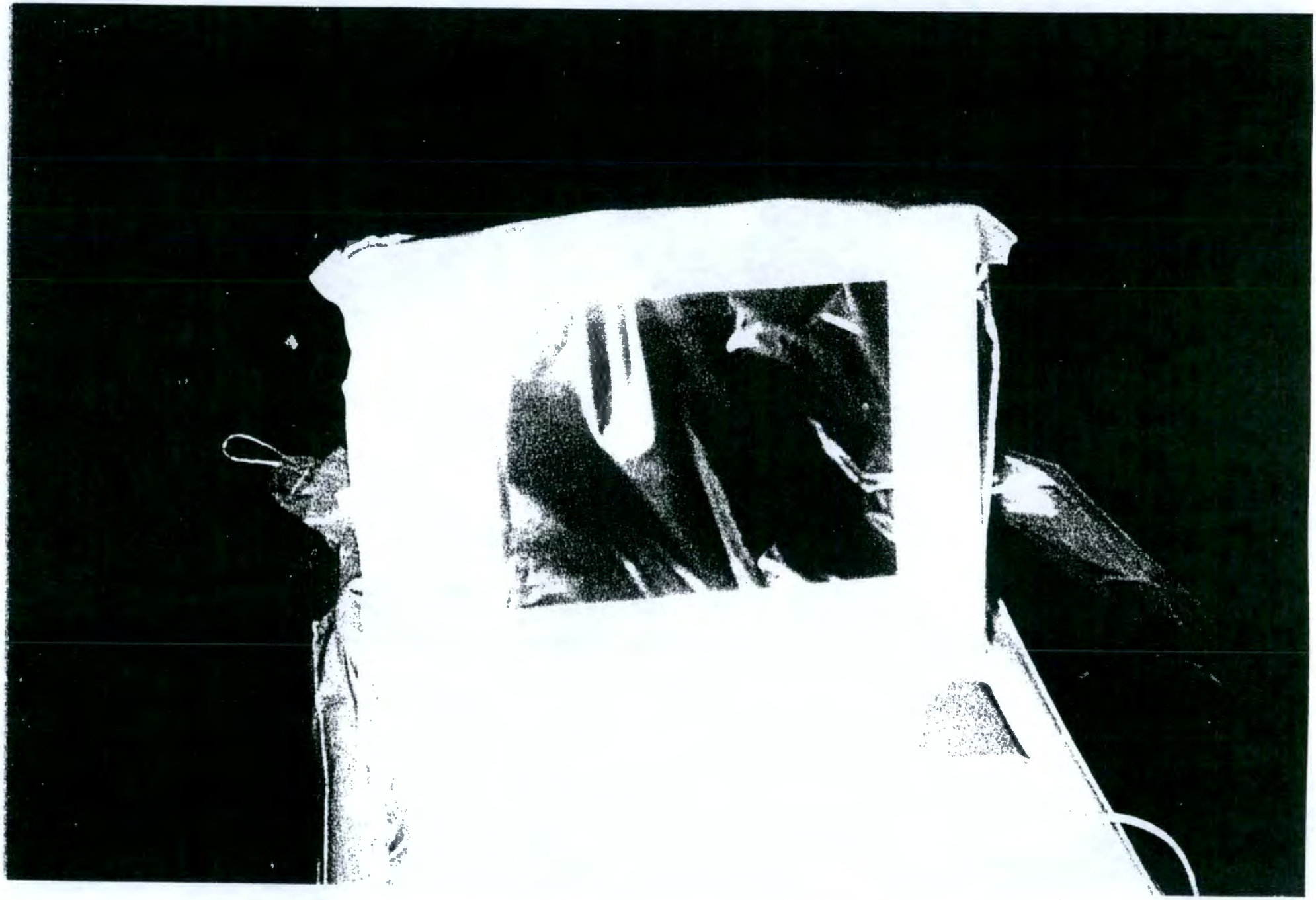


48. Lead blankets used to shield Cs-137 gamma rays from adjacent sources

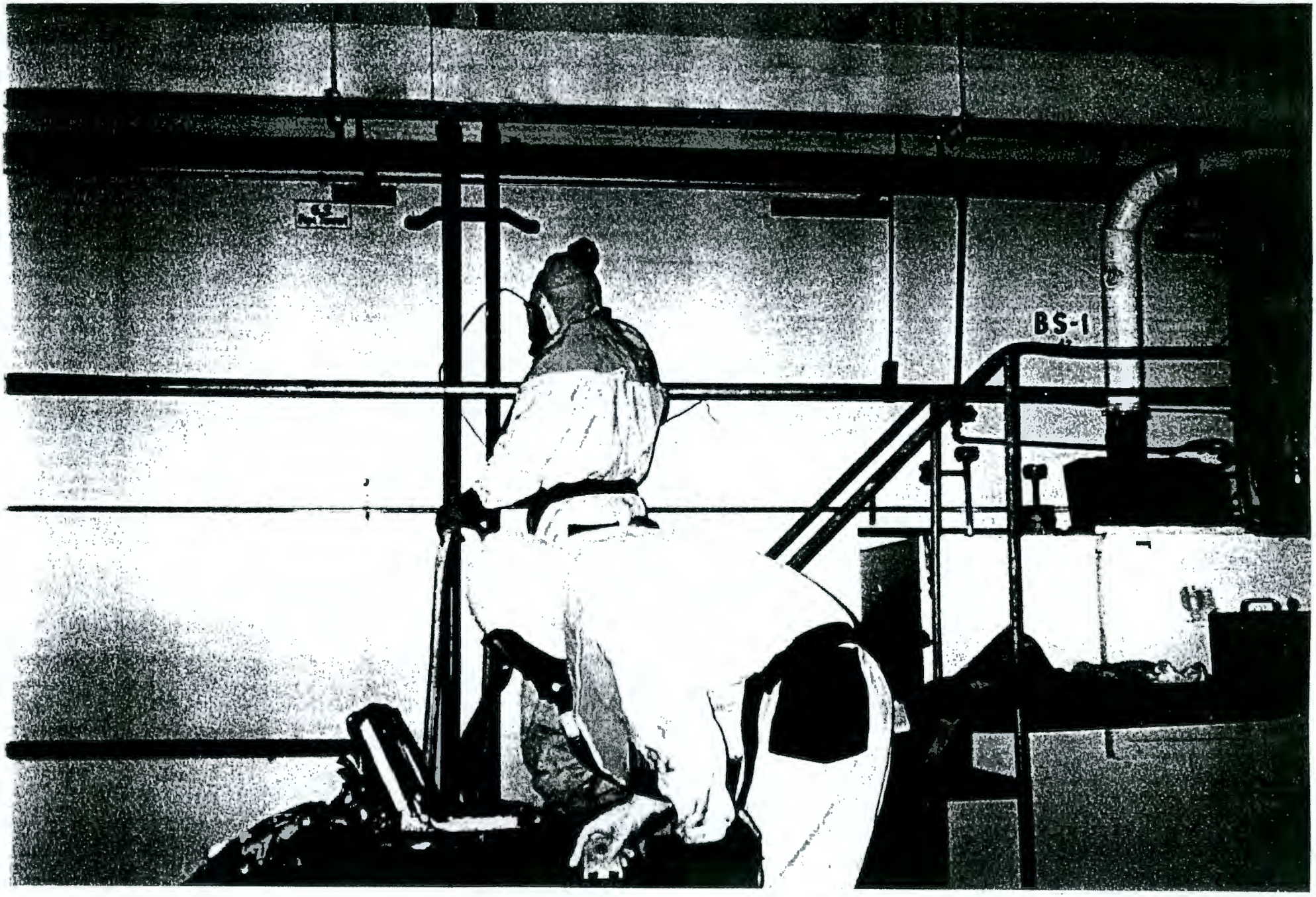


49. Lead blankets used to shield Cs-137 gamma rays from adjacent sources

50. Lap top computer and portable electronics (wrapped in plastic) used to control gamma spec. system



51. Lap top computer (wrapped in plastic) used to control gamma spectroscopy system



52. Preparing computer and electronics for measurements

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<u>ERC Team</u>	
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