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APPROVED FOR PUBLIC RELEASE

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V.L. Birkland (signature)   May 24, 1995

V.L. Birkland

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7. Abstract

Westinghouse Hanford Company is seeking industry solutions to underground single-shell tank waste retrieval at the Hanford Site located in southeastern Washington. this is not a request for proposals; it is a request for information to facilitate continued discussion. Westinghouse Hanford Company will not reimburse any costs incurred for providing the information requested.

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SURVEY PACKAGE - TECHNICAL AND CONTRACTING STRATEGIES FOR SINGLE-SHELL TANK WASTE RETRIEVAL ON THE HANFORD SITE

May 1995

Acquire Commercial Technology for Retrieval
Westinghouse Hanford Company
Richland, Washington

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SURVEY PACKAGE - TECHNICAL AND CONTRACTING STRATEGIES FOR SINGLE-SHELL TANK WASTE RETRIEVAL ON THE HANFORD SITE

1.0 INTRODUCTION

Westinghouse Hanford Company (WHC) is seeking industry solutions to underground single-shell tank (SST) waste retrieval at the Hanford Site located in southeastern Washington. This is not a request for proposals; it is a request for information to facilitate continued discussion. Westinghouse Hanford Company will not reimburse any costs incurred for providing the information requested.

The following is provided as a guide for those wishing to respond to this request for information.

Westinghouse Hanford Company is interested in innovative, commercially available or adaptable retrieval system equipment, concepts, and contracting strategies that will add to existing Hanford Site technology and significantly reduce cost and/or risk from the baseline retrieval approach of sluicing (hydraulically mining) the waste from the SSTs onsite. The objective of this request is to gather information from industry to identify and summarize a suite of retrieval-related components, systems, and contracting approaches. This information will be used to ensure that WHC understands the various waste retrieval alternative approaches, their risks, and their application on the Hanford Site tanks for those occasions when sluicing is not sufficiently effective, appropriate, or cost-effective. An additional objective is to facilitate industry's understanding of the tank and site interface requirements for SST waste retrieval and the complex statutory, legal, regulatory, labor, and other institutional standards being applied to the Hanford Site.

This effort will identify and summarize retrieval solutions by the end of September 1996 so that a clear basis for future retrieval program decisions can be established.

2.0 DISCUSSION

Westinghouse Hanford Company seeks a full range of technical solutions, including components, subsystems, and entire systems. Information is being requested from industry in three areas of interest:

1. Existing components or subsystems that can be integrated into a cost-effective or risk-reduced solution for an entire system

2. Complete technical solutions (i.e., systems) for SST waste retrieval

3. Contracting methodologies that include the previous two elements and reduce upfront costs to the government, overall cost, and risk.

The retrieval solutions may range from existing equipment or concepts through complete designs generated by industry. The solutions emphasize simplicity and ruggedness because low maintenance and high reliability are essential for cost-effective, long-term, radioactive waste retrieval operations. A solution does not have to meet retrieval needs in all tanks; it is recognized that niche solutions may provide low-cost retrieval systems for removing waste in tanks that meet special conditions. Proprietary designs and information will be treated accordingly.

System elements that have been determined to be major cost and risk drivers include the following:

- Waste dislodging and conveyance system type, size, weight, and positioning requirements
- Tank access requirements/installation of new risers
- In-tank positioning system complexity
- Liquid and gaseous confinement and treatment of the tank ventilation stream, and the retrieval/conveyance stream.

Westinghouse Hanford Company may elect to, during this survey, contract for limited proof of principle testing, demonstrations, performance testing, simulation, and/or analysis of proposed equipment or systems, if the result would be a significant payback in reducing cost or technical risk. For example, a candidate waste removal process could be demonstrated using simulated SST waste if that system promises technical or cost improvement over the sluicing baseline. In this case, WHC and the commercial firm would develop test protocol, summarize the demonstration effort, collect and report performance or cost data, and make these data publicly available. On the other hand, completion of a design for a component or system would not be a candidate for WHC funding if there was not an obvious technical "breakthrough" to be gained, or if as a result of WHC funding the design work, the vendor would be precluded from competing for future retrieval work due to current procurement restrictions. Other funding sources that specifically target technology development may be identified for these instances.

A full range of solutions is sought, including enhancements that would make sluicing more effective or mitigate its affect on tank leakage potential. "Wet" systems could be proposed that would follow sluicing a tank for final cleanup. Alternatively, "dry" systems (those that use no water or immediately scavenge any water used) might be proposed to retrieve the waste without increasing the leakage potential of the tank. These could be applied where circumstances such as the possibility liquid waste leaking to the surrounding soil column may preclude the use of sluicing.

The emphasis of the solutions must be on lowering upfront and overall cost to the government. Ultimately, system simplicity and reduced life-cycle costs will be the overriding factors in selection of SST waste retrieval systems. Other important factors include the range of tank configurations and waste types that can be accommodated by the approach, and the amount of site preparation required.

Westinghouse Hanford Company has a project underway to retrieve the high-heat waste from tank 241-C-106 using sluicing. That retrieval action is expected to leave a hard waste heel in the tank and one application of the proposed retrieval solutions may be in the removal of that waste heel. Other applications may include retrieval of the first tank farm, and future campaigns in "sluicable" and "nonsluicable" tanks. It is not the intent of this program to choose the specific retrieval technology application for those projects but rather to identify a range of available retrieval solutions.

3.0 BACKGROUND

Radioactive waste has been produced at the Hanford Site since 1944 as a by-product of processing spent nuclear fuel for the recovery of plutonium, uranium, and neptunium. The first single-shell waste storage tanks were completed and placed in operation in 1944. Between 1943 and 1964, 133 23-m (75-ft) diameter SSTs were built for the storage of radioactive wastes at the Hanford Site. These SSTs are located in 12 tank farms of 4 to 18 tanks each in the 200 West and 200 East Areas on the Hanford Site. No wastes have been added to the tanks since November 1980. However, water is added to one of the tanks (241-C-106) for evaporative cooling purposes. Pumpable interstitial liquid and supernatant wastes are being removed from SSTs and transferred to double-shell tanks (DST).

At various times since 1944, four major chemical processing operations have been conducted. Three of these processes, the bismuth phosphate, Reduction-Oxidation (REDOX), and Plutonium-Uranium Extraction (PUREX) Plant processes, were specifically designed for plutonium recovery. The more advanced REDOX and PUREX processes recovered the uranium as well as the plutonium. The fourth process, the tributyl phosphate process, was designed for the recovery of relatively large amounts of uranium that remained in the bismuth phosphate waste. These processing wastes, which contained most of the fission products and comparatively small quantities of uranium, plutonium, and other actinides, were originally stored as liquid wastes (with significant amounts of solids in the form of precipitated sludge) in the SSTs.

Liquid waste accumulation and storage in SSTs continued until 1980, when the DSTs were used exclusively for receiving new waste. The 133 SSTs presently contain more than 140,000 m^3 (37 million gal [Mgal]) of waste. In 1968, the interim stabilization program was started. This program removes the pumpable liquid from the SSTs, which results in a semi-dry sludge and salt cake-type residue. This program is primarily intended to reduce the leak potential of the SSTs.

4.0 SST DESCRIPTIONS

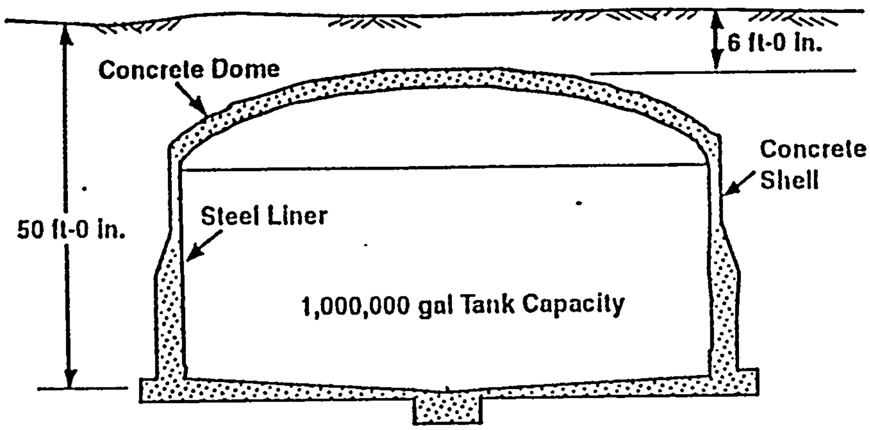
The following information is intended as a summary of the Hanford Site SSTs. Figure 4-1 and Table 4-1 provide additional perspectives on the range of tank conditions. Table 4-1 identifies some of the operating attributes needed to complete SST waste retrieval as they relate to existing tank and waste conditions. The table helps define the relative importance of each criterion by considering such things as the number of applicable tanks. Photographs and descriptions of Hanford Site tanks are located in the Appendix.

4.1 TANK CONFIGURATIONS, ACCESS

The Hanford Site has 133 SSTs that are 23 m (75 ft) in diameter. They range in height from 9 to 16 m (30 to 54 ft) (at their highest points) with nominal capacities of 1,900, 2,850, and 3,800 m^3 (500,000, 750,000, and 1,000,000 gal). The maximum waste depths are 5, 7, and 9 m (17, 24, and 31 ft), respectively. A total of 2 to 2.4 m (6 to 8 ft) of earth cover each tank at the centerline of the dome. The minimum headspace (dome top to maximum liquid level) on the tanks is about 4 m (12 ft). The basic shape of the tank interior and typical location relative to the ground level is shown in Figure 4-1 for each size (or type) of tank. The SST design has varied during a 30-year construction schedule. The tanks are of reinforced concrete construction with 15-cm (6-in.) concrete floors, 33- to 60-cm (13- to 24-in.) concrete walls, and 33- to 38-cm (13- to 15-in.) concrete domes. The tank floor and walls are lined with 6- to 10-mm (1/4- to 3/8-in.) plate steel while the concrete dome is unlined in most tanks. A small number of tanks have a steel dome liner.

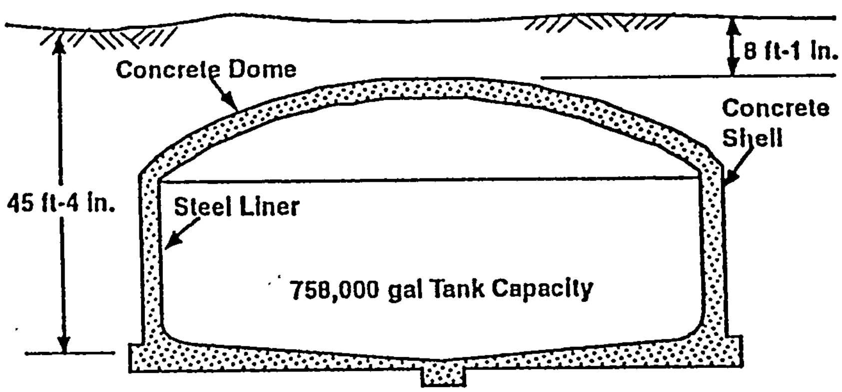
Presently, access to the tanks is provided by risers penetrating the domes of the tanks and extending above grade. Although varying from tank to tank, the tanks were constructed with three general riser arrangements. Risers vary in size from 10 to 107 cm (4 to 42 in.) with 10 and 30 cm (4 and 12 in.) diameter being most common. All tanks have a center or near center riser of at least 30 cm (12 in.) in diameter. The number of currently available risers ranges from 0 to 11, with the majority of tanks having 3 to 5 of the smaller sizes. Typically, tank domes contain a large number and variety of penetrations, not all of which extend up to the ground surface via risers. Additional or larger risers could be installed at or near the center of each tank or in a clear part of the dome with an obvious cost penalty. In addition, a cost penalty also exists for clearing existing obstructed risers and pits because many of the risers WHC may want to use contain salt well screens, pumps, or other equipment. Internally, most of the tanks are relatively unobstructed, having only three to six in-tank structures, while two dozen or so are quite crowded.

Figure 4-1. Typical Tank Sections.

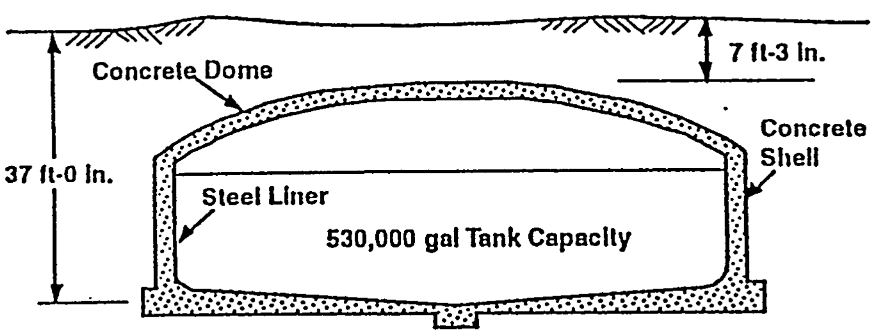


75 ft Diameter Single-Shell Tank
Tank Farms: A*, AX*, SX

* A and AX have flat bottoms



75 ft Diameter Single-Shell Tank
Tank Farms: BY, S, TX, TY



75 ft Diameter Single-Shell Tank
Tank Farms: B, BX, C, T, U

To convert inches to centimeters, multiply by 2.54.
To convert feet to meters, multiply by 0.3048.
To convert gallons to liters, multiply by 3.785.

Table 4-1. Operating Attributes Summary.

Operating attribute	Applicability	Comments
Retrieve waste with loose items discarded in the tank	133 tanks	Discarded items include embedded metal tapes, wire, small steel weights, fist-sized rocks, etc.
Retrieve hard waste	Most tanks	Hard salt cake or agglomerated sludge
Retrieve soft waste	3/4 of the tanks	Soft salt cake or sludge
Work remotely in radiation environment (in-tank)	All tanks	Radiation fields vary from low to 500 R/h
Work in a caustic environment	133 tanks	pH-12+
Operate in a relatively uncongested tank	105 tanks	2 to 5 widely separated vertical structures
Access tank through 30-cm (12-in.) riser	133 tanks	At or near center of the tank
"Dry" retrieval process	Possibly any tank (currently 66 assumed/known leakers)	Does not increase tank leak potential, i.e., any water used is immediately scavenged. Backup to PPS in the event of a leaking tank where PPS cannot be used.
"Wet" retrieval process	Possibly any tank	Use of water volumes and recovery rates similar to PPS to mobilize and convey the waste. Backup to PPS where PPS can be used but has not retrieved enough difficult waste or where PPS can be made more efficient.
Operate in a congested tank	24 tanks	A dozen vertical structures plus guy wires from tops of four structures to the floor
Negotiate soft surfaces	~50 tanks	Sludge/mud
Clean tank walls	~133 tanks	Tanks have varying amounts of material caked on the walls
Negotiate precipitous waste surfaces	A dozen tanks, est.	Stabilized salt tanks with a center depression 1.2 to 1.8 m (4 to 6 ft) deep resulting from dewatering
Negotiate stable surfaces	~80 tanks	Ranges from bare metal to damp salt to hard pan
Access tank through 91 cm (36 in.) or larger riser	Available on 2 to 3 dozen tanks	--
Operate in Watch List tanks	--	Restrictions for flammability, minimum moisture level in organic tanks, etc.
Restricted head space ~4 m (~13 ft)	12 tanks	--
Restricted head space ~38 cm (~15 in.)	12 tanks	--
Operate in a highly congested tank	4 tanks	2 to 3 dozen vertical components, 1.5 to 3 m (5 to 10 ft) apart

PPS = Past-practice sluicing

4.2 IN-TANK HARDWARE (ITH)

The retrieval system must either avoid, move, or work in the presence of ITH to retrieve the waste. The general categories of ITH are as follows:

- Fixed, built-in (permanently installed during tank construction)
- Fixed, riser installed (nominally removable, mounted through a riser)
- Loose items discarded in the tank (inaccessible for removal).

Twenty-one tanks have four built-in air lift circulators (ALC) each. The tanks have gas lines rising to the dome and guy wires angling off to the tank bottom as well as a half-dozen riser-mounted items. Four tanks are extremely congested with 22 riser-mounted ALCs plus a half-dozen additional items. Another dozen are moderately congested with 6 to 10 riser-mounted items. The remaining majority of tanks are relatively unobstructed with three to four peripherally mounted items and one or two center-mounted items. All tanks have loose material that has been discarded in the tanks. This material includes, but is not limited to, pipe sections, fist-sized metal weights, 15-m (50-ft) stainless steel measuring tapes, and river rock.

In-tank equipment and discarded material need not be removed from the tank. There is a solid waste disposal cost penalty on removed equipment disposal.

4.3 WASTE

The majority of the wastes stored in SSTs was generated by chemical processing operations. Other wastes were sent to the SSTs in smaller volumes, and these include research and development program wastes, facility and equipment decontamination wastes, laboratory wastes, and Plutonium Finishing Plant wastes.

Subsequent waste management operations have created a complex intermingling of the tank wastes. Nonradioactive chemicals have been added to the tanks while varying amounts of waste and heat-producing radionuclides have been removed. In addition, natural processes have caused settling, stratification, and segregation of waste components. Waste was also cascaded (allowed to flow via gravity from one tank to another) through a series of tanks; cooling and precipitation of radionuclides and solids occurred in each tank of the cascade. As a result, it is very difficult, if not impossible, to precisely estimate the character of the wastes contained in the tanks from existing operational records.

4.3.1 Waste Types and Quantities

The SSTs contain three general waste types: sludge, salt cake, and liquid. Sludge consists of the solids (hydrous metal oxides) precipitated from the neutralization of acid wastes before their transfer to the SSTs. Salt cake consists of the various salts formed after the evaporation of water from the neutralized alkaline waste. Liquids exist as supernatant and interstitial liquid in the tanks. These waste types do not necessarily exist as discrete layers, but are intermingled to different degrees. Sludges and salt cake may contain interstitial liquids and be relatively soft. Other salt cakes and sludges may be drier and harder as a result of agglomeration or experimental addition of cement and various desiccants in an effort to prevent leakage. Sludge, salt cake, and liquid are thus used as general descriptions and classification of a waste as one waste form; however, this does not imply that the waste does not contain any of the other waste forms.

The chemical constituents of the SST wastes consist primarily of sodium hydroxide; sodium salts of nitrate, nitrite, carbonate, aluminate, and phosphate; and hydrous oxides of iron and manganese. The radioactive components consist primarily of heat-producing fission product radionuclides such as ^{90}Sr and ^{137}Cs, and actinide elements including uranium, plutonium, and americium and various relatively short-lived radioisotopes such as ^{106}Rh, ^{60}Co, and ^{125}Sb. These solid wastes (salt cake and sludge, with nondrainable interstitial liquid) vary considerably in physical consistency as well as in chemical and radionuclide content, not only from tank to tank, but within a tank as well.

The SSTs store a total of 140,000 m^3 (37 Mgal) of waste. Of this waste, about 2,700 m^3 (0.7 Mgal) are supernatant, 89,000 m^3 (23.6 Mgal) are classified as salt cake, and 48,000 m^3 (12.7 Mgal) are classified as sludge. The salt cake and sludge contain 34,000 m^3 (8.9 Mgal) of drainable interstitial liquid. The bulk of the interstitial liquid, about 19,000 m^3 (5 Mgal), is contained in salt cake and is being pumped to DSTs.

4.3.2 Waste Characteristics

Definitive physical parameters of the SST wastes are not presently available. A kaolin clay simulant and a potassium magnesium sulfate simulant have been developed as a limited representation of sludge and salt cake wastes. Photographs of the tank interiors show irregular surfaces for the wastes in some SSTs. Waste levels near the edges of tanks may be significantly higher than the center or where the removal of liquids has resulted in waste slumping.

4.3.3 Radioactive Source Terms

Dose rate estimates for the different tanks vary from 0.1 to 5 Gy/h (10 to 500 rad/h) at the waste surface. Higher doses are expected below the waste surface. The dose at >1 m (3 ft) from the surface is expected to be less than half of the surface reading. A dose level of several hundred rad/h is a nominal expected range for most SSTs.

4.4 GENERAL NOTES, CURRENT LIMITATIONS, AND UNCERTAINTIES

- The retrieval of waste from the Hanford Site's SSTs is the subject of a Tri-Party Agreement (Ecology et al. 1994*) with the Washington State

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*Ecology, EPA, and DOE, 1994, *Hanford Federal Facility Agreement and Consent Order*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

Department of Ecology, the U.S. Department of Energy, and the U.S. Environmental Protection Agency. Currently, the Tri-Party Agreement has established a goal that at least 99% of the waste be removed; there are no requirements for the removal of ITH.

- Direct, additional (total) loads on the SST domes exceeding approximately 445 kN (50 tons) should not be imposed.
- Direct, additional loads on the SST risers can generally not be tolerated by the weak riser to dome joint.
- Requirements for additional risers and extensive site preparation should be minimized; however, the addition of access risers of various sizes is allowed, and may actually prove to be cost-effective in some system configurations.
- The design of waste material-handling equipment can be based on the properties of two nonradioactive waste simulants, one sludge and one salt cake, conservatively derived from the opinions of operators during the 1960's and 1970's on the physical properties of the waste. These recipes are available upon request from WHC.
- Equipment put into a tank does not necessarily have to be radiation hardened.
- Undetermined downstream process requirements for initial pretreatment of waste before vitrification, and the following low- and high-level waste vitrification feed requirements, may impact the retrieved SST waste feed quantity and quality requirements.
- Environmental, occupational radiological exposure, safety, and quality assurance considerations will be significant factors in the SST waste retrieval system design, development, and demonstration. Control of potential radioactive and hazardous emissions to the environment and personnel radiological exposure are of utmost importance.

5.0 VENDOR RESPONSE GUIDANCE

Westinghouse Hanford Company's review will be streamlined if the information provided follows the following format. It is not necessary to address all aspects of this outline; it is presented for general guidance only.

Please consider your information as an opening for further discussion, rather than a final submittal. Westinghouse Hanford Company can supply additional information, if needed. Westinghouse Hanford Company may also respond with questions and comments should your information be unclear or if WHC is interested in more detail. You are free to update or revise your information, if you choose. Please indicate which information is proprietary, and WHC will treat it accordingly.

5.1 GENERAL INFORMATION

5.1.1 Company Name

5.1.2 Other Companies Teamed in this Effort (if Appropriate)

5.1.3 Primary Contact (Include Name, Title, Telephone Number, Facsimile Number, and Electronic Mail Address)

5.2 DESCRIPTION

Provide the following information for each submittal (there may be more than one per company or team).

5.2.1 Title (Include a Few Words that will Distinguish your Effort from Similar Submittals)

5.2.2 Equipment or Systems

Discuss your equipment or system. Responses should be brief and may include brochures, concept sketches, and/or drawings. Describe the application of your equipment, system, or service for retrieving the waste from the tanks, e.g., mobilizing the waste in the tank, removing the waste from the tank, or transporting the waste once it is outside the tank. Describe the approach taken for accessing the tanks and considerations of hole size and location that are important to your equipment or system. Describe the approach taken for control and monitoring of your equipment or system. Include your approach to operator interface with, and control of, the equipment or system.

5.2.3 Contracting Approaches

For contracting approaches, describe methods that are best suited to implementation of your technical approach. Use examples from your experience or that have been demonstrated with the DOE or other government agencies. What contractual considerations are important?

5.3 APPLICABILITY

Using Tables 4-1 and 5-1, indicate which operating attributes and tank configurations you think can be addressed by your proposed component or system.

Table 5-1. Single-Shell Tank Farm Breakdown.

Tank Farm	Volume (m^3/gal)	Number tanks lg (sm)	Congested with in-tank hardware?	Center riser access	Other riser access	How full are tanks?	In-tank hardware comments
A	3,800/ 1 M	6	Yes, 4 fixed ALCs plus	No, riser extends to tank bottom	7 x 30 cm (3 x 12 in.)	96% max, 20% min, 26% ave.	ALC has guy wires to bottom of tank (flat bottom)
AX	3,800/ 1 M	4	Yes, 22 ALCs plus	30 cm (12 in.) near center	86 cm (34 in.) 30 cm (12 in.)	75% max, 1% min, 23% ave.	Very congested (flat bottom)
B	1,900/ 1/2 M	12 (4)	No	30 cm (12 in.)	10 x 30 cm (4 x 12 in.)	75% max, 6% min, 32% ave.	Peripheral only plus 1 center
BX	1,900/ 1/2 M	12	No	30 cm (12 in.) min	10 x 30 cm (4 x 12 in.)	69% max, 5% min, 26% ave.	Peripheral only plus 1 center
BY	2,850/ 3/4 M	12	Partly	30 cm (12 in.) near center + 107 cm (42 in.) maybe	Some 30 cm (12 in.)	87% max, 39% min, 53% ave.	Peripheral plus center cluster
C	1,900/ 1/2 M	12 (4)	No	30 cm (12 in.) min	10 x 30 cm (4 x 12 in.)	60% max 12% min, 35% ave.	Peripheral only plus 1 center
S	2,850/ 3/4 M	12	No	30 cm (12 in.) near center + 107 cm (42 in.) maybe below grade	Some 30 cm (12 in.)	93% max, 31% min, 64% ave.	Peripheral plus center cluster--3 to 5 max
SX	3,800/ 1 M	15	Yes, 4 fixed ALCs plus	30 cm (12 in.) near center + 107 cm (42 in.) maybe below grade	Some 30 cm (12 in.)	69% max, 2% min, 28% ave.	ALC has guy wires to bottom of tank
T	1,900/ 1/2 M	12 (4)	No	30 cm (12 in.)	10 x 30 cm (4 x 12 in.)	91% max, 4% min, 31% ave.	Peripheral only plus 1 center
TX	2,850/ 3/4 M	18	No	30 cm (12 in.) near center + 107 cm (42 in.) maybe below grade	Some 30 cm (12 in.)	85% max, 5% min, 52% ave.	Peripheral plus center cluster--3 to 5 max
TY	2,850/ 3/4 M	6	No	30 cm (12 in.) near center + 107 cm (42 in.) below grade	Some 30 cm (12 in.)	31% max, 2% min, 14% ave.	Center cluster--3 to 5 max
U	1,900 1/2 M	12 (4)	No	30 cm (12 in.) min	10 x 30 cm (4 x 12 in.)	91% max, 5% min, 56% ave.	Peripheral only plus 1 center

ALC = Air lift circulator

5.4 TECHNICAL MATURITY

Describe the maturity of the approach (equipment exists, needs to be adapted, or concept only). Where has your equipment been used? If a concept, what work remains to prove the concept? Describe any technical risks and the actions necessary/information needed to resolve those risks.

5.5 DEMONSTRATION, SIMULATION, AND TESTING

Describe tests, demonstrations, or simulations that could help resolve the risks you have previously described. Describe any cost sharing, the use of existing equipment, or other approaches that would reduce cost or improve results.

5.6 SITING

Describe buildings, support structures, and utility requirements for your equipment, system, or service.

5.7 COMPANY/TEAM EXPERIENCE

Describe any experience in providing equipment, systems, or services that were designed for operation in a radioactive environment. Has your company had experience designing, building, and operating equipment to be used in a radiation environment? If so, describe the application.

5.8 ROUGH ORDER OF MAGNITUDE COST ESTIMATE

What is the "off-the-shelf" cost or price for your equipment or system? If possible, provide a rough order of magnitude (+/- 50%) planning estimate for adaption of your equipment, system, or services for retrieval of waste from tanks at the Hanford Site, and describe what is included in the estimate.

APPENDIX

PHOTOGRAPHS AND DESCRIPTIONS OF HANFORD SITE TANKS

LIST OF FIGURES

APPENDIX

PHOTOGRAPHS AND DESCRIPTIONS OF HANFORD SITE TANKS

The following narrative describes the photographs in this appendix.

Figure A-1. B Tank Farm, Aerial View

The twelve B Tank Farm "100 Series" tanks, 241-B-101 through 241-B-112, are shown. The tank number is centered on each tank. The three squares on tanks 241-B-101, 241-B-102, and 241-B-103 are pits installed after the tanks were placed in service for the installation of sluicing equipment. Each tank has two pairs of 10- and 30-cm (4- and 12-in.) access risers at the edge of the tank 180 degrees apart in the northwest and southeast quadrants. The risers can be seen clearly on tank 241-B-107. Each tank has a 30-cm (12-in.) access riser at its center.

Bermed pipe lines that traverse the farm, a (0.3- to 0.6-m [1- to 2-ft]) drop in elevation in the direction of the arrows (north) for each row of tanks, and instrumentation, ventilation, and power structures constrict vehicular access to locations in the farm. The farm is considered contaminated with attendant access control restrictions. However, Baltimore Avenue running alongside B Farm is unrestricted.

Figure A-2. Tank 241-B-105, Composite

Tank 241-B-105 is a nearly full, 1,900-m^3 (500,000-gal), 23-m (75-ft) diameter tank. It is typical of low-obstruction tanks, which comprise the majority of Hanford Site single-shell tanks. This tank contains a salt well screen (25-cm [10-in.] pipe), a liquid observation well (8-cm [3-in.] pipe), a liquid-level probe (wire or flow-indicating controller tape), an abandoned pump, and three temperature probes. The waste form is salt cake with a large, flat surface in the foreground and a sunken area with sloping walls in the background.

Figure A-3. Tank 241-B-105, Detail

A salt well screen (25-cm [10-in.] pipe) is shown penetrating the salt cake at the bottom of an approximately 1.8-cm (6-ft) deep depression. The depression was exposed when supernatant liquid was drawn off via the salt well. These steep walls of waste occur in only a few tanks. Large lumps of salt are more common, though usually associated with in-tank hardware that seeded crystallization.

Figure A-4. Tank 241-BX-107, Composite

Tank 241-BX-107 is a two-thirds full, 1,900-m^3 (500,000-gal), 23-m (75-ft) diameter tank. It is also typical of relatively uncongested tanks, which comprise the majority of Hanford Site single-shell tanks. This tank contains a salt well screen (25-cm [10-in.] pipe), a liquid-level probe (flow-indicating controller tape), and a temperature probe. Discarded level probe tapes are visible. Each tank is estimated to contain several such discarded tapes. The waste form is soft sludge. The colored stain is of unknown origin.

Figure A-5. Tank 241-BX-107, Detail

Soft, moist sludge with a small liquid pool is shown. A discarded level probe tape is visible near the pool. The colored patches were apparently floating on the surface of the supernatant liquid before it was pumped out.

Figure A-6. Tank 241-BY-111, Composite

Tank 241-BY-111 is a three-fifths full, 2,850-m^3 (750,000-gal) tank. It is typical of a congested tank of which there are about two dozen. This tank contains a salt well screen (25-cm [10-in.] pipe), a liquid observation well (7.6-cm [3-in.] pipe), three air lift circulators (25-cm [10-in.] pipe), a liquid-level probe (wire or flow-indicating controller tape), and a temperature probe. Discarded level probe tapes are visible. The waste form is salt cake with a broken surface.

Figure A-7. Tank 241-BY-111, Detail

This photograph shows broken surface salt cake, probably formed by a collapsing crust, with imbedded level probe tapes. A temperature probe, a salt well screen (25-cm [10-in.] pipe), and the truss supports for two air lift circulators are visible. One air lift circulator has a salt "lollipop" attached.

Figure A-8. Tank 241-AX-102, Composite

Tank 241-AX-102 is a nearly empty 3,900-m^3 (1-Mgal) tank. It is one of four highly congested tanks ranging from nearly empty to nearly full. This tank contains a salt well screen (25-cm [10-in.] pipe), 22 air lift circulators (25-cm [10-in.] pipe) estimated to be 3.7 m (12 ft apart), a liquid-level probe (flow-indicating controller tape), a manual level tape, four temperature probes, a dry well, a sluicing pump, a sluicing nozzle assembly, and a 101.6-cm (40-in.) diameter steam coil.

Figure A-9. Tank 241-AX-102, Detail

The detail shows air lift circulators and a pump extending to the bottom of the tank. This tank contains about 0.30 m (1 ft) of salt cake/sludge waste. In another tank (241-AX-101), this area is covered by 7.3 (24 ft) of salt cake waste.

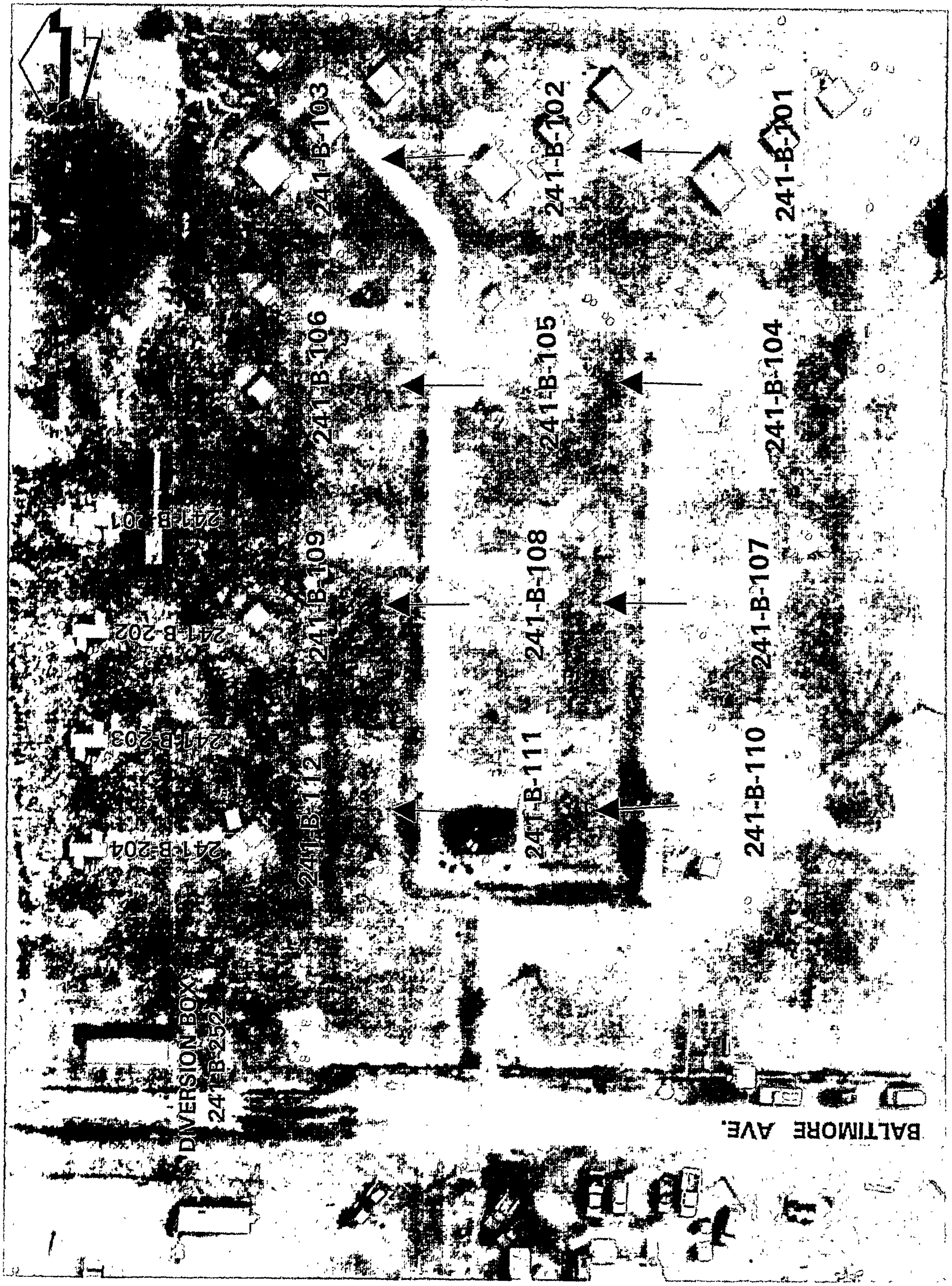

Figure A-1. B Tank Farm, Aerial View.

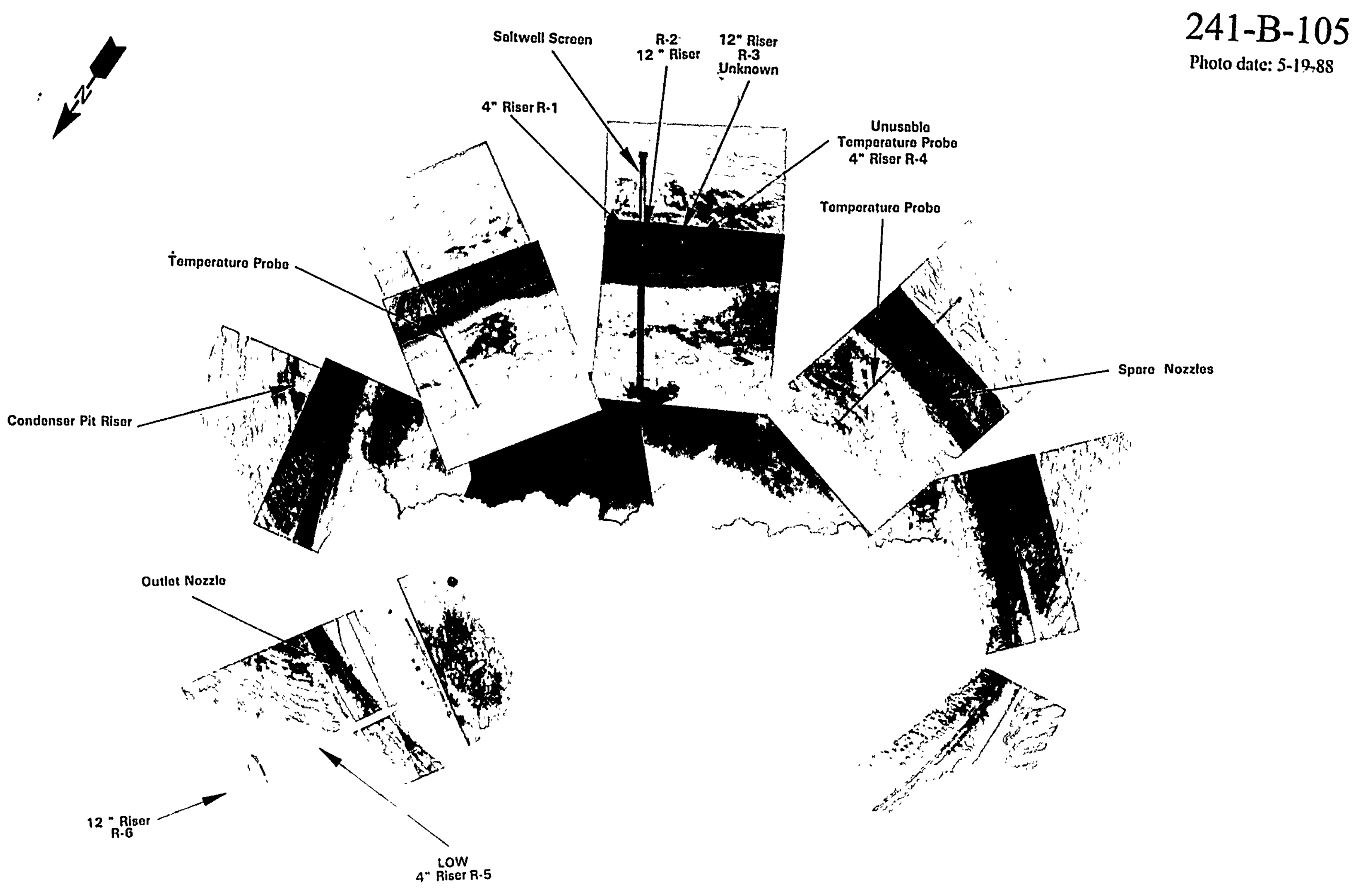

Figure A-2. Tank 241-B-105, Composite.

Figure A-3. Tank 241-B-105, Detail.
(neg. 8802710-10cn)

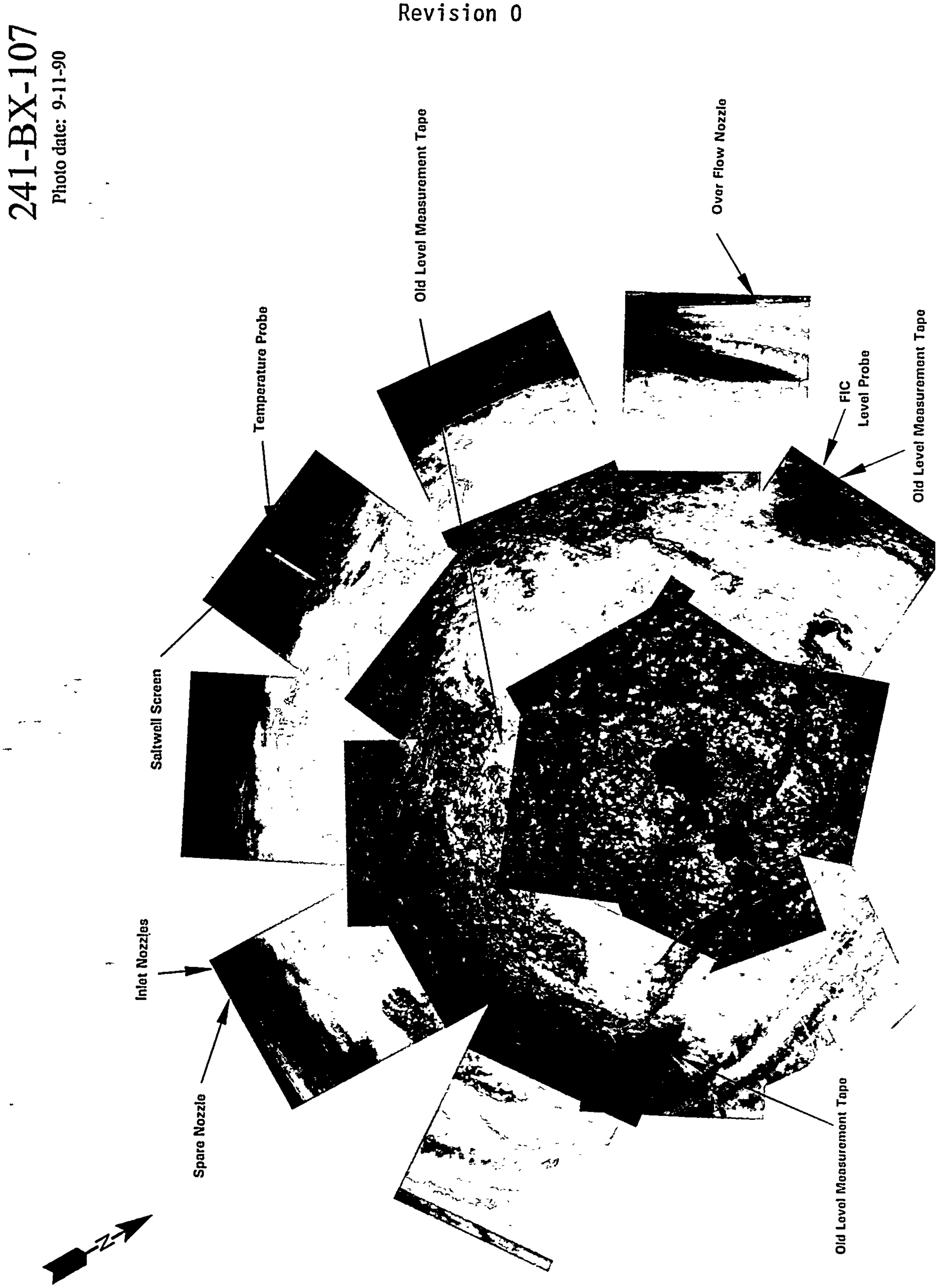

Figure A-4. Tank 241-BX-107, Composite.

Figure A-5. Tank 241-BX-107, Detail.
(neg. 90091139-7cn)

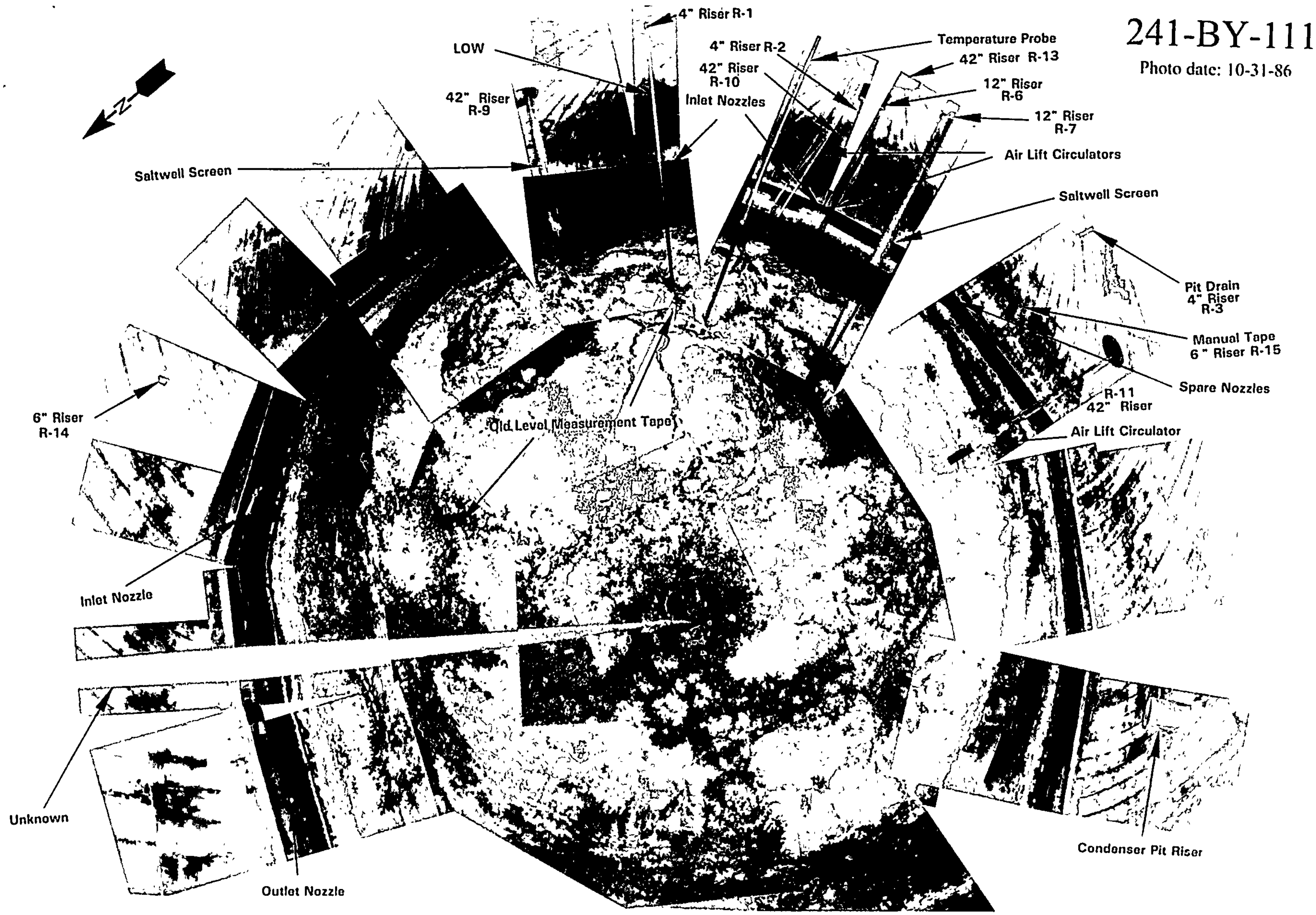

Figure A-6. Tank 241-BY-111, Composite.

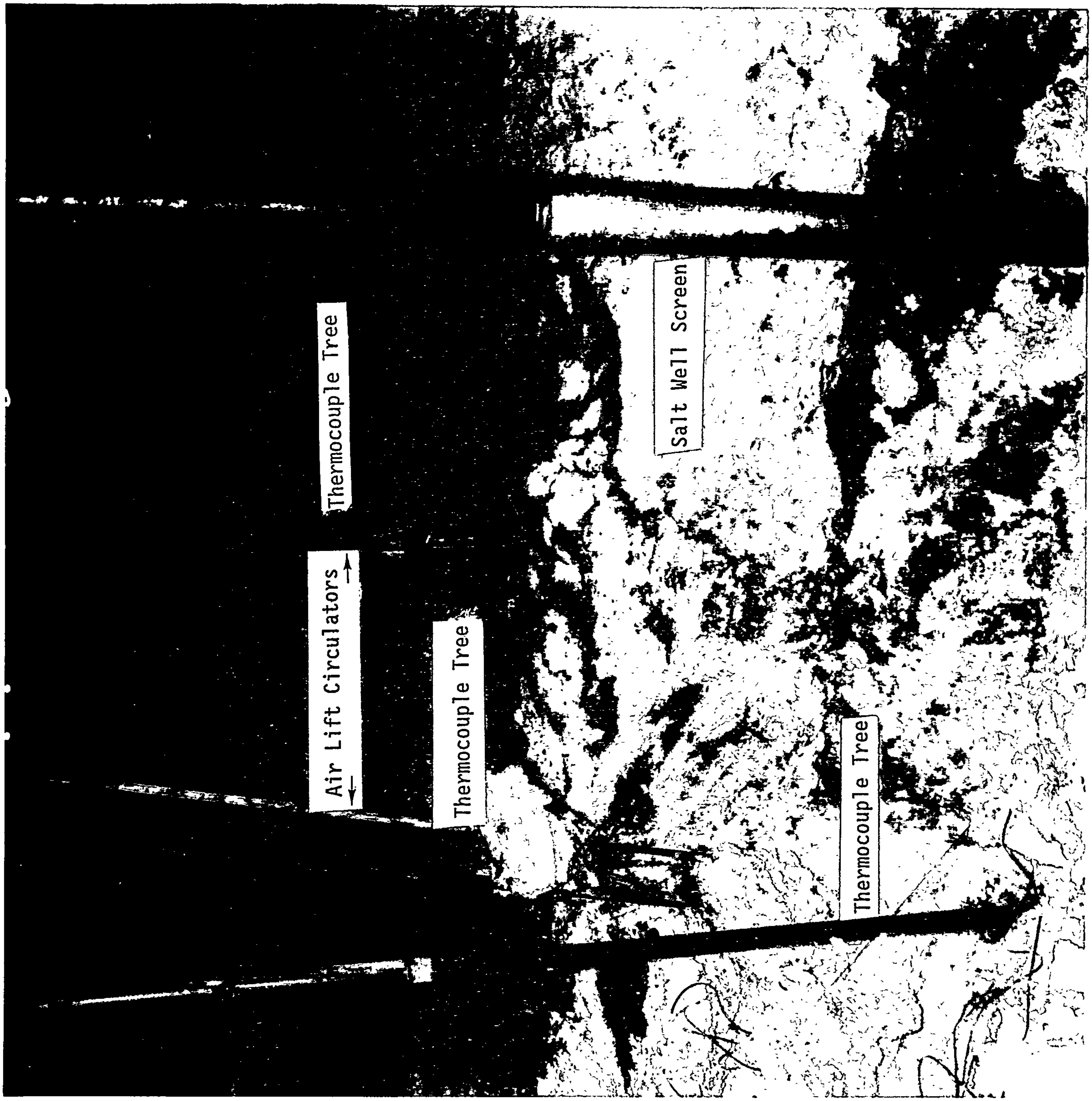

Figure A-7. Tank 241-BY-111, Detail.
(neg. 8606972-13cn)

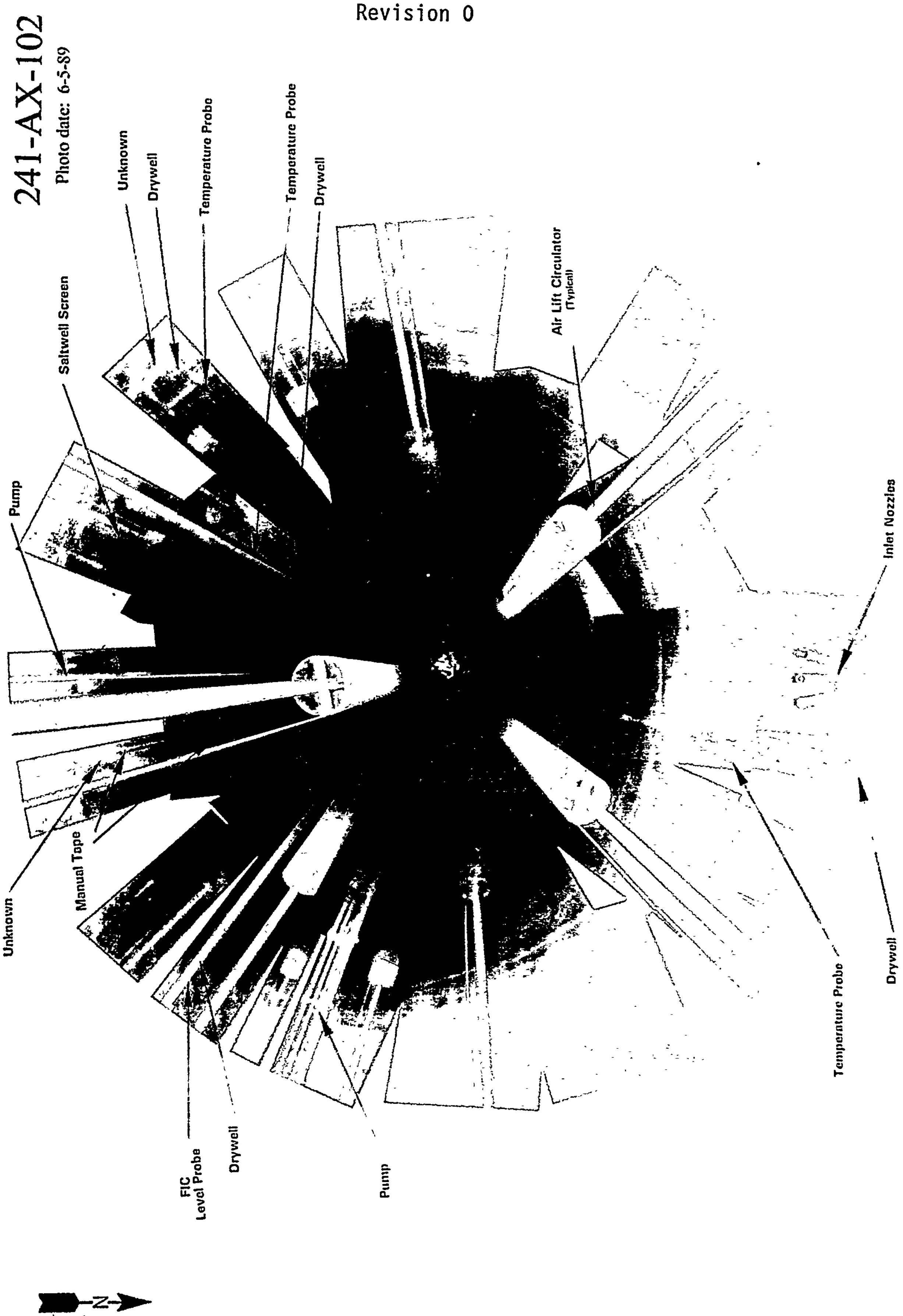

Figure A-8. Tank 241-AX-102, Composite.

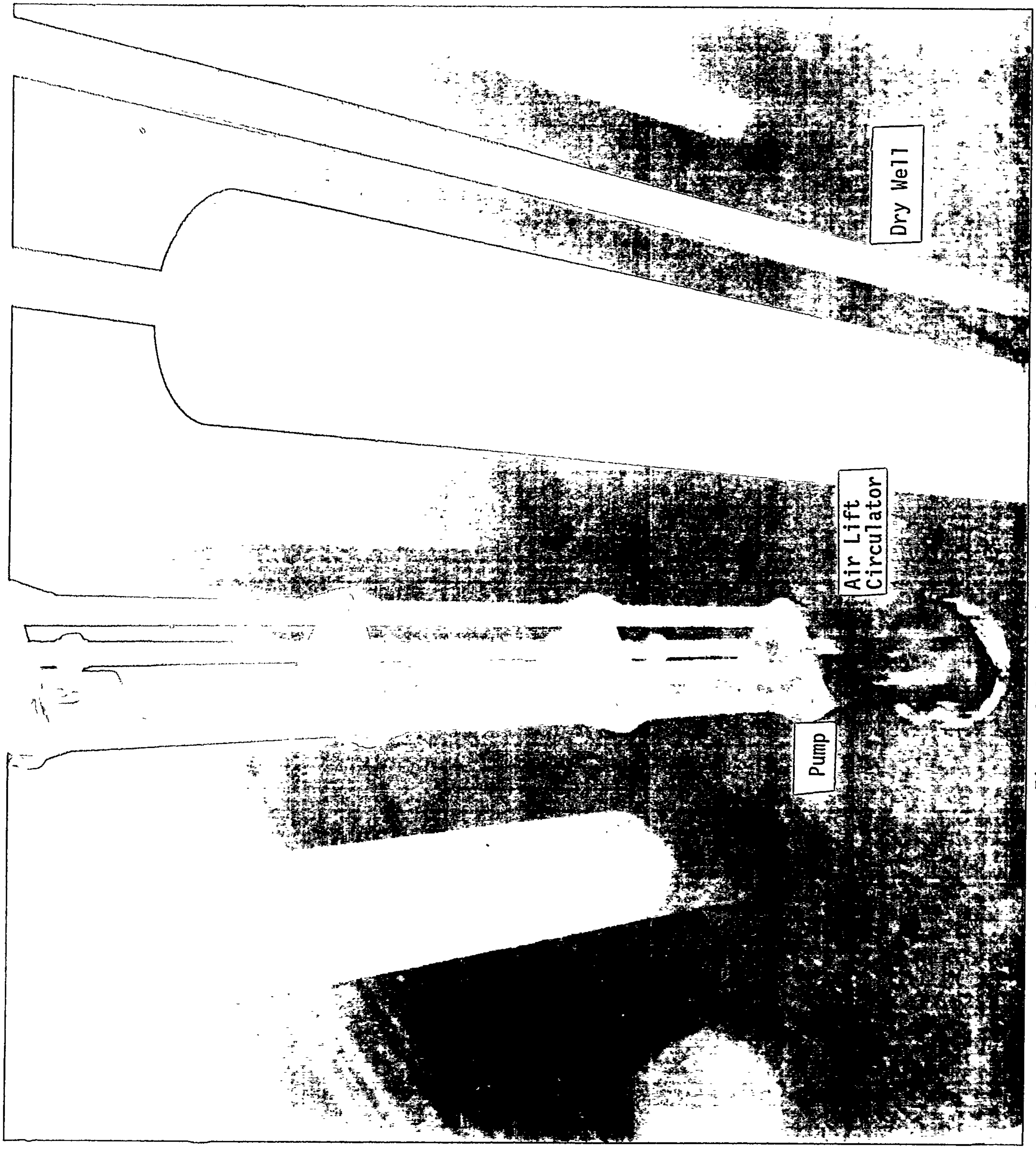

Figure A-9. Tank 241-AX-102, Detail.
(neg. 89060541-24cn)