

MASTER

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THE NWCF MAINTENANCE
FEATURES AND CAPABILITIES

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Allied Chemical Corporation

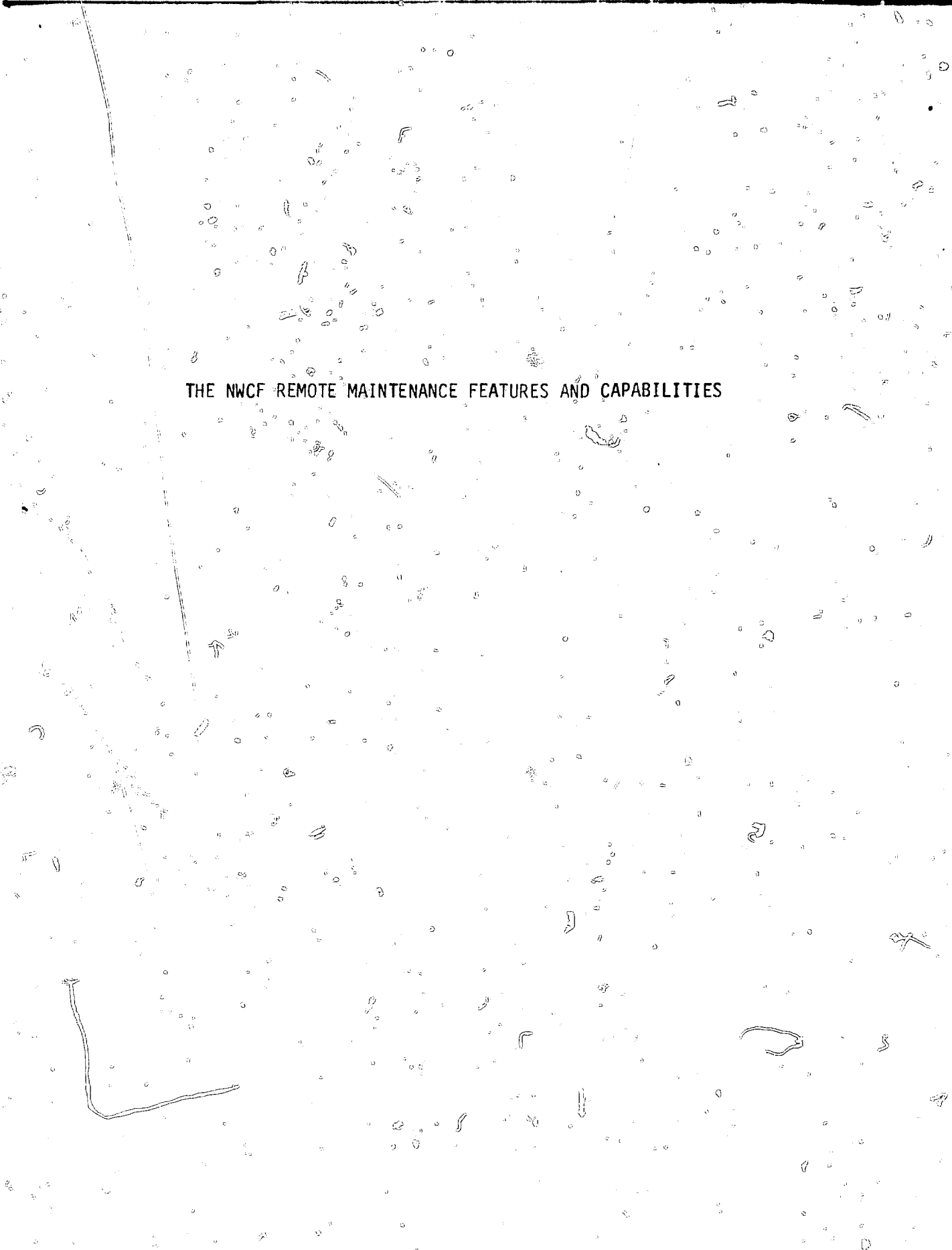
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Idaho Falls, Idaho

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Number of figures 3

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The image shows a technical drawing of a ship's hull, likely a submarine, with various annotations and a title. The drawing is oriented vertically on the page. The hull is shown in profile, with a curved bottom and a flat top. There are numerous small circles and lines scattered across the hull, representing rivets, bolts, or other structural details. A prominent feature is a large, curved line on the left side, which could be a structural reinforcement or a specific part of the hull. The title "THE NWCF REMOTE MAINTENANCE FEATURES AND CAPABILITIES" is centered on the page. There are also several arrows and other markings pointing to specific areas of the hull, indicating points of interest or maintenance features.

THE NWCF REMOTE MAINTENANCE FEATURES AND CAPABILITIES

ABSTRACT

A New Waste Calcining Facility is being built at the Idaho Chemical Processing Plant to replace the existing Waste Calcining Facility which was built to demonstrate fluidized-bed solidification of highly radioactive liquid wastes. The new facility is being designed to provide a higher waste throughput, more corrosion resistant materials of construction, more effective cleanup of effluent streams, and extensive remote maintenance and equipment replacement capability. The facility will also contain extensive decontamination capability should contact maintenance become necessary. The facility is presently in construction and is scheduled for hot operation in 1980.

INTRODUCTION

A New Waste Calcining Facility (NWCF) is being built at the Idaho Chemical Processing Plant (ICPP) at the Idaho National Engineering Laboratory (INEL) to replace the existing Waste Calcining Facility (WCF) built in the early 1960s. The WCF was built as a pilot plant unit to demonstrate the solidification (calcination) of highly radioactive liquid waste in a heated, fluidized-bed. Since its completion, the WCF has served as a production facility and has been used to convert some 2.7 million gal (10.2 million liters) of liquid waste into 45,000 ft³ (1274 cm³) of solids.

Recent operating experience with the existing calcining facility has shown that if the total volume of liquid waste presently stored at the ICPP plus that continually being produced by fuel reprocessing operations is to be processed, a new calcining facility must be constructed. This new facility will provide a number of process and facility improvements which experience with the existing facility has shown are needed including a higher waste throughput; more corrosion resistant materials of construction; better cleanup of effluent streams; more effective contamination control and most importantly, significant remote maintenance and equipment replacement capability. The new facility is presently under construction and is scheduled to be operational in 1980.

FACILITY DESCRIPTION

The NWCF (Figure 1) will be a concrete and steel structure approximately 250 ft long, 125 ft high, (76 meters long, 38 meters wide, and 23 meters high) with approximately one-half the structure located below grade. Thick concrete shielding walls will divide the below grade portion of the facility into the following functionally isolated process cells: a feed blend and hold cell where the liquid waste is prepared for calcination; a calciner cell where the calcination process occurs; an off-gas cell where the process off-gas stream is cooled and scrubbed to remove solids; an adsorber cell where the gas passes through silica gel beds for ruthenium removal; and a filter cell where prefilters and high-efficiency particulate air (HEPA) filters perform final off-gas polishing. The facility also contains two other below grade cells -- one where process off-gas HEPA filters are processed and packaged for disposal, and another where highly radioactive process equipment items can be taken for disassembly, decontamination, and repair.

The above grade portion of the facility contains primarily support areas and systems including the control room, the emergency generator and switchgear room, chemical makeup and storage areas, offices, change rooms, locker areas, vehicle decontamination areas and a maintenance area. The maintenance area covers the entire process or below grade portion of the facility and contains two 30-ton (27,000 kilograms) bridge cranes and a bridge-mounted manipulator.

The NWCF will be located slightly north and east of the present WCF to provide convenient access to existing ICPP facilities including the liquid waste storage tank farm, the underground calcine storage bins, the Atmospheric Protection System, the ICPP stack and the WCF utility system.

PROCESS DESCRIPTION

The WCF and NWCF process systems (Figure 2) are very similar. Changes are primarily in equipment sizes, materials of construction, and additional and more efficient effluent cleanup devices. The calcination process operates by spraying liquid wastes into a calciner vessel which contains a fluidized-bed heated to 500°C by in-bed combustion of kerosene and oxygen. During calcination the water in the waste solution is vaporized, and the chemical species in the waste are converted to calcine particles. The product (calcine) is removed from the bed continuously (or intermittently) and is pneumatically transferred to underground storage bins. Off-gases from the calciner pass through a combination dry and wet cleanup system to remove radioactive particulates before the gases are discharged to the atmosphere. Removal devices include a dry fines collector, a quench tower, a venturi scrubber, mist eliminators, ruthenium adsorbers, and HEPA filters.

Contaminated liquid wastes generated by the system either during operation or shutdown are recycled as calciner feed. Uncontaminated liquid wastes are discharged to the ground through the ICPP liquid waste diversion system.

The process system will be constructed primarily of three different materials: Type 347 stainless steel for the calciner vessel and the dry fines collector; Nitronic-50 for the calciner feed and wet off-gas portions of the system; and type 304L stainless steel for everything else. Material selection was based on the type of service expected and on corrosion resistance. Cell wall and floor linings will also be stainless steel. Those portions of the cells not covered with stainless steel will be covered with an epoxy material.

REMOTE HANDLING

One of the most significant changes being incorporated in the NWCF is the addition of remote maintenance techniques and methods. Remote maintenance is relatively new to ICPP, because all ICPP facilities were originally built for direct maintenance (i.e., following extensive in-place decontamination all maintenance operations are performed by personnel in direct contact with the equipment to be maintained). However, in keeping with the current philosophy of reducing annual personnel radiation exposures to ALARA levels and maximizing equipment on-stream times, remote maintenance techniques are being incorporated into all new facilities now being designed and constructed at ICPP.

In the past, the accepted approach to remote maintenance has been the canyon concept wherein all process equipment is installed in canyons or deep cells such that defective or failed equipment can only be remotely removed and replaced with an overhead crane operated from a shielded cab.

Actually, with this concept, remote in-place maintenance or repair is not possible -- only remote replacement, with maintenance or repair being performed later in another cell. There are, however, serious problems associated with the construction and operation of remote canyons including large and expensive buildings, extensive mockup support facilities, large engineering support efforts, significant spare parts inventory, and rather lengthy operator training periods. These problems are especially significant at the INEL where remote canyons have never existed.

Therefore, rather than employing a canyon method, the philosophy being used in the NWCF design is to optimize the "capital-cost, personnel-radiation-exposure" problem by providing remote maintenance capability for only the failure prone items and retaining direct maintenance for all other items. In most cases, remote maintenance will be restricted to replacement. However, when possible, design will allow in-place remote repair of failed equipment.

The classification of equipment items as to failure probability was based on an in-depth study of the 13-yr operating history of the WCF. This study showed that most maintenance problems were being caused by a relatively few equipment items including process control valves, wash solution pumps, calciner fluid flowmeters, calciner feed and flow control valves, calciner feed and fuel nozzles, HEPA filters, and sampling equipment. Therefore, in the NWCF these items are being located in the remote maintenance areas discussed in the following paragraphs and shown in Figure 3.

1. Valve Corridor. The valve corridor area extends along one side of the building and contains valves from the blend and hold cell, the off-gas cell, and the adsorber cell, the mist eliminator wash solution pump; some airlifts; and the process off-gas HEPA filters. This area is provided with a number of viewing windows, a small bridge crane, and a wall-mounted manipulator that can provide full vertical and horizontal coverage of the area and can be used to replace any of the items located in the area. A manipulator maintenance area is located at one end of the valve corridor, along with a transfer port through which contaminated equipment and filters may be introduced into the decontamination area.
2. Feed Flowmeter and Control Valve Cubicle. This area contains the flowmeters and feed control valves on the calciner feed lines and is provided with a window and set of master-slave manipulators to permit replacement of these devices. Portions of the solids sampling system are also located in this area.
3. Calciner Cell. The calciner cell contains the calciner vessel and cyclone and is provided with two viewing windows, two sets of master-slave manipulators, and a transfer port. The remote tasks to be performed in this area are changeout of the calciner fuel and feed nozzles. The calciner cell also contains a window frame and two sleeves for the future addition of another viewing window and a set of master-slave manipulators.

4. Off-Gas Cell. The off-gas cell contains a number of equipment items used for cleanup of the process off-gas including the quench system.

This area is provided with a viewing window and a set of master-slave manipulators to assist in replacement of the quench solution pumps.

5. Process Off-Gas Filter Cell. The NWCF process off-gas filtration system contains four parallel filter plenums, each containing (in series) a prefilter plus two HEPA filters. All remote handling operations are performed in this cell using a wall-mounted electro-mechanical, single-arm manipulator observed through a viewing window. The remote handling operations are:

- 1) removing and replacing filters,
- 2) operating the filter elevator mechanism for lowering or raising (sealing) the filters,
- 3) transporting the filters from the filter cell,
- 4) removing the filter housing door for seal replacement,
- 5) removing the elevator assembly for repair, and
- 6) filter housing door maintenance.

6. Sampling Cell. NWCF process operation will be monitored routinely by sampling the contents of all major vessels, by sampling the process off-gas stream upstream and downstream of each item of the off-gas cleanup equipment, and by sampling the calciner bed solids.

Liquid and gas samples are collected in the Sampling Cell and the solids sample is collected in the Feed and Flowmeter Cubicle. All sampling is done remotely.

The Sampling Cell is equipped with a shielding window and master-slave manipulators. All components of the sampling system can be removed and replaced remotely using master-slave manipulators, a shielded transfer cask, and a viewing window.

7. Decontamination Area. The two remaining areas provided with remote capabilities are the filter processing cell and the decontamination cell. These areas are used to process the contaminated process off-gas HEPA filters and prepare them for disposal and to decontaminate highly radioactive process equipment items. Each cell is provided with shielding windows and master-slave manipulators. A bridge crane and a wall-mounted manipulator that are common to both cells are also provided.

OPERATING PHILOSOPHY

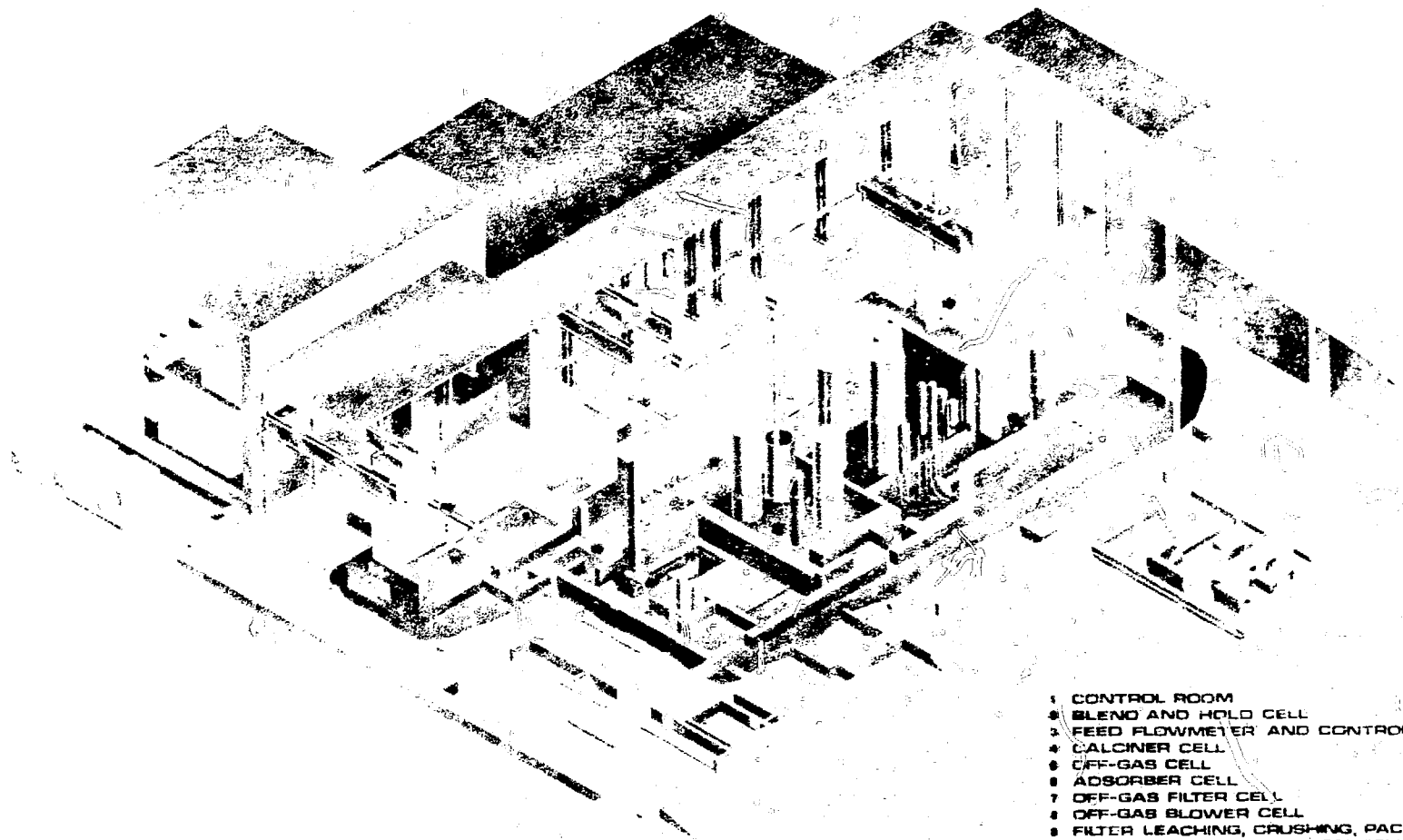
1. ALARA. The general radiation exposure policy of ACC-ICP at the Idaho Chemical Processing Plant (ICPP) is to bring both individual and total plant personnel radiation exposure to As-Low-As--Reasonably-Achievable (ALARA) levels. All ACC-ICP personnel are charged with the responsibility to reduce (1) personnel exposures, (2) uncontrolled contamination, and (3) releases of radioactivity to the environs. The reduction of the above three items within the NWCF will be achieved by the maximum use of the remote equipment and techniques for operations and maintenance previously mentioned in this report. Use of remote equipment and techniques eliminates (1) breaching contaminated cell areas for maintenance activities,

and (2) personnel contact with contaminated equipment. Thus, the basic design objective of providing a facility with a maximum on-stream time that can be operated and maintained with personnel exposures and effluent releases as-low-as-reasonably-achievable (ALARA) will be achieved through the optimum use of the remote equipment.

2. Contamination Control. Contamination will be controlled at or as near the source as possible. Thus, primary control of contamination spread will be achieved through maintaining the integrity of the NWCF process vessels and piping.

In the NWCF, equipment can be transferred remotely from process to decontamination areas also within the facility. Since this equipment does not enter personnel occupied areas, contamination is confined to process cells. Through the use of the remote equipment, there is a reduced requirement for entrance to NWCF process cells and other areas containing radioactive contamination. Thus, corresponding reduction in contamination spread and clean-up results along with a reduced need for lengthy decontamination, reduced generation of contaminated chemical wastes, and longer lifetimes for process equipment and systems as the result of a reduced number of decontamination cycles.

NEW WASTE CALCINING FACILITY



- 1 CONTROL ROOM
- 2 BLEND AND HOLD CELL
- 3 FEED FLOWMETER AND CONTROL VALVE CUBICLE
- 4 CALCINER CELL
- 5 OFF-GAS CELL
- 6 ADSORBER CELL
- 7 OFF-GAS FILTER CELL
- 8 OFF-GAS BLOWER CELL
- 9 FILTER LEACHING, CRUSHING, PACKAGING CELL
- 10 REMOTE DECONTAMINATION CELL
- 11 HOT SUMP TANK ACCESS
- 12 VALVE CUBICLE
- 13 MANIPULATOR PARKING AND MAINTENANCE AREA

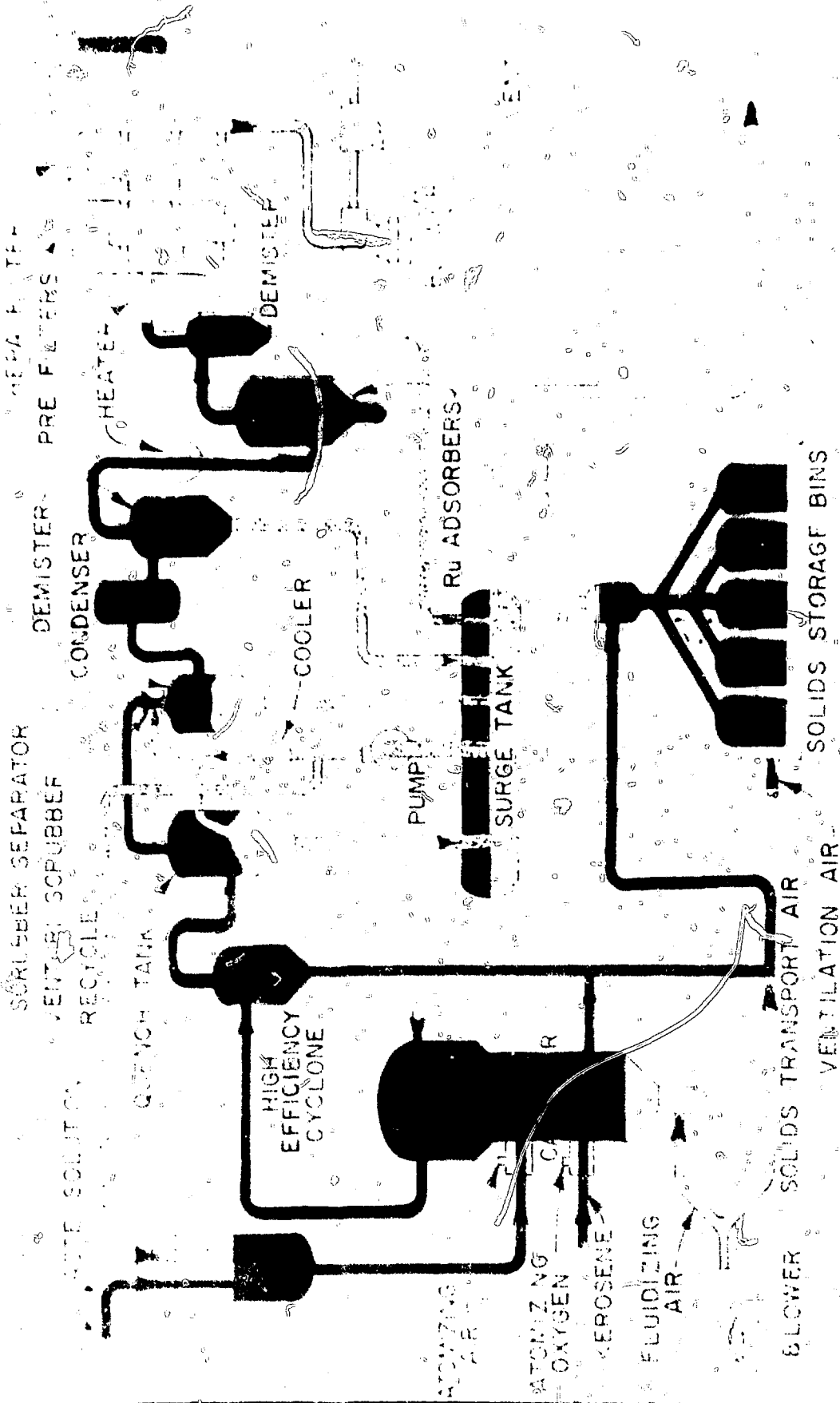


Figure 2

NEW WASTE CALCINING FACILITY

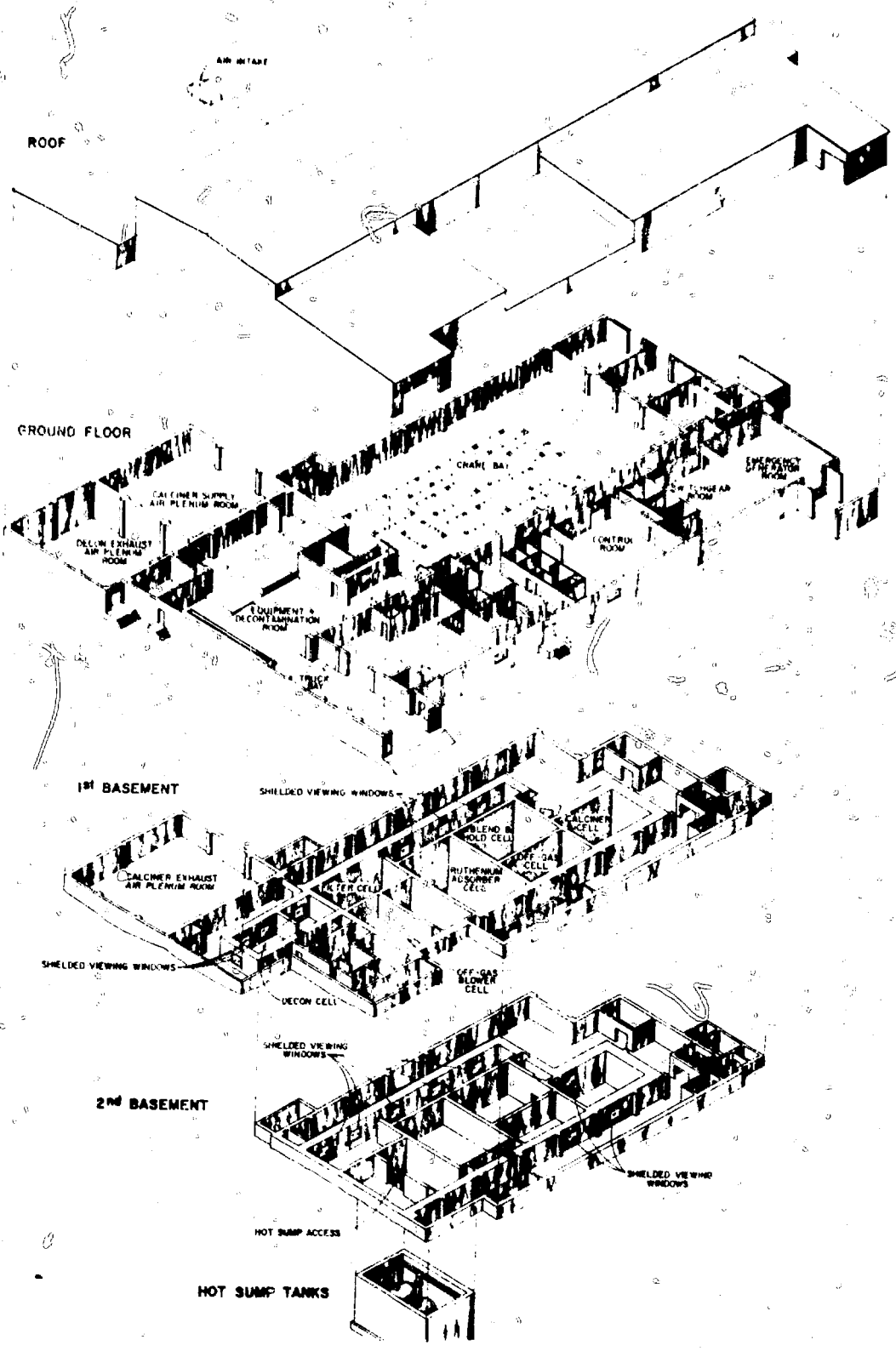


Figure 3

Figures

1. New Waste Calcining Facility
2. NWCF Process Systems
3. Isometric of the NWCF