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AN INTEGRATED REMOTE PROCESS SAMPLING SYSTEM FOR THE NWCF

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AN INTEGRATED REMOTE PROCESS

SAMPLING SYSTEM FOR THE NWCF

ABSTRACT

Increased emphasis on lowering personnel radiation exposures to as-low-as-reasonably-achievable (ALARA) and on containment of radioactive materials influenced a special emphasis on remotely operated sampling systems for the New Waste Calcining Facility (NWCF).

This paper describes work done by Allied Chemical Corporation in designing and testing remote solid, liquid and gas sampling systems for the NWCF.

Work also included a transfer system for transferring samples to an analytical facility. Remote maintenance capabilities were designed into the system so that any failure prone component or subassembly could be remotely removed and replaced.

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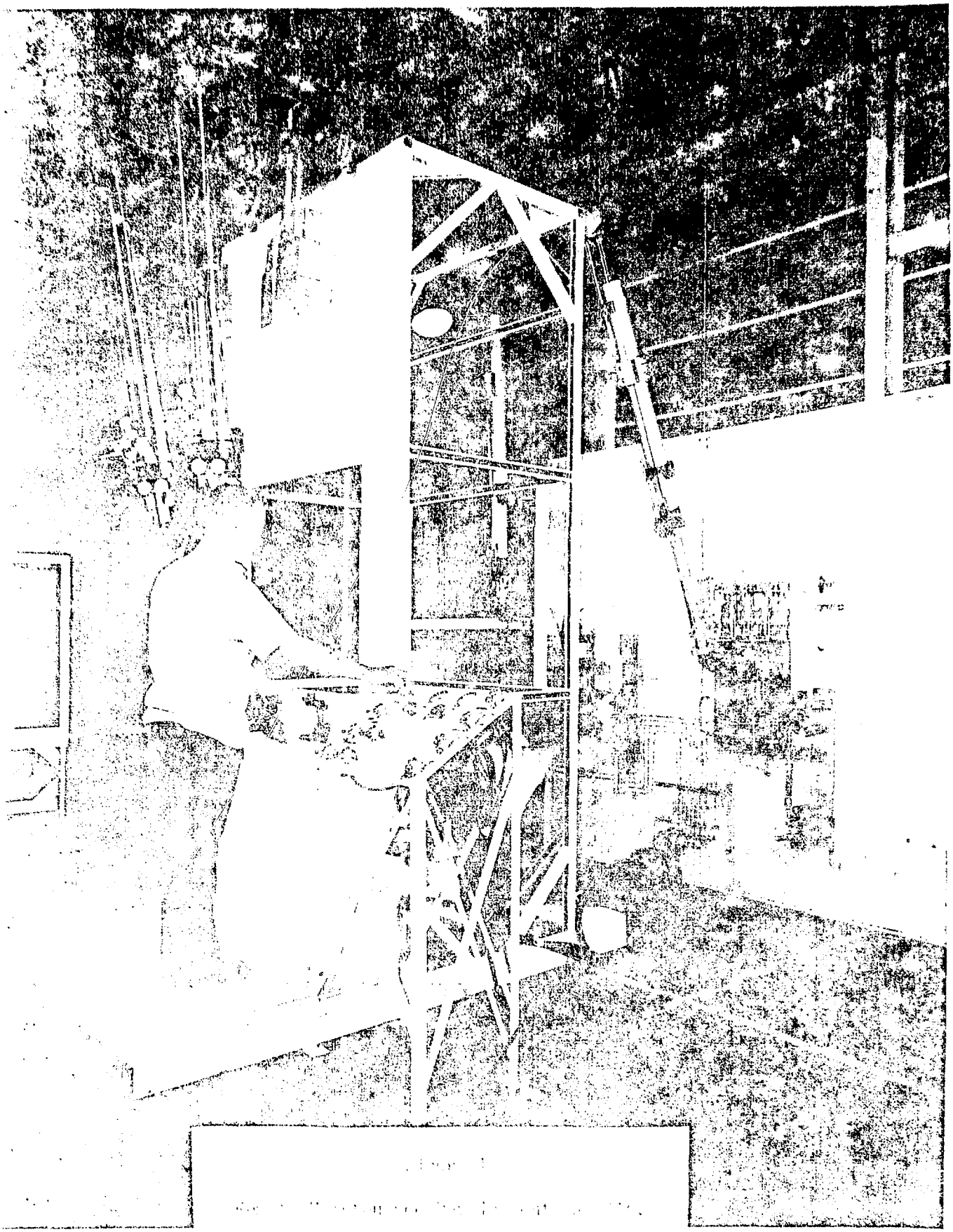
INTRODUCTION

The NWCF sampling and transfer systems will be installed to permit continuous monitoring of process conditions. Sample stations will be provided to obtain those solid, liquid and gas samples necessary to monitor the process and to determine the composition of both the feed solutions, the solid product and the gaseous effluent, and to evaluate the operating efficiency of each effluent cleanup device.

To be effective, samplers must provide samples which are representative of the stream being sampled, and of sufficient quantity for laboratory analysis. In addition, samplers must be designed so that samples can be taken remotely and high-maintenance components can be easily and quickly removed and replaced remotely. In addition, the NWCF sample system must provide the capability to remotely load samples into a shielded cask for transfer to the Remote Analytical Facility for analysis.

The Remote Maintenance Development Facility (RMDF) was used extensively to develop and test full-scale mockups of the NWCF's sampling systems and the remote handling requirements (Figure 1). The primary function of the sample mockup area was to mock up the final design of all NWCF sampling equipment, to test and prove remote removal and replacement and as necessary make modifications. Criteria for remoting selected components and subassemblies of the sample system were based on past performance and experience in existing facilities.



solids sample station. The sample is placed into a pneumatic transfer system container and pneumatically transferred from the flowmeter cubicle to the sampling cell. The solids sample is then placed in a Central Research Double Door Sealed Transfer system (DDSTS) for removal from the cell. This DDSTS canister with the sample is then transferred to the Remote Analytical Facility for analysis. Following transfer of the sample container, the sample lines and recirculating lines are purged with air to return all solids to the calciner vessel.

SOLIDS SAMPLE SYSTEM MOCKUP

The solids sampler shown in Figure 2 was mocked up and tested using final design drawings of the solids sampling system that will be installed in the NWCF. There are only slight differences in the mockup and in the actual system that will be installed in the NWCF such as dummy valves; however, space and access requirements are the same. In addition, the differences will cause no change in the ability to remove or assemble the remotely removable sections of the sampling station.

Testing included remotely removing and replacing the following components.

1. The three jumpers shown in Figure 3 were removed and installing using a master-slave manipulator and an open end wrench. The time required to remove and replace the jumpers was a total of ten min. The jumpers were fabricated of stainless steel tubing and standard Swagelok "B" nuts. In the final NWCF sample station design, B nuts have been modified to include a larger shoulder to simplify alignment. The union has also been modified by increasing the depth to which tubing inserts into the union (Figure 4). These modifications make alignment and starting of the B nut considerably easier.

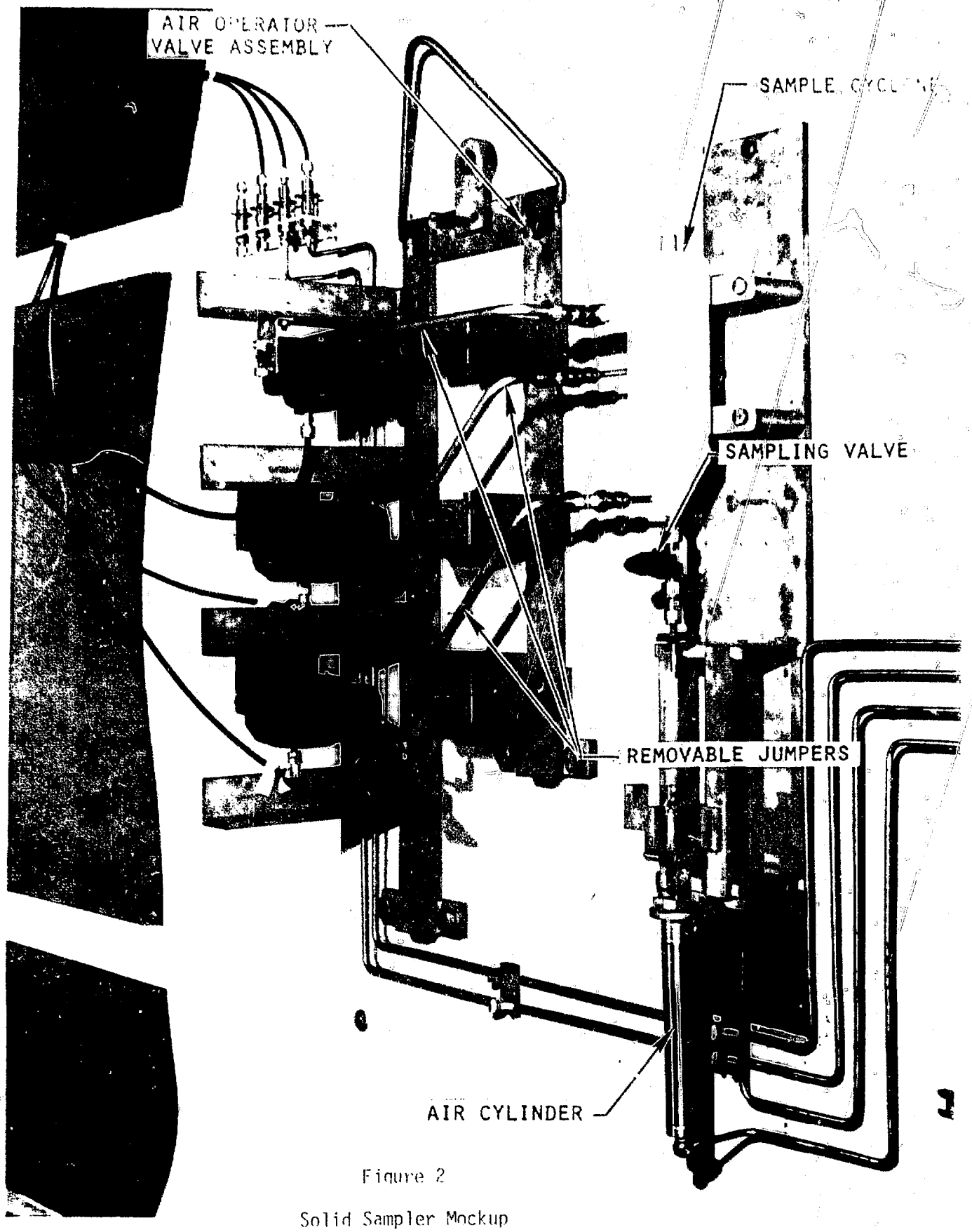


Figure 2

Solid Sampler Mockup

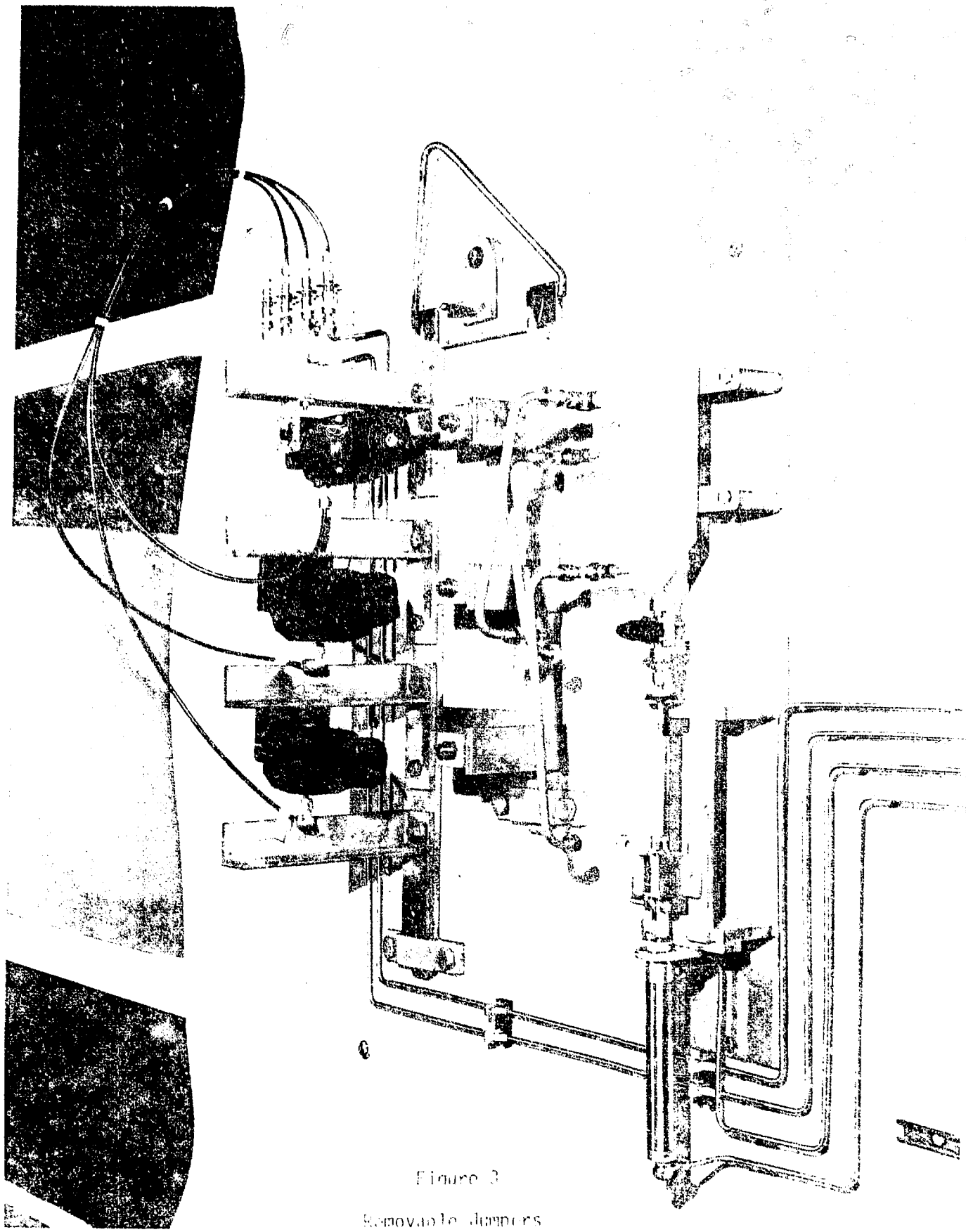
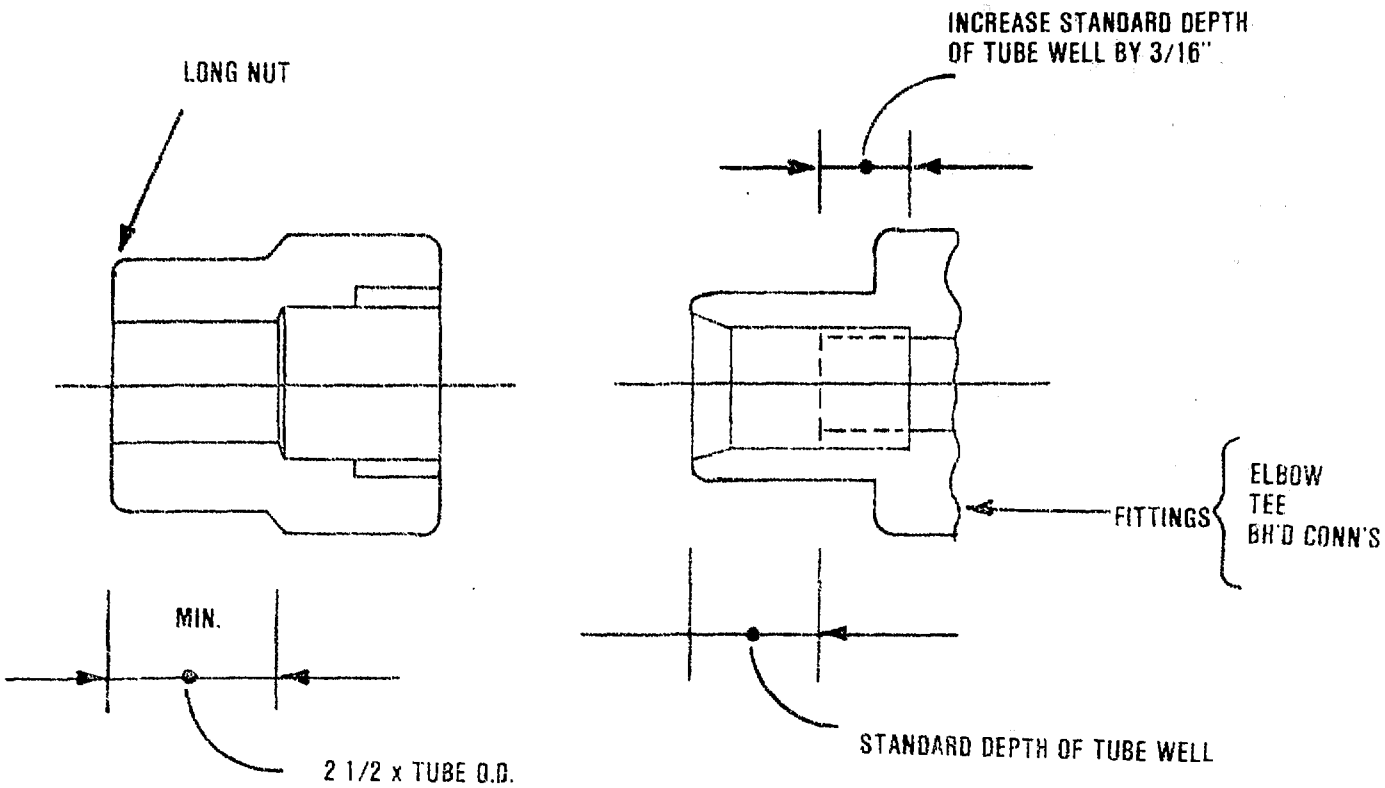


Figure 3

Removable dampers



DETAIL-MODIFIED FITTINGS

Figure 4

Modified Tubing Fittings

2. The three air operated valves are mounted on a panel and are remotely removable as an assembly. Removal of this assembly requires removal of the three jumpers and the flexible air supply line to each of the valves. The total time required to remove and install this assembly was seven min. Removal and installation of this assembly is accomplished using open end wrenches, a master-slave manipulator, and an electric hoist (Figure 5).

Future mockup and checkout is planned of a modification that will allow remote removal of a single air operated valve. The modified valve will be designed to fit into the existing mockup package.

NWCF LIQUID SAMPLING SYSTEM (GENERAL)

The liquid sampling system which consists of ten sampling stations and four decontamination stations will be located in the NWCF sampling cell (Figure 6). This sampling cell is inside a shielded area and is 7.6 m (25 ft) long by 1.37 m (4.5 ft) wide by 4.42 m (14.5 ft) high. The sampling cell contains equipment for liquid and gas sampling, a pass-through transfer system, a pneumatic sending and receiving system, and a capsule capping and decapping device. Overhead decontamination sprays will be provided for cell decontamination and external decontamination of the cell equipment. Entrance to the cell will be through a shielded air lock. Overhead hatches will be provided for removing large equipment. Two shielding windows and two sets of master-slave manipulators will be provided to facilitate remote sampling and replacement of sampling equipment.

The sampling system has been designed so that all high maintenance

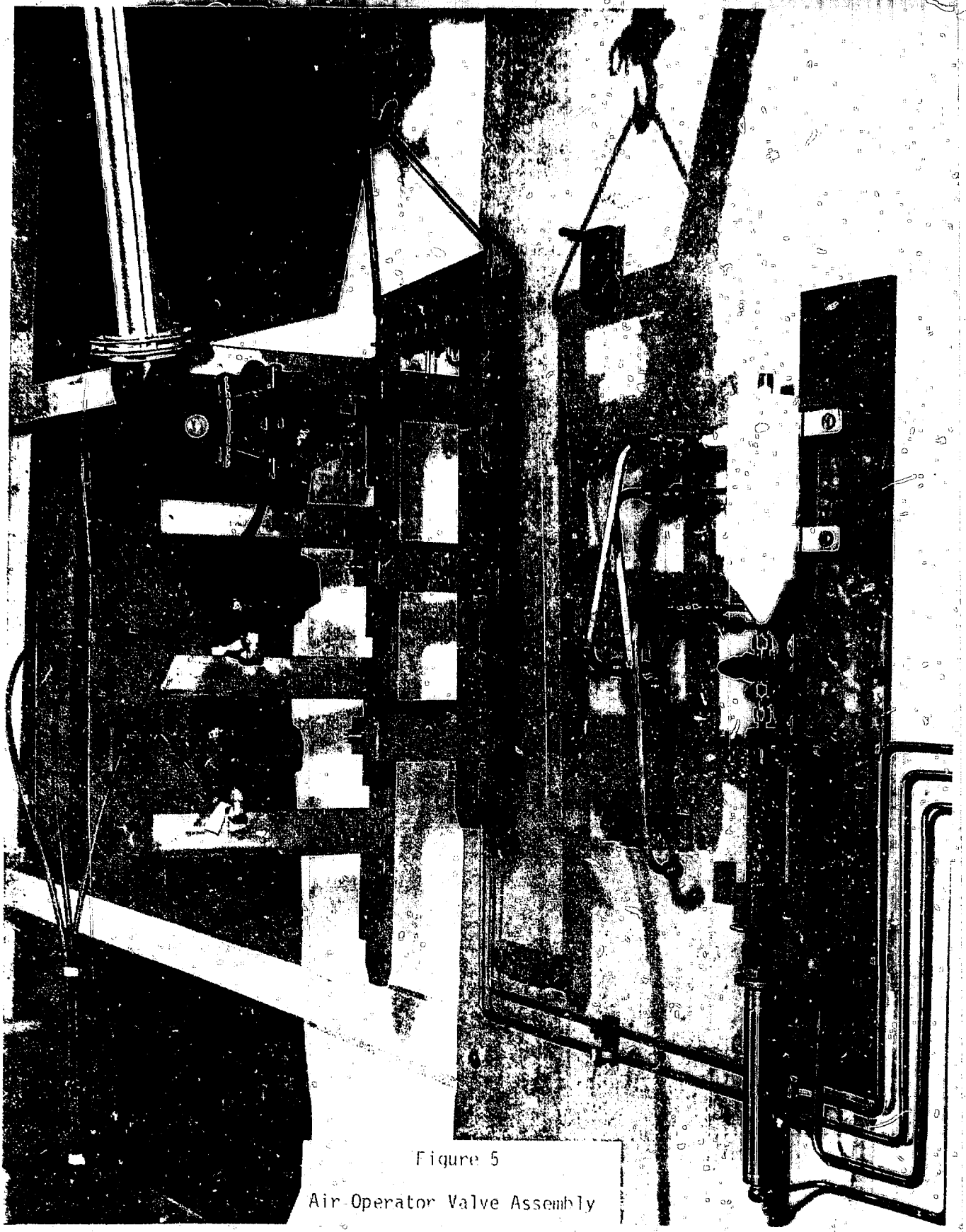


Figure 5

Air Operator Valve Assembly

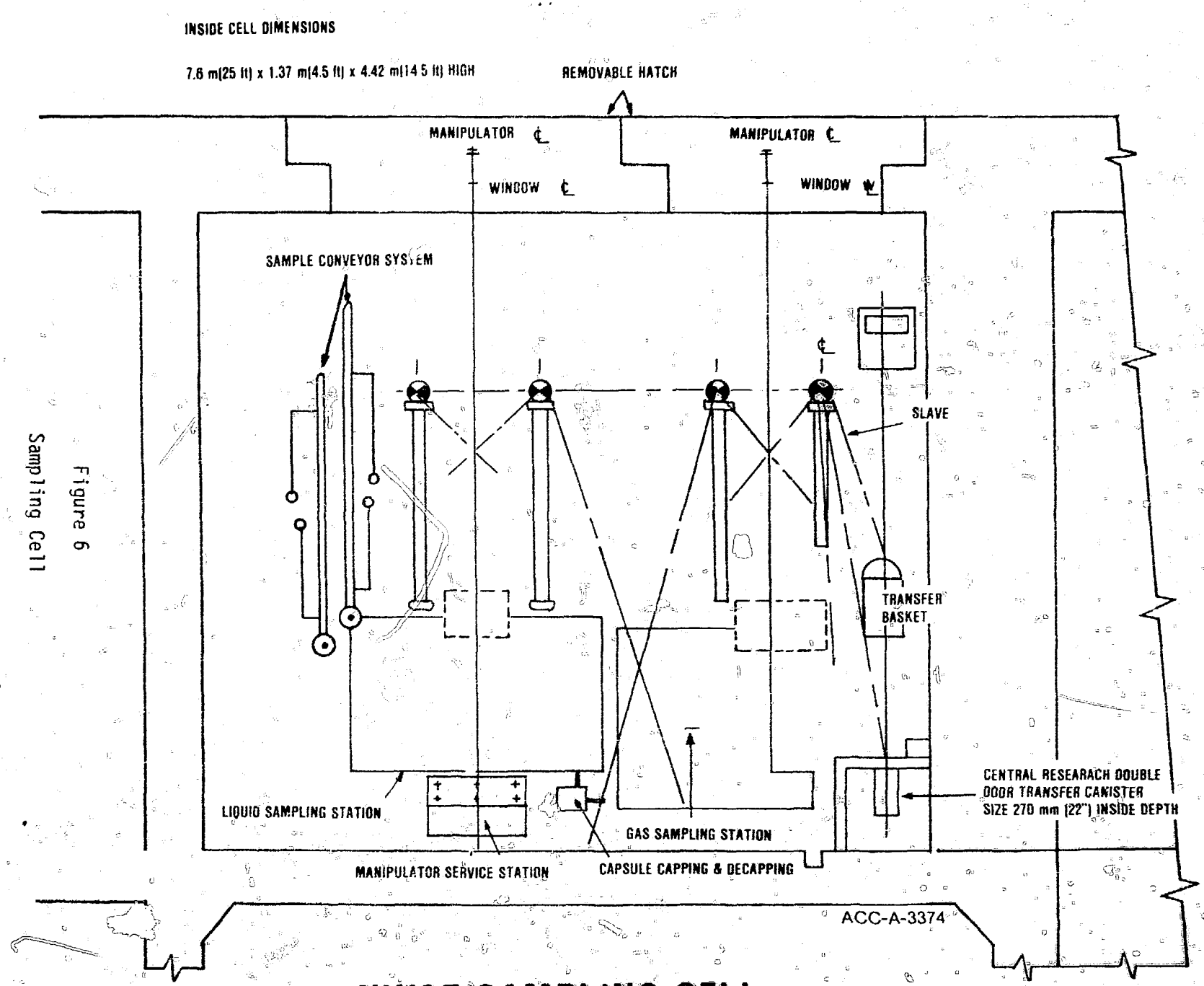


Figure 6
Sampling Cell

NWCF SAMPLING CELL

items can be replaced remotely. The remote removal and replacement of sampling system components inside the shielded, sealed area will reduce radiation exposure to personnel and will prevent spreading contamination into the operating area. Samples and small items can be removed from the sampling cell via the pass-through transfer system.

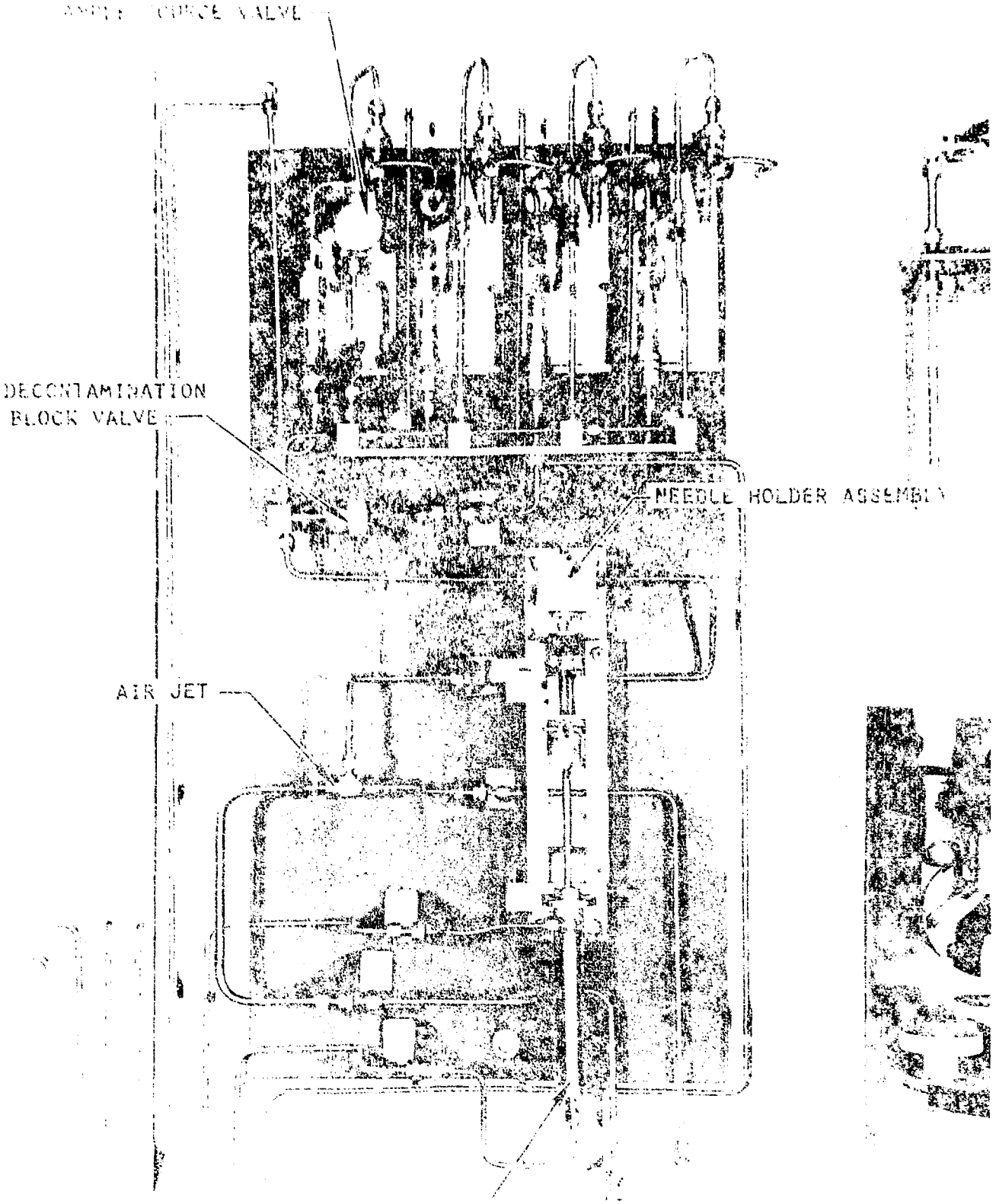
To obtain a liquid sample, a standard 15 ml sample bottle is placed in the sample bottle holder and the appropriate isolation valve opened remotely using a master-slave manipulator. Jets, valves and air lifts are then used to obtain samples from any one of the several liquid sample points.

LIQUID SAMPLING SYSTEM MOCKUP

The liquid sampling station (Figure 7) has been mocked up and tested. The mockup was fabricated from design drawings of the NWCF liquid sampling system. The liquid sample station mockup contained three liquid sample sources plus piping for complete internal decontamination of the sample station. The liquid sampling system was designed for remote removal of five components. These five components are representative of all the sample stations and are the high maintenance items in the system.

All of the remote testing and checkout of this mockup was accomplished with the use of Central Research heavy duty Model "F" manipulators and an open end wrench. The mockup was located on the exact vertical and horizontal dimensions of the sampling system in the NWCF. The manipulator was located so that the tests represented the most difficult to reach NWCF samplers.

The following components were removed and installed remotely and a time check taken for removal and installation times. Photos of each


DECONTAMINATION
BLOCK VALVE
AIR JET

the stainless steel air supply lines to the air cylinder. The total time to remove and install the air cylinder was about nine min.

NWCF OFF-GAS SAMPLING SYSTEM (GENERAL)

Off-gas samples will be taken at several locations in the NWCF process off-gas piping to determine the operating characteristics and efficiency of each process off-gas cleanup equipment item.

The gas sampling system is located in the NWCF sampling cell. This system was designed so that gas samples can be remotely taken from fifteen different sources at nine sample stations. Some gas samples have been manifolded together to decrease the number of sample stations. To obtain a sample from any of the sources the purge air is shut off, the blind flange removed from the sample station and then one of two sampling loops installed. If the sample is from a manifold source the appropriate ball valve is opened. Gases are passed through the sample loop long enough to collect a representative sample from the selected source. The time required to accumulate an appropriate sample may vary from fifteen min to more than four hrs depending on which source is being sampled. After the sample has accumulated, the sample loop is removed and placed into the DDSTS canister and transferred to the Remote Analytical Facility.

OFF-GAS SAMPLING SYSTEM MOCKUP

The off-gas sampling station (Figure 8) has been mocked up and tested. Remote checkout and testing of this gas sampling station was to demonstrate the ability to remove and install any of the components that might require replacement during operation of the NWCF. Removal and installation of the sample loop was a very simple operation and required about one min to complete. The operation was accomplished using a

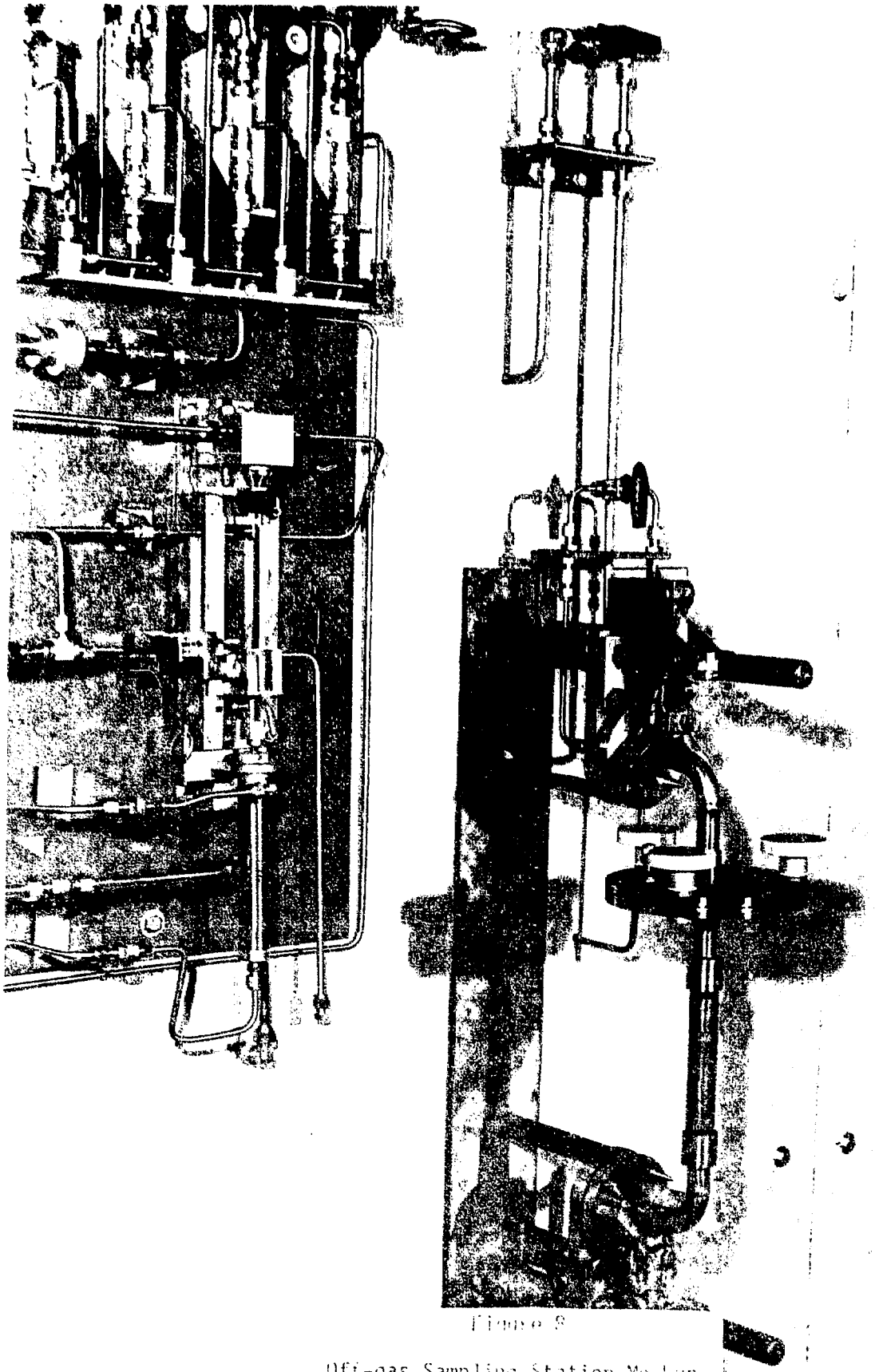


Figure 8

Off-gas Sampling Station Mock Up

master-slave manipulator to release the flange clamps. The loop is held to the sample station by two indexing guide pins and simply lifted off the guide pins and then transferred to the Remote Analytical Facility through the DDSTS. The sample loop weighs approximately 10 kg (22 lb) and can be easily handled with Central Research Model "E" heavy duty manipulators.

The sample source selection valve was removed and replaced in about ten min using a manipulator and an open end wrench. The purge line valve was removed and replaced in about ten min using the same equipment and techniques used for the sample source valve.

NWCF PASS-THROUGH TRANSFER SYSTEM (GENERAL)

The NWCF pass-through transfer system is located in the sampling cell, and was designed so that samples, equipment and small radioactive or contaminated items could be removed from the cell through a Central Research DDSTS (Figure 9). The DDSTS is designed so that a canister can be installed from outside the cell on the bottom side of a flange that is located in the sampling cell using an electric powered hydraulic cart (Figure 10). This cart is driven into a cubicle located at one end of the sampling cell where the canister is lifted and rotated 60^{0} onto the underside of the sealed cell flange. During rotation, the canister locks and seals to the cell flange. The canister cover is also locked and sealed to the cell mounted door. The canister door is opened for access into the canister. Items are removed from the cell by placing them into the canister and reversing the above procedure. This design permits introducing and removing small items from the sampling cell with little possibility of spreading contamination or exposing personnel.

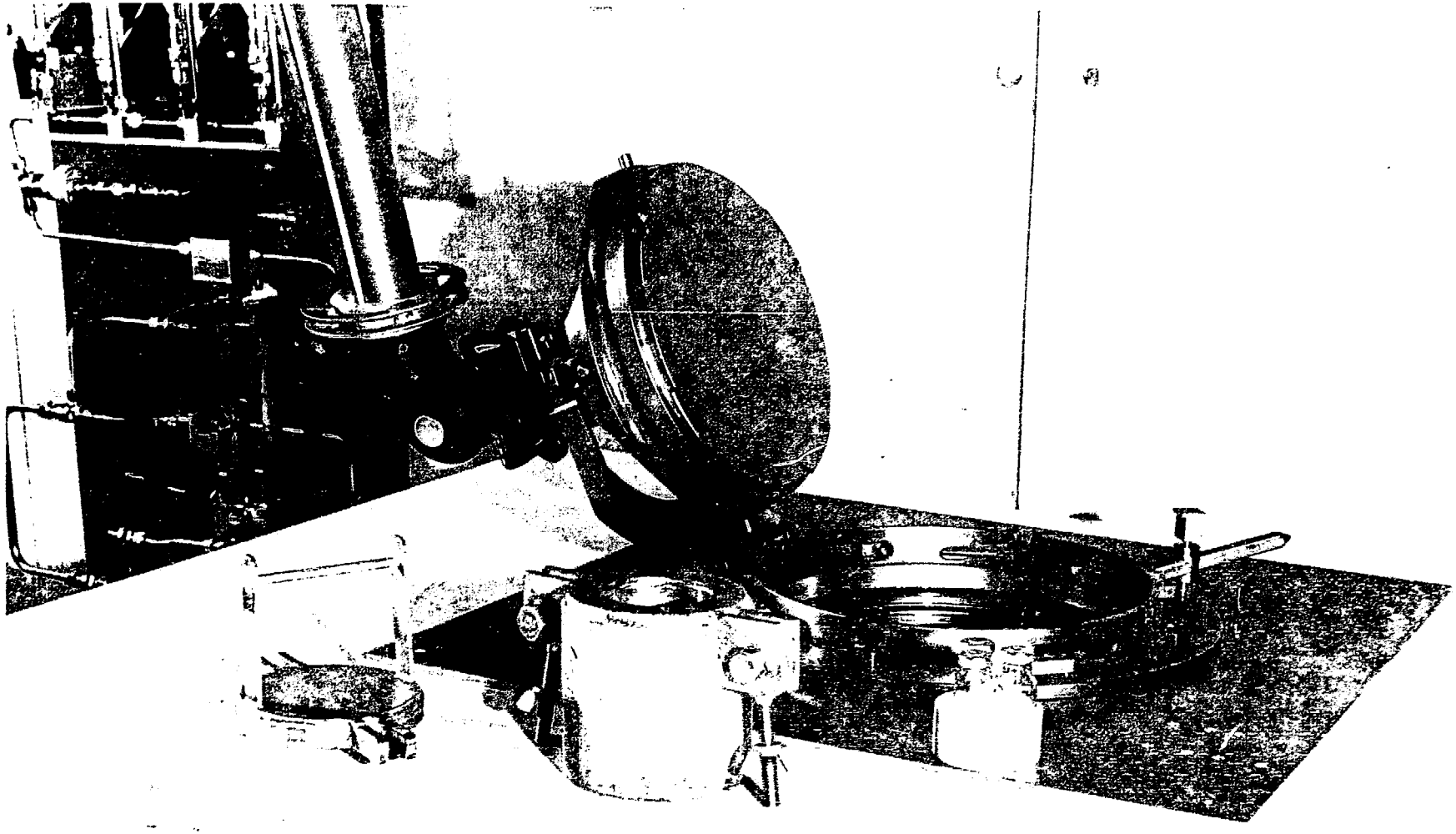


Figure 9

DDSTS (Pass-through Transfer System)

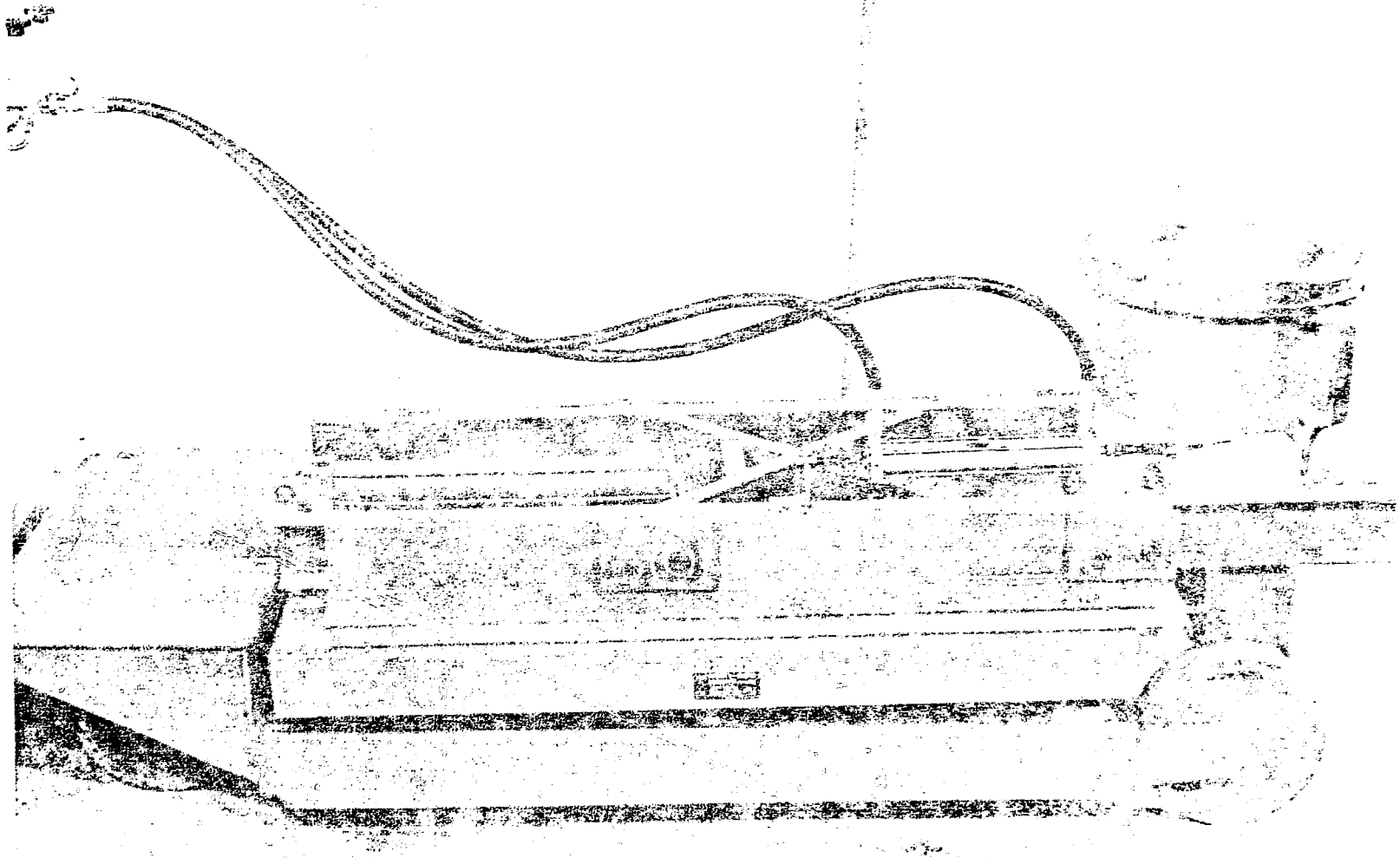


Figure 10

Sample Canister Installation Cart

PASS-THROUGH TRANSFER SYSTEM MOCKUP

The pass-through transfer system has been mocked up. The mockup was located in the mockup area and checked for remote operability. The BPSTS can be unlocked and opened quite readily with a master-slave manipulator. Tests simulating loading and unloading solid, liquid and gas samples have been accomplished. None of the above operations created any problems and were readily demonstrated.

CONCLUSIONS

Improvements to sampling systems used in the existing calcining facility will be used in the NWCF. These improvements include complete remote sampling versus semi-remote sampling, remote maintenance of sampler components versus direct maintenance of sampler components, and in-cell containment of radioactive contamination versus open-door transfer. By incorporating these features in the NWCF design, radiation exposure to personnel and contamination spread have been greatly reduced or eliminated.

Full-scale tests [illegible] of all of these samplers [illegible] shown them to be both workable and [illegible] improvement.

FIGURES