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THE WASTE MANAGEMENT IMPLICATIONS OF THE DECOMMISSIONING AND AND REFURBISHING OF ACTIVE FACILITIES

Part 1 Decommissioning a Radiochemistry Facility

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Part 2 Preparation for Refurbishment of a Cave line at Berkeley Nuclear Laboratories

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Part 3 Decontamination and Refurbishment of Hot Cells at Winfrith

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PART 2

PREPARATION FOR REFURBISHMENT OF A CAVE LINE AT BERKELEY NUCLEAR LABORATORIES

- by -

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1. BACKGROUND

The cave lines currently being stripped for refurbishment have been in use since 1968 for the examination of Magnox fuel elements from first generation nuclear reactors and components from advanced gas cooled reactors of the Central Electricity Generating Board (ref 1). Material entered the caves via roof posting ports or was carried from the pond on an elevator which served both caves 4 to 6 and caves 1 to 3. The caves are basically similar in structure comprising 9 working stations in 6 caves which can be isolated by sliding partition doors (fig. 1). The exception is cave 4 which is approximately 1.5m deeper than the others and has, at the rear, a sliding partition door.

The work on Magnox fuel elements involved stripping away structural components and sectioning uranium bars to provide metallographic specimens. During the period of operation approximately 15,000 fuel elements were examined and approximately 1500 of these were sectioned to provide metallographic samples. In addition to its duties as a receipt and despatch facility cave 4 was used for the preparation for disposal of waste arising from all the shielded facilities at Berkeley Laboratories.

In order to minimise outage time it was decided that the refurbishing would be carried out by contractors. However, the initial cave clearance would be the responsibility of the operators. During this stage all work would be carried out remotely.

2. WASTE CATEGORISATION

Waste is graded by activity and type as shown in table 1.

The first stage was to remove all fissile material and return it for reprocessing. Particular attention was paid to accountancy procedures to ensure that all samples listed on the inventory were identified and that all in-cave stores were properly emptied. Availability of a computerised record system helped considerably at this stage.

It is known that uranium stored in damp, inert conditions can form uranium hydride. In the past ignition of hydride has occurred when opening storage containers and there was concern that further incidents would occur given the number of containers to be opened and the storage time. This did, in fact, happen and although the ignition was immediately extinguished it was decided to open the remaining containers in a purpose built reaction vessel. This allowed the controlled conversion of hydride to oxide and hence prevented ignition. Progress of the reaction, if any, was followed by hydrogen monitoring, and the outlet gases from the vessel were filtered to prevent contamination of the cave extract filters. After recovery the uranium samples were sealed by welding into stainless steel cans prior to being sent for reprocessing.

While the reprocessable scrap was being cleared an inventory of all items within the caves was taken. For items standing on the bench this was straightforward but to survey below the bench it was necessary to use a TV camera. This was held, generally, by the power manipulator but in some locations a special remote controlled tank was used to carry the camera and a lighting unit (fig. 2).

These surveys confirmed the type and location of the bench supports and also revealed that a considerable amount of material had fallen from the back of the cave 4 bench. It also showed that there was a substantial quantity of hydraulic oil on the floor which had leaked from equipment hoses.

Recovery of discrete items from the floor was achieved by removal of a section of the bench shuttering to allow access, followed by the use of specially designed tools suspended from the crane or power manipulator. A long reach pneumatically operated grab and a remotely operable electro magnet have been particularly useful in this respect. Following removal of all discrete objects the use of a special vacuum cleaner to collect the hydraulic oil from the floor will be investigated.

Equipment is dismantled and packed into drums according to its activity. Almost all items generated by dismantling or sectioning are further reduced in volume by compaction in a baling press. The compacts are then sealed into drums 0.3 metres diameter by 0.3m high which are lifted in pairs through the roof into a shielded flask which then takes them to silo storage. Combustible and non-combustible waste is segregated prior to compaction.

Larger pieces of equipment, such as machine bases, were decontaminated with fluoro carbon liquid inside the cave before removal to the maintenance bay for further decontamination. In this way it was possible to reduce the surface contamination of these items to a level that allowed land burial in a low active waste dump. A purpose built fluoro carbon dispenser is used that can operate either through a cave service plug or a similar plug in the maintenance facility (fig. 3).

Residual highly active waste e.g. swarf arising from fuel element sectioning was immobilised by setting in concrete. It was then loaded into a mild steel liner which was sent by shielded flask to the high active storage silo at Windscale.

Every effort was made to reduce liquid arisings. Where these were inevitable e.g. cleaning fluid they were dispersed by evaporation. If this was not possible e.g. hydraulic oil, the liquid was removed by absorbtion onto a proprietory porous material which was liquid retaining. This material was then sealed into drums for low active silo disposal.

3. TECHNIQUES

The first and most obvious requirement was for adequate viewing, lighting and services. The first two items were straightforward since the cave illumination system was available and additional viewing was readily arranged by using standard TV cameras. Services present more difficulty since many of the service lines originally provided had deteriorated and were unusable. Further they were often attached to in-cave structures which had to be removed. To overcome this problem new service lines were introduced by means of specially designed shielded plugs fitted into existing penetrations in the front wall. This allowed all the old service units to be isolated and disconnected at the start of cave clearance.

A substantial amount of equipment was dismantled using conventional tools specially adapted for remote use e.g. spanners, allen keys etc. Where this was not possible size reduction was achieved by cutting with a commercially available cutting machine which incorporated a high speed abrasive disc. The main problem with this technique was extensive sparking of swarf and to contain the sparks special guards were fitted. Arrangements were also made to allow remote changing of the cutting discs. The machine was always used on a flat metallic bench from which all items had been cleared and no combustible materials were allowed in the cave during cutting. This technique proved quick and efficient.

For sheet up to approximately 3mm thick electrically operated cutting blades (shears) were adapted for remote use and proved very effective, provided that the size of cut taken was not too large. For box sections it was often necessary to make several drill penetrations initially to provide access for the cutting jaws.

4. PROBLEMS ENCOUNTERED

Although most of the cave equipment had been designed to be free standing on the bench dismantling of the larger items has not proved easy. It is now clear that given more careful thought at the design stage it would have been possible to build the rigs so that they could be broken down into more readily disposable units.

There are also several substantial items of equipment (a baling press, the X-ray machine bed and several wall mounted hoists) which can only be removed by entering the caves. With current operating experience it is now possible to design all this equipment to allow remote removal.

Over the years problems have arisen with hydraulic oil leaking from service pipes which run under the benching. Because of the inherent simplicity of hydraulically driven equipment there is considerable incentive to continue to use this system in the refurbished cave line. However, it will be essential to ensure that sealing mechanisms operate when leakage occurs and to eliminate pipe runs beneath the benching.

The zinc bromide filled window servicing cave 5b had been leaking at a slow rate for about 6 months when the containment glass on the active side of the tank cracked near its base. A prolonged delay to the programme to allow replacement of this glass was unacceptable since refurbishing of the window was already planned to follow cave clearance. It was finally decided to drain and clean the window and then to seal the crack with adhesive plastic tape. The window was then filled with demineralised water and a special operating regime instituted to ensure that no radiation sources were placed in this cave. With this provision cave face working doses were kept within normal working limits and extensive interference with the clearance programme avoided.

One objective of the refurbishment is to eliminate the requirement for a power manipulator since a breakdown of this unit disrupts the complete cave line. Power manipulator breakdown has occurred during the clearance period and it has been necessary to withdraw this unit for repair on several occasions. The effect has been to delay the programme and to increase the radiation dose of the repair team. This experience has further supported the decision to use retractable, purpose built, hoists in the refurbished cave line.

Other difficulties that have slowed the clearance have been the need to ensure that all uranium samples were free of hydride before disposal (as described above) and the discovery of a substantial quantity of uranium fines in the cutting oil sump of the fuel element sectioning machine. Over the years finely divided material had passed through the filter system and settled out in the sump. It was necessary therefore to develop a technique to separate the uranium fines from the residual cooling oil and render them inert before disposal.

5. DISCUSSION

Although the sequence of operations in the cave clearance was straightforward it required careful planning to ensure that a proper inventory of equipment was drawn up, that targets were identified and that the work proceeded at an even pace. Even so, the occurrence of the unforeseen incidents described caused considerable delays. The ability to deal efficiently with such incidents has a major effect on the time required for cave clearance.

The cave clearance was carried out by a 5 man operating team with additional service assistance provided as required. The operating team devised and prepared many of the tools that the work demanded. At this level of effort work has continued for about a year and all major items of equipment have been removed. During this period it has been necessary to ensure that cave 4 is available for the preparation of waste taken from all the other caves and cells in the facility for disposal. About 200 drums of active waste have been sent for disposal since clearance began and in this period all the original items of equipment (approximately 150 units) have been scrapped.

Currently decontamination of the benchwork prior to stripping and disposal is in progress. The intention is to reduce the residual dose rate in the cave line to ≤1mSv/hr (100 mR/hr) in order to maximise the time available for man entries.

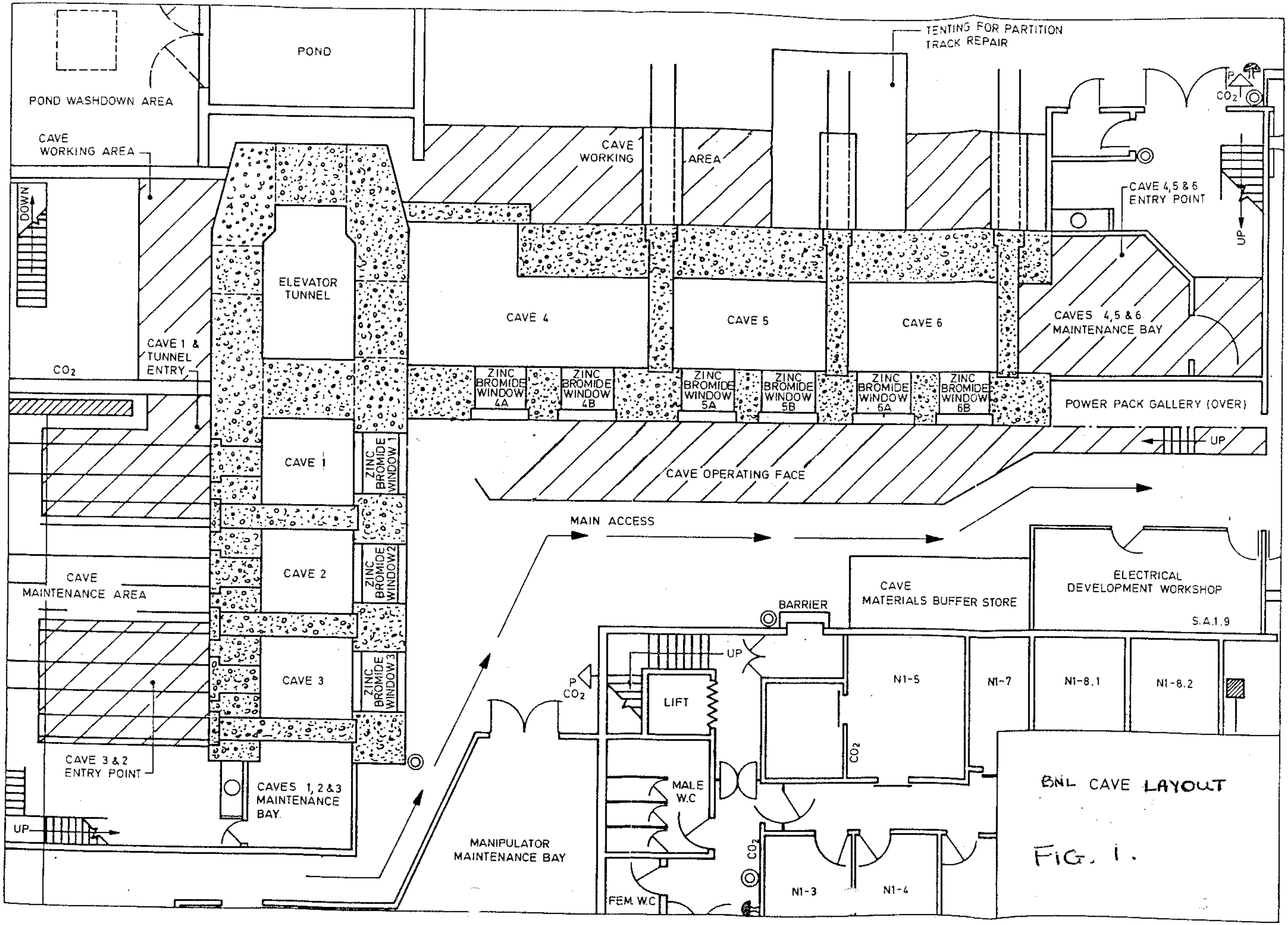
6. REFERENCE

The development of the Remote Handling Facilities at Berkeley Nuclear Laboratories - Hines, G. F., Haddrell, V. J., Stagg, M. S., 1972.

Proceedings of the 20th Conference on Remote Systems Technology, USA, 1972.

TABLE 1 - DISPOSAL CATEGORIES FOR RADIOACTIVE WASTE

WASTE CATEGORY			DEFINITION	DISPOSAL ROUTE
LOW ACTIVITY	Combustible		Less than 0.15 mSv/hr (15 mR/hr) at container surface. All materials combustible.	Packed into paper sacks for incineration
LOW ACTIVITY	Non-Combustible		Less than 1 mSv/hr (100 mR/hr) at container surface maximum fissile content 1 gm as contamination	Packed into 200 litre drums after sealing into polythene bags and sent for land burial
LOW ACTIVITY	Liquid	Aqueous	As non combustible	Treated in the effluent disposal plant
LOW ACTIVITY	Liquid	Non-Aqueous	As combustible	Solidified prior to disposal and then treated as combustible
HIGH ACTIVITY	Combustible		$\leqq$ 20 mSv/hr (2 R/hr) at container surface. Contains inseparable free burning material	Packed into 178mm diameter cans which are then sealed into 3300mm diameter drums for disposal in a high active silo
HIGH ACTIVITY	Combustible		$\geqq$ 20 mSv/hr (2 R/hr) at container surface	Packed into a 254mm diameter container for disposal in a high active silo
HIGH ACTIVITY	Non Combustible		$\leqq$ 20 mSv/hr (2 R/hr) at container surface Negligible free burning material and fissile contamination 1 gm	As for equivalent activity combustible waste
HIGH ACTIVITY	Non Combustible		$\geqq$ 20 mSv/hr (2 R/hr) at container surface	As for equivalent activity combustible waste
HIGH ACTIVITY	Liquid	Aqueous	All levels >0.15 mSv/hr	Solidify and treat as non combustible waste in appropriate activity level
HIGH ACTIVITY	Liquid	Non-Aqueous	As above	Solidify and treat as combustible waste in appropriate activity level



BNL CAVE LAYOUT

FIG. 1.

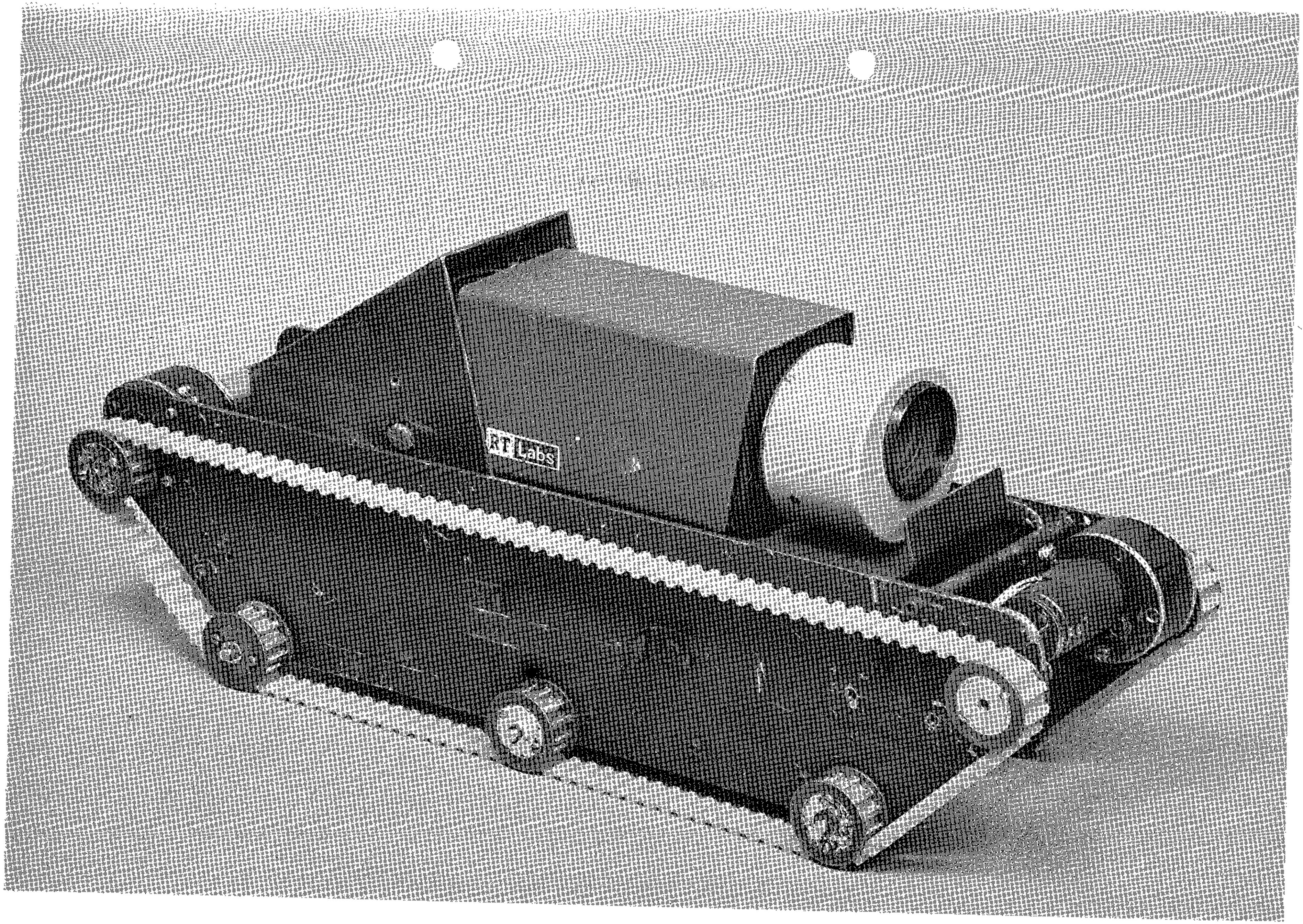


FIG. 2 REMOTE CONTROLLED TANK FOR IN CAVE INSPECTION

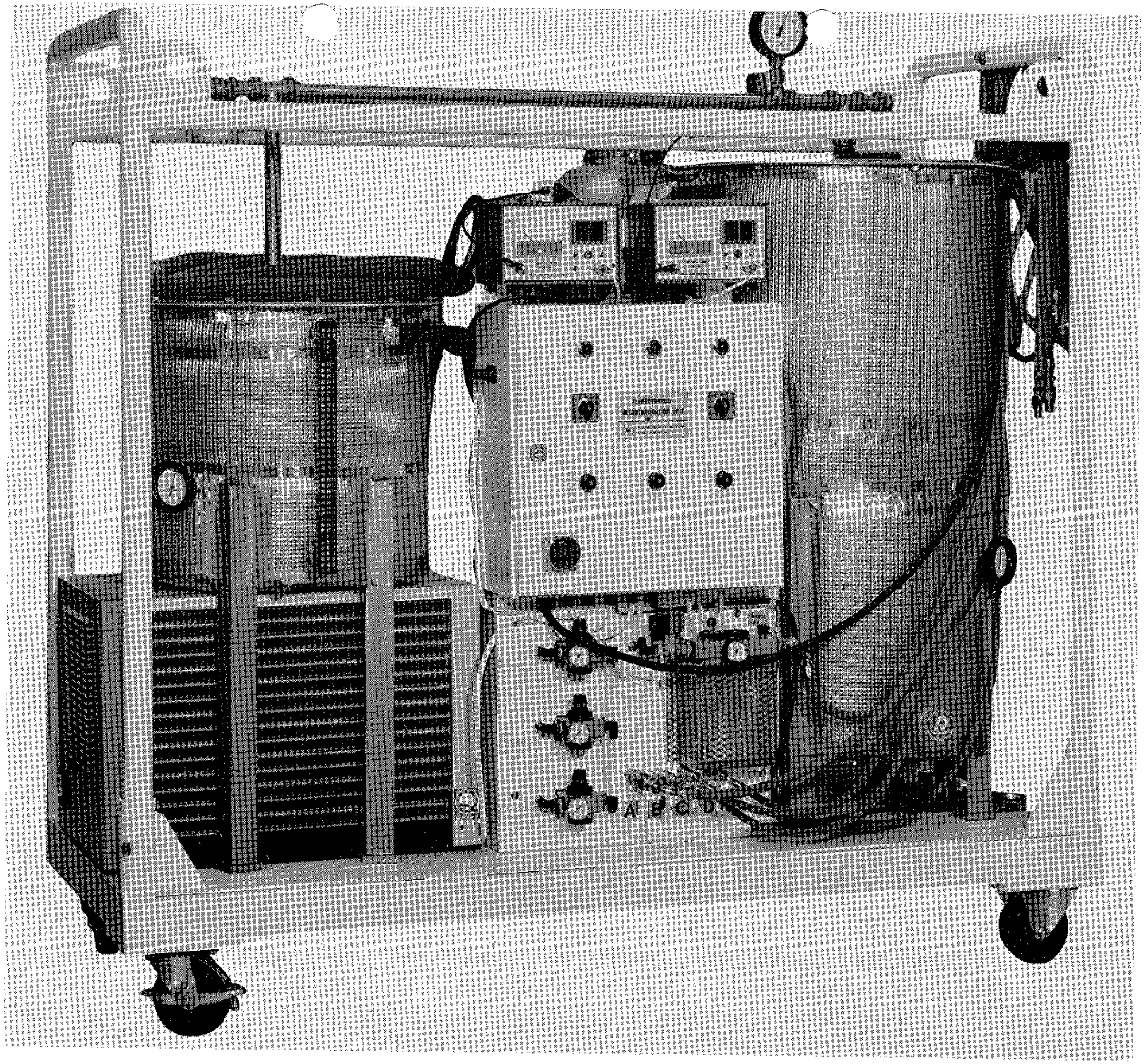


FIG. 3 FREON DECONTAMINATION EQUIPMENT