HOT LABORATORIES COMMITTEE MEETING '79

Irradiation and contamination sources due to radon-emanations

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TEC/39.3619/09/ACD/AD/fq
June 1979

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ABSTRACT

When chemical treatment of dissolved radium, actinium and thorium salts takes place, the waste (solid and liquid) formed in the alpha-tight hot cells presents a permanent risk of contamination spread-out due to the gaseous radon isotopes and their daughter products.

By using completely tight PVC-tents this contamination is highly eliminated or at least circumscribed.

The experience acquired by such actions has allowed to solve the much easier contamination problems due to gaseous or volatile β-γ emitting isotopes such as Kr, Xe, T_2 and I_2.

Finally the prevention of contamination due to interventions upon installatior bearing plutonium sources, creating fines of plutonium oxide or dust, are mainly avoided using such tight and ventilated PVC-tents.

1. INTRODUCTION

In the course of several years, during the chemical treatment of reactor irradiated Ra-Ac-Th salts in α-tight hot cells, and later during the dismantlir of this installations and the treatment and conditioning of the waste, there was a permanent danger for contamination and irradiation, essentially caused by the presence of the particle α-emitting gaseous isotopes and their daughter products.

The following table gives the essential elements of the three decay chains .

TABLE I

Nuclear properties of ^{226}Ra, ^{227}Ac and ^{228}Th

Mother product	Half life	Daughter products				Stable fin isotope
		Gas isotope	Half-life	Isotopes	Half-life	
^{226}Ra	1620 years	^{222}Rn	2.8 d	^{210}Pb	22 years	^{206}Pb
^{227}Ac	22 years	^{219}Rn	4 s	^{211}Pb	36 min	^{207}Pb
^{228}Th	1.9 years	^{220}Rn	56 s	^{212}Pb	10.6 h	^{208}Pb

As the reduction of radioactive contamination is more difficult in cases where radioactive gases isotopes are involved, the first intervention tents used for decontamination purposes, did not meet the expectations. These tents were constructed using a framework of steel tubing, the P.V.C. foils were put in strips over the frame and interconnected by tape ; this way a more or less tight tent-system was created.

The construction of real air-tight tents was found however an absolute necessit due to the fact that the intervention periods upon contaminated infrastructures became the more and more longer and complicated.

The construction of the first "tight" tent has been difficult but the purchase of good weldable P.V.C. and other adequate material made it possible that presently real tight tents in all forms and dimensions can be constructed in the laboratory.
Also for interventions at hot cells in which highly irradiated uranium-plutonium oxide mixtures have been treated and in cells were β-γ isotopic production has taken place, this technical experience has been used with very good results.

2. CONSTRUCTION

The concept of the new type of tents was directed to the completely tightness of them : the roof, the walls and the bottom are now welded together. The closing of the entrances is realized now by a zip closing of equivalent system in P.V.C.
Welding of P.V.C. foil occurs by means of a high-frequency welding machine on both sides of which long tables are constructed (Fig. 1) where the P.V.C. foils can be put. Also the inwelding of hang rings and zip closings is performed by high-frequency welding.
The tent is constructed according to the scheme drafted in accordance with the actual need at the cell to be decontaminated ; also the steel framework can be independently constructed and the plastic foil tent is hanging in between the frame. Fig. 2 shows a detail of the connection elements of the steel framework and the suspension system of the tent ; the used P.V.C. foil has a thickness of 0.3 mm. For special applications for example tents in which a burner has to be used, non-burnable (self attenuation) P.V.C. is used.

3. CHARACTERISTICS AND PROPERTIES

3.1. Tightness

High-frequency welding produces a strong and tight connection between P.V.C. foil pieces from which the tent is constructed. The zip closing is such that it can be welded at the P.V.C. foil so that the connection between foil and zip closing is as tight as other weldings.

3.2. Fast mounting

The P.V.C. tent as well as the framework can be constructed by forehand and independently. The suspension of the tent in the framework can be made very fast which sometimes is essential when high radiation fields are encountered. The major time consumed is due to the adaptation of the tent to the interventic zone, for example the α-box. To this end, a special "tunnel" has to be connected to the α-box in a gas-tight way and which can only be made at the site. The construction time for such a "tunnel" can be quite different from case to case.

3.3. Fast dismantling and discarding

When the tent has been used, it can be discarded as slightly radioactive burnable waste. Dismantling consists of cutting the suspension rings of the tent while the tent remains under depression by ventilation. This tent is then easily enroled to a small pact, in this way preventing the escape of possible contaminated dust during the discarding operation. Fig. 3 gives depicts the discarding of such a tent.

3.4. Form and dimensions

Each tent is made "at measure". Also the "subdivision" and the side where the entrance and windows had to be mounted, and different, and depend on the work to be performed and on the usable room at the site. In each tent there are at least two rooms, a working zone and a transition sas. This transition sas can be doubled if necessary ; sometimes a separate room for waste disposal has to be foreseen.

3.5. Diminution of the waste volume

As the framework in which the tent is suspended cannot be contaminated anymore, a serious reduction of the non-burnable waste volume is realized in comparison with earlier tent concepts. In such a way there is an indirect gain in cost as the spreading of possible contamination has been essentially reduced.

3.6. Variable volume and dimensions

When a temporary non-use of such a tent is necessary or when rapid volume reductions have to be made, such a tent may be reduced in volume without disrupting the integrity of the tightness itself. The P.V.C. material permits the reduction of the dimensions of the tent by folding the tent such as allowing reduction ; the tent itself remains in connection with the ventilation and can thus for a certain time be remained in such a situation.

3.7. Cost

The estimation of the price of such tents can be made easily by taking the amount of material needed and the number of working hours for constructing such tents. It is however clear that time can be gained as well at the moment of construction as at the moment of discarding the tent and that there is much less hindrance for other activities in the work hall which then yields indirect gain.

Besides the former characteristics and properties commented, there are still more particularities which can best be illustrated by practical examples.

4. EXAMPLES OF PRACTICAL REALIZATIONS

4.1. Tents used during the different phases of dismantling of the infrastructure of the 1000 Ci-cell in which reactor irradiated radium had been treated.

4.1.1. Tent used as personnel entrance and exit at the intervention sas (Fig. 4 - tent No. 1

This tent has been renewed twice during the dismantling operations of the 1000 Ci-cell. Fig. 5 gives a view of the tent which is connected at one side with the intervention sas, and at the other side with the planned construction where the radiation control service had to be installed temporarily.

4.1.2. Tent used for the decontamination and discarding of an 11 ton weighing concrete door out of the hot cell to the outside of the laboratory
(Fig. 4 - tent No. 2)

4.1.3. Tent for reducing contaminated test in the work hall

In connection with the re-use of the hot cell,a new connection possibility has been foreseen for transport containers. With this in mind, a larger opening in the 80 cm concrete wall had to be made up to the dimensions of 120 cm x 80 cm. This required electric burners and compression hammers. For keeping the fine possibly contaminated dust in a determined volume, a tight and ventilated tent (Fig. 4 - tent No. 3) had to be used.

4.1.4. Intervention upon the filter room of the hot cell

An intervention upon the filter room on top of the roof of the hot cell for renewing the filters had to be performed regularly. As the constructed tent was hindering the use of the hoists in the work hall, the framework of this tent has been constructed in such a way that the intervention dimensions could be easily reduced if no direct use was necessary. The tent remained undamaged and could be re-used at the following intervention just by pushing up the framework which permitted to re-use the tent. (Fig. 4B - tent No. 4).

4.1.5. Dismantling of the nuclear infrastructure from the basement under the 1000 Ci-cell

In order to dismantle the infrastructure in the basement under the 1000 Ci-cell a gas-tight tent has been built over the basement trap for allowing discharge of a large quantity of radium-contaminated lead bricks. The roof of the tent could be opened in the two perpendicular directions with zip closings to allow the use a hoist through the roof by which the lead bricks were taken up from the basement (Fig. 4 - tent No. 5).

4.1.6. Treatment of contaminated Cendrillon container

The treatment of the contaminated Cendrillon container has been made possible by using a gas-tight tent which could be ventilated while a hook from the hoist could be introduced through the roof.
The tent was necessarily built near an α-zone where the entrance opening had always to be freely accessible. For this reason a double entrance sas has been made disconnectible. Fig. 6 gives a view on the tent with entrance sas.

4.2. Intervention tents for Pu-contaminated α-boxes built in hot cells

Maintenance and repair of the equipment in hot cells makes it necessary to enter the α-boxes when such operations are not possible with the devices, normally available. At the contaminated work cell two plexiglass windows had to be renewed in the α-box ; this cell was in operation since 1963 and was thus highly contaminated with irradiated oxide fuel.
Due to the positioning of the hot cell in a corner of the work hall it was impossible to use the steel intervention box generally used for such works. After preparation of the hot cell, the plexiglass windows could be renewed into two sequent interventions. Each time, after removing the lead wall, a tent has been connected to the α-box. By adapting the ventilation speed in the tent and the α-box at the moment the old window was taken away and before replacing it by the new one, any α-contamination could be avoided. Fig. 7 gives a situation scheme of the cell with the two tents ; Fig. 8 shows a view in the tent at the α-box.

4.3. Intervention test for a β-γ contaminated facility

4.3.1. The use of a tent for dismantling of the equipment inside α-box in the last hot cell which has been used for the ^{133}Xe and $^{(69)}$Mo production. Fig. 9 shows a scheme of this tent. Besides the entrance for the personnel and the work zone, a hole has been foreseen for discarding the waste.
In this hole a steel vessel could be placed which could be filled from the work zone and after the opening was closed, the tent could be opened by zip at the front side. Fig. 10 shows the tent with open waste-hole. In this compartment a steel vessel could be placed.

5. CONCLUSIONS

The afore- mentioned examples have made it clear that the use of gas-tight welded tents provides very interesting facilities for the different maintenance and intervention tasks in a hot laboratory.
The possibilities and advantages are even more clearly demonstrated in a situation like the hot laboratory at Mol where, near-by, isotopes of completely different nature are treated.
Even from the point of view of radiation control, the limitation of contaminati from different origins is very important.
The use of completely tight intervention tents is necessary due to the presence of α-emitting gaseous isotopes (radon) and has been extended to interventions at the hot cells where the post-irradiation examinations are carried out. Such techniques supply a great contribution in preventing the non spreading of troublesome contaminations.

LIST OF FIGURES

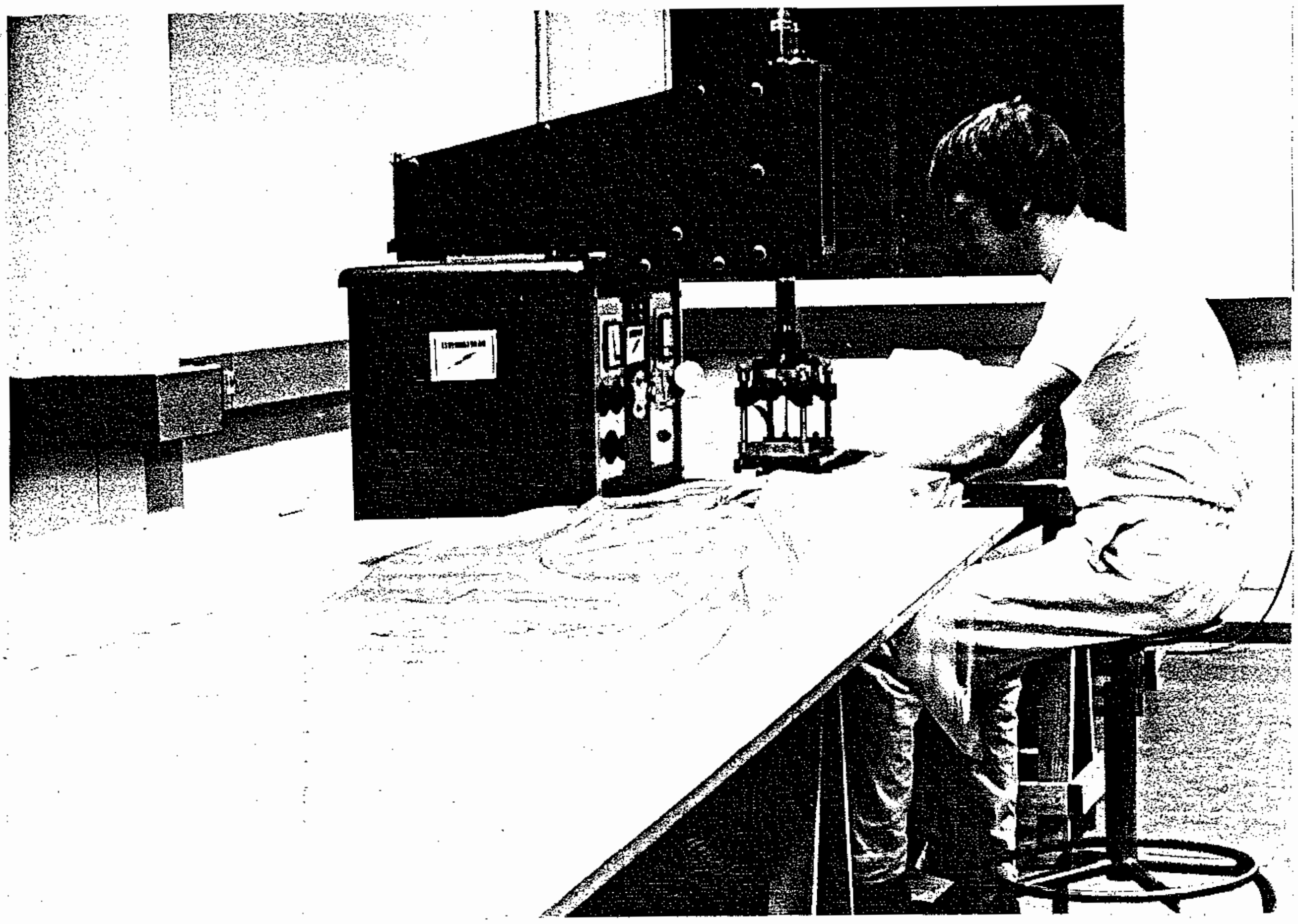

Fig. 1. Photo of the welding equipment and the working table.

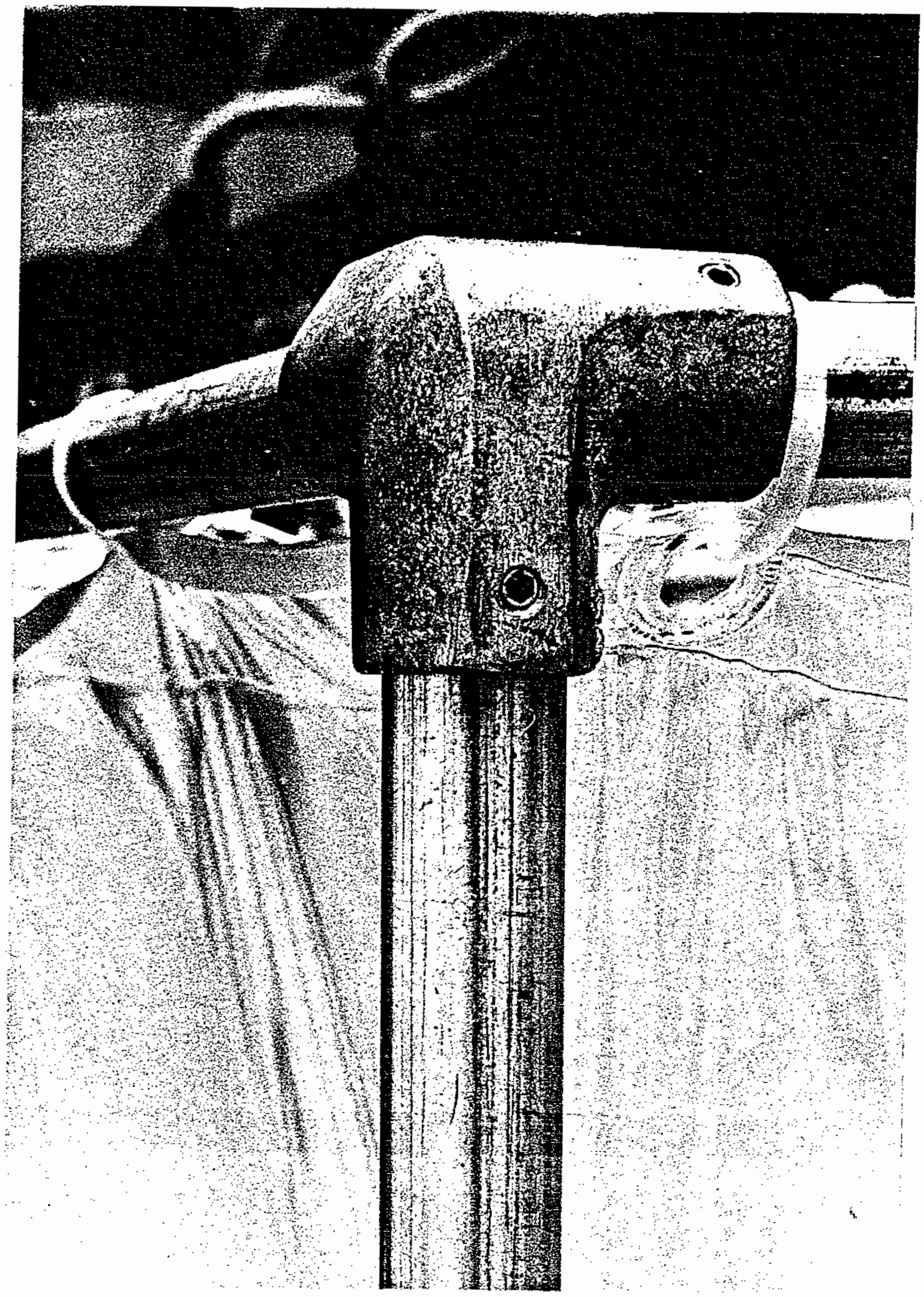

Fig. 2. Photo : Detail of the suspension of a tent and its connections.

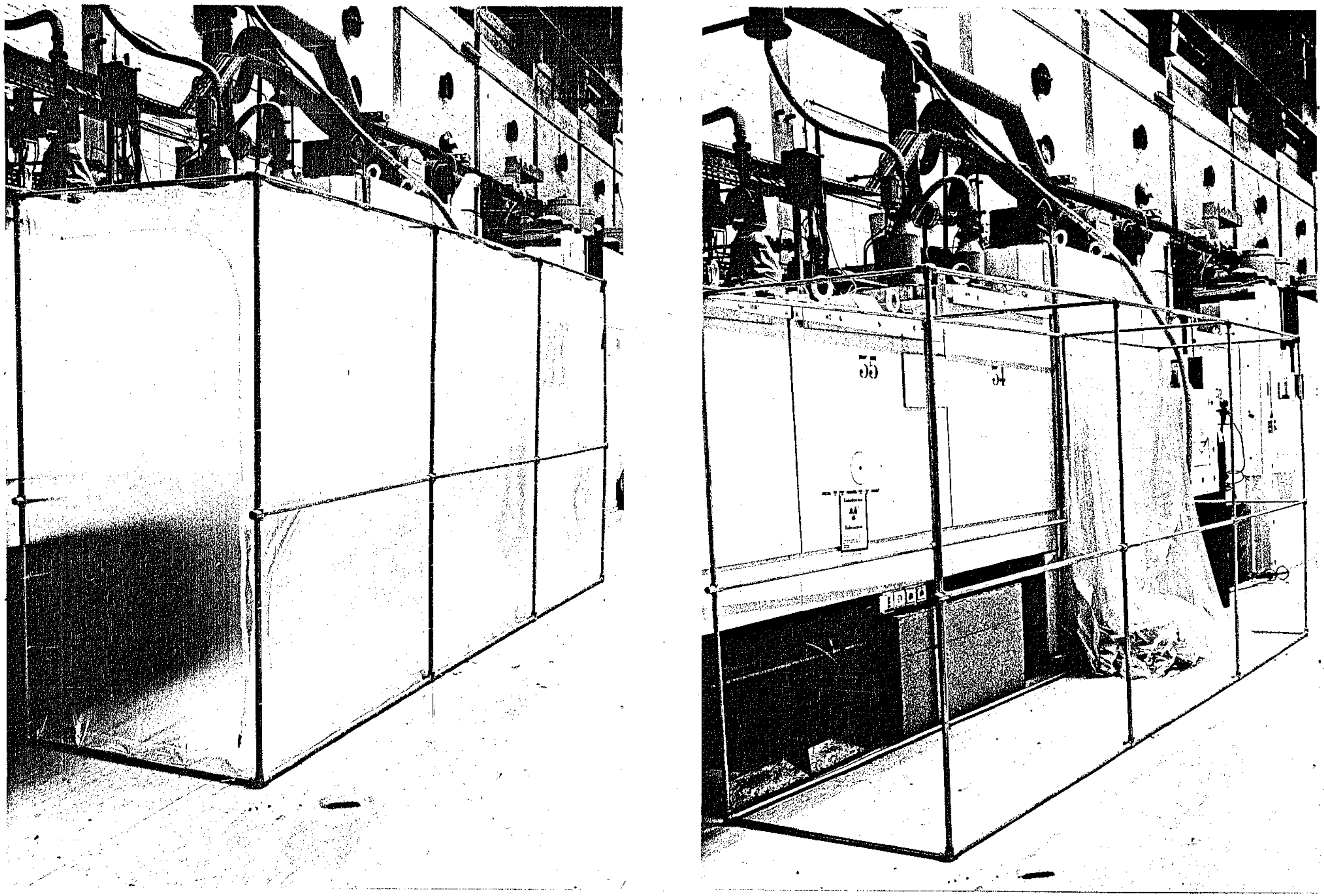

Fig. 3. Photo : Discarding of a tent while it is ventilated.

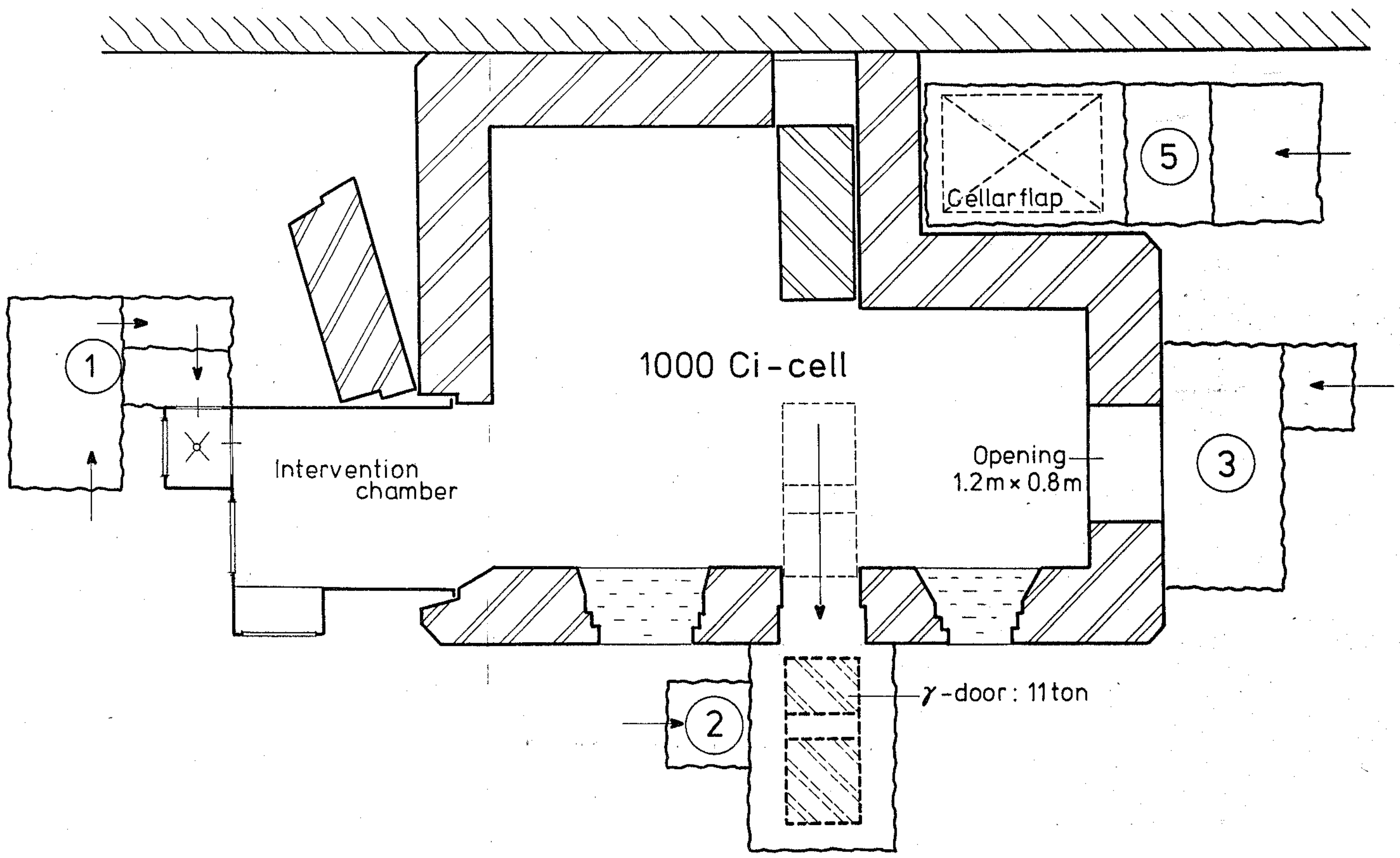

Fig. 4.A. Schematic view of the 1000 Ci-cell and the intervention tents.

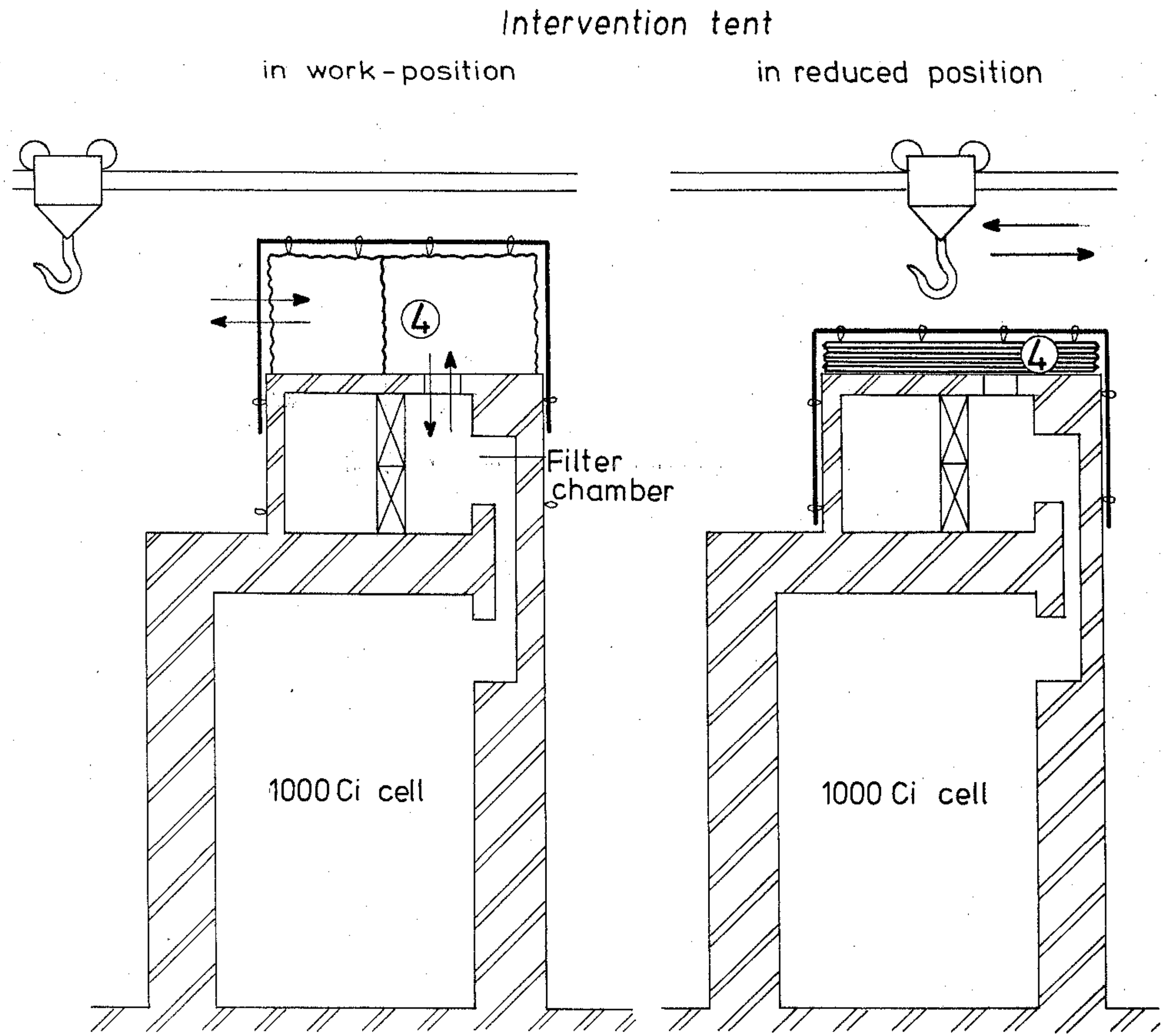

Fig. 4. B. Schematic view of the tent upon the filter room, two situations.

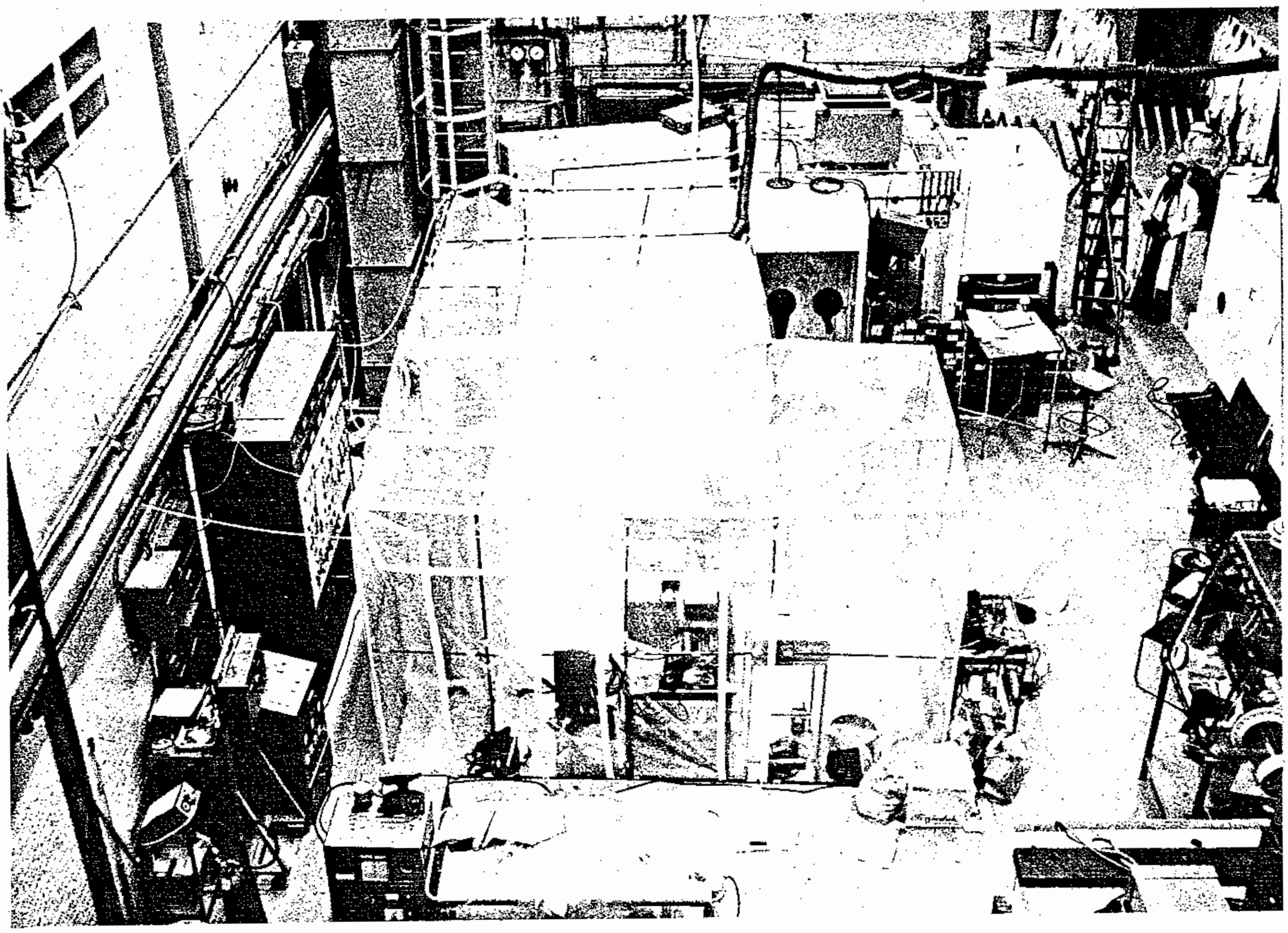

Fig. 5. Photo : Tent and intervention sas + 1000 Ci-cell in the Hall.

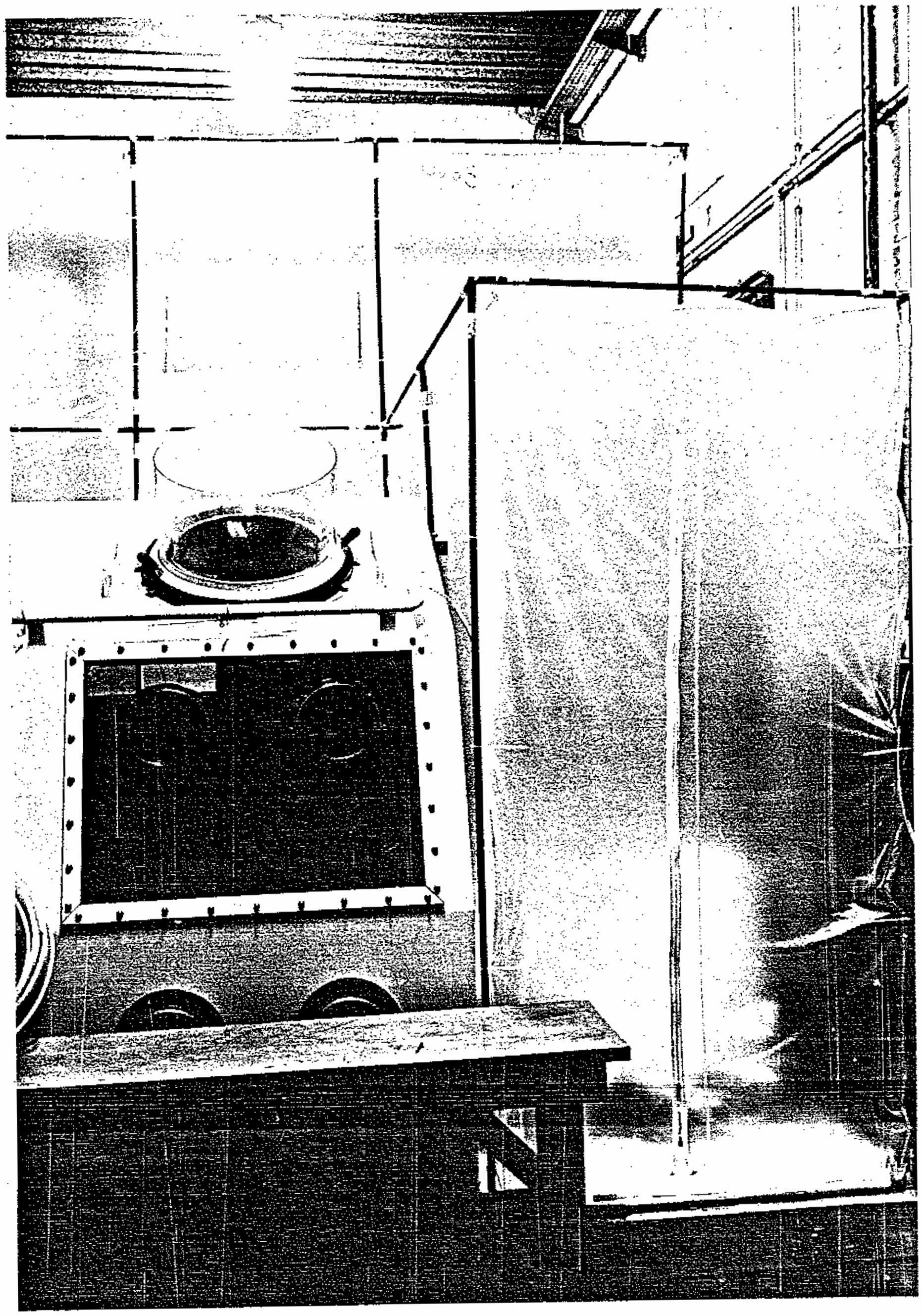

Fig. 6. Photo : Tent with sas.

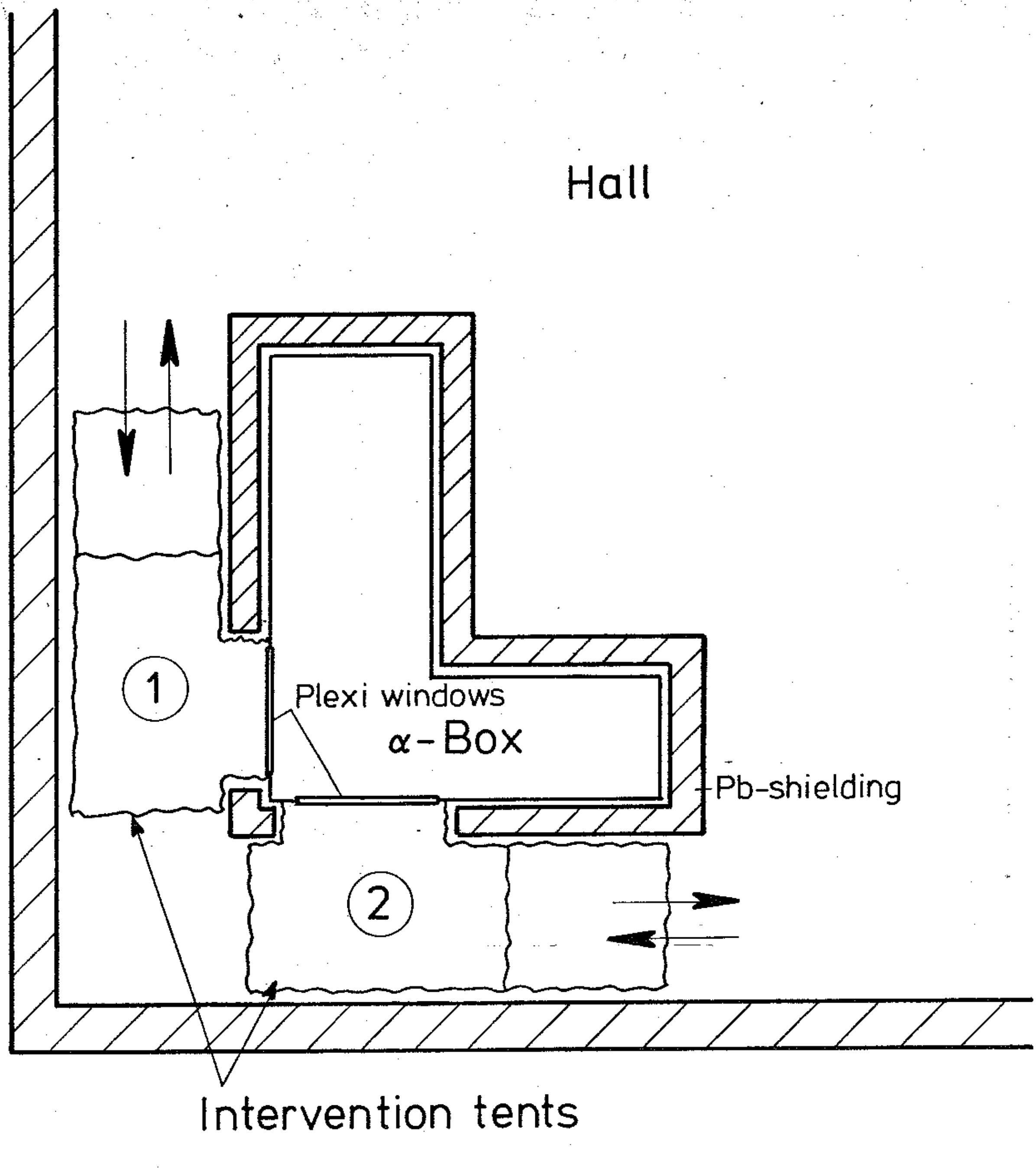

Fig. 7. Scheme of cell 10 + intervention tents.

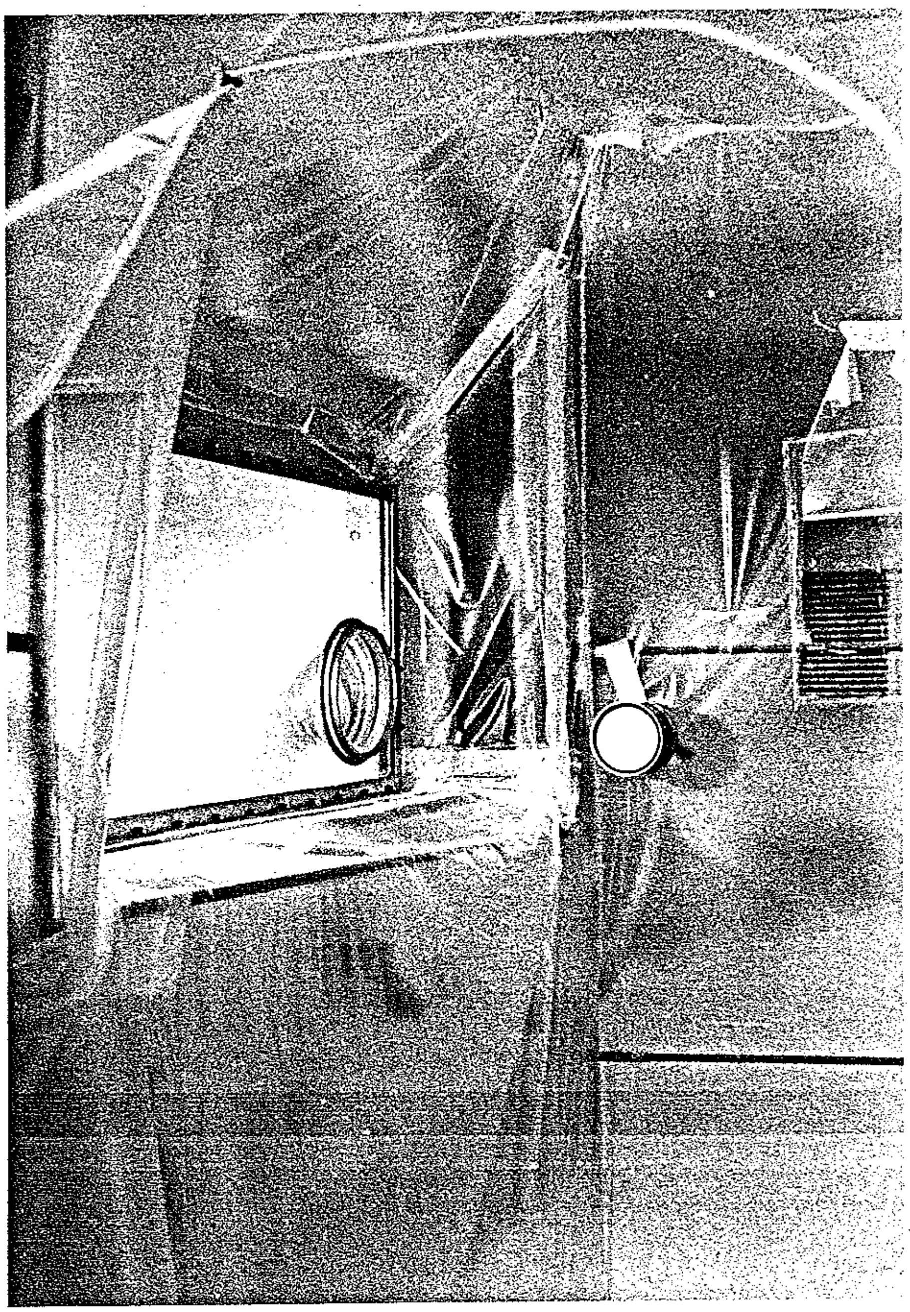

Fig. 8. Inner view of intervention tent mounted at cell 10.

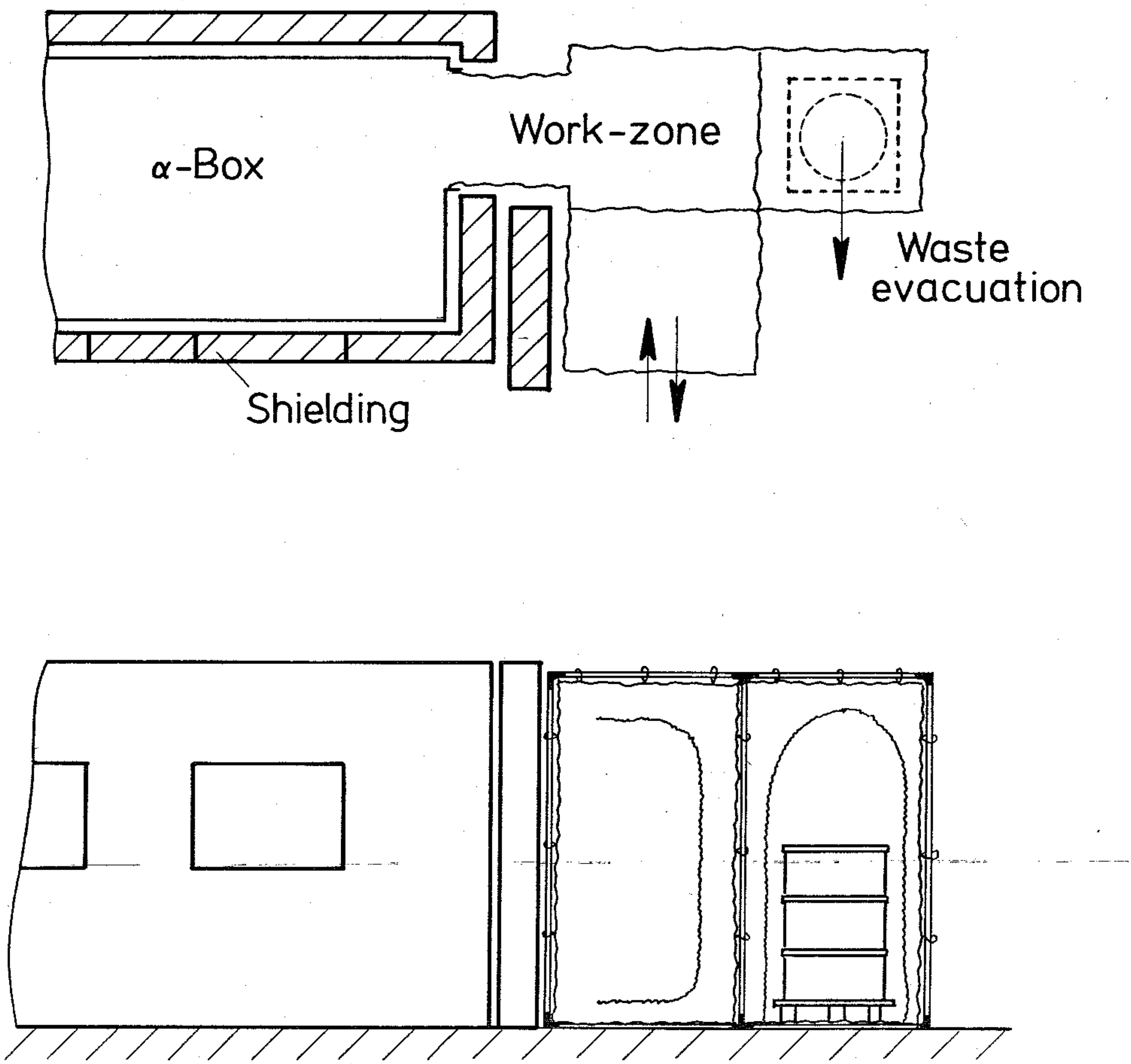

Fig. 9. Scheme of tent in local 20.

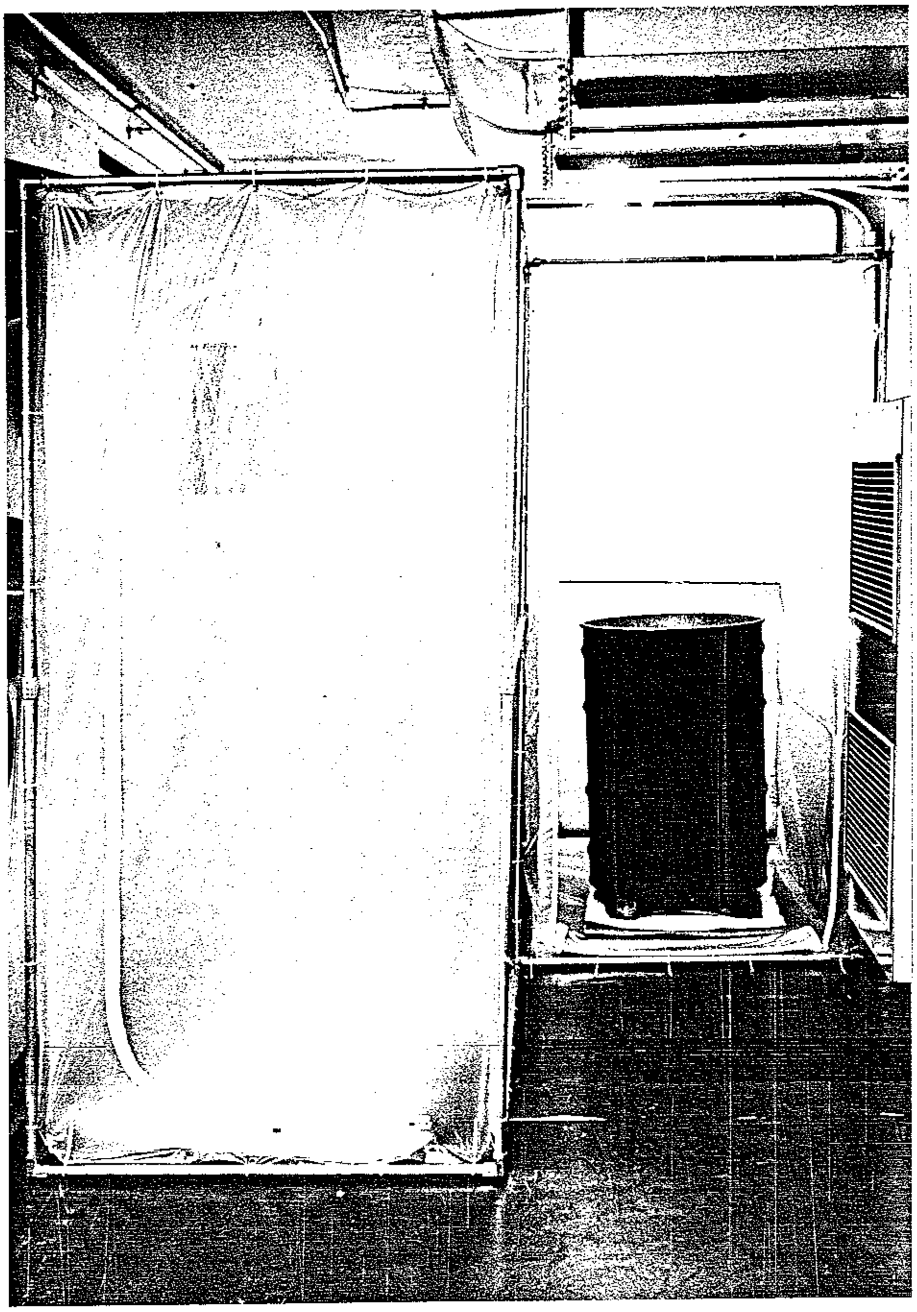

Fig. 10. Photo : Tent in local 20 with opened waste reservoir.