FACILITY FOR LOW-LEVEL SOLID WASTE TREATMENT

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ABSTRACT

A facility for low-level solid waste compaction, encapsulation and storage is described. Solid wastes are compacted in 200 ℓ drums and stored over concrete platforms covered with canvas, for decay or for interim storage before transport to the final disposal site.

INTRODUCTION

Low-level solid wastes arise from the research laboratories and radioisotopes production facilities in the Instituto de Pesquisas Energéticas e Nucleares - IPEN (Energy and Nuclear Research Institute).

The IPEN also receives wastes from other institutions, mainly radioisotopes users in hospitals.

These wastes have in most cases short-lived radionuclides, with half-lives of about weeks or a few months; long-lived radionuclides that can be present in the wastes are tritium, natural uranium and thorium and eventually small amounts of fission products and activation products from the research reactor IEA-R1.

These solid wastes are mainly made up of papers, plastics, rags, glass, air filters and small pieces of equipment discarded from laboratories.

Until 1978 those wastes were buried in shallow trenches, in selected sites within IPEN boundaries. Because of increasing wastes amounts and activities, decreasing space for disposal and aiming at getting expertise on waste treatment techniques it was decided to start studies for the construction and commissioning of a waste treatment facility. It was decided too, that the wastes should be stored in 200 liters drums without any treatment until the facility became operational.

The construction of the waste treatment facility was started in 1980 and in the middle of 1983 it begun operation.

The treatment adopted was volume reduction by compaction and storage for decay or interim storage before transport to final disposal.

Although compactible solid wastes were the urgent problem, provisions were made for future expansions to handle other wastes, like combustible wastes, liquid wastes requiring treatment and immobilization etc.

DESCRIPTION OF THE FACILITY

The waste treatment is located in a fenced area measuring 30 by 50 meters. The site is supplied with water, eletricity, telephone and sewer. The planned installations are shown in figure 1.

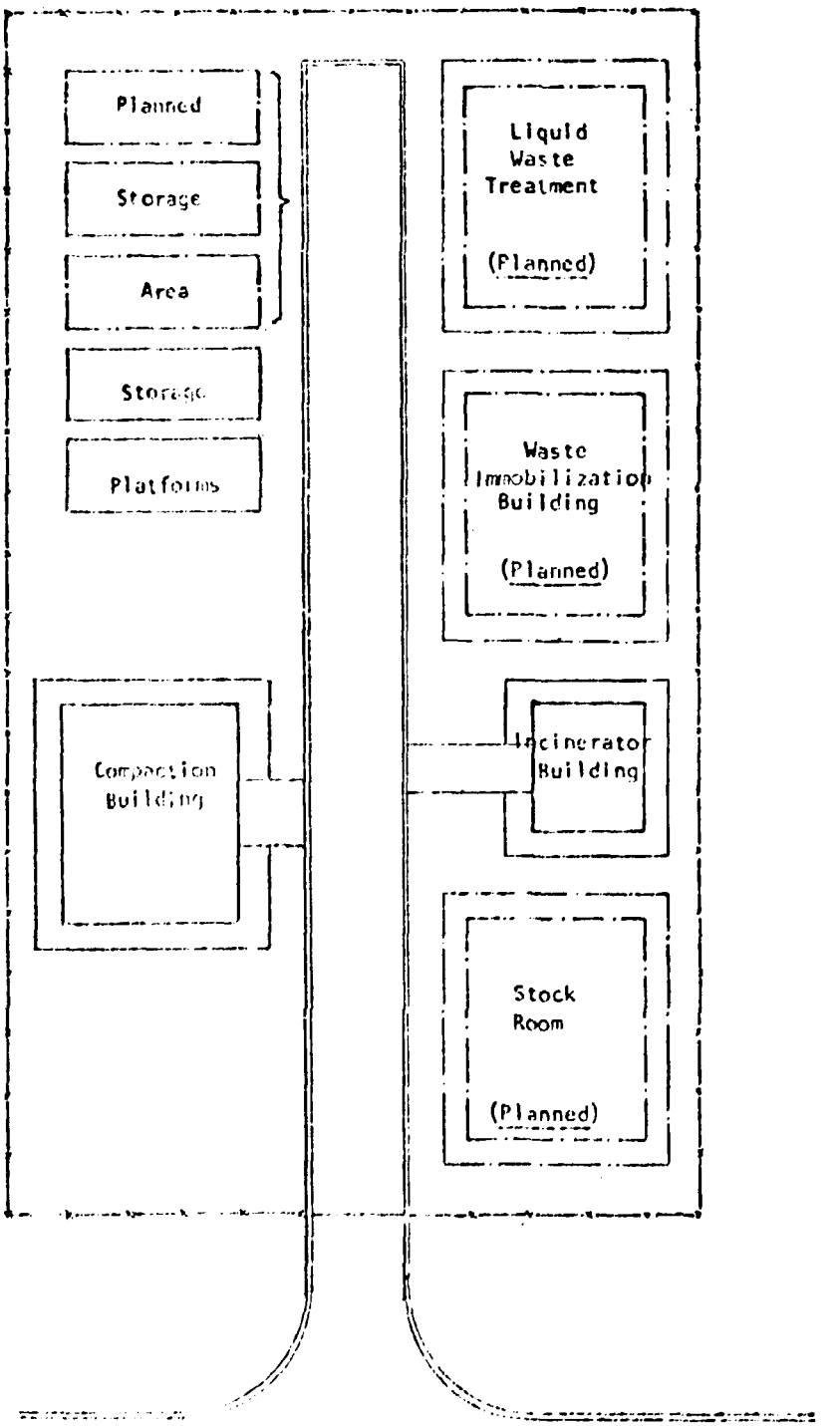

Figure 1 – Waste treatment facility

In the first stage the compaction facility and the storage place were built. Figure 2 is a lay-out of the building that shelters the waste compaction equipment. This is a commercially available 10 tons hydraulic press in which some modifications were made to adapt it for this work. It is shown in figure 3.

An exaust duct takes away gases, vapours and aerosols coming from the wastes being compacted. HEPA filters and charcoal filters prevent the release of radioactive materials to the environment. The air filtration system is shown in figure 4.

The building is fitted out with a space for the storage of uncompacted wastes that are transported from the laboratories in paper and plastic bags. The storage place is shielded with concrete walls.

A glove-box is provided for eventually necessary waste sorting and to dismantle, to cut or to saw pieces that not fit the drum or that could damage it. The glove-box is assigned mainly for the dismantling of replaced HEPA filters. It is shown in figure 5.

The floor under the press and under the glove-box and in the storage area is coated with an epoxi-resin-based paint for easy decontamination.

A trolley conveys unfilled and filled drums between the places of drum filling and compaction and to outside of the building.

A radioactive sewer drains water used in decontaminations of the storage area and the press and brings it to an interim storage tank placed underground and outside of the building. This is a 1 m^3 concrete tank, internally coated with epoxi-resin paint and fitted with a pump which can discharge the liquid to the sewage system or to a mobile tank. An alarm for high liquid level and a sampling line are provided in the tank.

The drums used as packaging for the wastes are made of 18 U. S. gauge tinplated iron sheet with two bracing rings and a removable lid. They are coated with epoxi-resin-based paint. This package complies with the requirements for LSA materials set forth in the regulations for the safe transport of radioactive materials.

A few percent of the solid waste volume can be classified as non-compactible waste. It is mainly metal scrap, debris from dismantling operations and contaminated tough materials.

This wastes are simply packed in the drums, or depending on the activity and nature of radioactive material, they are, after placed in the drums, embedded in fresh cement mortar.

The drums are stored over concrete platforms and are covered with canvas. In figure 6 the storage facility is shown.

Some modifications in the compaction and storage facilities were done later where the experience in operating the installation showed necessary. The observed problems and their solutions are presented in another paper (Experience on the operation of a low-level solid waste treatment facility).

SAFETY OF THE FACILITY

Some safety related aspects were considered in the design and the erection of the facility. Attention was paid for:

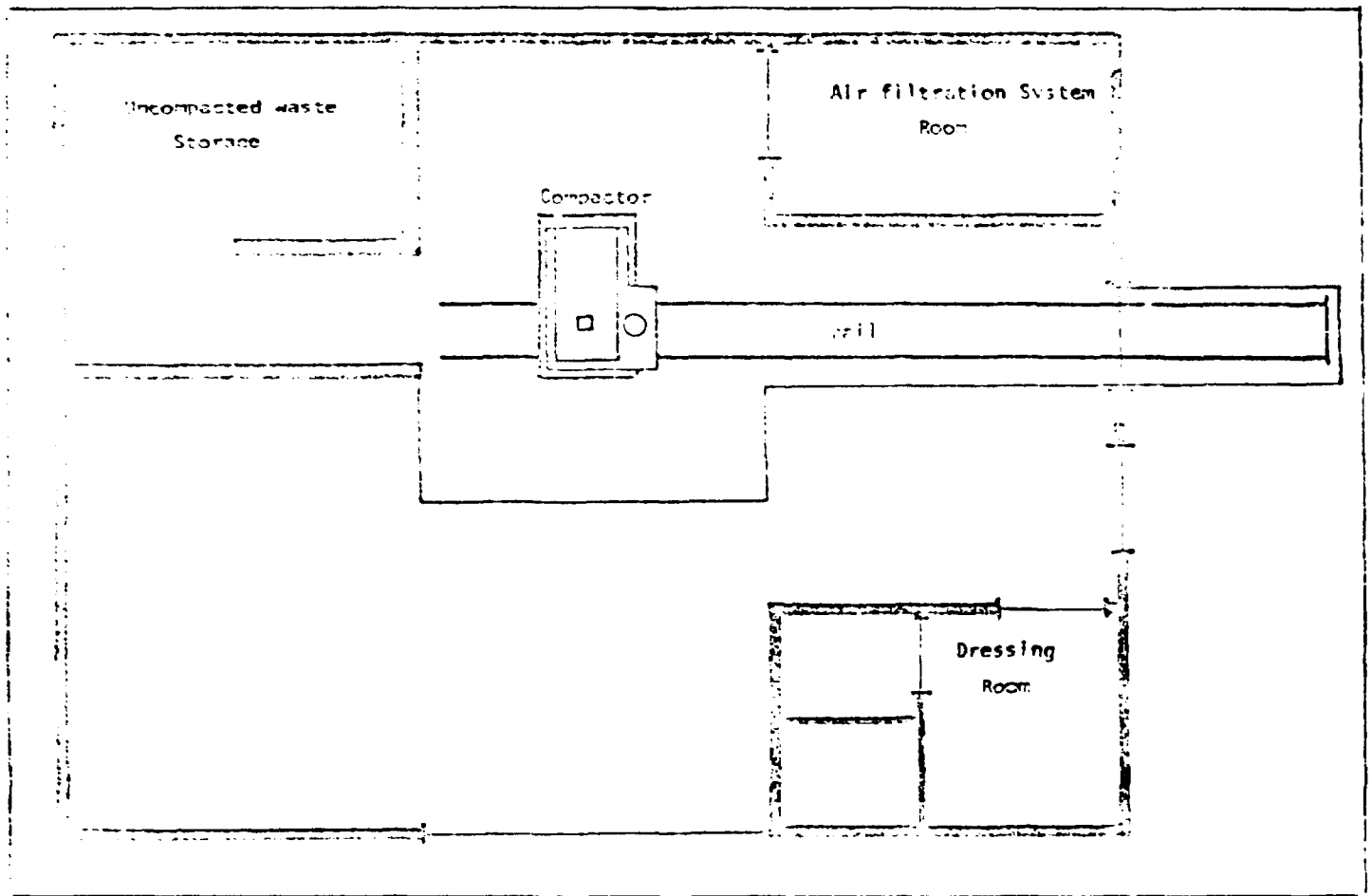

Figure 2 – Waste compaction building

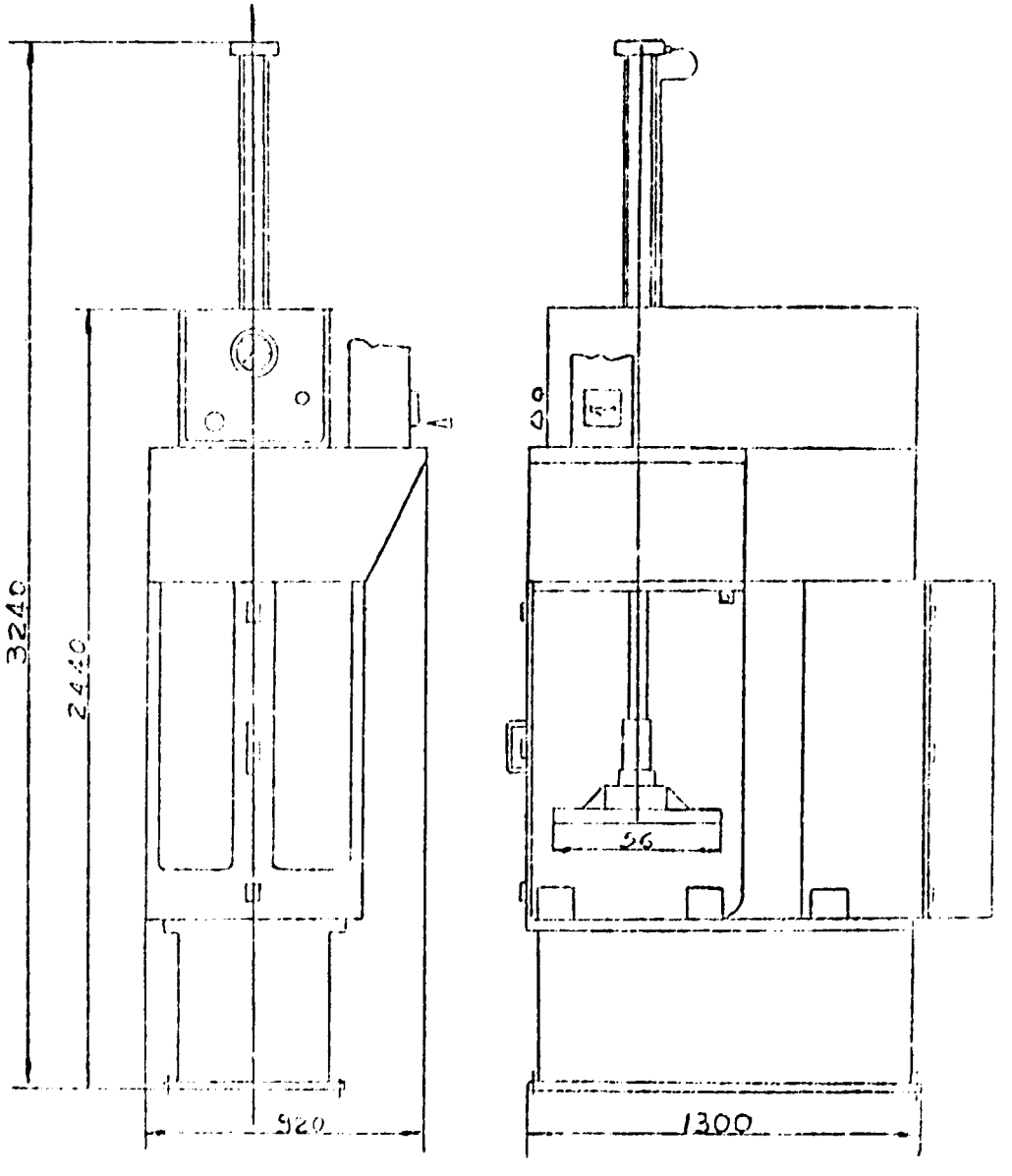

Figure 3 – Hydraulic press

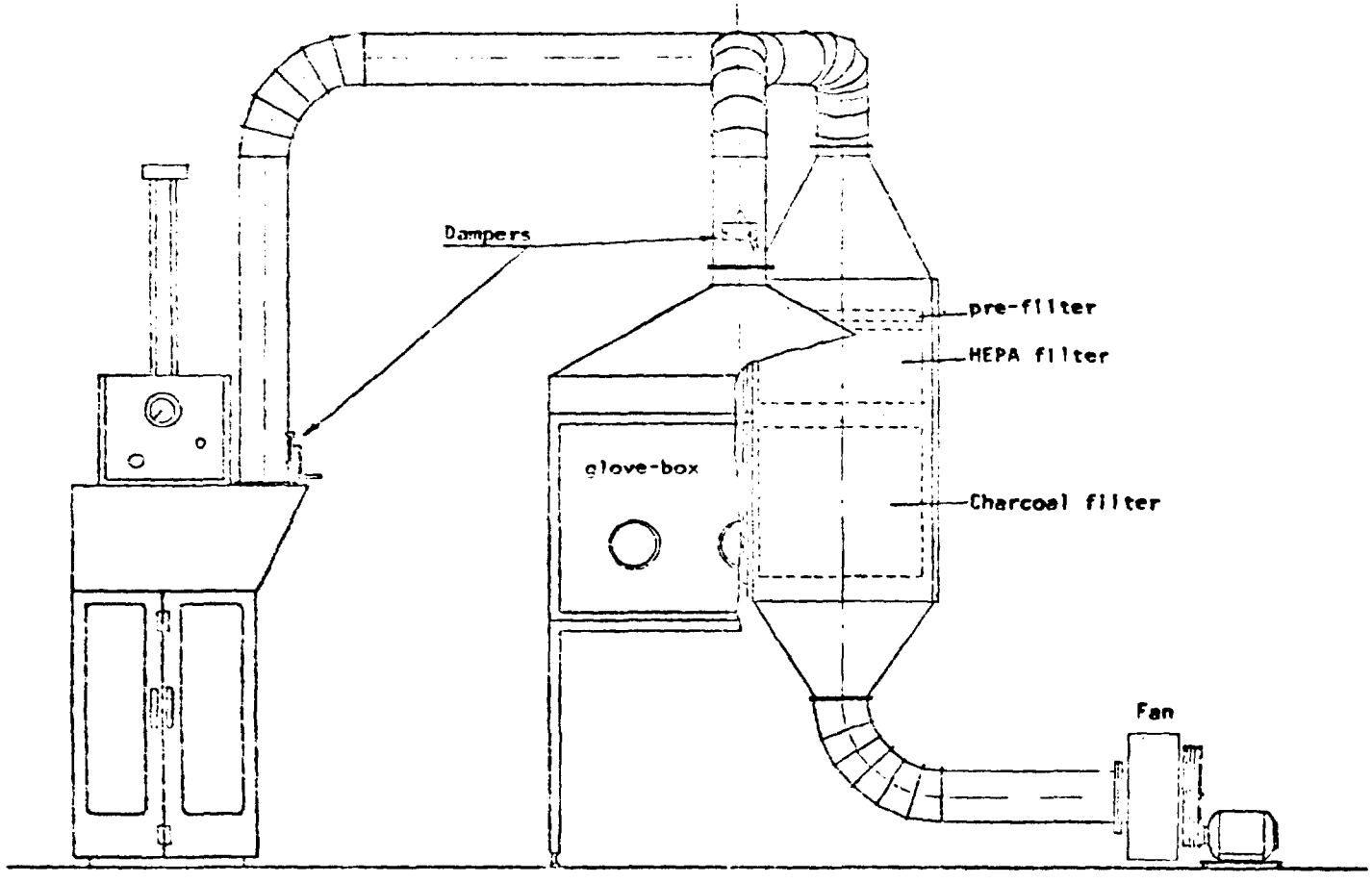

Figure 4 – Air filtration system

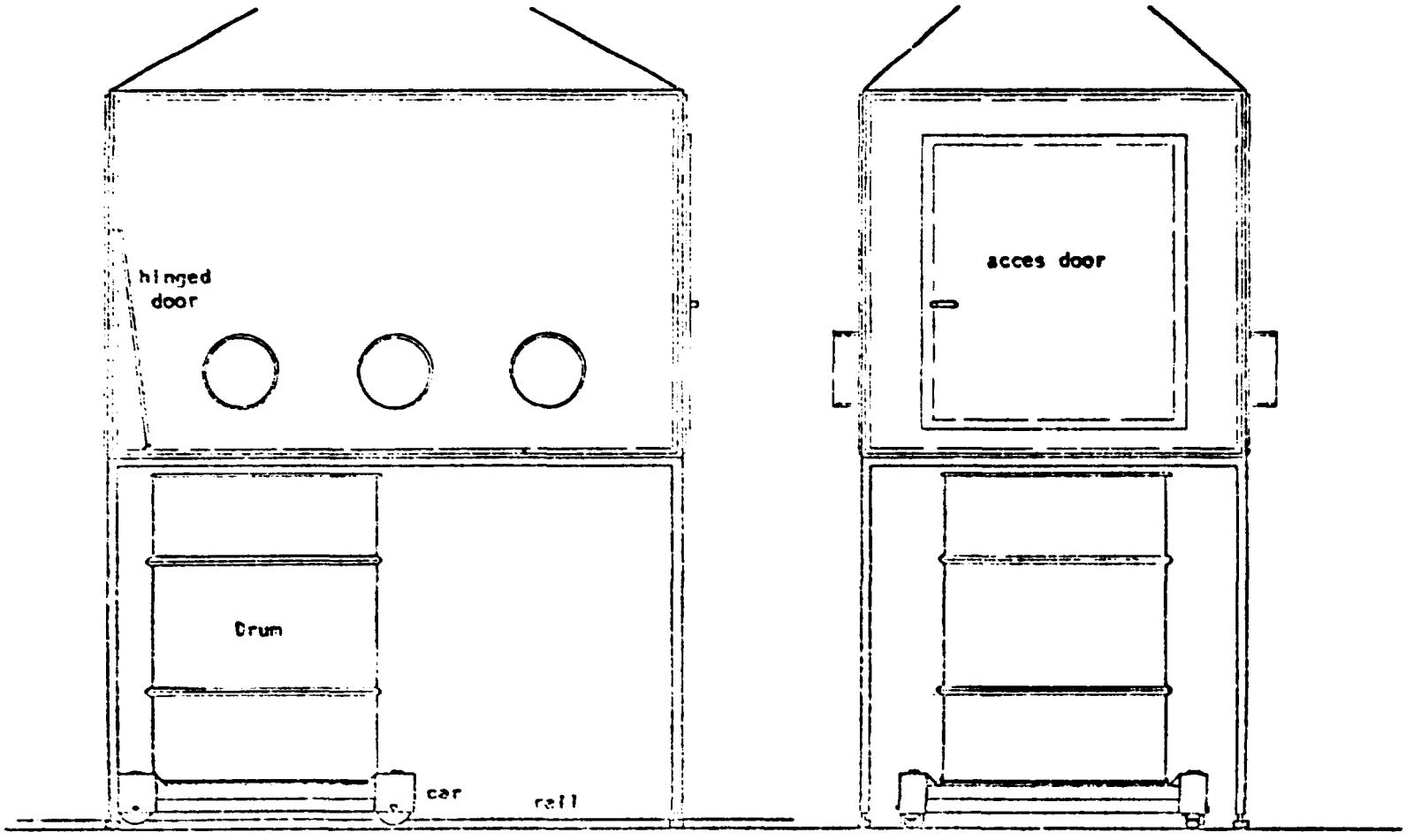

Figure 5 – Glove-box for sorting and dismantling

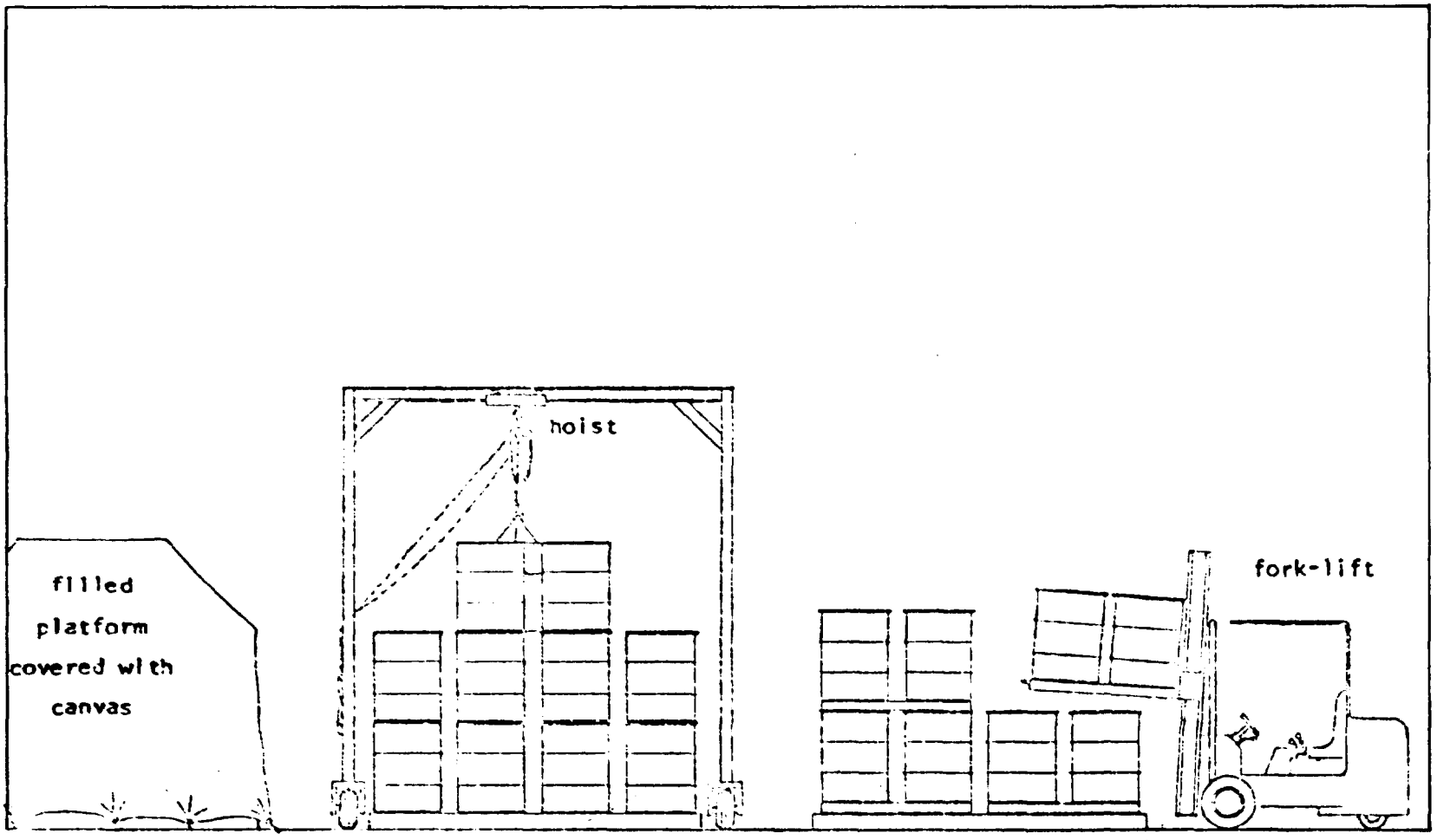

Figure 6 – Storage area

- Radiation doses in the personnel and public during normal operation;

- Radiation doses due to accidental releases;

- Countermeasures in accident conditions;

- Detection of fire and fire-extinguishing;

- Inadvertent intrusion.

In normal operation three irradiation paths were considered: irradiation by the gamma field; airborne radioactive material released from the air exhaust system; and radionuclides in liquid efluents released from the interim storage tank. It is, at least, difficult to know the radiochemical inventory of the solid wastes stored in the facility at any time. However estimates based on activities handled in the laboratories and facilities and on conceivable releases to the solid waste and from these to the environment upon compaction show that doses in general public are negligibly small. Also, the doses in the workers are well bellow dose limits for workers as shown by personnel dosimetry.

The doses incurred from accidents were calculated by simplified models and with a conservative scenario. Eventhough all the inventory were released in the air (as a consequence of fire, for instance) the doses in the critical group would be negligible. The possibility of flooding is unconceivable because the site is in a hill.

Small accidents that are possible to ocurr are the drop of a filled drum or a rip in a waste bag. In these cases the release of radioactive material is small and limited to the facility. To repack the waste and to decontaminate the floor are the measures forseen to handle the incident.

In any case, care is taken to do not include in the solid wastes: pyrophoric, explosive, putrescible or low flash-point materials.

The storage area for waste bags in the building is provided with a sprinkler system. At 60° C a shower is activated over the storage.

The facility is fenced with a 2,5 m fence with barbed wire in the top and hanging warning signals.

SITE CHARACTERIZATION

Two wells were dug in the site for ground water investigations. The water table lies between 6.5 m and 11 meter depth, and the horizontal water flow velocity varies between 9.3 and 42 cm/day.

The vertical water flow velocity was determined by tritium tracer; three months after injection of the tracer, the rain water infiltration was 134,9 cm.

The soil is clayed with silt and sand, were predominate caulite and ilite. The ion exchange capacity is low (0.7 to 2.0 meq/100 g).

Data of 1978 and 1979 indicates an average annual rainfall of 1399 mm; wind velocities less than 1 m/s predominate (about 30%) and maximum average velocities are about 10 m/s.

In figure 7 the population in the neighborhood of the facility are shown. Between 0 and 2 km in west, north and east directions that population is composed mainly by the workers and students of the University of São Paulo, IPEN and other public institutions. In the other regions the population is made up of dwellers.

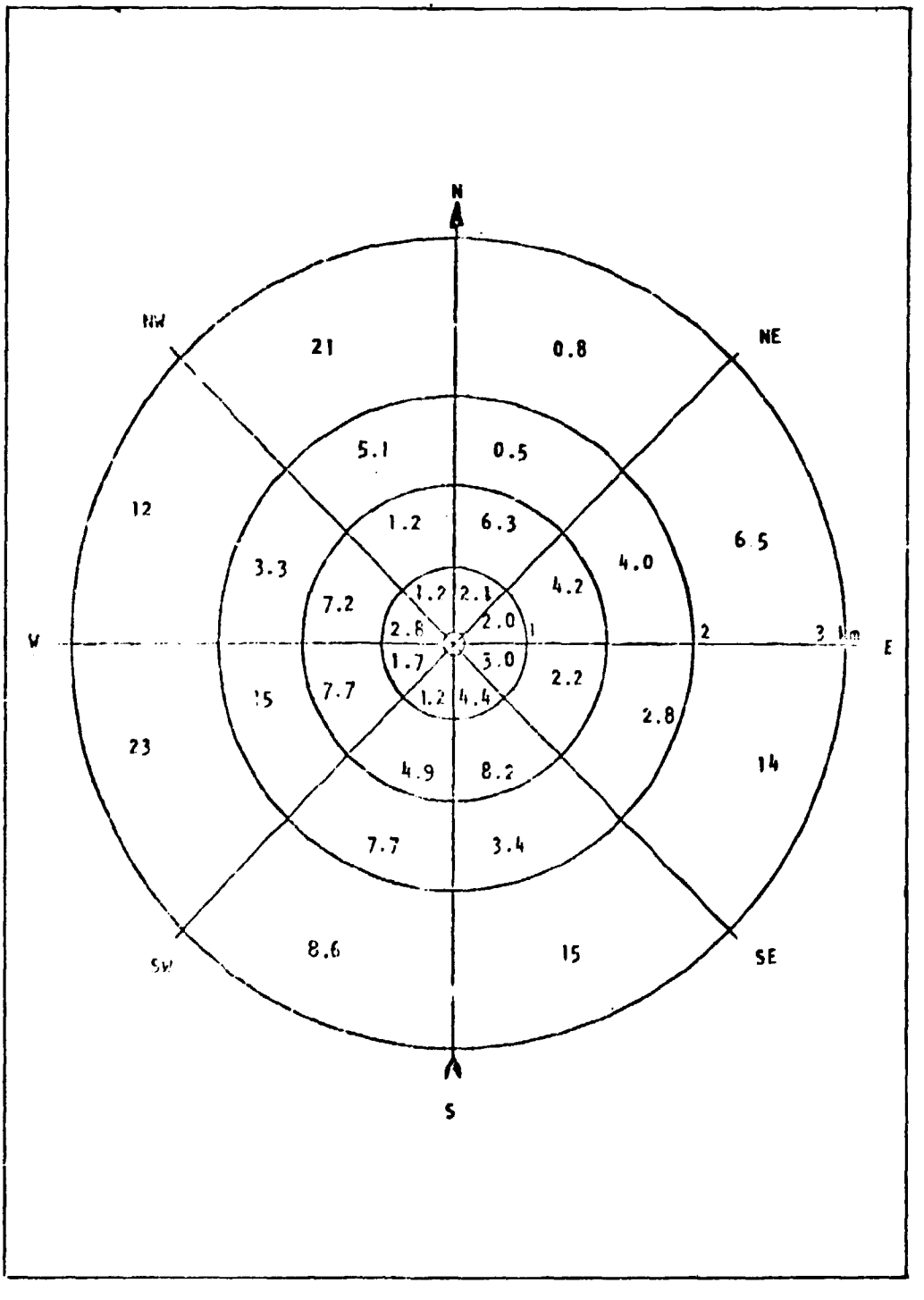

Figure 7 — Population near facility. (In thousands)