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PRINCIPLES OF LONG-TERM STORAGE OF PLUTONIUM OXIDE

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Contribution from France

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PRINCIPLES OF LONG-TERM STORAGE OF PLUTONIUM OXIDE

DEFINITION.

In the context of this paper long term storage is defined as :

- A storage which is suitable for keeping the plutonium for the normal period of operation of the associated industrial nuclear plants (10-20 years). The storage must be capable of beeing used both for plutonium which will be storec for many years and plutonium which will be needed after a short time.
- The storage must be large enough to match the output of an industrial plant and will therefore need to be large enough to hold several tonnes of plutonium

a) Quality of plutonium.

The plutonium in question comes from light water reactors and a characteristic composition is as follows :

% Pu in PuO_2	87.5 %
% Pu 238	2.5 %
% Pu 239	55 %
% Pu 240	24 %
% Pu 241	14 %
% Pu 242	4.5 %

Fission products :

8 micro curies/g of plutonium in energy emitters in the region of 0.75 MeV

Thermal emission - is of the order of 17 kCal $h^{-1}kg^{-1}$.

b) Packaging of plutonium.

The plutonium oxide is contained either directly in a container which is the transfer module or in canisters which may or may not be grouped within the container.

The container and canister are designed and manufactured so as to eliminate any risk of deterioration which might damage the integrity of the container during the period of storage.

c) Basic design of storage.

The plutonium is stored in a building which is divided into several specialised areas :

i- For the reception of fuel containers

ii- For actual storage where the containers are placed in separated racks

iii- A loading area where the containers are put into approved transport containers

- Various service areas :

  . control room
  . ventilation
  . receipt and despatch of goods
  . electricity and other services

The brief description of the storage principles given above shows that they can be applied to all cases whether the storage comprises a single unit or one which can be extented by a modular type of construction. A similar system can also be used for the storage of mixed oxide.

d) General handling principles.

Even after the fission products have been separated as far as possible from the plutonium the poisonous nature still requires remote handling and automatic control. It is necessary that the highest standards of physical protection and safeguards are maintained throughout the whole of the store. To ensure this, the construction is of heavy concrete and steel which forms a "strong-box" which gives the maximum assurances against theft or other diversion.

- Before active material is put into the store the structure is inspected to verify that the confinement is intact.
- During operation any necessary maintenance operations are carried out under strict control to avoid any possibility of diversion

e) General administration principles.

By definition the weight of plutonium oxide received in the store is known precisely as it is established by weighing at the preceding stage.

Analysis of samples taken during the preceding stage establishes the composition of the plutonium oxide and enables the exact weight of plutonium to be calculated for each container and each rack.

The standard inventory procedures and methods of checking on the progress of the fissile material are rigorously observed and in particular the records of contents of the store are updated after each movement of plutonium.

f) Criticality control principles.

Criticality safety is ensured by limiting the amount of oxide in each rack with the geometric position being precisely determined.

The weight of oxide in the store takes into account all foreseeable incidents, particularly the risk of flooding.

The store construction method also guarantees the permanence of the geometrical layout.

g) Principles for protection against irradiation.

Protection is ensured by the use of a biological shield and remote control for transferring the oxide containers.

h) Principles for fire prevention.

Fire prevention is ensured by the use of non-inflammable or flame-resistant materials so that the risk of fire is as low as possible. The fire regulations (fire detectors, extinguishers etc...) are strictly observed.

i) Ventilation and services.

Ventilation of the store aims to :

- Maintain the temperature and humidity control at levels conductive to the preservation of goods and apparatus
- Cool the plutonium oxide containers
- By the creation of zones of different air pressure, the circulation of the air constitutes a dynamic barrier between :
  - . the storage and the control room
  - . the storage building and the environment

The main services are electricity with an emergency generator; inspection and control equipment; and physical protection equipment.

j) Maintenance principles.

The nature of the design limits maintenance to the mirimum and whenever possible is carried out from outside the storage zone.

In call cases of maintenance and especially for any operation which involves the storage zone a pre-determined procedure agreed by all concerned must be followed as it has been reminded in the general principles of handling.

k) Physical protection principles.

Physical procedures are classified and no details can be given, but all necessary precautions have been taken.

However it is considered as most important past of the safety system.

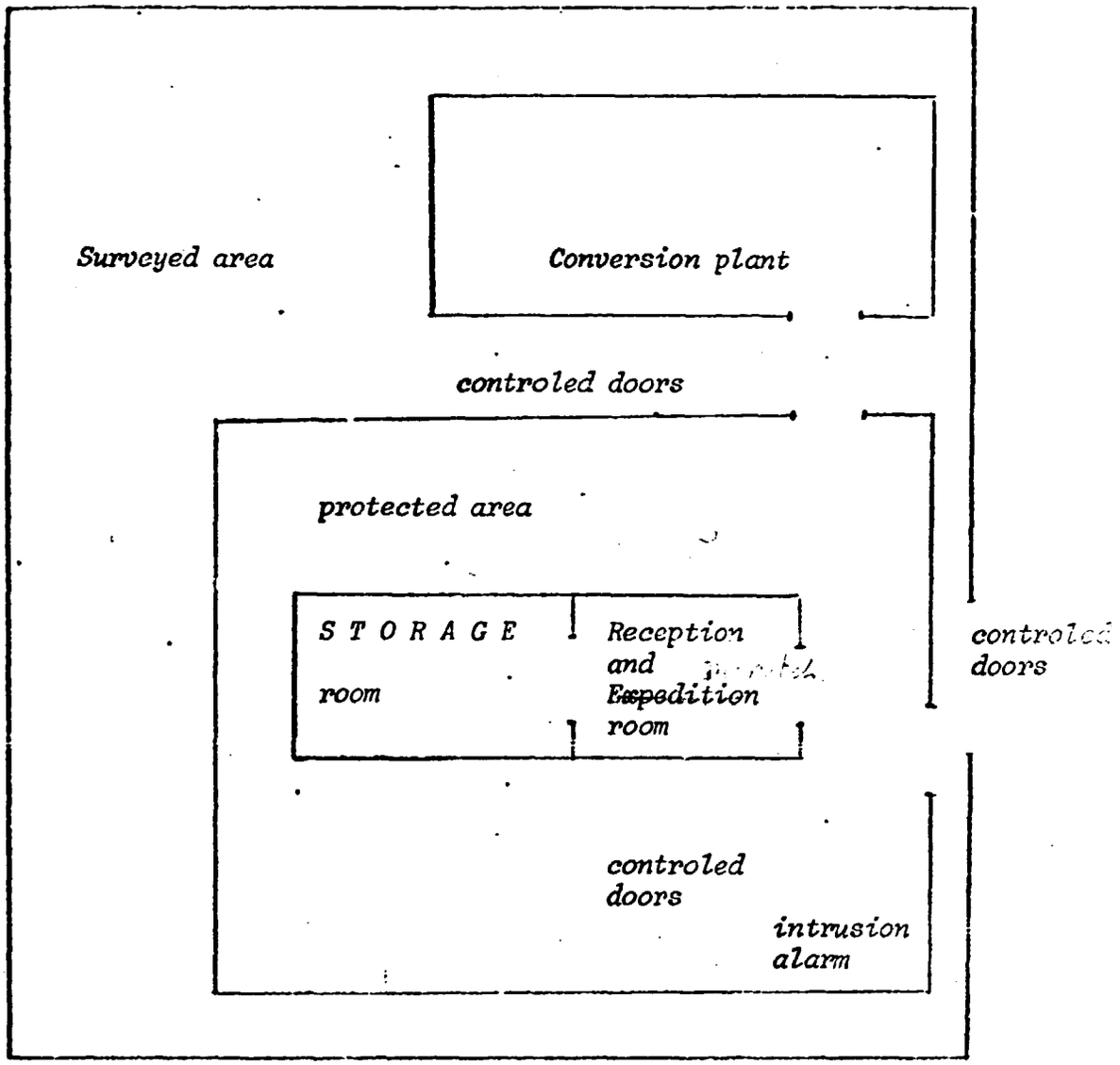
l) Safety analysis.

Safety analysis takes into account all the normal risks including those arising from radioactivity.

In particular, occurences which might have a direct or indirect effect on the environment have been the subject of a detailed study.

In the case of plutonium storage an effect on the environment could be caused by a leakage of plutonium oxide and the first cause of such a leak could be a fire.

The probability of such an occurence is very slight. Precautions taken to control its development (detection, intervention) and to minimise its effects by containment barriers mean that one can assume that risks to the environment are negligible.



French contribution to INFCE/WG.4/32 (B)
Definition of Pu Storage