DISPOSAL OF ATOMIC FISSION PRODUCTS IN GREENLAND OR ANTARCTIC

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ABSTRACT

There are accumulated in nuclear energy plants highly radioactive fission products, which threaten mankind genetually, if, considering the planned scope of nuclear energy use, only a small fraction of these products are allowed to escape into the atmosphere or open water. It is therefore necessary to set aside byproduct materials which contain such fission products, at least until the radioactivity has been sufficiently reduced by decay to be completely with safety limits.

The possibility of storage of these byproduct materials in the ice masses of Greenland or the Antarctic will be considered. These substances would first be loaded in bombs and dropped from the air in the vicinity of the highest elevation of inland ice masses. Careful thought shows that these ice masses and ice as such, possess exactly the properties which one must have for expecially favourable preliminary conditions.

These ice masses behave have high viscosity liquids. There exists at the proposed places of disposal no liquid water since they are permanently below the ice point. Also by strong shocks of the ice block and destruction of the containers a practically complete, tight enclosure by the ice would be reformed. The danger of the escape of these products, which exists when disposal is accomplished in the earth, through earthquakes etc. and subsequent expulsion by gas or water is not here present. Also the danger of spreading through currents or biological uptake upon disposal in the sea is not present when disposal in ice is made.

As a result of precipitation these substances will be gradually covered with a deeper layer of ice. At the same time they will gradually migrate toward the edges of the ice mass. This gradual migration will insure a long storage time in the ice and the covering with fresh layers of ice will result in limited diffusion of free material. With simplifying assumptions one may estimate ice storage time as a function of the initial position, the precipitation and the viscosity of the ice. Further estimations may be made of the expected diffusion from damaged ice reservoirs through the surface as a function of the precipitation, diffusion constant and the initial depth of storage.

Under the unfavourable conditions of precipitation amounting to 10 cm/year, an ice viscosity of $12 \cdot 10^{13}$ g/cm.sec and a correctness of placement of the highest ice elevation of 10% of the horizontal extent of the ice mass, there would result a storage time of at least 30.000 years; under favourable conditions this time would be much greater. This storage time would be sufficient, since the radiation of the extensive number of short lived fission products would have completely subsided and only a few long lived products, having a diminished activity would remain. These stored substances would also not be simultaneously released but rather would be discharged over a period of 10^4 to 10^5 years by the glaciers, so that these substances could indeed be relatively quickly disposed by sedimentation in the sea with no danger of the formation of a high concentration in the free water.

Under the likewise unfavourable conditions of a precipitation of 10 cm/year, a diffusion constant of 10^{-6} cm^2/sec and an initial storage depth of 300 cm, the probability of the outward diffusion of a particle, existing free in the ice, is considerable smaller than 10^{-40}. The deep covering up of the bombs by the snow in the middle of the ice would therefore be sufficient to prevent diffusion.

This situations are therefore expecially favourable.