EVALUATION OF THE RADIOLOGICAL RISK RESULTING FROM ROAD TRANSPORTATION OF TRITIATED WATER

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INTRODUCTION

The objective of this paper is introducing a methodology for the evaluation of the acceptability of certain conditions proposed for the road transportation of tritiated water in drums.

For such purpose, the acceptability criterion proposed by the Argentine Licensing Authority (1) has been adopted. This criterion consists in verifying that the points representative of the two values (the probability of incurring a given dose vs. the resulting effective dose equivalent) fall within the area qualified as acceptable in Figure 4.

DESCRIPTION OF THE METHODOLOGY

Considering the transportation conditions (total volume of liquid to be transported, tritium concentration in the liquid, probable meteorological conditions at the site and time of the accident), the radiological conditions resulting from the incident are evaluated (effective dose equivalent incurred by the most-exposed individual) and the corresponding probability of occurrence.(2)

The proposed methodology has been drafted in Figure 2. In order to evaluate the probable dose to be incurred by an individual potentially exposed to the consequences of the accident, for a given volume of liquid to be transported and as per the possible degrees of severity of the accident under analysis, an estimation is made of the volume of spilt liquid. For the purpose of calculating evaporation and taking into account considerations made by several authors (2,3), the spilt area was considered as independent from the characteristics of the road at the site of the accident. As a function of the meteorological conditions prevailing, the evaporation rate of the spilt liquid may be calculated per unit area. The total evaporation rate may then be established on the basis of the area determined above.

The concentration of steam in the air in the surroundings of the accident site, conservatively evaluated, along with the concentration of tritium in the transported water, are used for the calculation of the effective dose equivalent, admitting a certain period during which the exposed individual would remain at the site under study.

In order to quantify the probability (PT) of incurring a given dose for a hypothetical individual living in the vicinity of the accident site or travelling by the road where the accident occurs, the following items must be taken into account:

1. The probability for an individual to be involved in the radiological consequences of the accident (PI), which may be evaluated by means of the following equation(2):

$$PI = T\ d\ N\ ft$$

where:

T is the accident rate per kilometer travelled;

d is the length of the road implying consequences upon the individual under analysis;

N is the number of trips per year; and,

ft is the permanence factor (fraction of time during which the individual is thought to remain at the accident site)

d and ft will depend on the fact that the individual lives or travels in or by the area of the accident.

2. The probability of incurring a given dose (PH), which is a function of the degree of severity , of the area classification and of the meteorological conditions. The PH value may be evaluated as follows:

$$PH = Ps\ Pm$$

where:

Ps is the probability for the accident to occur in a given area and to have a given degree of severity; and,

Pm is the probability of occurrence of the various possible meteorological conditions at the site of the accident.

Therefore:

$$P_S = fs\ fp$$

where:

fs is the fractional occurrence of accidents of a given degree of severity; and,

fp is the fractional occurrence of accidents in areas with diverse populational density, defined for each degree of severity.

After an evaluation of PH and PI, it may be concluded that:

$$Pt = PH\ PI$$

Finally, on the basis of the two values: effective dose equivalent and probability for an individual to incur such dose as an

effect of the accident, the graph in Figure 1 establishes the boundaries for acceptability or non-acceptability of the proposed conditions, as far as the various representative points are contained within the acceptability area.

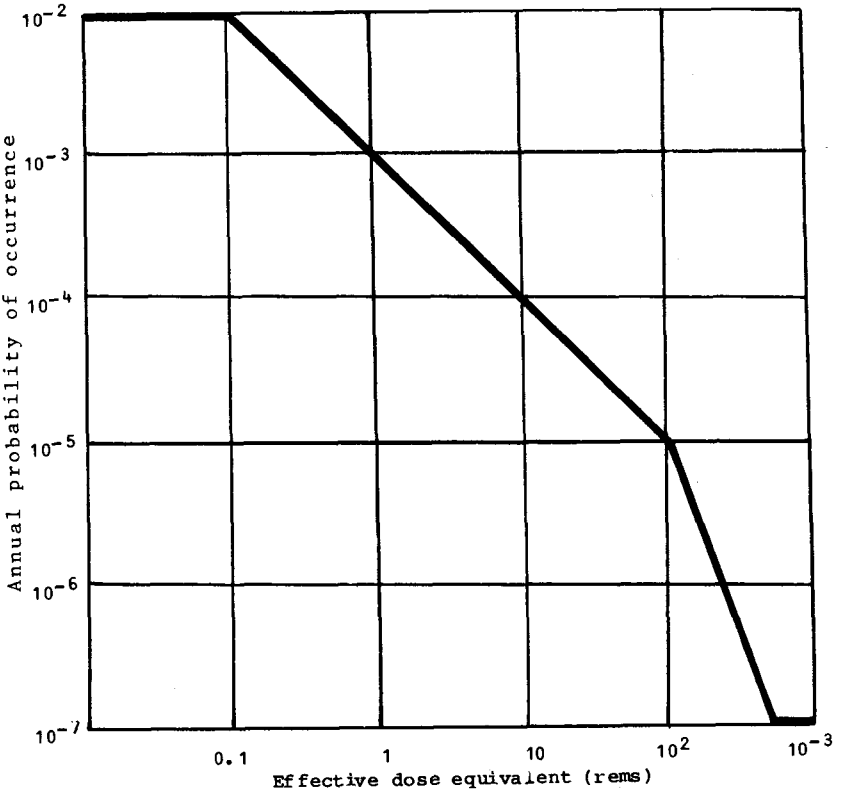

Figure 1. Acceptability curve (Ref. 1)

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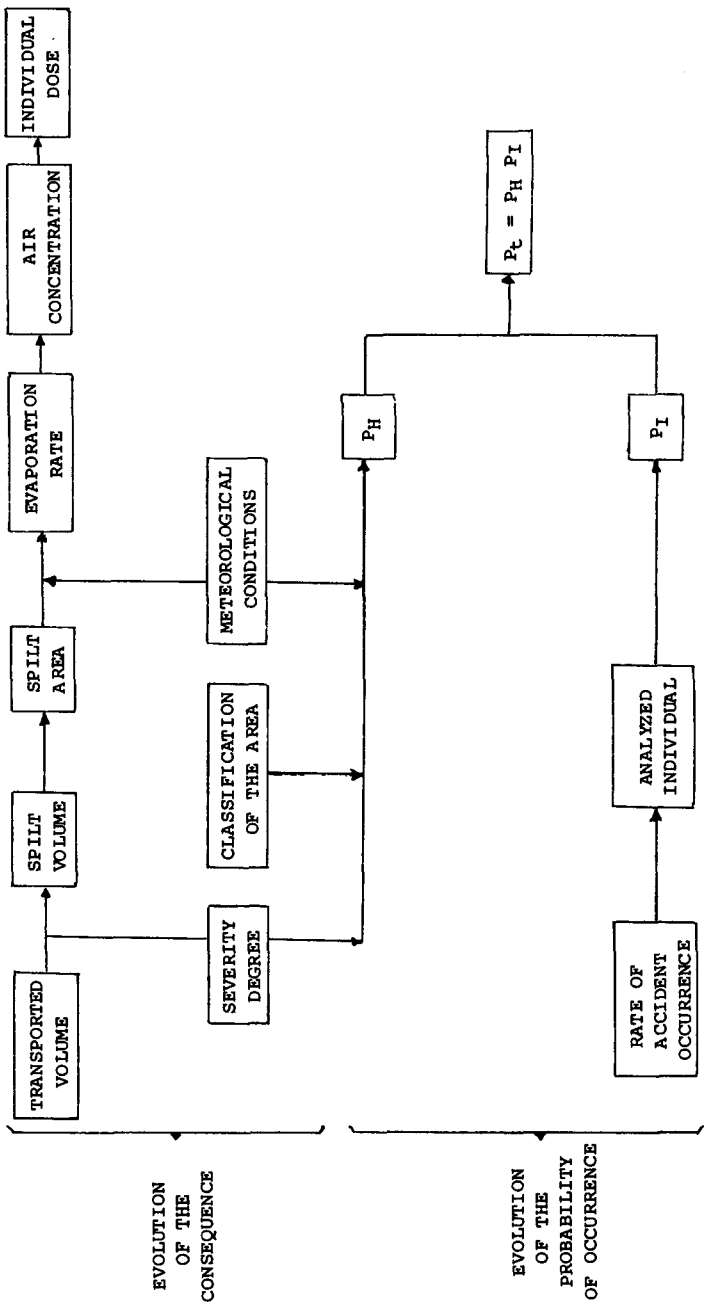

Figure 2. Flowsheet of the methdology applied