ATMOSPHERIC DISPERSION ESTIMATES OF THE GASEOUS RADIONUCLIDES FROM THE TAIWAN RESEARCH REACTOR

Dong-Pao Chou, Chau-Yuan Lin, Chao-Ming Tsai

Health Physics Division
Institute of Nuclear Energy Research
Post Office Box 3-10
Lung-Tan, Taiwan 325
Republic of China

1. INTRODUCTION

The Taiwan Research Reactor (TRR) is a Canada NRX type ractor, air is used for cooling the reactor structural material such as graphite reflector, thermal shield etc.. The small amount of ^{40}Ar in air is activated to radioactive ^{41}Ar, and is released to atmosphere through a 50 meter height stack.

During the reactor was in 40 MW full power operation, by experiment ^{41}Ar released rate was found to be 3332 curies per day (1). This value is much larger than that of the same type reactor in India (650 Ci/day) (2). The gaseous radioactive effluents from the TRR analysised by Ge(Li) detector was found that the major component was ^{41}Ar, the other radionuclide was very little. The environmental radiation doses obtained by thermoluminescent dosimeters (TLD's) and environmental monitoring system are contributed by ^{41}Ar and natural background only. Using environmental radiation doses data, ^{41}Ar released rate was determined to be 3332 Ci/day (3). The discussion is limited to nuclide of particular importand to the TRR, namely ^{41}Ar.

2. CALCULATION AND MEASUREMENT

A computer code (4) is used for the calculation of doses to the general population due to atmospheric emissions of radionuclides. A standard sector-averaged gaussian-diffusion equation is solved repeatedly for each radionuclide, wind sector, stability class and downwind distance. Radionuclide contributions to doses up to four critical organs are summed and printed by sector and downwind distance. Population doses (person-rem) are

also calculated. Ground deposition, cloud depletion, and first daughter product ingrowth are considered in the calculations. In-plant holdup time and in-plant radionuclide decontamination factors may be provided as input data if desired. Radionuclide dose contributions are calculated for up to four critical organs. The code is dose model independent.

Two general classes of dose calculations are treated explicitly. These are: doses that are directly proportional to the ground level air concentration of radionuclides, and whole body doses due to gamma rays emitted by nuclides in the overhead cloud (cloud gamma doses).

Doses from inhalation, external beta, and transpiration dose modes are directly proportional to ground level radionuclide concentrations. For these dose modes "dose conversion factors" (DCF's) are used to relate dose data to concentrations. DCF's are derived from appropriate model (5).

Cloud gamma doses are calculated using dose tables obtained from a model that considers the finite extent of the cloud in the vertical direction.

For the calculation of whole body doses due to gamma rays emanating from radionuclides in the overhead airborne cloud (cloud gamma doses), we utilize dose integrals obtained from a model that considers the finite extent of the cloud.

Gamma doses are calculated using a sector-average diffusion model based on a crosswind integrated gaussian plume constrained between the ground and an inversion lid. A slightly modified and corrected version of Cooper's EGAD code (6) was used to produce a table of dose integrals appropriate to the effective stack height and lid height (H_{lid}) for the facility. The table of dose integrals is interpolated for specific gamma energies and vertical dispersion coefficients.

Meterological data were analysed by Hsia's method (7). Environmental radiation doses around the TRR are measured by thermoluminescent dosimeter and environmental monitoring system.

3. RESULTS AND DISCUSSION

The calculated and mesured environmental radiation doses for each season

were in fairly good agreement within 27%, poovided 1) the reactor locates at open area, 2) there must be detailed reactor operation record and 3) hourly meterological data. The annual environmental radiation doses around the TRR are shown in Figure 1.

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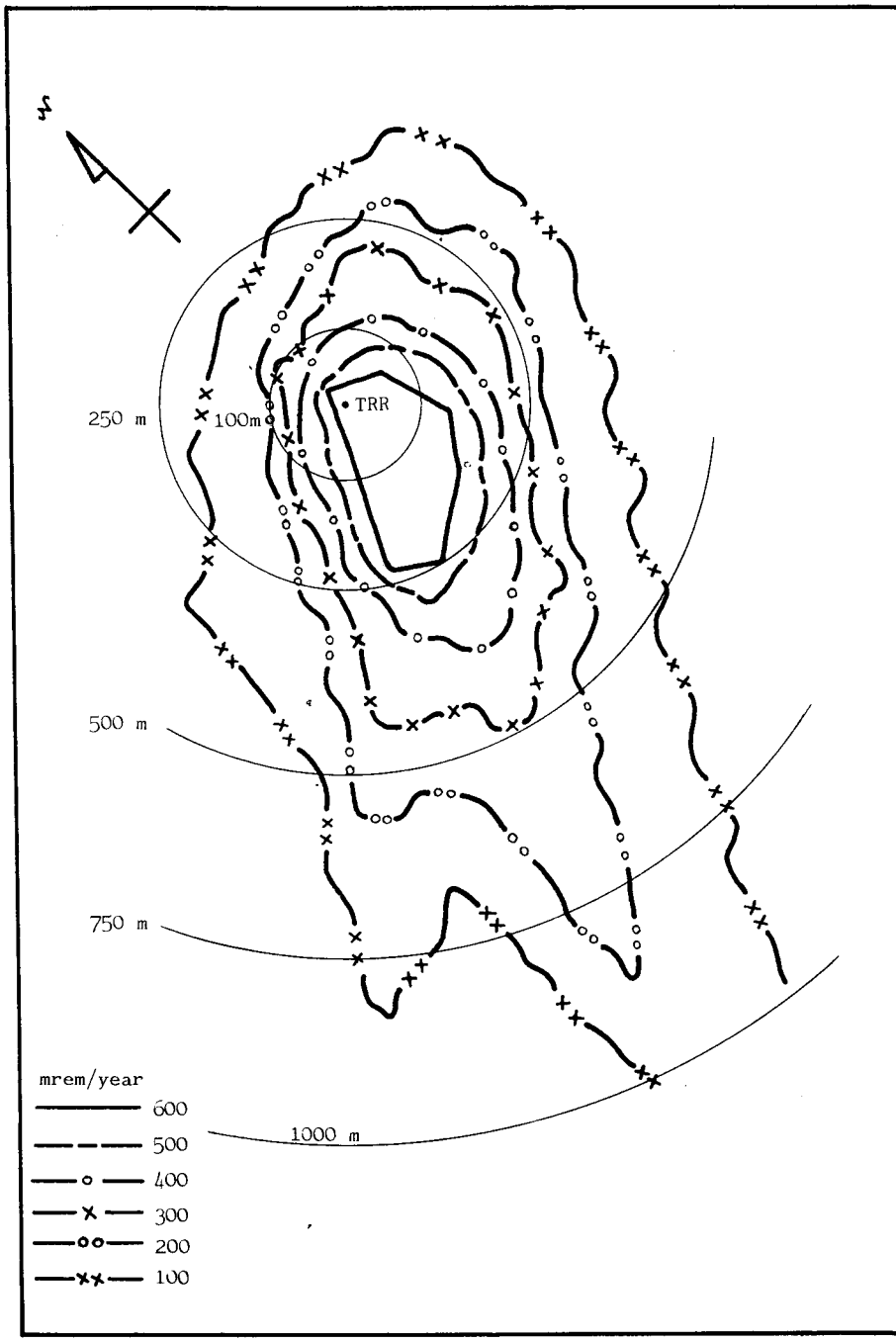

Figure 1. Annual environmental radiation doses around the TRR from May 1975 to Apr. 1976