ASSESSMENT OF POPULATION DOSE FROM THE OPERATION OF ATOMIC POWER STATIONS IN INDIA.

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INTRODUCTION

Environmental surveillance is carried out at the atomic power station sites in India for evaluating radiation exposure of the general population. At present, there are two atomic power stations under operation for many years and the third has been commissioned last year. The Tarapur Atomic Power Station (TAPS) located at the coastal site at Tarapur has two BWR units (210 MWe each) and the Rajasthan Atomic Power Station (RAPS) located inland at Rawatbhata has two PHWR units (220 MWe each). The work presented here deals with evaluation of dose to the maximum exposed individual of the critical group of population and dose to population within 15 km from site from the environmental monitoring at the two power stations during 1980-82 period.

METHODS

Radiation dose to the public from the power plant releases is evaluated from the environmental surveillance data. The external dose due to stack plume is evaluated using TLDs installed at different locations in the environment.

Average daily intake of different food components produced in the area has been evaluated earlier(1). The daily intake of radionuclides by the individual public is estimated from the radioactivity data in the environmental samples of food materials and the dietary intake data. The committed effective dose equivalent (CEDE) is estimated from the ICRP(2) values of uSv/Bq intake.

From the measured external dose rate due to stack release and the population distribution in the concerned region, the population dose due to external exposure is evaluated. From the evaluated individual internal EDE and the population distribution, the population EDE due to radionuclide intake is evaluated. Addition of these two components give the power station contribution to the population EDE in the specified region.

TAPS (BWR) STATION

External exposure:

The external exposure showed a detectable increase over the natural background only at the two nearby population centres existing within 1.6 to 5 km region. The village in the north with a population of 2066, had the annual increase in exposure of 0.2 mGy during 1980-82 period. The villages in the south of site having population of 4678 had the annual increase in exposure

during the same period as 0.15 mGy. Thus the annual effective population dose equivalent as evaluated from TLD measurement is 1.115 person-Sv. The annual individual dose increase at the site fencing was 0.283 mGy which is the external exposure dose of the maximum exposed individual.

The gaseous release rate during 1980-82 period was 1.682 GBq/sec (10% Tech.Spec.Limit). The estimated dose from the gaseous release agreed well with the above evaluated dose.

Dose due to Dietary Intake

Terrestrial food products grown and consumed in the Tarapur environment beyond 2 km from site have not shown pick up of any power station released radionuclides. Cs-137 in the terrestrial food products (0.2 to 1.1 Bq/kg) is attributable to the pick up of stratospheric fallout radiocesium. Thus the terrestrial food samples collected beyond 2 km from site do not contribute any radiation exposure due to deposition or stack releases. Sea food samples from the coastal environment have been regularly analysed since this has been found as the critical food item for population exposure at Tarapur(3). I-131, Cs-134, Cs-137 and Co-60 are the only detectable station released radionuclides in the organisms collected from the coastal area. The last 3 years (1980-82) annual average radionuclide intake through diet and the resulting CEDE to individual public (4.1 uSv) is shown in Table-1 for region 2 to 15 km from site.

On a conservation estimate, it can be considered that population within 15 km from TAPS site have the intake of nuclides through sea food. The population within 15 km is 65000. Thus the population internal dose equivalent is estimated as 65000 x 4.1 uSv = 0.266 person-Sv. At Tarapur BWR environment the total population dose (within 15 km from site) evaluates to 1.4 person-Sv.

Table - 1.

Internal dose due to intake of radionuclides released from TAPS.

Critical food (sea food) intake = 52.2 kg/yr.

Nuclide	1980-82 Average annual intake for individual public Bq	Common from annual intake uSv
Co-60	56.89	0.14
I-131	53.24	1.33
Cs-134	55.33	1.51
Cs-137	65.77	1.12
	Total	4.10 uSv

Dose to the Maximum Exposed Individual from the Critical Group:

The fishermen group has been found as the critical group of population in the Tarapur environment(1). The CEDE to the maximum

exposed individual due to annual intake of radionuclides worked out as (i) CEDE through nuclides in sea food was .396 mSv and (ii) CEDE through nuclides in terrestrial food grown at site fencing was 0.11 mSv giving total CEDE of 0.407 mSv.

Since the nuclides considered have short effective half life, the dose is delivered within the same year of intake. The total of external and internal annual effective dose equivalent to the maximum exposed in the critical group was 0.690 mSv.

RAPS Station

External Exposure :

A-41 and H-3 are the main gaseous activity in the stack release. H-3 does not contribute to the external dose of the general public to any significant extent. Increase in external radiation dose due to A-41 could not be detected in the RAPS environment from the TL dosimeters distributed in different locations.

The average stack release rate of A-41 was 16 mBq/sec (0.75% of Tech.Spec.) and that of H-3 was 8 mBq/sec (.03% of Tech.Spec.). The estimated annual dose from this release rate was only 5 to 7 uSv at the station site boundary and it is insignificant beyond this region.

Dose Due to Dietary Intake & Inhalation :

The critical radionuclide in the RAPS environment for population exposure has been identified as tritium. H-3 in air has been measured even up to 10 km from site and H-3, Zn-65, Sr-90 I-131 and Cs-137 were the nuclides identified in the RAPS environment. The observed levels of Sr-90 and Cs-137 activity in the dietary material could be attributed to pick up of weapon fallout. Thus H-3, Zn-65 & I-131 are the nuclides contributing to the dose from the power station releases. The average annual intake of radionuclides for the period 1980-82 and the resulting CEDE are given in Table-2.

Table - 2.

Internal dose to individual public due to intake of radionuclides released from RAPS.

Nuclide	1980-82 Average annual intake (Bq)	Cede from the annual intake (uSv)
H-3	2.25 x 10^5 (air + water)	3.82
Zn-65	27.7	0.15
I-131	1.75	0.04
	Total	4.01 uSv

In this case also, the dose can be considered as delivered in the same year as intake. With the individual CEDE as 4.01 uSv and the population within 15 km from the power site as 25000, the population dose equivalent due to power station releases is evaluated as 0.1 person-Sievert.

Dose to the Maximum Exposed in the Critical Group :

The critical group of population are the public living in the housing colonies on the banks of the Ranapratap Sagar lake, since they use lake water for drinking, irrigation and eat fish caught from the lake. The maximum exposed individual had the external exposure of 7 uSv due to A-41 measured at the site boundary. Due to inhalation of H-3 and intake of station released radionuclides through dietary materials and drinking water, the evaluated CEDE to the maximum exposed in the critical group during 1980-82 period was 175.0 uSv. The total internal and external annual dose equivalent is 0.182 mSv.

DISCUSSION

The maximum exposed the critical group at TAPS received about 14 % of the permissible annual dose of 5 mSv, but at RAPS it was only 3.6% of the permissible.

The population dose within 15 km at TAPS is 1.4 person-Sv where as it was only 0.1 person-Sv at RAPS indicating the lower environmental population exposure in case of RAPS.

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