Review on the Optimized Public Protective Action on NPP Having 30km UPZ Risk Based on the New Protective Action Guidance

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1. Introduction

The emergency planning zone (EPZ) is separated to precautionary action zone (PAZ) and urgent protective action planning zone (UPZ) in nuclear emergency preparedness act on 2014. The PAZ for nuclear power plant (NPP) is defined as 3 to 5 km radius, and the UPZ as 20 to 30km radius in the act. EPZ is normally considered as the zone for the evacuation of the residents in its area. PAZ is the precautionary evacuation zone before exposure by an accident and UPZ is the urgent evacuation zone according to the measurement at a field. But some people think all residents in EPZ should be evacuated. In this research, the optimized protective action was reviewed based on ICRP-103 recommendation and IAEA recent requirement.

2. Meaning of 30km UPZ

2.1 Meaning in IAEA Safety guide

PAZ and UPZ in the nuclear preparedness act is from IAEA safety guide for emergency preparedness [1]. The IAEA safety guide suggested PAZ as 3-5km and UPZ as 5-30km for the reactors greater than 1000MW(th). PAZ radius is the approximate distance for which the acute (2day) dose to bone marrow is 1Gy and the acute dose to lung is 6Gy, for preventing a deterministic health effects. UPZ radius is the approximate distances for which the total effective dose for inhalation, cloud shine and ground shine for 48hours will not exceed 1-10 times of the 50mSv for evacuation. This result is from the calculation in the condition of average meteorological condition, no rain, ground release. The maximum does during emergency (2days) of 30km UPZ reactor considered by IAEA can be simply described as under description.

1Gy(1Sv=1000mSv) at 5km of PAZ
500mSv(10 times of 50mSv) at 5km of UPZ
50mSv(1 times of 50mSv) at 30km of UPZ

2.2 Assumption of dose by distance

U.S. NRC considered under simple equation during 10mile EPZ determination for U.S. nuclear power plants [2].

$$D = D_0 \times (\frac{r}{r_0})^{-1.5} \quad (1)$$

Where, D_0 is the dose at the distance r_0, D is the dose at the distance r. From the above equation, if the plume centerline dose at 30km away from a nuclear power plant is 50mSv, and then the dose by distance can be calculated like under Fig. 1.

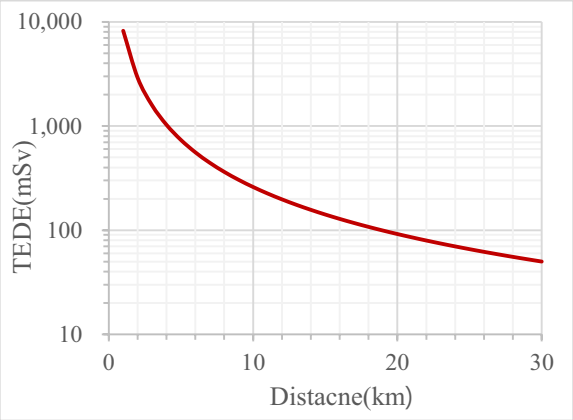

Fig. 1. Dose by distance of 30km UPZ NPP.

3. Protective Action Strategy

3.1 New protective action guidance

ICRP 103 recommends 20-100mSv residual dose as reference level during emergency exposure situation. IAEA general safety requirements part 3 selected 100mSv projected dose in the first7days for the protective action.

3.2 Review on the optimized protective action

U.S. EPA published protective action guides (PAG) for nuclear emergency. The PAG describes the exposure reduction factor from nuclear fallout like under Fig. 2.

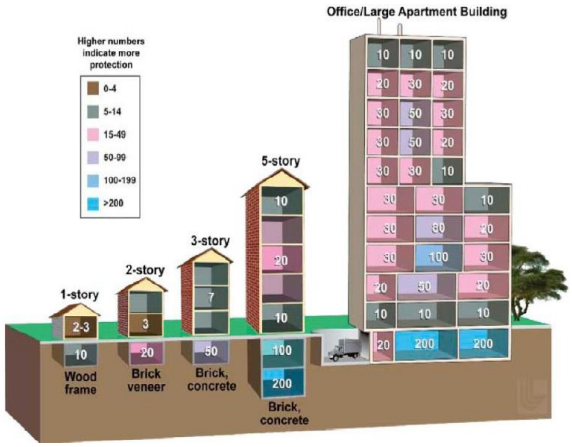

Fig. 2. Reduction factor from nuclear fallout.

If people stay in their home for 12hrs in a day and outside for 12hrs in a day and the reduction factor is 10, then the reduction ratio is 55%. It means normal life after accident, then the dose can be reduced like under table 1 from Fig. 1.

Table 1. Dose in normal life after accident

Distance(km)	TEDE(mSv)
2.734	1000
12.7	**100**
20.1	50
30	28

If no protection action implemented, then the public to 12.7km from nuclear power plant will receive more than 100mSv residual dose.

4. Results and Consideration

The public in 2.734km should be evacuated ungently to avoid deterministic health effects, the public in 12.7km should be evacuated in several hours to get the residual dose less than 100mSv. The protective action for the public outside the 12.7km can be considered with time and field measurement results.

REFERENCES

[1] IAEA, “Arrangements for Preparedness for a Nuclear or Radiological Emergency”, Safety Guide No. GS-G-2.1 (2007).

[2] U.S. NRC, “Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in support of Light Water Nuclear Power Plants”, NUREG-0396 (1978).