INFLUENCE OF PRECIPITATION, BUILDING AND PLUME RISE ON THE DOSES RECEIVED BY THE POPULATION IN CASE OF ACCIDENTS IN A PHWR-POWER PLANT

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The influence of precipitation, buildings and plume rise on the doses received by the population for some hypothetical accidents proposed for the CNA-II was analyzed. The CNA-II is a 745 MWe heavy water pressure vessel reactor, fuelled with natural uranium and installed by Paraná River (Argentina). CNA-II is under construction.

Two hypothetical accidents were analyzed: loss of coolant accident (LOCA) with containment isolation failure (occurrence probability: approx. $2.0 \times 10^{-7} y^{-1}$) and LOCA with normal operation of safety systems (probability: approx. $1.0 \times 10^{-3} y^{-1}$).

The atmospheric dilution factor was estimated according to Pasquill model because it is suitable for flat terrain like Paraná's River zone. Six weather conditions (A to F) were considered for each accident. The most probable condition is D. For ground level releases a height of 10 m was assumed. Stack height is 40 m.

The following irradiation paths were analyzed: external exposure due to cloud passage and to deposition on ground and inhalation. The ingestion path was not taken into account for the calculation of the immediate accident consequences because of the delation due to transportation and/or processing time. Countermeasures were not considered.

PRECIPITATION EFFECT

Rain produces iodine and aerosol washout with the consequent decrease of their concentration in the radioactive plume and increase of deposit on ground. The model proposed in IAEA safety series N° 57 was used. The doses were calculated under the plume-center line for weather conditions C and D because rain is considered possible only under these conditions.

The results obtained for the critical group (x = 1 km) in case of LOCA with containment isolation failure show that dose considering precipitation is 22% larger than dose without considering rain, for weather condition C and 6% for condition D. In case of LOCA with normal operation of safety systems the difference is negligible: 1%.

It must be said that aerosol and iodine releases are overestimated because their behaviour inside the containment was not considered (all the activity initially present in the containment was supposed to be released). So the expected influence of precipitation should be lower than that obtained with the above mentioned assumption. It should also be taken

into account that accident and rain probability must be multiplied so, the total probability is lower than that without considering precipitation.

BUILDING EFFECT

Buildings near the emission source produce eddies which increase the dispersion in the travel direction. The model proposed in IAEA safety series N° 57 was used. This effect has to be considered when the building height is larger than two times the release height. For accidents with release through stack this condition is not fulfilled. It must be said that there are no cities near CNA-II nuclear power plant. So the turbine building was selected because is one of the biggest.

The results show that the dose obtained considering building effect is lower than that without taking it into account. The difference increases with the stability of weather condition and begins to be noticeable for weather condition D: 13%. For weather condition E dose considering building is approx. 25% lower than dose without considering building and for the worst case (condition F) this difference is 40%. It can be concluded that calculations made without taking building effect into account are conservative, with differences only noticeable for stable weather conditions (E, F).

PLUME RISE EFFECT

Efflux velocity and buoyancy produce a rise of the real release height, thereby reducing the ground-level concentration. The model of Briggs was used to estimate plume rise value. Once this value is estimated it is added to the real release height to obtain the effective release height.

The results obtained for the critical group (x = 1 km) in case of LOCA with normal operation of the safety systems (release through stack) are the following: dose considering plume rise for weather condition D is approx. 23% from the value without taking plume rise effect into account. For weather condition E the value is approx. 7%. The largest influence of plume rise is observed for weather condition F: dose considering plume rise is 0.06% from the value without considering this effect.

The conclusion is: plume rise effect should be considered specially for stable weather conditions (E, F) when realistic values of dose to the critical group are needed, otherwise the obtained dose values would be too much overestimated.

DISTANCE INFLUENCE

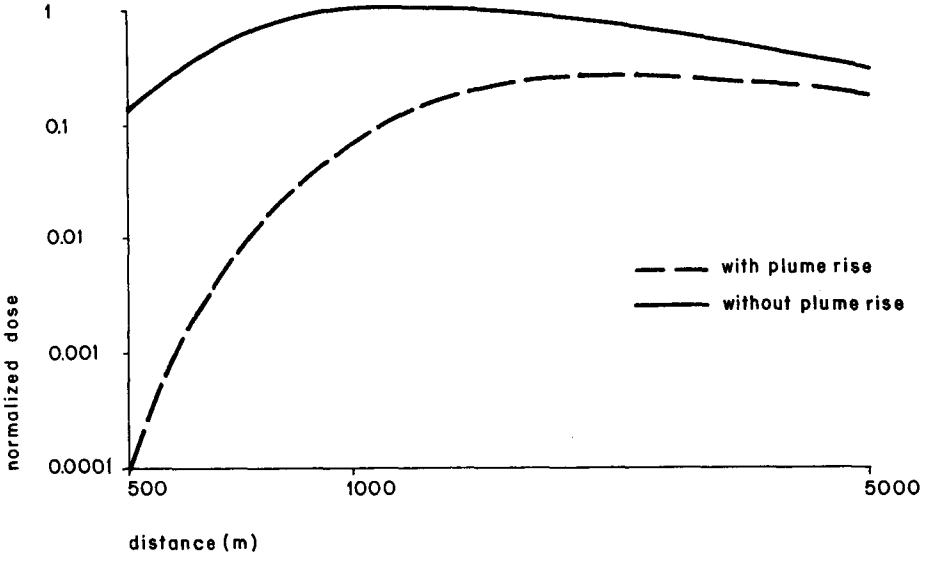
Some graphs corresponding to the analyzed accidents are included as example.

Plume rise effect is observed in Graph 1 for a LOCA with normal operation of safety systems and weather condition E. It is observed that the influence of plume rise decreases with increasing distance and is very important near the source.

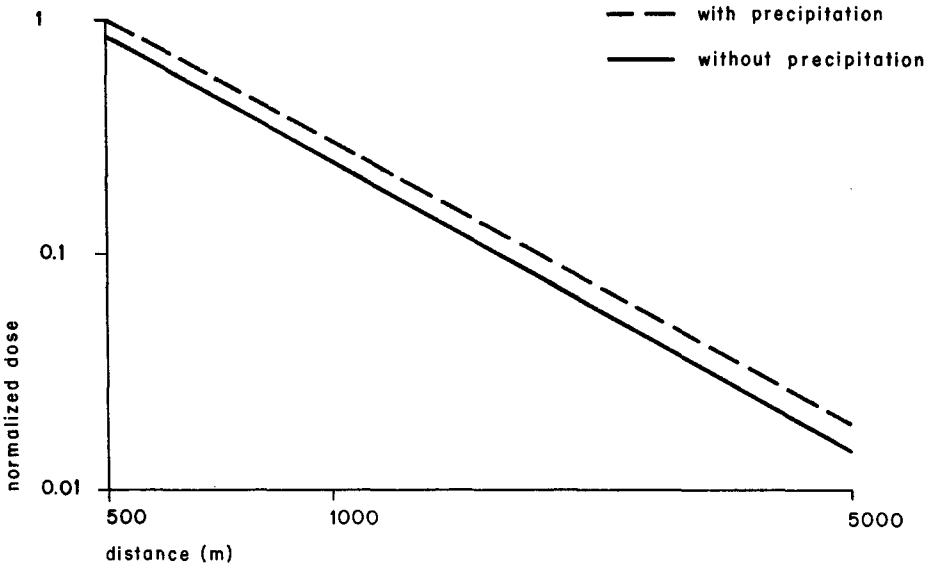
Graph 2 represents the influence of precipitation for weather condition C in case of LOCA with containment isolation failure. It is observed that the influence of precipitation is approximately constant with increasing distance.

Graph 3 represents the influence of building for the above mentioned accident and weather condition F. The influence of building decreases with increasing distance.

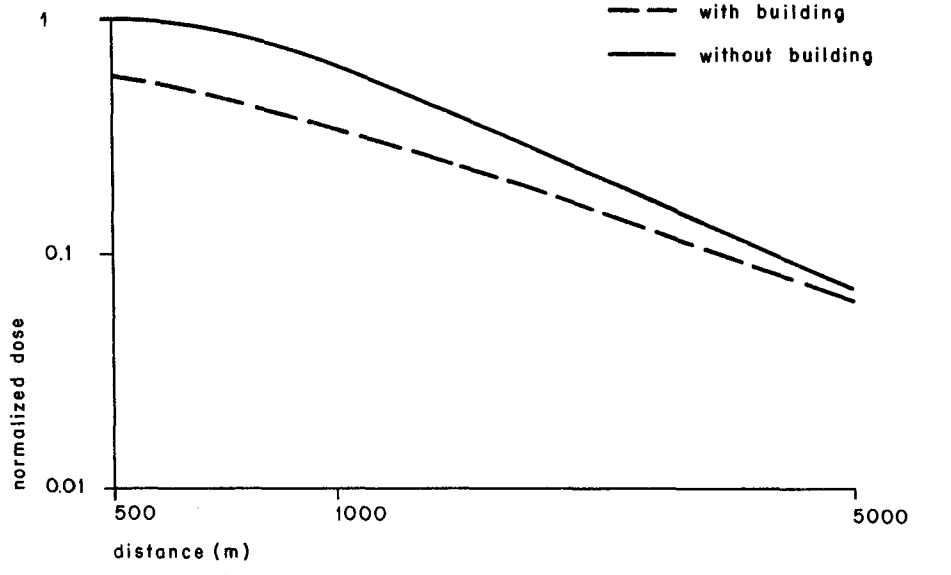
Reference: Influence of precipitations, buildings and plume rise on the doses received by the population in case of accidents in the CNA-II Power Plant. María C. Conte. TN3-002-1986. ENACE.



Graph 1 - LOCA with normal operation of safety systems. Plume rise effect. Weather condition E.



Graph 2 - Precipitation effect. Weather condition C.



Graph 3 - Building effect. Weather condition F.