

## PROBABILITY ANALYSIS OF REINFORCED CONCRETE STRUCTURE FAILURE OF NUCLEAR POWER PLANTS DUE TO LOSS OF COOLANT ACCIDENT

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*This paper describes the probability analysis of reinforced concrete containment structure of NPP with the reactor VVER V-230 under high internal overpressure. The summary of calculation models and calculation methods for the probability analysis of the structural integrity in the case of the loss of coolant accident (LOCA) is showed. The probabilistic structural analysis (PSA) level 2 aims at an assessment of the probability of the concrete structure failure under excessive overpressure. In the non-linear analysis of the concrete structures a layered approximation of the shell elements with various material properties have been included. The uncertainties of longtime temperature and dead loads, material properties (concrete cracking and crushing, reinforcement, and liner) and model uncertainties were taken into account in the  $10^6$  direct MONTE CARLO simulations. The results of the probability analysis of the containment failure under excessive overpressure show that in the case of the LOCA accident at overpressure of 122,7 kPa the probability is smaller than the required  $10^{-4}$  for design resistance.*

Key words: nuclear power plants, concrete containment, structural integrity, concrete cracking and crushing, ANSYS, MONTE CARLO, probability

### 1. Introduction

The International Atomic Energy Agency set up a program to give guidance to its member states on the many aspects of the safety of nuclear power reactors. The resistance of the building structure has been checked for extreme steam pressure in the case of small or medium-sized accidents [9] and on the ground of these results the reconstruction of the structures and technological equipments was realized.

The concrete structures of hermetic zone were analyzed for number of situations, such as a LOCA (Loss of Coolant Accident) or a HELB (High Energy Line Break as steam line break) on the different primary loop piping system.

In the case of the analysis PSA 2 level it's necessary to determine the probability of the concrete structure failure under higher overpressure. Consequently even in a case of a PSA project the objective was not to find the mean failure pressure, but rather the probability of failure under an internal overpressure of definite value.

The general purpose of the probability analysis of the containment integrity was to define the critical places of the structure elements and to estimate the structural collapse. In this paper the nonlinear analysis of the concrete containment resistance for mean values of loads,

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