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Analysis of Rod Withdrawal at Power (RWAP) Accident using ATHLET Mod 2.2 Cycle A and RELAP5/mod 3.3 Codes

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The system code ATHLET is being developed at Gesellschaft für Anlagen-und Reaktorsicherheit (GRS) in Germany. In 1996, the NPP Krško (NEK) input deck for ATHLET Mod 1.1 Cycle C has been developed at Faculty of Electrical Engineering (FER), University of Zagreb. The input deck was tested by analyzing the realistic plant event 'Main Steam Isolation Valve Closure' and the results were assessed against the measured data. The input deck was established before plant modernization that took place in 2000 and included the power uprate and SG replacement. The released ATHLET version (Mod 2.2 Cycle A) is now being available at FER Zagreb. Accordingly, the NEK input deck for ATHLET Mod 2.2 Cycle A has been developed. A completely new input deck has been created taking into account the large number of changes due to power uprate and SG replacement as well as taking advantage of developmental work on NEK data base performed at FER. The new NEK input deck for ATHLET code has been tested by analyzing the Rod Withdrawal Power (RWAP) accident and the results were assessed against the analysis performed by RELAP5/mod 3.3 code. The RWAP accident can be either Departure from Nucleate Boiling (DNB) ratio or overpower limiting accident depending on initial power and reactivity insertion rate. Since the automatic rod control system is assumed unavailable, the only negative reactivity is due to Doppler and moderator feedback. Consequently, the nuclear power and the transferred heat in the steam generators (SGs) increase. Since the steam flow to the turbine and the extracted power from the SGs remain constant, the SG secondary pressure and the temperatures on the primary side increase. Unless terminated by manual or automatic action, the power mismatch between primary and secondary side and the resultant coolant temperature rise could eventually result in DNB ratio and/or fuel centreline melt. In order to avoid core damage, the reactor protection system is designed to automatically terminate the transient before the DNB ratio falls below the limit value, or the fuel rod power density limit (kW/m) is reached. For both ATHLET and RELAP5 analysis, the steady state calculation has been performed for the first 1000 seconds. The RWAP accident is simulated by constant reactivity insertion rate equal to 2.4 pcm/sec.

Keywords: *accident analysis, ATHLET, NPP Krško, RELAP5, rod withdrawal at power, system code*