

**INTRODUCTION OF
PROBABILISTIC SAFETY
ANALYSIS OF THE NPP
TEMELIN**

Author: Miroslav Jakeš

Contents

- **Introduction of PSA**
- **Summary of PSA results**
- **Present PSA conclusions**
- **Updating actions**

Introduction

- **First part of the Level 1PSA**
- **Second part of the Level 1 PSA**
- **The key numerical results of the Level 1 PSA**
- **The results of the Level 2 PSA**

First part of the Level 1 PSA

- **Identification all the different failures and events that can cause reactor trip or lead to a loss of coolant from the primary to secondary system**
- **Development of a comprehensive model of the plant systems, accounting for their interdependency, interactions between events and systems, performance of the operators including impact of the normal and emergency procedures, and the effect of maintenance policy on the system availability**
- **The quantification of the sequences of events leading to core damage**

Second part of Level 1 PSA

- **Determination of the progression of events within the vessel and containment following the loss of decay heat removal for the various plant damage stage**
- **Prediction of progress of the core melting**
- **Determination of the impact the steam and hydrogen behaviour on the pressure inside containment.**
- **Examination of the quantities of fission products released from the vessel during the core melting and vessel failure.**

Introduction of major findings

- **The key numerical results of the PSA Level 1:** estimation of the frequency of core damage for the internal and external initiating events at power, the frequency of loss of cooling to the fuel (RHR cooling is in operation), and the frequency of loss of spent fuel pool cooling during refueling operation.
- **The results of the PSA Level 2:** description of the accident progression following core damage for the sequences at power, and containment response for the various plant damage stages.

Summary of PSA results

- **The core damage frequency for power operation from internal initiation events is $9.0E-5$ per year, from internal fires $1.8E-5$ per year, and from floods $2.3E-6$ per year. (see Table 2-1)**
- **The core damage frequency is dominated by the current relatively high frequency of the large primary to secondary coolant leakage in the steam generator.**
- **The results for the shut analysis are presented as the frequency of loss of cooling (the frequency of loss of cooling to the fuel during residual heat removal operation is $9.0E-5$ per year).**

Present conclusions of PSA

- **The results of the core damage frequency from internal events at Temelin in comparison with other plants within the middle of the range of results (see Table 3-1)**
- **One major assumption which is implicit in the PSA: the new equipment supplied by Westinghouse is compatible with the equipment currently installed, and the dynamic response of the original system will not be impaired.**
- **The dominant contribution to core damage and to off-site release are sequences of events initiated by primary to secondary leakage, and particular steam generator header cover leakage.**

Present conclusions of PSA (cont'd)

- **The highest contributor to loss of cooling to the core during RHR operation (refueling outage)**
- **The containment failure is likely through the penetration in the containment basemat**
- **Loss of off-site power contributes less than 5 % to the CDF**
- **The contribution of anticipated transients with failure to scram to core damage is small in the order of 3 %**
- **The CDF from fire and flooding events is on the order of 10 % of that from internal events**
- **The contribution to CDF from external events was found as negligible (well below 1E-7)**

Updating actions

- **Revising the expected frequency of steam generator header cover leakage based on the design changes to the steam generator**
- **Performing realistic T-H analysis of the leakage through the header cover to determine the time available for the prevention of the core damage**
- **Performing the accident analysis for the bypass sequences and those leading to basemat penetration melt**
- **Extending the fire and flooding analyses according to the cabling and control room desing information**
- **Updating the operator reliability analysis (after procedures completion)**