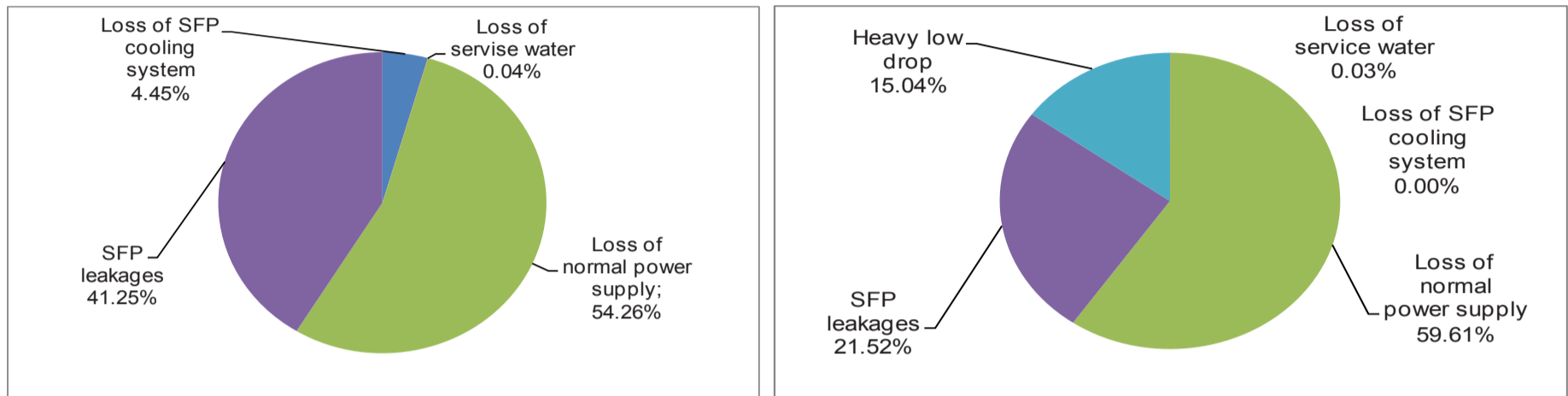


# Assessing the risk related to the spent fuel pool and interactions with the reactor core for WWER type reactors

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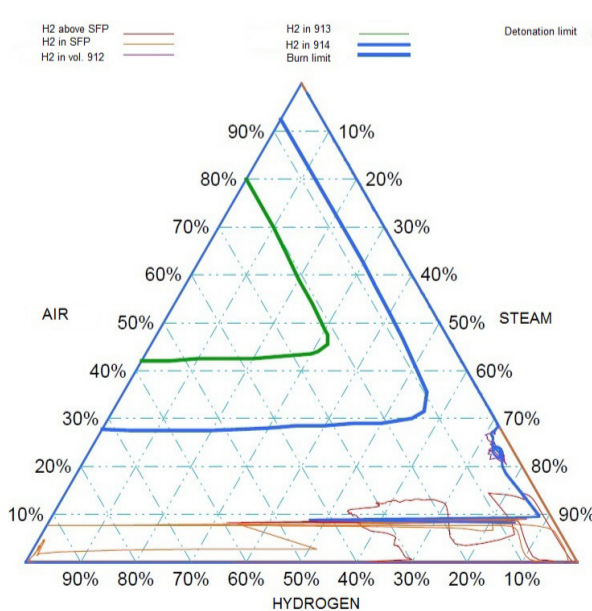
The spent fuel pool (SFP) in nuclear power plants can represent a significant risk of radiation releases in case of melting/damage of stored spent fuel. NPP safety analyses performed up to date are mainly focused on the reactor core. The accident at Fukushima Daiichi unit 4 has demonstrated the vulnerability of SFP with regard to extreme hazards and loss of residual heat removal. SFP interactions with the reactor core is a new task for detailed analysis.



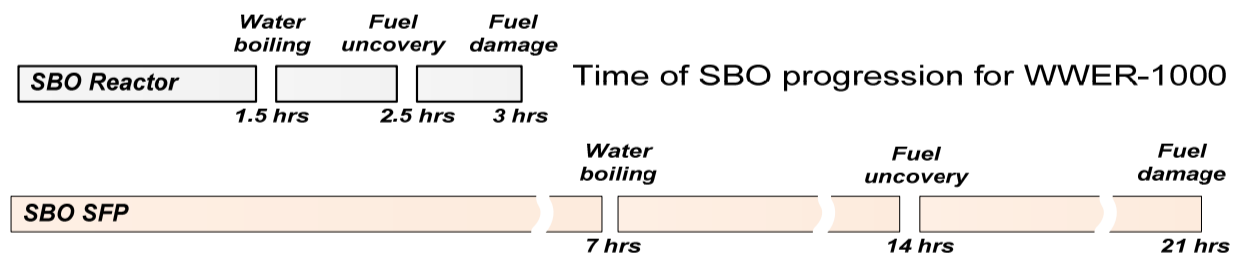
## IE contribution to FD frequency for WWER-440 and WWER-1000

Four main groups of internal IEs are identified for SFP PSA: loss of SFP heat removal, SFP leakages, criticality accident and heavy load drops. SFP parameters such as boric acid concentration, temperature and water level, availability and configuration of safety systems and SFP cooling systems, initiating events that may occur are the key factors for defining the SFP operational states. Human reliability analysis should take into account the positive factor associated with substantial time to take appropriate actions. Assessment of potential types of containment/reactor hall failures should consider early isolation failure, late reactor building failure (due to hydrogen risk), late melt-through and intact reactor building.

According to available evaluations, the fuel damage frequency for operating WWER-400 and WWER-1000 is estimated at the level of  $10^{-6}$  1/year. This evaluation do not take into account the safety upgrades on SFP makeup in case of station black-out from portable diesel-driven pumps or from additional protected stationary equipment under implementation as one of the lessons learnt from the Fukushima accident.



## Hydrogen flammability in the SFP and in the reactor hall WWER-440



Regarding reactor building for SFP of WWER-440, upon the preliminary results of SFP PSA Level 2 the most dominant mode is intact reactor building. This mode does not mean that there is no release of radioactive products into environment, but it means that there are releases from the airtight zone through untightnesses. Magnitude of release depends on a scenario. Risk of hydrogen combustion is decreased by a huge volume of the reactor hall and by a high concentration of steam in reactor hall atmosphere. This paper also presents several examples of mutual impact of the reactor and SFP for WWER-1000 as the first step to understand the problem of SFP and reactor interactions to be further analyzed and carefully considered in probabilistic and deterministic models of PSA.