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An integrated software platform for best estimate safety analyses of nuclear power plants

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Abstract-*Nuclear power plant safety is granted through the demonstration that regulatory acceptance criteria are fulfilled by the provided (calculated) analyses of the NPP performances and sufficient safety margins are respected during normal operation, anticipated transients and postulated accident conditions. Safety margins are very hard to determine in absolute terms, numerical calculations are used to assess their values. Over the last 30 years an extensive effort has been carried out aiming to improve the knowledge of the nuclear power plant behaviour under transient scenarios. The development of Best Estimate (BE) computer codes are the direct consequence of these noteworthy efforts.*

The availability of more sophisticated and specialized computer codes gives the analyst the possibility to perform very detailed analysis in all the fields involved in the safety of a NPP: thermal-hydraulics, CFD, 3D neutron kinetics etc. The possibility to create a software environment where a multidisciplinary problem can be solved adopting different specialized codes able to exchange data among them is a fruitful approach to the problem aiming to improve the results.

The computational tools, adopted in best-estimate approach in licensing, include a) the best estimate computer codes; b) the nodalizations together with the procedures for the development and the qualification; c) the uncertainty methodology.

The Nuclear Research Group of San Piero a Grado of the University of Pisa has developed a software platform with 15 interacting computer codes. Such platform covers the reactor simulation multidisciplinary problem from generation of neutron cross-sections, through system thermal-hydraulic analyses, up to detailed structural and fuel mechanics studies and it embeds software procedures for automatized data transfer between codes. Together with methodological procedures for nodalizations development and qualification the platform leads to a great decrease of the human induced error in the results. The developed platform has been tested and successfully applied to perform the safety analyses required by the Chapter 15 of the Final Safety Analysis Report of the CNA-2 nuclear power plant in Argentina.