

Objectives

The European Validation of the Integral Code ASTEC (EVITA) involves 19 partners from eight European countries plus JRC. It started in February 2000 and ends in July 2003. The main objective is to distribute the severe accident integral code Accident Source Term Evaluation Code (ASTEC), jointly developed by "Institut de Radioprotection et de Sûreté Nucléaire" (IRSN, France) and "Gesellschaft für Anlagen- und Reaktorsicherheit" (GRS, Germany), to European partners in order to apply the validation strategy issued from the VASA project (4th European Community Framework Programme).

Severe accident management (SAM) measures are currently being developed and implemented at Nuclear Power Plants (NPP) worldwide in order to prevent or to mitigate severe accidents. This needs a deep understanding of processes leading to severe accidents and of phenomena related to them. As greater account of severe accident measures is taken in the regulation of plants, there will be the need to show a greater degree of validation of codes and a better understanding of uncertainties and their impact on plant evaluations.

The EVITA evaluation of ASTEC code capabilities and the corresponding feedback towards the code development will be an important step towards the intention to provide end-users (like utilities, vendors and licensing authorities) with a well validated European integral code for the simulation of severe accidents in NPPs,

European Validation of the Integral Code ASTEC (EVITA)

Challenges to be met

To fulfil the objectives nearby described, systems of computer codes, so-called "integral" codes, are being developed to simulate the scenario of a hypothetical severe accident in a light water reactor, from the initial event until the possible radiological release of fission products out of the containment. They couple the predominant physical phenomena that occur in the different reactor zones and simulate the actuation of safety systems by procedures and by operators. In order to study a great number of scenarios, a compromise must be found between precision of models and calculation time. This search of compromise is a real challenge for such integral codes. Such codes have been developed in the United States (MAAP4, MELCOR) and are used worldwide.

In France and in Germany, experimental and analytical work in the field of severe accidents were successfully performed in a distinct manner. It is evident that French and German organisations did not want to use severe accident codes as 'black boxes' without detailed knowledge of what is going on inside the code. Consequently, the French IRSN and the German GRS decided to co-operate in development and validation of a new integral code ASTEC that would contain the best available modelling.

The needs for such a code are: source term determination studies, PSA level 2 (PSA-2) studies, accident management studies, as well as detailed analyses of particular phenomena to improve the understanding of the phenomenology.

As the great number of users has significantly increased especially the level of MELCOR, IRSN and GRS - learning from this - opened the ASTEC use for extended validation and generic application to a wide spectrum of European organisations, first realised in EVITA. The objective was also to get an evaluation of the code capabilities, especially its user-friendliness.

Following the complementary dualism of risk- and phenomenon-oriented validation strategies, experiments and severe accident plant sequences have been selected for the ASTEC validation and application process:

- Validation on high-quality experiments such as International Standard Problems (ISP) of OECD,
- Plant applications (see Table 1) on different types of NPP (PWR, VVER) with activation of safety systems (spray, venting, etc..).

Each case included a comparison with internationally used codes which should represent the State of the Art in modelling: detailed codes for validation, integral codes for plant applications.

Achievements

ASTEC versions V0 and V1 were installed successfully on the partners' platforms. The extensive portability check concluded that the ASTEC user should not fear portability effects.

One of the partners' conclusions was that the level of ASTEC models was near the state of the art in most domains. Of course understanding and thus adequate modeling is still missing, like in all other codes, in some domains: reflooding of a degraded core, MCCI, iodine behaviour in RCS, etc... But obviously recommendations were made to continue efforts of validation and plant application.

The new version V1 allows simulating complete scenarios including the front-end phase. Both developing organisations, GRS and IRSN, which will continue to assure the code maintenance beyond EVITA, ensure that the EVITA outcomes will be respected for the future ASTEC development. Some of the above needed improvements are already foreseen, as well as the extension to Boiling Water Reactors.

Further recommendations are given to improve:

- Management of input decks: tools for automatic check, standard inputs for generic plant applications,
- visualisation / post-processing (remark: actually the GRS visualisation tool ATLAS will be coupled to the next code version),
- user support, including: continuous training courses (not only for beginners, but for experienced users too), wish for faster response of the ASTEC Maintenance team, more complete and detailed code documentation.

EVITA Information Column

Title:

European validation of the integral code ASTEC (**EVITA**)

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Battelle, Eschborn (Germany),
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Joint Research Center (JRC) Ispra/Petten (Italy / The Netherlands),
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Period:

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Status:

Completed

The plant applications with the first version of ASTEC V1 showed that the code is still not so robust that a sequence is calculated up to a foreseen end. Suggestions are made especially for increasing the robustness of the coupling of the two new modules CESAR-DIVA that calculate the circuit thermalhydraulics and the core degradation, so that a significant progress is expected in short time.

With respect to computing time, the different types of EVITA users - researchers, licensing authorities and industry - accepted the definition elaborated in the VASA project as target, that even a full sequence calculation (incl. post-processing) should not need more than 12 hours.

The progress since the beginning of the project where only a preliminary code version was available is important. The actual version allows to simulate the entire sequence of events during a severe accident. Besides, a first level of validation was attained successfully within the project. As EVITA has very successfully made the first step into the intention to provide end-users (like utilities, vendors and licensing authorities) with a well validated European integral code for the simulation of severe accidents in NPPs, the EVITA partners strongly recommend to continue validation, benchmarking and application of ASTEC. This work is foreseen in SARNET (Severe Accident Research Network) in the 6th Framework Programme where ASTEC will play a key role as the reference European integral code.

	French PWR 900	Westinghouse PWR 1000	EPR	Konvoi 1300	VVER 1000	VVER 440/213	VVER 440/230
ENEA	TMLB (<i>MELCOR</i>)						
FANP-Gmbh			SBLOCA with CPA containment module (<i>COCOSYS</i>)				
EA		SBO (<i>MELCOR</i>)					
EDF	H3 (<i>MAAP4</i>)						
FANP-Paris	LFW (<i>MAAP4</i>)						
GRS				SBLOCA (<i>MELCOR 1.8.4</i>)			
IRSN	LFW						
NRI					SBLOCA SBO (<i>MELCOR</i>)		
VEIKI						MBLOCA with CPA (<i>MAAP4, MELCOR</i>)	
UJD						SBO (<i>MELCOR 1.8.3</i>)	SBLOCA (<i>MELCOR 1.8.3</i>)
VUJE						MBLOCA LBLOCA SBO (<i>MAAP4-VVER</i>)	LBLOCA (<i>MAAP4-VVER</i>)

Table 1 EVITA Plant Applications (codes for comparison are in italics)

Partnership

19 partners from eight European countries plus JRC, all having an excellent expertise on severe accidents and code use, were involved in the project, including researchers, licensing authorities and industry. Significant progress on evaluation of ASTEC code capabilities by partners was made possible thanks to a close cooperation inside the project between code users and the IRSN-GRS code development team.

Selected References

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