

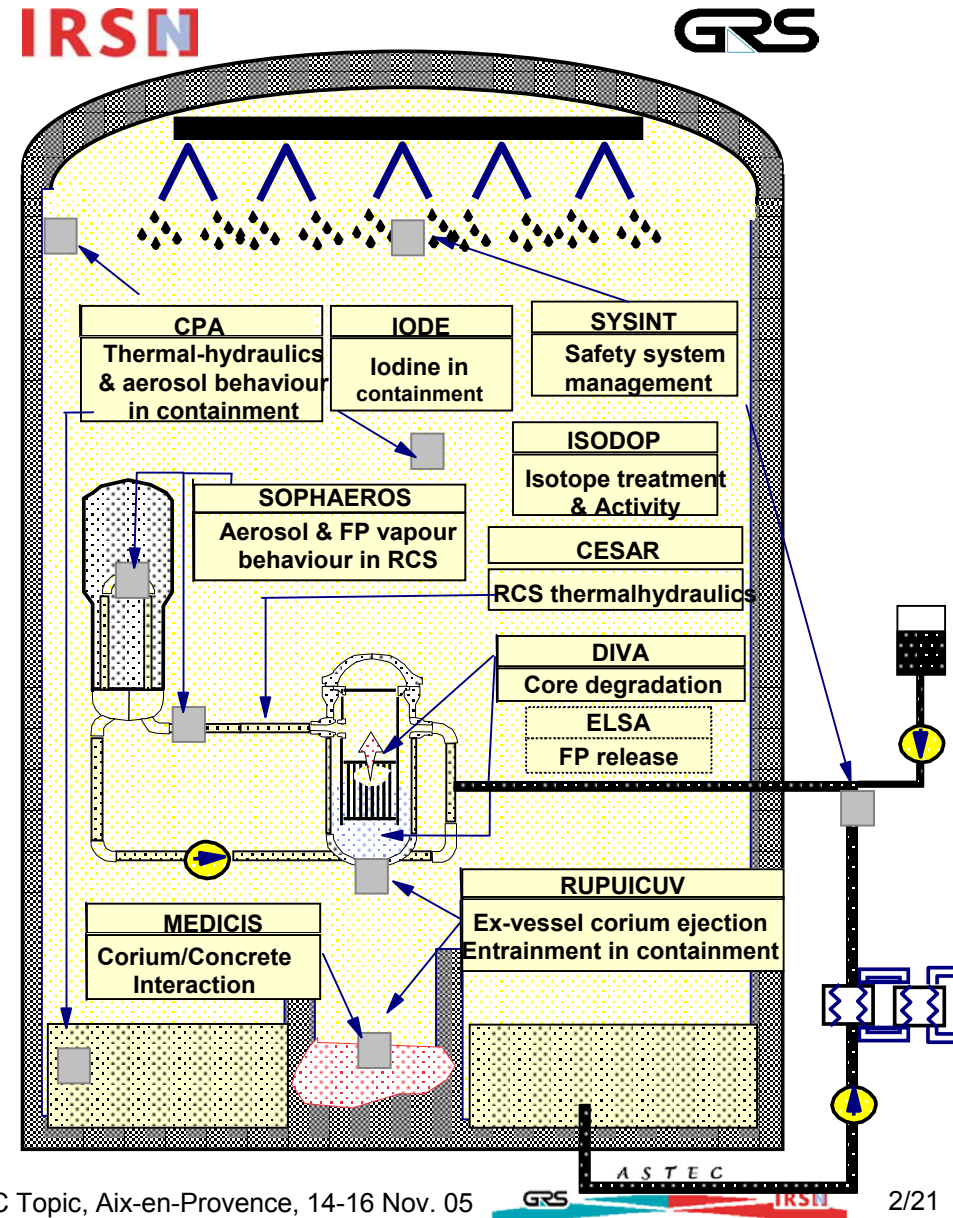
Overview of ASTEC Topic after 19 months

*J.P. Van Dorselaere (IRSN),
Coordinator of the ASTEC Topic in SARNET
(With the contribution of all ASTEC Topic members)*

Contents

- Presentation of ASTEC Topic
- ASTEC Users' support
- ASTEC validation
- ASTEC benchmarks
- Conclusion

- IRSN-GRS development since 1996 of the integral code **ASTEC (Accident Source Term Evaluation Code)** for evaluation of source term and for safety studies during a Severe Accident in a LWR (present and future PWR, BWR, VVER).
- Main other objectives:
 - PSA level2,
 - Evaluation of SA management,
 - Support/interpretation of experimental programmes.
- "Fast-running" code: some hours of calculation / day of accident.
- Includes on the physical modelling level all outcomes of Phébus.PF programme (and other analytical ones) on Fission Products.



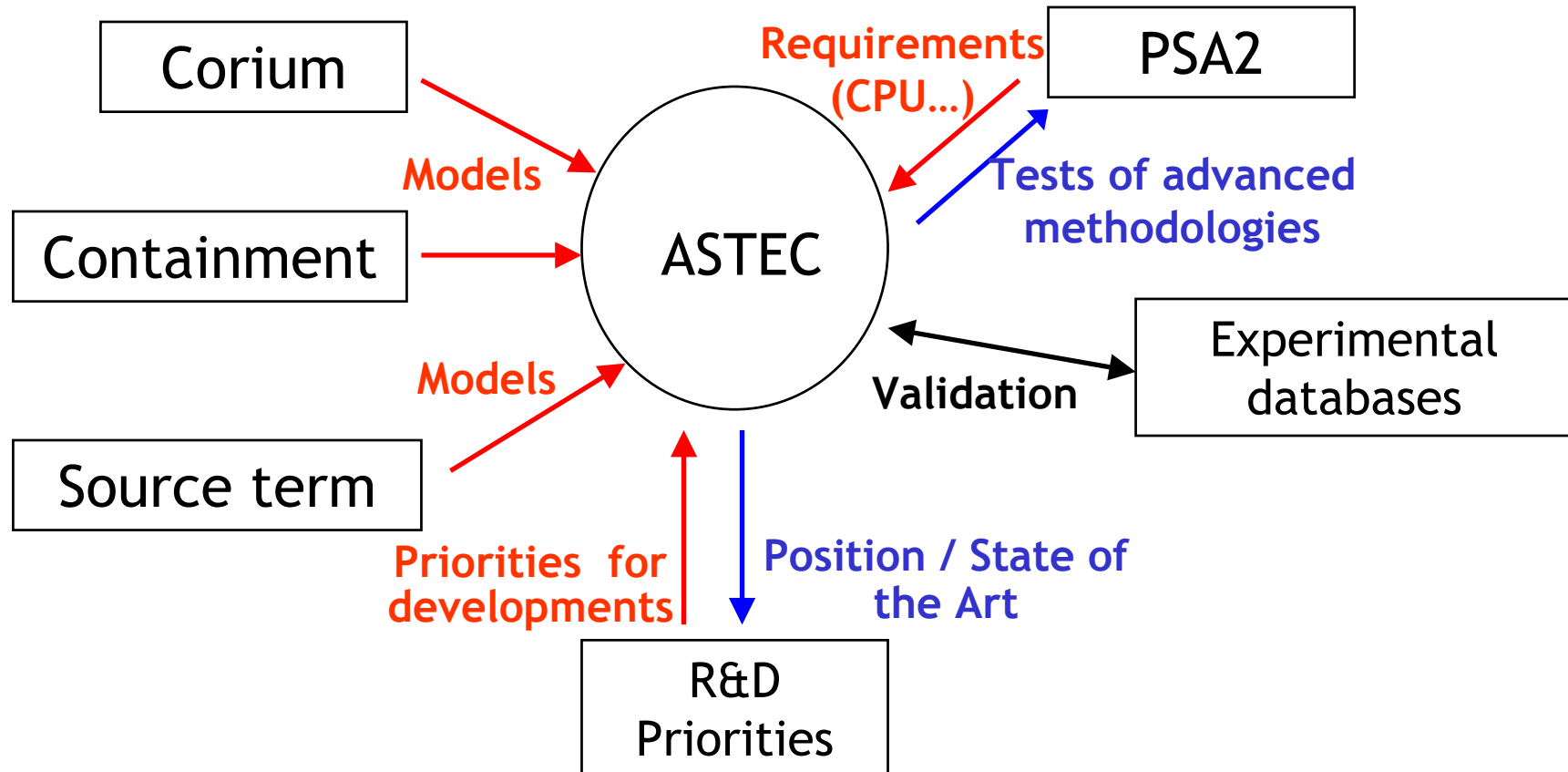
27 partners (out of IRSN-GRS) in JPA2, incl. 2 new partners RUB and PSI / JPA1



- ARCS (Austria)
- BUTE (Hungary)
- CEA (France)
- CIEMAT (Spain)
- DIMNP (Italy)
- EA (Spain)
- EDF (France)
- ENEA (Italy)
- FRA/Paris (France)
- FZK (Germany)
- IKE (Germany)
- INR (Romania)
- INRNE (Bulgaria)
- IVS (Slovak. Rep.)
- JRC-IE (EC)
- JSI (Slovenia)
- KTH (Sweden)
- LEI (Lithuania)
- NRG (Netherlands)
- PSI (Swiss)
- RUB (Germany)
- TRACTEBEL (Belgium)
- TUS (Bulgaria)
- UJD (Slovak. Rep.)
- UJV (Czech rep.)
- VEIKI (Hungary)
- VUJE (Slovak. Rep.)

Topic coordination by IRSN: 3 WP,

- **USTIA**, ASTEC Users Support and Training, Integration and Adaptation:
 - IRSN-GRS code release, users' training and support,
 - Model developments by partners, incl. extension to other NPP than PWR.
 - **PHYMA**, ASTEC Physical Model Assessment:
 - Validation against experiments by partners.
 - **RAB**, ASTEC Reactor Application and Benchmarking:
 - Benchmarks on plant applications by partners and comparison with other codes.
- + Work in **SAP** (= *Separate Associated Program, beyond the JPA*):
- *IRSN-GRS: development of code versions/updates, complementary validation and benchmarking, preparation of future versions ASTEC V2.*
 - *Partners in SARNET WP: complementary validation or benchmarking, in continuity / JPA; code applications for safety studies.*

- Progressive integration of knowledge (models) from R&D into ASTEC
→ *repository of knowledge* (see below the strong links with other Topics)
- Progressive ASTEC deployment as **European reference integral code**.



- ASTEC Web site open, with news on code, model description, code input decks, technical reports, access to the update code versions....
- Delivery by IRSN-GRS of **ASTEC V1.1** mid-04 and **V1.2** mid-05 on a CD-ROM containing code source, executable programs, users' tools, documentation, delivery test-cases.
- Users' support:
 - Users' training course (1 week) organized by IRSN in Aix-en-Provence in June 04 for beginners on ASTEC use: 36 participants.
 - 1st Users' Club at Köln in Feb.05 (4 days): 45 participants from all 29 organizations + 8 members of the ASTEC IRSN-GRS team.
- Maintenance status:
 - MARCUS tool for workflow users-developers: > 100 sheets. 
 - Active Forum on ACT: questions on input data, etc... 



- Model developments: good progress of CEA dev. on I/V late phase (in close collaboration with IRSN).
- Extension to other NPPs: reports on identification of specificities/PWR and preliminary needs of model adaptations,
 - VVER-440 and VVER-1000 → *Few necessary adaptations.*
 - BWR → *strong needs (except for cont.).*
 - CANDU → *Main difficulty=horizontal core. ASTEC existing applications (out of SARNET) for FP transport in RCS and for containment.*
 - RBMK → *Main difficulty = RCS and core. Already ASTEC applications in PHYMA for the confinement structure.*
- Main perspectives for JPA2:
 - Continuation of CEA model developments (e.g. vessel external cooling),
 - Consolidation of NPP specifications through exploratory calculations.
 - *Taken in account in the IRSN-GRS ASTEC development plan (short term in ASTEC V1 or long-term in frame of future ASTEC V2 versions).*

Total JPA2 volume ≈ 5 persons / year.

ASTEC MODULE	PARTNER	PHENOMENA	CODE FOR COMPARISON	EXPERIMENT
CESAR	BUTE	RCS t/h in VVER (DBA)		PMK2
	IVS	RCS t/h in VVER	RELAP5-3D	PACTEL (<i>SBLOCA exp. from IMPAM-VVER</i>)
DIVA	IKE	Late-phase of PWR core degradation	KESS and ATHLET-CD	Phébus FPT4
		Early-phase of PWR core degradation, and H ₂ production during core reflooding	KESS and ATHLET-CD	CORA 13 (ISP 31) incl. quench phase
	FZK	H ₂ production during core reflooding	SCDAP/RELAP5	QUENCH-04, 06, 07, 11
	IRSN	H ₂ production during core reflooding	SCDAP/RELAP5 from FZK, ICARE/CATHARE from IRSN	QUENCH exp. to select
	KTH	Late-phase of PWR core degradation	MVITA	FOREVER and SIMECO exp.
	UJV	Core degradation	ICARE2	Phébus FPT2
	JRC-PT	Core degradation	Overview of SA code results	Phébus FPT2
INR	Core degradation	IKE, FZK and IRSN results	CORA W2	
ELSA (DIVA)	TUS	FP release and transport	-	COLIMA (<i>PLINIUS project</i>)
	JRC-PT	FP release	Overview of SA code results	Phébus FPT0 -1 -2 (<i>coupled application DIVA-ELSA</i>)
CESAR-DIVA	CEA	RCS t/h and core degradation	-	TMI-2 (<i>formally in RAB frame</i>)
	EDF	RCS t/h and core degradation	-	TMI-2 (<i>formally in RAB frame</i>)
	ENEA	RCS t/h and core degradation	ICARE/CATHARE, SCDAP/R5	TMI-2 (<i>formally in RAB frame</i>)
SOPHAEROS	JRC-PT	FP deposition/resuspension in primary circuit	-	STORM SD and SR exp. (incl. ISP40) (<i>coupled application SOPHAEROS-CESAR</i>)
	JRC-PT	FP transport in RCS	Overview of SA code results	Phébus FPT0 and 1
	JRC-PT	FP transport in RCS		TUBA TT28 and TD07
	UJV	FP transport in RCS	MELCOR 1.8.5	Phébus FPT1 -2
	TUS	FP transport in RCS for VVER	-	COLIMA (<i>PLINIUS project</i>)
RUPUICUV	IRSN	DCH in “open” cavity geometry	-	SNL-SUP2

MEDICIS	GRS	MCCI	COCOSYS-WEX	MACE-M3B, 1 LACOMERA exp.
	ARCS	MCCI	COCOSYS-WEX	ACE L4, MACE M4
	IRSN	MCCI	-	ACE L2-5-7
CPA	JRC-PT	T/h - aerosols in containment	Overview of other SA code results	Phébus FPT0: effect study on aerosols Phébus FPT2
	JSI	T/h - aerosols in containment	CONTAIN	KAEVER (ISP44)
	TUS	T/h - aerosols in containment	-	LACE LA4
	IRSN	T/h in containment	TONUS-LP	TOSQAN-MISTRA-ThAI (ISP47)
	LEI	T/h - aerosols in RBMK containment	COCOSYS	Real transient in Ignalina RBMK-1500
CPA-THY	GRS	T/h and spray in containment	COCOSYS	HDR-E11-1
	UPI	T/h in containment	MELCOR, FLUENT, FUMO	TOSQAN (ISP47)
CPA-IODE	CIEMAT	T/h and iodine in containment	-	Phébus FPT2 <i>(coupled calculation)</i>
	ENEA	T/h and iodine in containment	MELCOR	Phébus FPT1 (ISP46) <i>(coupled calculation)</i>
IODE	GRS	Iodine in containment	COCOSYS-AIM	Phébus FPT1 (ISP46) iodine part
ASTEC	INR	Integral behaviour	Existing calculations	Phébus FPT2: variants <i>(integral calculation)</i>
	IRSN	Integral behaviour	Existing calculations (I/C...)	Phébus FPT1 (ISP46) <i>(integral calculation)</i>
	JRC-PT	Integral behaviour	-	Phébus FPT2 <i>(variants of integral calculations)</i>
	GRS	Integral behaviour	Existing calculations	Phébus FPT1 (ISP46) <i>(out of iodine part)</i>
	TUS	Integral behaviour	Existing calculations	Phébus FPT1 <i>(integral calculation)</i>

JPA2 volume \approx 7 persons / year, SAP2 \approx 1,5 p/y (out of IRSN-GRS).

- CESAR: good results on PACTEL T5.2, acceptable on PMK2.
- DIVA: good results on QUENCH (ISP45), CORA-13 (w/o quench phase), and Phébus FPT4 
- Good results for FP models on Phébus FPT0-1 (incl. sensitivity studies) that mostly confirm former IRSN analysis.
- MCCI modules:
 - Acceptable behaviour of water injection models on MACE M3B and M4,
 - Good agreement for tests with real homogeneous corium melts (ACE, OECD-CCI2); more discrepancies for tests with stratified thermite melts (BETA, COMET) → *Need of new experiments to progress.*
- CPA: good t/h results on ISP44 (KAEVER), ISP47 (TOSQAN-MISTRA-ThAI) and Phébus FPT0-1.
 - *1st application to real transient on ALS of Ignalina RBMK: some good results; other less due to model deficiencies (soon improvements).* 



- Important integrating step was achieved mid-05 on definition of a large **common ASTEC validation matrix** that covers:
 - All phenomena,
 - Some NPP-type specificities (except for CANDU),
 - Most available “open” experiments: old, recent, ongoing.
- Main perspectives for JPA2 period, beyond consolidation/completion of ongoing work:
 - Extension on foll. phenomena: core reflooding (QUENCH database), spray in containment, iodine in containment, DCH,
 - Applications to Phébus FPT2,
 - Start of reflections on joint recommendations about **validation guidelines and criteria** (“how good is good”).

REACTOR TYPE	PARTNER	SEQUENCE	MODULES	CODE FOR COMPARISON
Westinghouse 1000	<u>EA</u>	SBO	CESAR-DIVA then +CPA	MELCOR
	TRACTEBEL	SBO, SBLOCA	CESAR-DIVA then +CPA	MELCOR
Konvoi 1300	<u>GRS</u>	MBLOCA	CESAR-DIVA-CPA	MELCOR
	IKE	MBLOCA (I/V only)	CESAR-DIVA-CPA	ATHLET-CD
	NRG	MBLOCA	CESAR-DIVA-CPA	MAAP4
PWR 900	<u>IRSN</u>	SBLOCA	All (incl. MEDICIS)	ICARE/CATHARE
	F-ANP/SAS	SBO	All (incl. MEDICIS)	MAAP4
	ENEA	SBO	All (incl. MEDICIS)	MELCOR 1.8.5
VVER-1000	<u>UJV</u>	LBLOCA (incl. FP)	CESAR-ELSA-DIVA-CPA-SOPHAEROS	MELCOR 1.8.5
		LBLOCA (cont. only)	CPA	MELCOR 1.8.5
	<u>UPI</u>	SBO, SBLOCA	CESAR-DIVA-CPA Then extension to ex-vessel	MELCOR SCDAP/RELAP5
	INRNE			
	TUS			
	<u>KTH</u>	SBO	CESAR-DIVA-CPA	MELCOR
VVER-440/213	<u>VUJE</u>	SBO	CESAR-DIVA-CPA	MAAP4/VVER
	IVS	SBO	CESAR-DIVA-CPA	MAAP4/VVER
	UJD	SBO	CESAR-DIVA-CPA	MELCOR
	VEIKI	PRISE	CESAR-DIVA-CPA	MELCOR

JPA2 volume \approx 9 persons/ year ; SAP2 \approx 1,5 p/y (out of IRSN-GRS).

Most objectives reached: a majority of applications reached the time of vessel lower head failure, but often with save-restarts → *Needs of improvements of code robustness (1st progress in V1.2).*

See also ERMSAR papers on PWR900 (+ TMI2) and on VVER-440.

- Good agreement on front-end t/h phase  and on early-phase of core degradation,
 - But divergences on accumulators injection and on late-phase core degradation, mainly due to different corium relocation models.
- 1st appl. to LBLOCA (acceptable results) and SGTR (difficulties).
- In-vessel H₂ production underestimation (*improvements with V1.2*).
- Good agreement on containment t/h. 
- FP release-transport (few analyses up to now): some difficulties if RCS backflows (*improv. with V1.2*); CANDU physically good results.

- Computation speed already \nearrow of V1.2 / V1.1 $\Rightarrow \approx$ real accident time.
Efforts to be continued.
- High interest of Groups of users (FoBAUs on VVER-1000 in Bulgaria and SHAUG on VVER-440 in Slovakia-Hungary): very high efficiency...
+ convergence towards reviewed reference input decks.
- Perspectives for JPA2 period:
 - Extension of “global” benchmarks, on a limited number of sequences, to FP and Ex-vessel behaviour.
 - Exploratory work on RBMK, CANDU and BWR plant applications.
- Beyond, in JPA3: two-tier approach in parallel with “global” benchmarks (including SAM) but also more “detailed” analysis in order to better understand the origin of the discrepancies (e.g. simplest scenarios or focus on parts of the sequences).

- Positive feedback from all participants to the Users' Club: very fruitful discussions between users and developers.
 - 2nd Users' Club in Spring 2006.
 - Good progress of work, reaching most JPA1 18-months objectives, but needs of code robustness ↗ (progress in ASTEC V1.2).
 - **More “integrated” work plan in JPA2:** use of a joint validation matrix, convergence towards reference input decks/NPP, optimised work within specific Users' groups, more experienced users.
 - Feedback end of 2005 of validation/benchmarking outcomes, users' needs, modelling work in the other Topics: used by IRSN-GRS for the ASTEC development plan, in particular for the preparation of the future versions ASTEC V2.
- *“Circles” of users collaborate closer and closer. Exchange of experience and information is gradually increasing. Networking on ASTEC becomes more efficient...*

Marcus - Microsoft Internet Explorer

Adresse <http://marcus.grs.de:8080/irsn/irsn/login?op=Connect>

Marcus - Closed request list

Print dashboard | E-mail dashboard

Description : Closed request list

	Request author	Module	Version	Request type	Priority	Desired deadline	Abstract
1 <input type="checkbox"/> SARNET/7/ALL	Christophe Seropian	ALL		Installation	Medium	28/07/2004	Example of Request Card in tmi2 calculation,
2 <input type="checkbox"/> SARNET/85/DIVA	Claire Depascale	DIVA		Anomaly	Medium	30/09/2004	abnormal end of calculation in DIVA module
3 <input type="checkbox"/> SARNET/10/CPA	SARNET:acaillaux	CPA		Anomaly	Medium	01/02/2005	Unexpected pressure evolution in containment (900MW / H2)
4 <input type="checkbox"/> SARNET/23/CPA	Klaus Mueller	CPA		Evolution	High	10/08/2004	IEEE error two different nodalizations
5 <input type="checkbox"/> SARNET/27/CPA	Klaus Mueller	CPA		Evolution	High	10/08/2004	IEEE error in the first timestep
6 <input type="checkbox"/> SARNET/31/CPA	Peter Matejovic	CPA		Anomaly	High	30/09/2004	Incorrect valve function. Abnormal termination of the code.
7 <input type="checkbox"/> SARNET/46/ALL	Didier Tarabelli	ALL		Evolution	Low	31/08/2004	Modification of an SR1 using EVENT

Terminé | Internet | 14:27



Discussion on ASTEC use - Microsoft Internet Explorer - IRSN

Fichier Edition Affichage Favoris Outils ?

← Précédente → Recherche Favoris Média

Adresse <http://sarnet.grs.de/sites/WP2/Lists/General%20Discussion/AllItems.aspx> OK Liens

Threaded Flat

Actions

- Add to My Links
- Alert me
- Modify settings and columns

New Discussion | Expand/Collapse

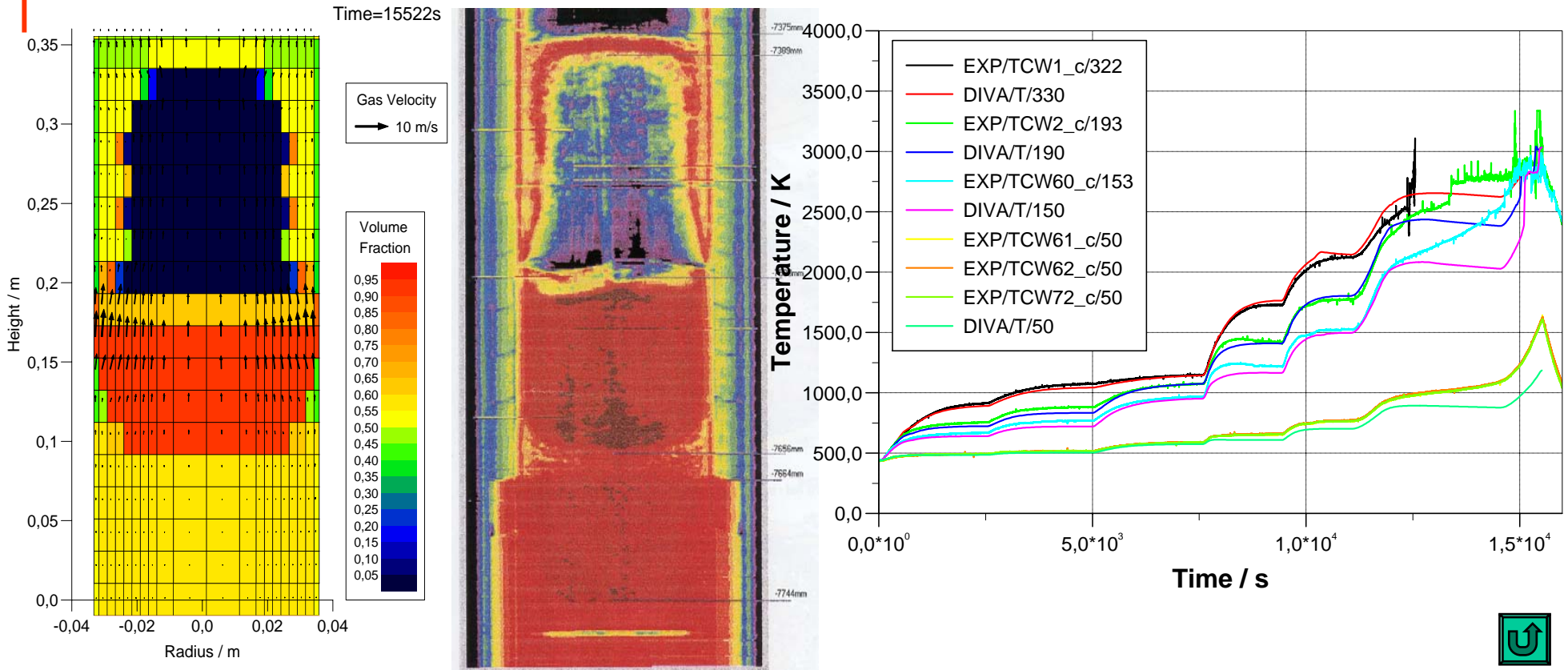
Subject	Replies	Posted By	Modified
ACT + Internet Explorer	0	Caillaux Arnaud	25/02/2005 13:40
Material of control rod guide-tubes in VVER-1000	0	Van-Dorselaere Jean-Pierre	24/01/2005 15:32
Hardware for ASTEC	2	Kalchev Boris	21/01/2005 09:51
General discussion on ASTEC input data	1	Gyenes Gyorgy	21/01/2005 09:52
Thermal-hydraulics of the cavity: there is a real need to model it with CPA?	1	Passalacqua Roberto	29/12/2004 10:11
SOPHAEROS fission product and decay heat input Hi all, Does anybody know how to define fission product decay heat when SOPHAEROS is used without other modules? I am not sure whether to call it "standalone" use, probably yes. I am calculating Phebus FPT1 and re-writing data previously used with ASTEC V0.3. There, the UO2 mass and relative masses of species were defined in STRUCTURE CIRC/STRUCTURE CORE/STRUCTURE POWE... There is...	2	Dienstbier Jiri	20/12/2004 15:26
SOPHAEROS fission product and decay heat input	1	Guillard Gaetan	05/01/2005 09:08
Cavity problems Please, see the attached file.	1	Passalacqua Roberto	02/02/2005 17:07
Cavity problems Dear Roberto First of all, sorry for my late answer ... concerning your first question : In french pwr900, a rupture disk is qualified to break if pressure difference between EVC chimney and cavity is higher than 80 mBars. This is the reason why we use this value. 2 - Yes you're right, but I prefer to model this connection in CPA by a RUPTURE type; and it is done like this in the future version....	0	Seropian Christophe	10/02/2005 17:04
Aerosol deposition on walls with CPA	2	Fontanet Joan	01/12/2004 15:23
VVER-1000 ASTEC applications FoBAUs (Forum of Bulgarian ASTEC Users) participants would like to receive the new input deck for a VVER-1000 with the improved SOPHAEROS data (allowing to reach the vessel failure and the ex-vessel phase of the accident). When do you plan to upload it in the SARNET web page?	6	Passalacqua Roberto	21/01/2005 09:50

Internet

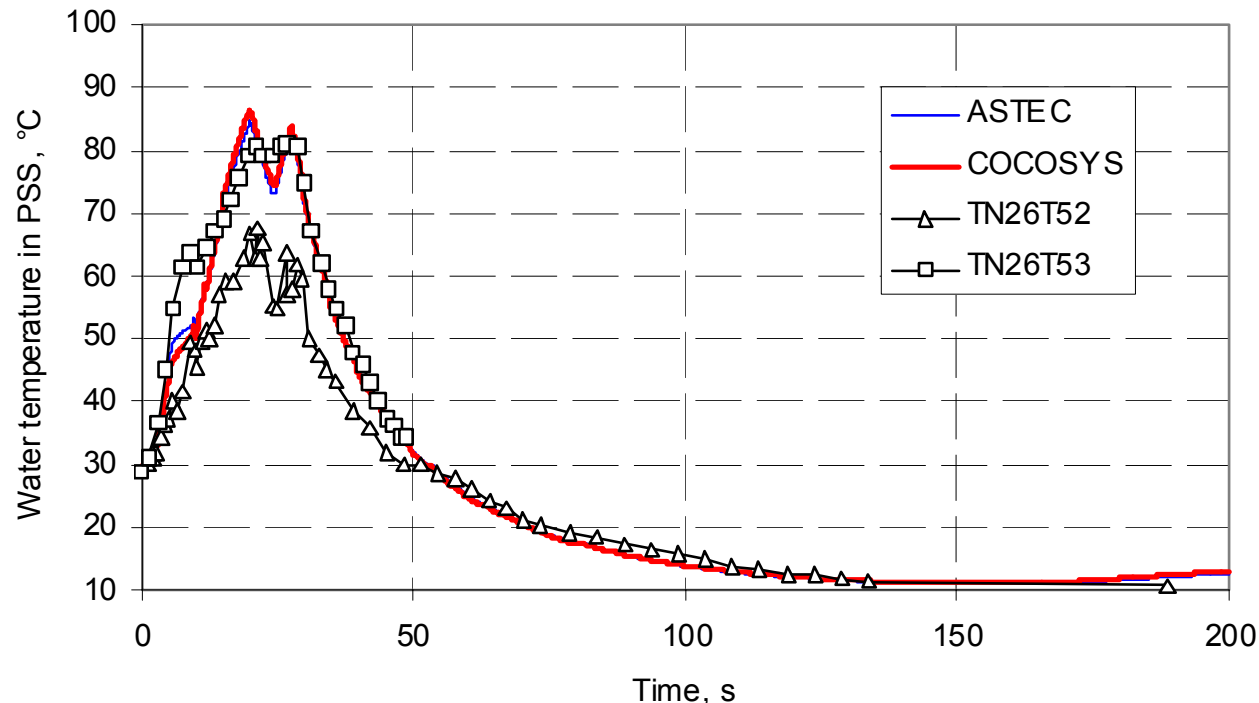
Démarrer Bo... d:... Mi... Di... C... Irf... Irf... 09:18



- DIVA good agreement (*IKE work*) on Phébus FPT4: (left) comparison of calculated final state of UO_2-ZrO_2 debris bed degradation with post-test radiography; (right) comparison of temperatures with measurements.

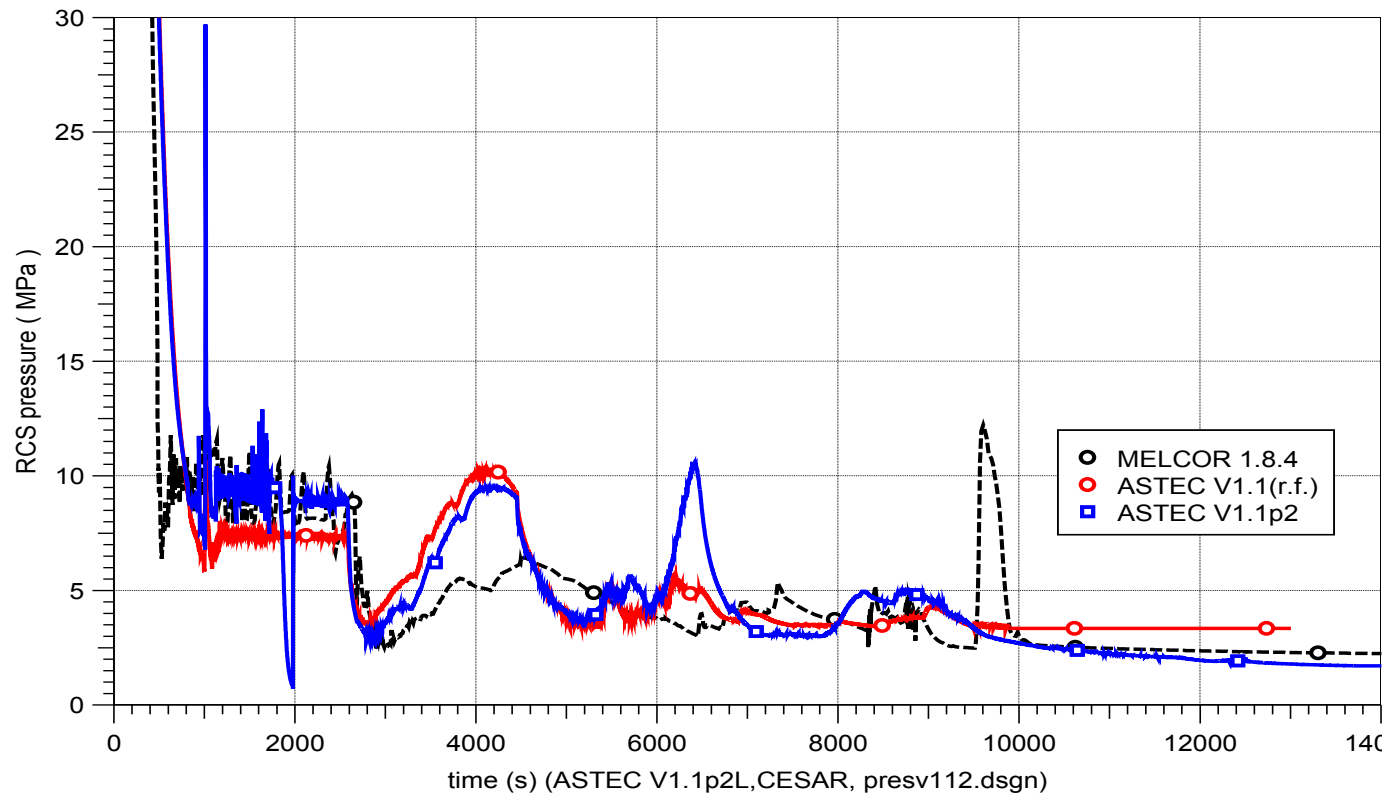


- Application (*LEI work*) to a real operational transient (unintentional single Main Safety Valve opening) in the Accident Localization System of the Ignalina RBMK-1500 confinement.
- Acceptable results (here water temperature in condensing pool), but needs of some model improvements, e.g. on some junctions between volumes.

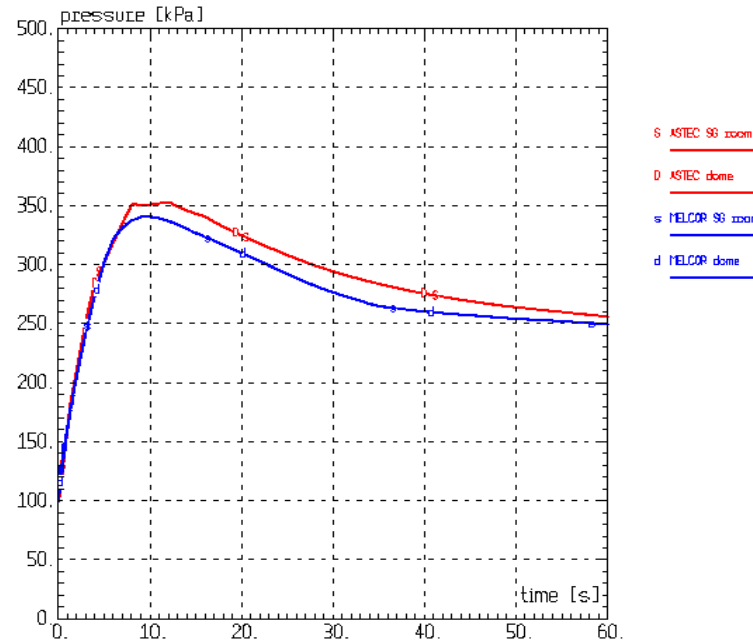


- (GRS work) Primary pressure comparison ASTEC / MELCOR: good overall agreement on 1st part of the sequence; some discrepancies in core degradation late-phase but consistent with current code uncertainties.

PWR1300 ASTECV1.1p2, V1.10rf compared with MELCOR 1.8.4 results



- (UJV work) Containment pressure comparison ASTEC-CPA (stand-alone) / MELCOR: good agreement.



VVER-1000/320 Balakovo, AB hot leg break, CPA

Fig.17 Containment pressure

ASTEC V1.1_p2
MELCOR 1.8.5

