

# 10<sup>th</sup> European Review Meeting on Severe Accidents Research

May 16-19, 2022, AkademieHotel, Karlsruhe, Germany

Severe Accident Research Eleven Years after the  
Fukushima Accident

**MONDAY, MAY 16<sup>th</sup>, 2022**

**12:30 Registration**

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**PLENARY SESSION: WELCOME AND INTRODUCTORY (Room TR 3-4-5)**

**Chairs: R. Stieglitz (KIT), F. Gabrielli (KIT)**

**13:00 Welcome**

W. Tromm

KIT

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**13:05 In Memory of Martin Kissane**

L. E. Herranz

CIEMAT/NUGENIA TA2

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**13:15 Opening**

W. Tromm

KIT

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**13:30 Overview of the NUGENIA TA2 Status**

L. E. Herranz

CIEMAT/NUGENIA TA2 (CIEMAT)

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**14:00 Coffee Break**

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**PLENARY SESSION: INTERNATIONAL PROGRAMS (Room TR 3-4-5)**

**Chairs: L.E. Herranz (CIEMAT), A. Bentaib (IRSN)**

**14:30 Euratom Projects on Severe accidents**

A. Iorizzo (on-line)

European Commission

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**15:00 OECD/NEA Projects & WGAMA Activities  
On Severe Accidents**

D. Jacquemain (on-line)

OECD/NEA

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**15:30 IAEA Activities Related to Severe  
Accidents**

A. Miassoedov

IAEA

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**16:00 Coffee Break**

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	Room TR 3-4-5		Room TR 20-21	
	<b>Session 1-1: In-vessel Corium and debris coolability</b>		<b>Session 2-1: Severe Accident Scenarios</b>	
	<b>Chair: T. Hollands (GRS), F. Gabrielli (KIT)</b>		<b>Chair: S. Brumm (JRC), S. Paci (Unipi) (on-line)</b>	
<b>16:30</b>	<b>The IAEA Coordinated Research Project on Developing a Phenomena Identification and Ranking Table and a Validation Matrix, and Performing a Benchmark for In-Vessel Melt Retention</b> A. Miassoedov (IAEA), S. Massara (IAEA)	<b>265</b>	<b>Source term estimation and dispersion analysis of VVER-1000 reactor in case of LBLOCA along with SBO</b> A. K. Mercan (KIT)	<b>287</b>
<b>16:55</b>	<b>Iron and zirconium oxidation at liquid state under Ar-O<sub>2</sub> and Ar-H<sub>2</sub>O gas mixtures in Severe Accident conditions</b> P. Piluso (CEA)	<b>319</b>	<b>Prediction of the Radiological Consequences of a Severe Accident Scenario in a Generic KONVOI Nuclear Power Plant</b> E.-M. Pauli (Framatome)	<b>311</b>
<b>17:20</b>	<b>In-vessel debris melting experiments performed in LIVE3D test facility</b> X. Gaus-Liu (KIT)	<b>336</b>	<b>CCFL Model Effect of Pressurizer Surge Line Flow on Severe Accident Progression in TMI-2 using CINEMA</b> R.-J. Park (KAERI)	<b>261</b>
<b>17:45</b>	<b>Integral modelling of continuous/dispersed phases mass transfer during in-vessel corium stratification transients</b> R. Le Tellier (CEA)	<b>259</b>	<b>Analysis of LOCA accident for BWR-4 under DEC-A conditions using ASTEC code</b> T. Kaliatka (LEI)	<b>318</b>

**18:10 Adjourn**

**TUESDAY, MAY 17<sup>th</sup>, 2022**

**PLENARY SESSION: FUKUSHIMA: 10 (+1) YEARS AFTER (Room TR 3-4-5)**

**Chair: A. Bentaib (IRSN), L.E. Herranz (CIEMAT)**

<b>9:00</b>	<b>Current understanding of the accident scenarios and major phenomena</b> Y. Kumagai (on-line)	OECD/NEA
<b>9:30</b>	<b>Current situation of the site</b> S. Mizokami	TEPCO
<b>10:00</b>	<b>Accident management &amp; nuclear decommissioning</b> K. Okamoto (on-line)	JAEA/CLADS

**10:30 Coffee Break**

	Room TR 3-4-5		Room TR 20-21	
	<b>Session 1-2: In-vessel Corium and debris coolability</b>		<b>Session 2-2: Uncertainties in Severe Accident Scenarios</b>	
	<b>Chair: S. Massara (IAEA), F. Gabrielli (KIT)</b>		<b>Chair: F. Mascari (ENEA), S. Paci (Unipi) (on-line)</b>	
<b>10:45</b>	<b>Characterization of prototypic corium sample simulating Fukushima Daiichi unit 2 lower head composition</b> C. Journeau (CEA)	<b>300</b>	<b>Status of the Uncertainty Quantification for Severe Accident Sequences of Different NPP Designs in the Frame of the H-2020 Project MUSA</b> S. Brumm (JRC)	<b>278</b>
<b>11:10</b>	<b>Modelling of premixed layer in stratified fuel-coolant configuration</b> M. Uršič (IJS)	<b>309</b>	<b>Overview of IAEA CRP I31033 “Advancing the state-of-practice in uncertainty and sensitivity methodologies for severe accident analysis in water cooled reactors”</b> H. U. Rehman (IAEA)	<b>314</b>
<b>11:35</b>	<b>Analysis of RANS Turbulence Models of Natural Convection of Corium Pool for In-Vessel Retention</b> D. Dovizio (NRG)	<b>322</b>	<b>The APR1400 SOARCA Study: Insights into the Severe Accident Progression and Source Term Analysis Results</b> K. Ahn (KAERI)	<b>264</b>
<b>12:00</b>	<b>Assessment of a dynamic global-coefficient subgrid-scale model for turbulent natural convection in a confined cavity</b> S. Whang (SNU)	<b>277</b>	<b>Uncertainty Quantification for a Severe Accident Sequence in a SFP in the Frame of the H2020 Project MUSA: First Outcomes</b> O. Coindreau (IRSN)	<b>275</b>

**12:25 Lunch**

	Room TR 3-4-5		Room TR 20-21	
	<b>Session 3-1: Ex-vessel Corium interactions and coolability</b>		<b>Session 2-3: Uncertainties in Severe Accident Scenarios</b>	
	<b>Chair: S. Bechta (KTH), P. Piluso (CEA)</b>		<b>Chair: O. Coindreau (IRSN), S. Paci (Unipi) (on-line)</b>	
<b>14:00</b>	<b>PIRT Development for the Corium Coolability and MCCI Phenomena during Postulated Severe Accidents in the Reactor Cavity</b> S.K. Sim (EN2T)	<b>331</b>	<b>Preliminary Uncertainty and Sensitivity Analysis of the ASTEC simulations results of a MBLOCA scenario at a Generic KONVOI Plant using FSTC tool</b> A. Stakhanova (KIT)	<b>327</b>

<b>14:25</b>	<b>Enhancing Ex-Vessel Corium Coolability for Installed Base Nuclear Power Plants</b> M. Hupp (Framatome)	<b>270</b>	<b>CIEMAT's outcomes from the PHEBUS-FPT1 uncertainty analysis in the framework of the EU-MUSA project</b> R. Bocanegra (CIEMAT)	<b>324</b>
<b>14:50</b>	<b>Quenching Phenomena in High Temperature Cylindrical Particle Bed-MONET Tests</b> M. Modak (SNU) (on-line)	<b>279</b>	<b>Parametric analysis of FPT-1 MELCOR 2.2 input deck as a preparation for uncertainty quantification study</b> M. Malicki (PSI)	<b>274</b>
<b>15:15</b>	<b>Thermodynamics of aerosols during a molten core-concrete interaction at Fukushima Daiichi unit 2 conditions</b> H. Laffolley (CEA)	<b>299</b>		

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**15:40 Coffee Break**

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	Room TR 3-4-5		Room TR 20-21	
	<b>Session 3-2: Ex-vessel Corium interactions and coolability</b>		<b>Session 4-1: Severe Accident Scenarios in Innovative Systems</b>	
	<b>Chair: A. Miassoedov (IAEA), P. Piluso (CEA)</b>		<b>Chair: H. U. Rehman (IAEA), F. Rocchi (ENEA)</b>	
<b>16:00</b>	<b>Super Absorbing Polymers as a Means to Enhance Melt Fragmentation in Water to Suppress Steam Explosions During Ex-Vessel Phase of a Severe Accident</b> M. Fischer (Framatome)	<b>271</b>	<b>Analysis ofbdba sequences in a generic IRIS reactor using ASTEC code</b> P. Maccari (ENEA) (online)	<b>338</b>
<b>16:25</b>	<b>Assessment of Ex-Vessel Corium Coolability of the VVER-1000 Reactor as a Measure of Severe Accident Mitigation</b> M. Kotouc (UJV)	<b>317</b>	<b>Severe Accident Analysis Research at CNL for Small Modular and Advanced Reactor Designs</b> A. Morreale (CNL)	<b>276</b>
<b>16:50</b>	<b>Experiment and Numerical Simulations on Long-Term Ablation of SFR Core-Catcher</b> B. Bigot (CEA) (on-line)	<b>337</b>	<b>MELCOR Integrated Severe Accident Code Scoping Uncertainty Study of Heat Pipe Reactor Accident Progression</b> D. Luxat (SNL)	<b>304</b>
<b>17:15</b>			<b>MELCOR Integrated Severe Accident Code Demonstration Uncertainty Study of High-Temperature Gas-cooled Reactor Accident Progression</b> D. Luxat (SNL)	<b>305</b>

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**17:40 Adjourn**

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**WEDNESDAY, MAY 18<sup>th</sup>, 2022**

	Room TR 3-4-5		Room TR 20-21	
	<b>Session 5-1: Source Term</b>		<b>Session 7-1: Hydrogen and Containment Related issues</b>	
	<b>Chair: N. Girault (IRSN), S. Gupta (Becker Techn.)</b>		<b>Chair: M. Hupp (Framatome GmbH), I. Kljenak (IJS)</b>	
<b>8:30</b>	<b>Research needs on Source Term: a CSNI/WGAMA perspective</b> L. E. Herranz (CIEMAT)	<b>328</b>	<b>Results of metallographic analysis of the QUENCH-20 bundle with B4C absorber.</b> J. Stuckert (KIT)	<b>340</b>
<b>8:55</b>	<b>Fission Product Behaviour in Severe Accident Condition: Focus on Information gained from VERCORS/VERDON Analytical Programs</b> Y. Pontillon (CEA) (on-line)	<b>292</b>	<b>Status of Modeling of FeCrAl Claddings in Severe Accident Codes and Application on the QUENCH-19 Experiment</b> T. Hollands (GRS)	<b>315</b>
<b>9:20</b>	<b>Experimental study of Csl revaporization behavior in RCS condition after a SA</b> E. Le Fessant (IRSN)	<b>268</b>	<b>Current understanding of high-temperature oxidation phenomena during air ingress scenarios</b> S. Park (Lee & Co)	<b>284</b>
<b>9:45</b>	<b>Experimental study on the feasibility for noble gases (Xe, Kr) trapping using Metal-Organic Framework</b> J. Nguyen-Sadassivame (IRSN)	<b>269</b>	<b>THAI Experiments on Iodine Behavior in a Room Chain Representing Flow Conditions in Large Containments</b> M. Freitag (Becker Technologies)	<b>356</b>

**10:10 Coffee Break + Poster Session**

	Room TR 3-4-5		Room TR 20-21	
	<b>Session 5-2: Source Term</b>		<b>Session 6-1: Severe Accident Modeling and Code Development</b>	
	<b>Chair: T. Lind (PSI), S. Gupta (Becker Techn.)</b>		<b>Chair: E.-M. Pauli (Framatome), F. Gabrielli (KIT)</b>	
<b>11:00</b>	<b>Pool scrubbing in Unit 1 of Fukushima Daiichi</b> L. E. Herranz (CIEMAT)	<b>294</b>	<b>Synthesis of the ASTEC V2.2 code validation vs. experimental data</b> P. Chatelard (IRSN)	<b>302</b>
<b>11:25</b>	<b>Bubbles dynamics under pool scrubbing conditions for iodine compounds trapping applications</b> M. Farhat (IRSN)	<b>298</b>	<b>Development of Severe Accident Code CORVES for Analysing In-Vessel Degradation Phase of Severe Accident in VVER-1000 Reactor</b> S. Sil (NPCIL)	<b>266</b>
<b>11:50</b>	<b>New pool scrubbing correlations based on reliable data</b> L. E. Herranz (CIEMAT)	<b>329</b>	<b>Modeling of Fission Product Release during Severe Accidents: Overview of Recent Developments in the Fuel Performance Code Alcyone</b> J. Sercombe (CEA)	<b>303</b>

<b>12:15</b>	<b>The R2CA project for a better evaluation of radiological consequences under Design Basis Accidents and Design Extension Conditions in LWRs : Motivation and first results</b> N. Girault (IRSN)	<b>332</b>	<b>A Simplified Core Catcher Model for the Containment Code AC2/COCOSYS</b> C. Spengler (GRS)	<b>313</b>
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**12:40 Lunch**

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**PLENARY SESSION: NEW ELEMENTS IN THE SA RESEARCH DOMAIN (Room TR 3-4-5)**

**Chair: H. U. Rehman (IAEA), I. Kljenak (IJS)**

<b>14:10</b>	<b>Accident Tolerant Fuels</b> M. Khatib-Rahbar (on-line)		Energy Research, Inc.	
<b>14:25</b>	<b>Small Modular Reactors</b> P. Dejardin		TRACTEBEL	
<b>14:40</b>	<b>Interface with environmental impact</b> W. Raskob		KIT	
<b>14:55</b>	<b>Innovation in Modeling</b> L. Chailan		IRSN	

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**15:40 Coffee Break**

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	Room TR 3-4-5		Room TR 20-21	
	<b>Session 7-2: Hydrogen and Containment Related issues</b>		<b>Session 4-2: Severe Accident Scenarios in Innovative Systems</b>	
	<b>Chair: M. Freitag (Becker Techn.), I. Kljenak (IJS)</b>		<b>Chair: C. Journeau (CEA), F. Rocchi (ENEA)</b>	
<b>16:00</b>	<b>High combustion risk sequences: Identification and characterization</b> L. E. Herranz (CIEMAT)	<b>339</b>	<b>MELCOR Integrated Severe Accident Code Scoping Uncertainty Study of Fluoride-salt-cooled High-Temperature Reactor Accident Progression</b> D. Luxat (SNL)	<b>306</b>
<b>16:25</b>	<b>Dynamically Prescribed Turbulent Numbers in Containment Atmosphere Mixing Simulations</b> R. Krpan (IJS)	<b>312</b>	<b>MSR Simulation with cGEMS: Fission product release</b> T. Lind (PSI)	<b>272</b>
<b>16:50</b>	<b>An Analysis of Combustion Regimes for Hydrogen/CO/Air Mixtures in Different Geometries</b> M. Kuznetsov (KIT)	<b>334</b>	<b>Modelling FPs Release from Sodium Pools under DBDA Conditions</b> L. E. Herranz (CIEMAT)	<b>323</b>
<b>17:15</b>			<b>On the Pursuing of Safety Enhancements in Sodium Fast Reactors</b> S. Perez-Martin (KIT)	<b>333</b>

**17:40** Adjourn

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**19:00** Conference Dinner at the AkademieHotel (GenoHotel)

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**THURSDAY, MAY 19<sup>th</sup>, 2022**

	Room TR 3-4-5		Room TR 20-21	
	<b>Session 7-3: Containment Behavior - Recombination</b>		<b>Session 6-2: Severe Accident Modeling and Code Development</b>	
	<b>Chair: A. Bentaib (IRSN), I. Kljenak (IJS)</b>		<b>Chair: L. Chailan (IRSN), F. Rocchi (ENEA)</b>	
<b>9:00</b>	<b>Experimental Investigation on the Effect of Carbon Monoxide on Platinum- and Palladium-based Catalysts for Passive Auto-catalytic Recombiners</b> G. Nobrega (IRSN)	<b>301</b>	<b>Sensitivity Analyses on MELCOR Accumulators Modelling</b> G. Agnello (ENEA)	<b>320</b>
<b>9:25</b>	<b>Enhancement of Recombination Rate Correlations for PARs in Oxygen-Lean Conditions</b> J. Fontanet (CIEMAT)	<b>286</b>	<b>Experiment Investigation of QUENCH-20 and Simulation with AC2/ATHLET-CD</b> T. Hollands (GRS)	<b>316</b>
<b>9:50</b>	<b>Effectiveness of Hydrogen Recombination by AgX and AgR Zeolites</b> F. Espegren (PSI)	<b>330</b>	<b>Detection of radionuclides in northern Europe in June 2020: investigations on possible source term location and origin</b> J.J. Ingremeau (IRSN)	<b>335</b>
<b>10:15</b>			<b>RCCS-2021 OECD specialist workshop on “Reactor core and containment cooling systems – long term management and reliability workshop” -Overview on the main outcomes</b> A. Bentaib (IRSN)	<b>293</b>

**10:40 Coffee Break****PLENARY SESSION: CLOSING (Room TR 3-4-5)****Chairs: L.E. Herranz (CIEMAT), F. Gabrielli (KIT)****11:10 Summary and conclusion of the Session  
Chairs**

Session Chairs

ERMSAR Technical Committee

**12:10 Concluding Remarks and Introduction of  
ERMSAR2024**

A. Bentaib, L. E. Herranz

NUGENIA/TA2 (IRSN, CIEMAT)

**12:30 Closing Remarks**

L. E. Herranz, F. Gabrielli

CIEMAT, KIT

**12:45 Adjourn**



## **FRIDAY, MAY 20<sup>th</sup>, 2022**

Technical visit to the experimental facilities at the KIT Campus North – optional program

- **HYKA**
- **QUENCH**
- **LIVE Experimental Platform**
- **KASOLA**
- **SOLTEC**

### **Timetable of the Technical visits**

<b>9:00</b>	Bus transfer from AkademieHotel to KIT Campus North
<b>9:40</b>	Arrival to KIT Campus North
<b>10:00</b>	Visit to the HYKA facility
<b>10:30</b>	Visit to the QUENCH facility
<b>11:00</b>	Visit to the LIVE and MOCKA facilities
<b>11:30</b>	Visit to the KASOLA and SOLTEC facilities
<b>12:00</b>	End of the visit Bus transfer to the Karlsruhe train main station