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INSTITUTE OF CONCEPTS IN NUCLEAR

FISA 2019

9th European Commission Conference
on EURATOM Research and Training
in Safety of Reactor Systems

4-7 June 2019
Pitesti, Romania



SNETP-NUGENIA Research and Innovation in Nuclear
a non-profit international organization to promote RD&D&I for
the safe long-term operation of GEN-II and -III

by Michel Maschi, President

Outline

- Nugenia Mission
- Who's NUGENIA
- NUGENIA open innovation platform
- NUGENIA project portfolio
- NUGENIA and its stakeholders
- Outcome of NUGENIA-FORUM-2019
- Nuclear is attractive and competitive
- Take away

What is NUGENIA?

Definition

- NUGENIA is an international non-profit association founded under Belgian legislation in November 2011 and launched in March 2012

Mission

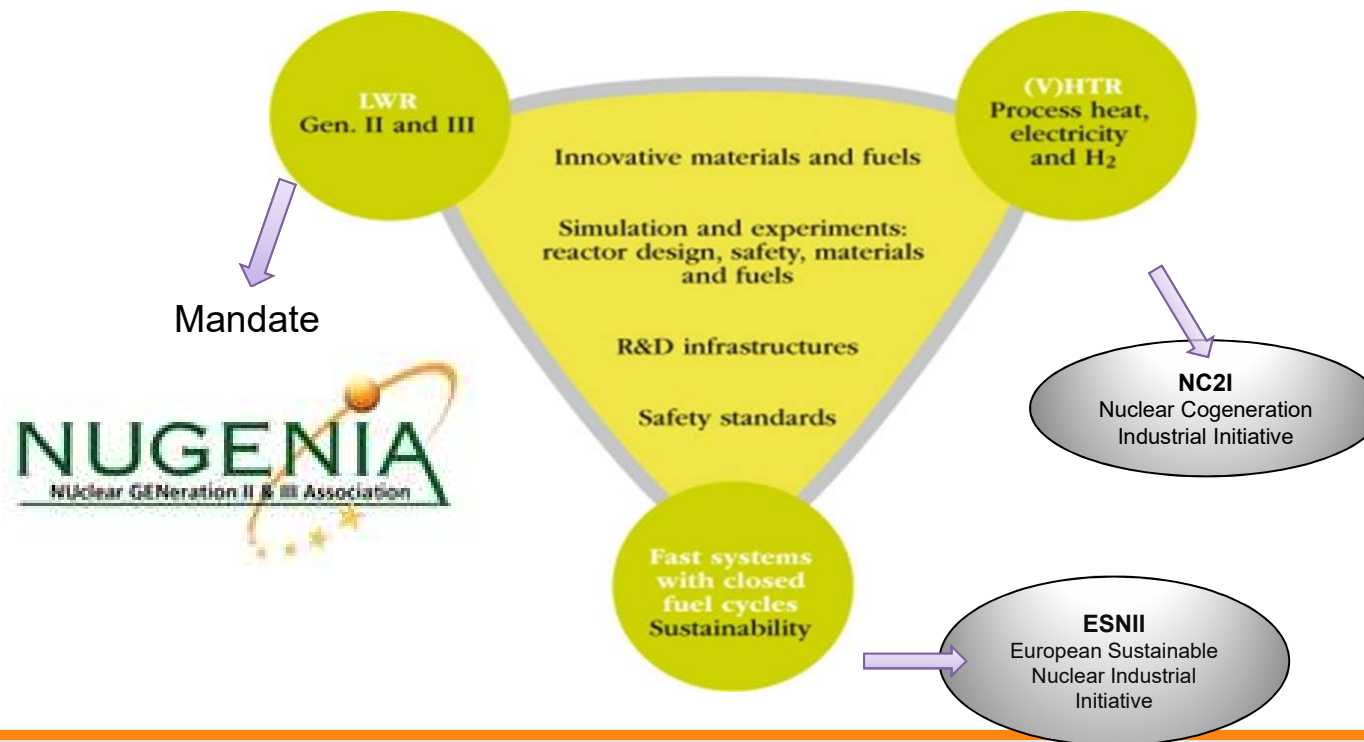
- Its mission is to be an integrated framework for safe, reliable and competitive Gen II & III fission technologies, whose objectives are to:
 - Fosters collaboration between industry, SMEs, RTOs, academia and technical safety organisations
 - Build knowledge and expertise
 - Facilitate the emergence of innovation
 - Maintain and develop the needed skills, competences to tackle the up-coming challenges (LTO, new build, dismantling,)



NUGENIA in the SNETP frame



The *Sustainable Nuclear Energy Technology Platform* is the European forum dedicated to nuclear fission technologies, with a focus on three strategic pillars:



Who is NUGENIA today?

- Members: major nuclear stakeholders
 - 103 full members and 8 honorary members from 24 countries (as of April 2019): Industry, utilities, research institutions, SMEs and technical safety organisations



- Honorary Members



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WORLD NUCLEAR
ASSOCIATION
Energy and Nuclear Systems

Work fields

Technical Areas

1. Plant Safety and Risk
2. Severe Accidents
3. Improved Nuclear Power Plant Operation
4. Integrity of Systems, Structures and Component
5. Fuel Development, Waste & Spent Fuel Management and Decommissioning
6. Innovative LWR Design & Technology
7. Harmonisation
8. In-Service Inspection and Qualification



Targets

- Raising public awareness on nuclear R&D
- Supporting technical excellence
- Improve safety in operation and by design
- Efficient integration of NPPs in the energy mix
- High reliability of components



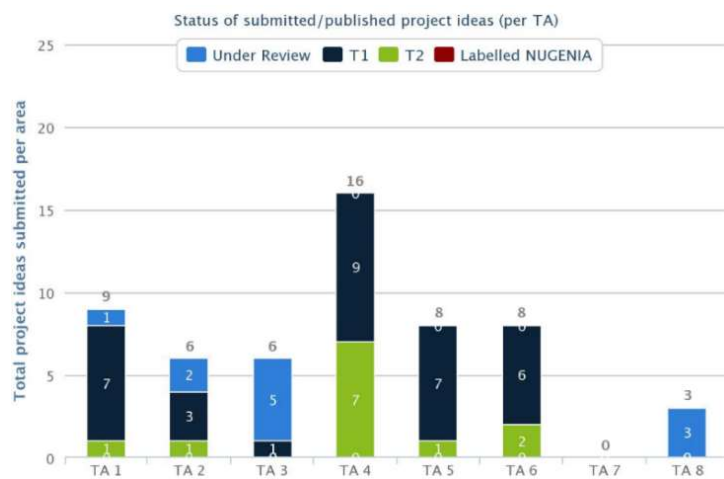
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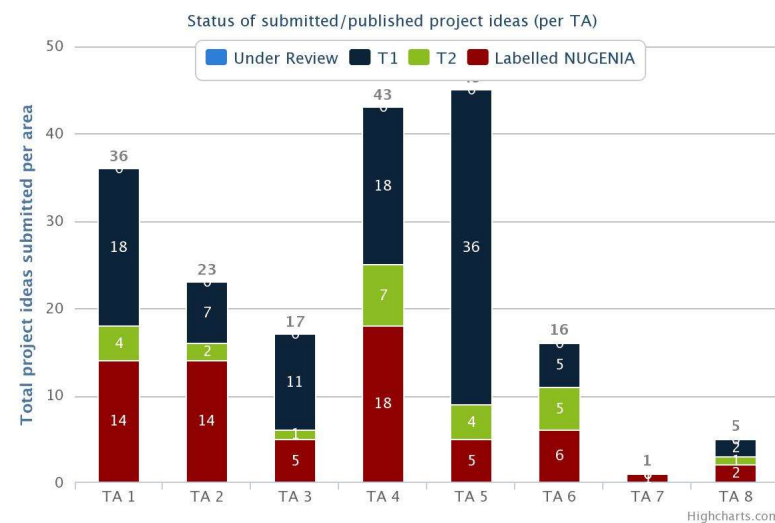
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Project ideas: Bottom-up approach

- NUGENIA Open Innovation Platform (NOIP) allowed identification of more than 180 project ideas (more than 1000 users)
- 63 project ideas labelled since May 2014



Sept' 2014



May 2019

NUGENIA+ project: Making NUGENIA ready for Horizon 2020 and beyond

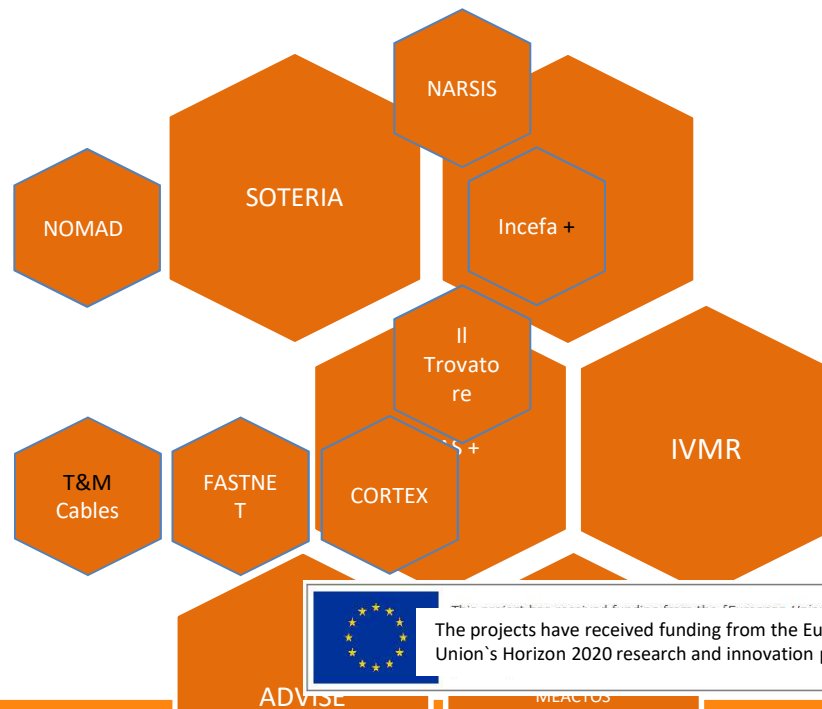
- The ultimate goal of the N+ project is strengthening of the role of NUGENIA
 - to become the reference association able to structure the R&D at the European level integrating private and public efforts, and
 - To initiate international collaboration creating added value in its activity
- 32 new partners joined the 18 original partners as the result of the pilot research project call launched in September 2014



NUGENIA portfolio (1/3)

18 H2020 Euratom ongoing projects

- 13 running since 2016-2017...



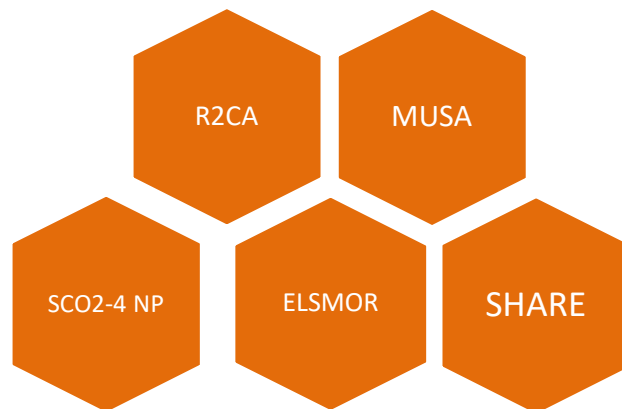
- **SOTERIA** (CEA): Safe LTO of LWR (Degradation of RPV and RVI, follow-up project of FP7 projects PERFORM60 & LONGLIFE);
- **Mc Safe** (KIT): High-Performance Monte Carlo Methods for SAFETY Demonstration – From Proof of Concept to realistic Safety Analysis and to Industry-like Applications
- **INCEFA+** (Wood): INcreasing Safety in NPPs by Covering gaps in Environmental Fatigue Assessment
- **IVMR** (UJV): Management Strategy of In-Vessel Melt Retention in existing and future NPPs
- **ATLAS +** (VTT): Advanced Structural Integrity Assessment Tools for Safe Long Term Operation
- **MEACTOS** (CIEMAT): Mitigating EAC Through Optimisation of Surface condition
- **ADVISE** (EDF): Advanced Inspection of Complex Structures
- **NOMAD** (IZFP): NDE System for the inspection of operation-induced material degradation
- **T&M CABLES** (EDF): European Tools and Methodologies for an efficient ageing management of nuclear power plant cables
- **Il Trovatore** (SCK-CEN): Innovative cladding materials for advanced accident-tolerant energy systems
- **CORTEX** (IRSN): Non-Intrusive Core Monitoring Techniques Relying on Inherent Reactor Dynamics
- **FASTNET** (IRSN): Fast Accident Source Term tools for Emergency Centers
- **NARSIS** (CEA): New Approach to Reactor Safety Improvements



NUGENIA portfolio (2/3)

18 H2020 Euratom ongoing projects

- ...And 5 started in 2019!



- **R2CA** (IRSN): *Reduction of Radiological Consequences in design basis Accident (R2CA)*
- **MUSA** (CIEMAT): *Management & uncertainties of severe accidents*
- **SCO2-4 NPP** (EDF): *sCO2-based heat removal technology FOR and increased level of safety of Nuclear Power Plants*
- **SHARE** (CEA): *StakeHolder-based Analysis of REsearch for Decommissioning*
- **ELSMOR** (VTT): *towards European Licensing of Small Modular Reactors*



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NUGENIA portfolio (3/3)

6 in-kind on-going projects



■ Projects description

- **CoreSOAR** (IRSN): In-Vessel Core Degradation State-of-the-Art Report Update
- **QUESA** (IRSN): QUENCH experiment with Steam and Air
- **GUSIP** (EDF): Guidance on the USability of a Inspection Procedure
- **IPRESA** (IRSN): Integration of Pool Scrubbing Research to enhance Source-term Calculations
- **ASCOM** (IRSN) : ASTEC Community
- **STRUMAT-LTO** (NRG) – STRUctural MATerials research for safe Long-Term Operation of LWR NPPs

A portfolio of about 120 M€, and more than 2500 europeans experts are involved
70% of the members are contributing to at least one project

NUGENIA Interactions

- **MoU signed between NUGENIA and:**
 - IAEA
 - European Radiation Protection Research Platforms (MELODI, EURADOS, NERIS, ALLIANCE: MENA)
 - Ministry of Economic Affairs and Employment of Finland
 -



March 18, 2015: Third General Assembly in London ratified EPRI as Honorary member



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NUGENIA Interactions

■ NUGENIA R&D Stakeholders' sessions

- Exchanges with the NUGENIA ExCom Members to share views on NUGENIA Activities and potential synergies
- Several Sessions in February, May and December:
 - Spain (Madrid – Empresarios Agrupados)
 - Czech Republic (Prague/Rez – UJV, CV Rez, CEZ)
 - UK (Manchester - Wood, NIRO)
 - France (Paris – CEA)
 - Finland (Helsinki – Fortum & VTT)
 - Hungary (Budapest- Bay Zoltan & MTA-EK)





After Budapest (2012, 2013), Madrid (2014), Ljubljana (2015)
Marseille (2016), Amsterdam (2017), Prague (2018),

Main Topics to be discussed:

- ✓ Improved safety: passive systems and ATF
- ✓ Hazards and environment: severe-accidents, earthquakes, fire, etc.
- ✓ Digital transition: multi-physics modeling and simulation, data analysis, visualisation, advanced instrumentation
- ✓ Components manufacturing: additive manufacturing, civil engineering
- ✓ Decommissioning and dismantling: advanced tools and methods
- ✓ Innovation and competitiveness of Nuclear: flexibility, SMR,



260 participants representing 90 organisations

Fostering Nuclear Industry R&D



Competitive



Attractive

**Driving Research and Innovation toward
existing fleet and new built**



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Nuclear of the Future

Competitive

Develop technological bricks

- Providing a *global and long-term vision*, with clearly identified milestones
- *Accelerating* integration of outsourced technological breakthroughs
- Identifying and tackling *technological and scientific challenges*
- Bridging academic and industrial research
- Featuring *flexibility*: new designs / existing fleet in operation

Attractive

Showcase nuclear R&D and communicate

- Rally academic partners to tackle our scientific challenges
- Enlarge collaboration to new players (start-up, SME)
- Attract new talented people



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Safety

Reducing severe accident impact & improving operation margins

Enhanced Accident Tolerant Fuel



SiC/SiC concept (release of silica, manufacturability)

Seismic evaluation to address more stringent requirement

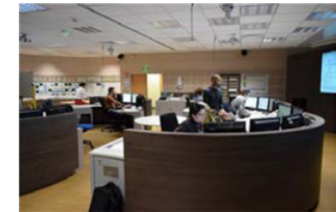
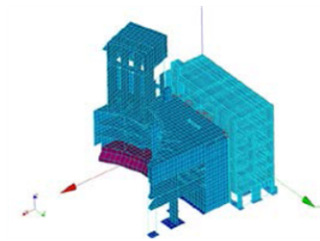


Extreme hazards, experimental data (knowledge acquisition, validation) and design of seismic-proof equipment

Passive systems to simplify new built design



Dimensions constraints limiting the ability to fulfill the function, ability of the codes to handle the phenomena



New Fabrication and Repair solutions

Identify game changing technologies

Powder metallurgy

- Additive Manufacturing (3D Printing) for spare parts or new components
- High Isostatic Pressure (HIP) manufacturing



*Metallurgic and mechanical properties
for nuclear use, control methods*



Polymers

New technology and methods of rebar
concrete and steel concrete panel



Fast and reliable welding process, control methods for concrete



Digital Transition and Data Analytics

Keys performances enablers to simplify operation and design

Outage preparation : as built Reactor Building
Mock up and deep learning tools



Adding more intelligence into digital models

Predictive maintenance with data analytics



Handle heterogeneous data

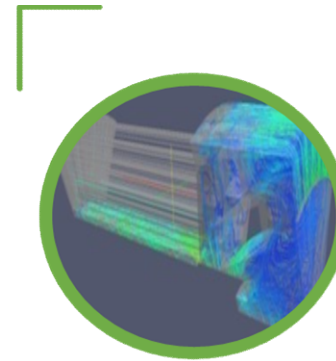
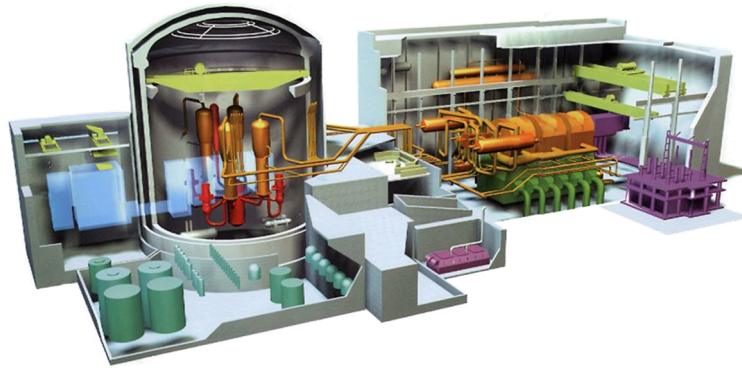
Virtual power plant, Digital Twins for operation
and maintenance



*Enhanced interaction by the use of virtual reality, develop the links
with simulation codes*



Digital Twins for Operation & Maintenance



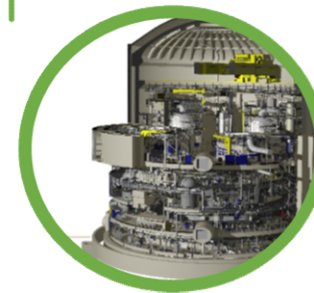
Process/multi-Systems



System



Local/building



Take away

NUGENIA has achieved:

- Strong **involvement** of utilities, vendors, suppliers, safety and R&D
- Annual **work plans** setting priorities, involving public authorities and private organisations
- A transparent **open-innovation process**: NUGENIA facilitates the bottom-up emergence of projects within the roadmap
- Balanced cooperation with **international counterparts on cross-cutting issues**

...still to do:

- Contribute to preparation of the **next generation** of researchers and engineers
- Future **structuring** within public-private (PPP) and/or public-public partnerships (P2P)
- Play a **driving role** in the implementation of **Horizon Europe/SET-PLAN** objectives
- Increase the **integration of innovation** (shorten the time to market through R&D)
- Development of mutual understanding through **public engagement**



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**Thank you for your
attention**

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