



International Conference on Fast Reactors and Related Fuel Cycles
April 19-22, 2022

Development of Safe and Sustainable Fast Reactor Systems: EU context and JRC Contributions

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Euratom Treaty – Conception of JRC

Signing of the Treaties of Rome, 25 March 1957
Treaty of the European Economic Community (EEC)
Treaty of the European Atomic Energy Community (EURATOM)



Paul-Henri Spaak and Jean-Claude Sauty et d'Oppuers at the signature of the Treaty establishing European Atomic Energy Community (EURATOM) 25.03.1957

The Nuclear Safety and Security Directorate of JRC

Petten

- Nuclear Reactor Safety, Emergency Preparedness



Geel

- Nuclear data
- Standards for Nuclear Safety, Security & Safeguards



Karlsruhe

- Nuclear Fuel Safety
- Waste Management
- Nuclear Science & Applications
- Nuclear Safeguards & Forensics

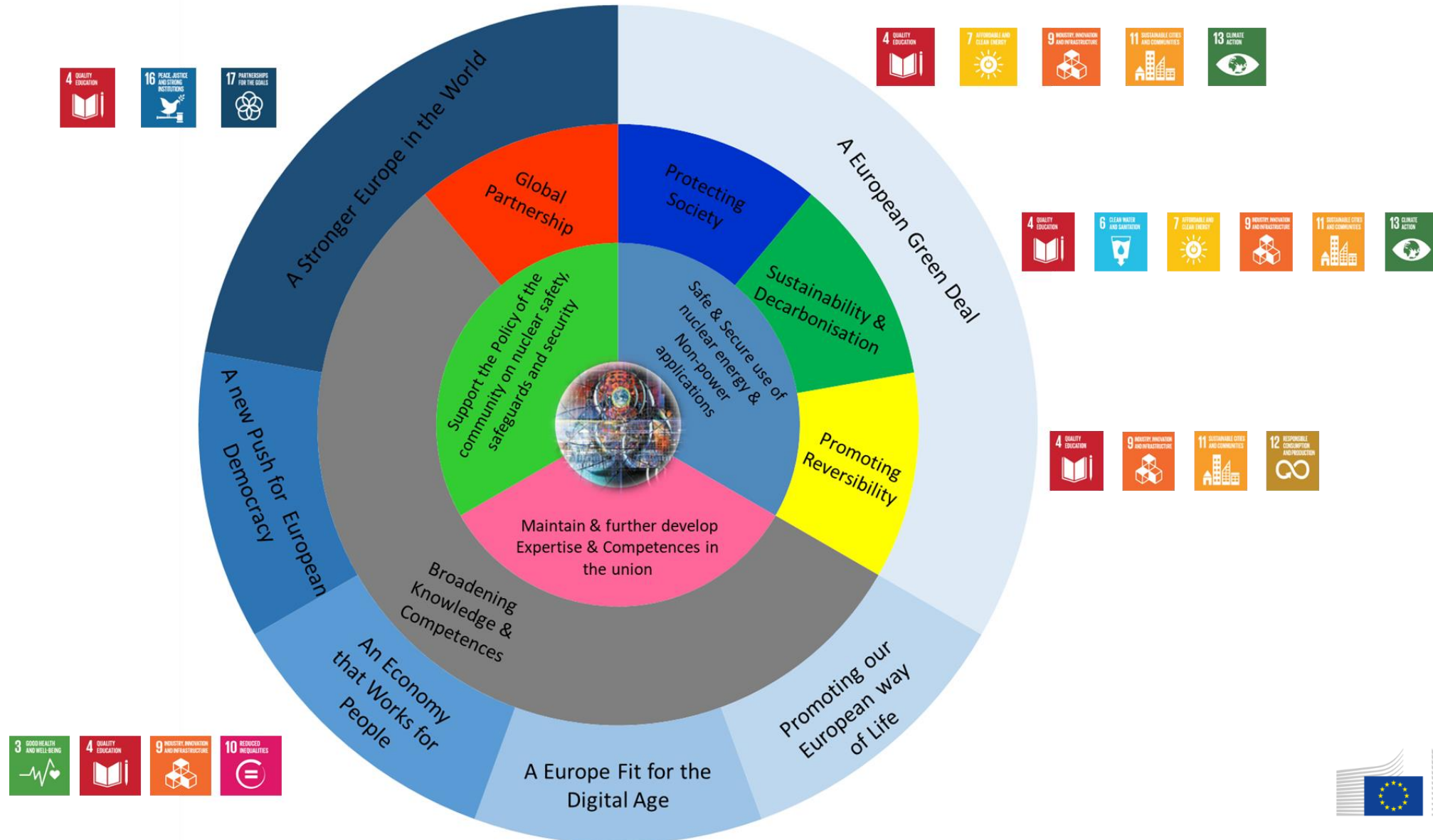
Ispra

- Nuclear Security & Safeguards
- (Nuclear Decommissioning)



EURATOM in a Global Context:

Social Challenges, Political Priorities & SDGs



JRC EURATOM Horizon Europe

Research, Training & Education Thematic Areas

Radioactive Waste Management

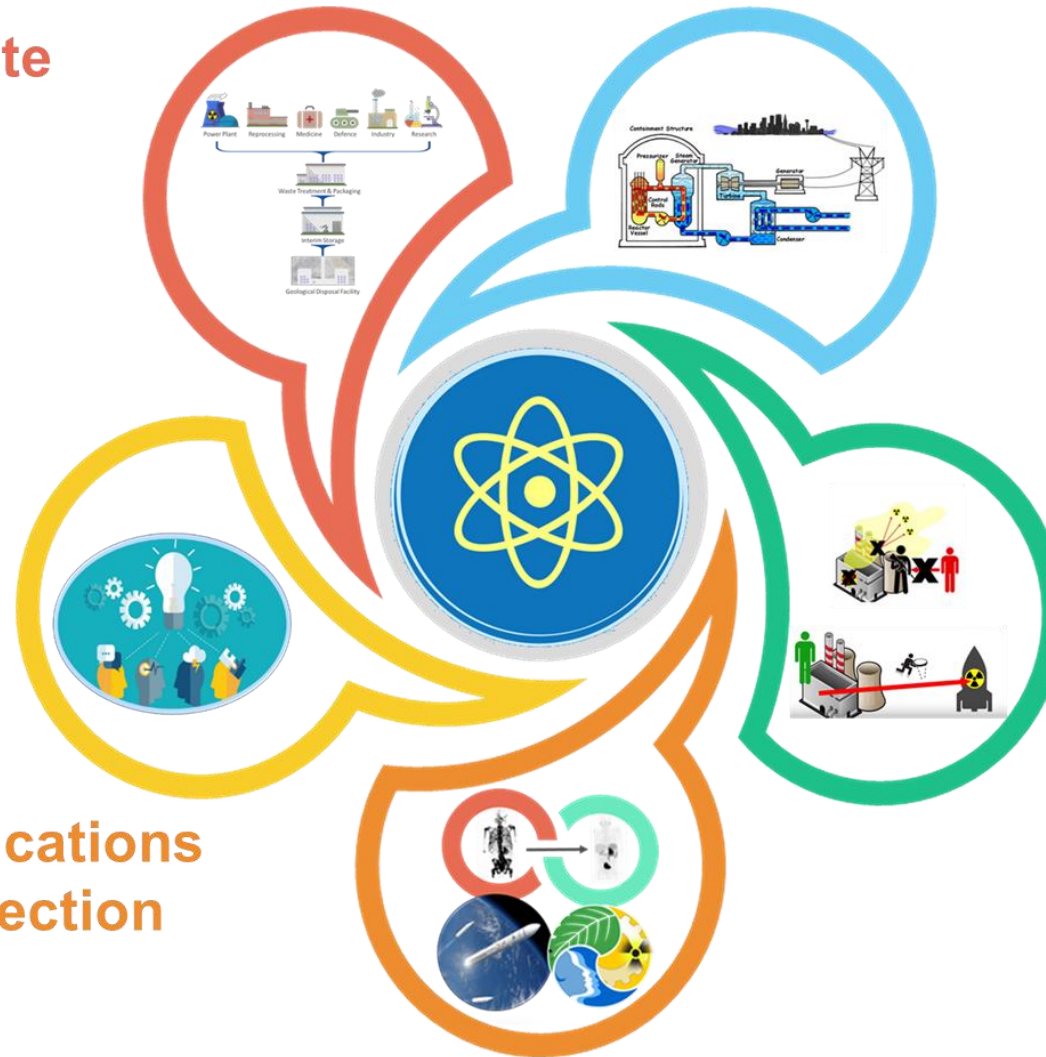
Deep Geological Disposal
Extended Interim Storage
New Waste Forms (ATF, SMR)
Regulatory framework
E&T, KM, Open Access

Nuclear Knowledge & Competence

Maintain Competence (E&T)
Human Resources Observatory
Support JRC Open Access
Reference Data & Standardization
Innovation & Technology
from Research to Industry

Non-power Applications & Radiation Protection

Medicine, Environment, Space
EU beating Cancer
Standardization
Accelerators
Open access, E&T



Nuclear Safety of Nuclear Power Plants

Nuclear reactor safety
Update of safety regulations
LTO, SMR, Gen-IV
Innovative materials
Fuel development and testing
Infrastructures: JHR, HFR and Open Access
Emergency Preparedness

Nuclear Safeguards and Security

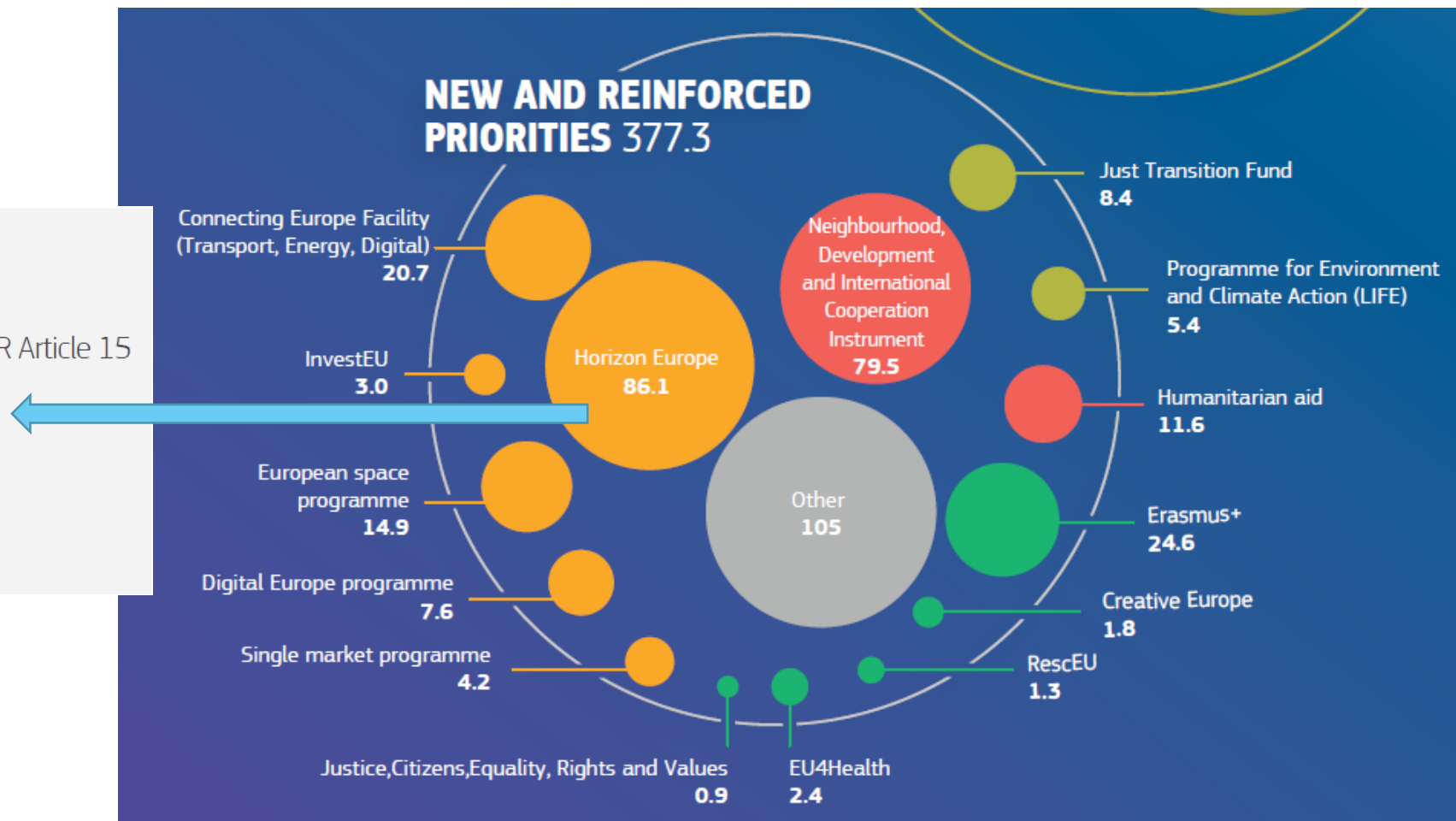
EU Safeguards obligations
EU nuclear non-proliferation
Synergies with Security Union & Defense
International Partnership
E&T, KM

Multiannual Financial Framework (MFF) 2021-2027

Horizon Europe
86.12 + 5.41 from NGEU
+ 3.42 under MFFR Article 5
+ 0.56 from reuse of decommitments under FR Article 15

Euratom
1.98

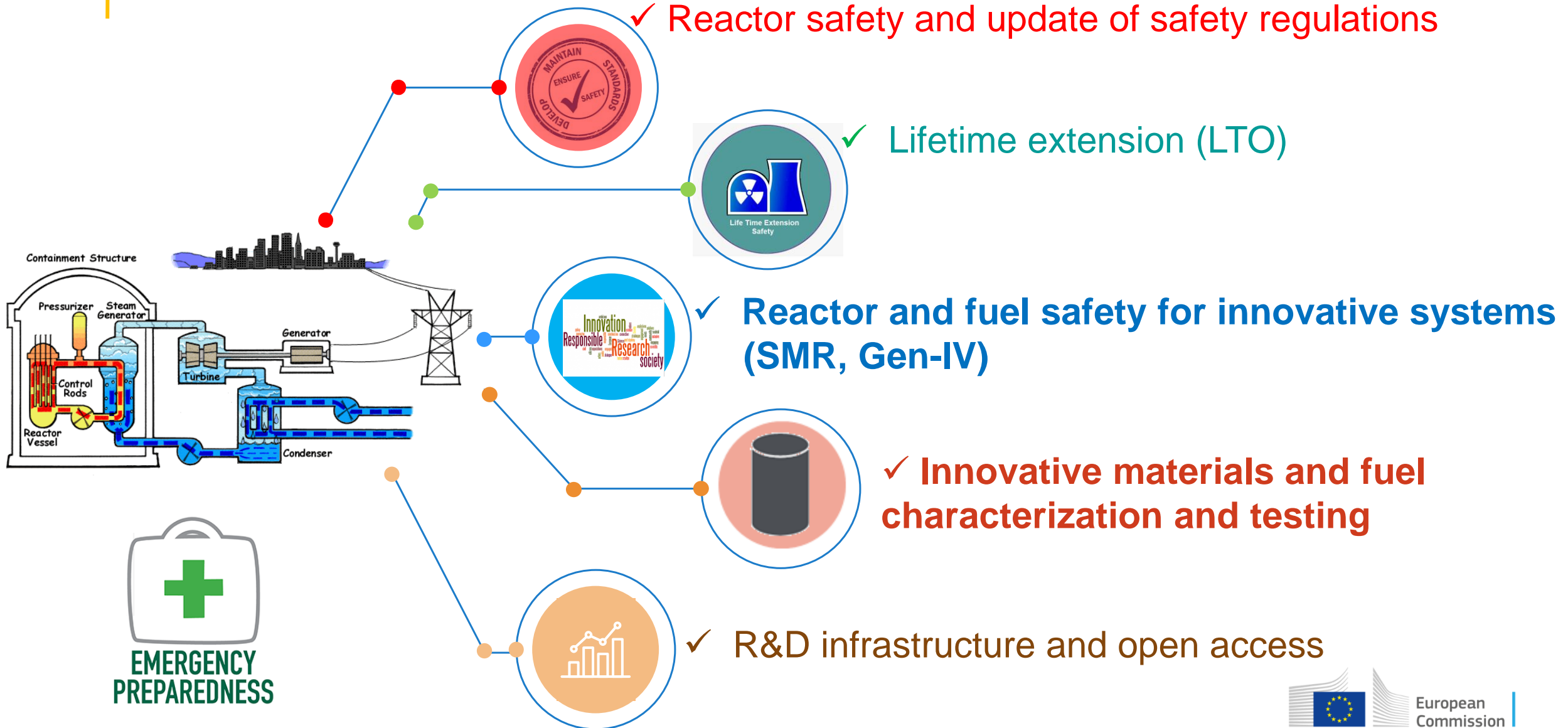
ITER
5.61



The EU's 2021-2027 long-term budget & NextGenerationEU – Facts and figures dated 29/04/2021

<https://op.europa.eu/en/publication-detail/-/publication/d3e77637-a963-11eb-9585-01aa75ed71a1/language-en>

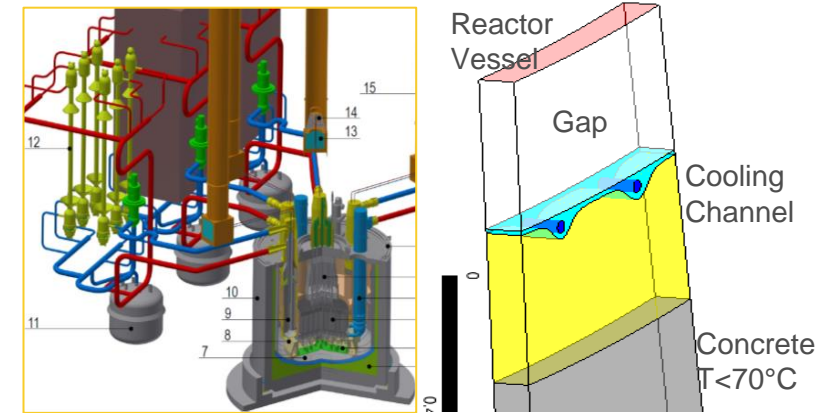
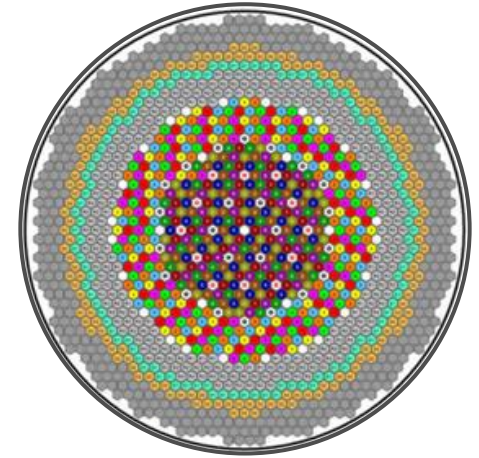
Safety of Nuclear Energy Systems



Advanced reactor research activities: systems

SFR, ADS, LFR, GFR, MSR and (V)HTGR

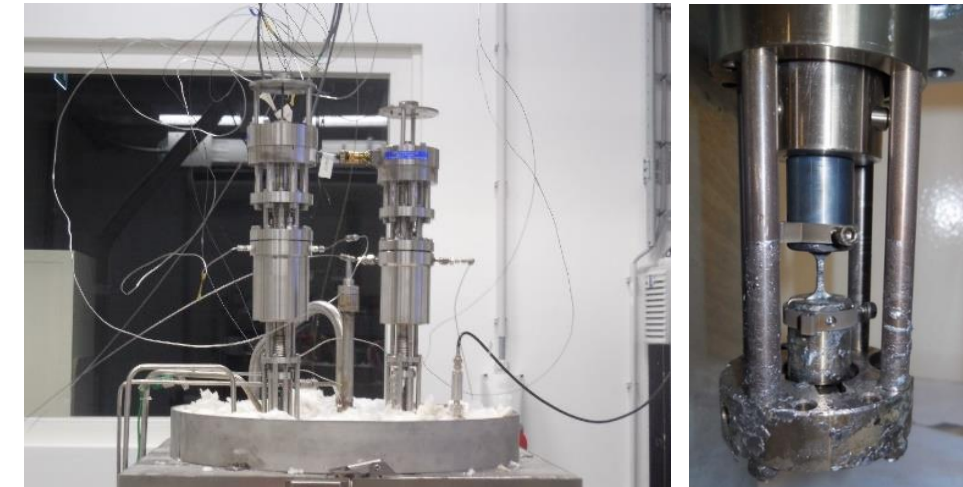
- Design and System Integration;
- Safety research: new safety approach and architecture; studies on effectiveness and resilience of safety systems;
- Development of licensing framework for new types of reactor;
- Development of computational tools and production of experimental data to support calibration and validation of models and reactor designs;
- Testing and qualification of new instrumentation and techniques;
- Liquid metal technology;
- Studies on severe accidents;
- Nuclear data (relevant cross sections of FR materials).



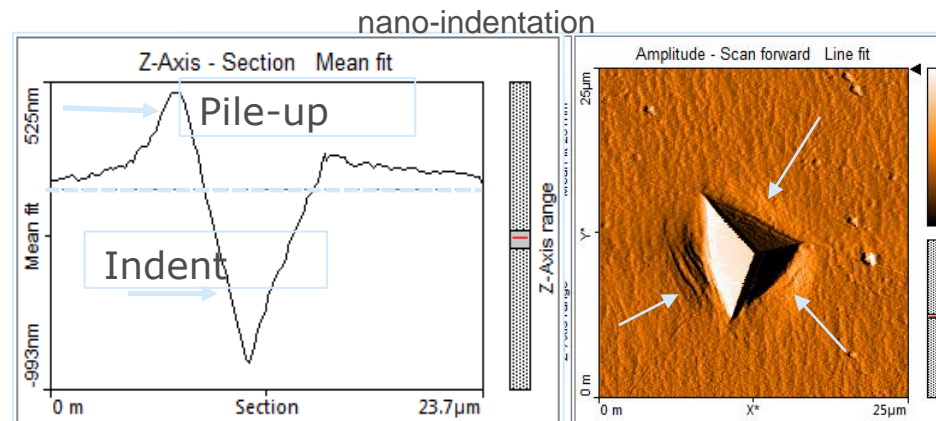
ESFR safety studies

Advanced reactor research activities: structural materials

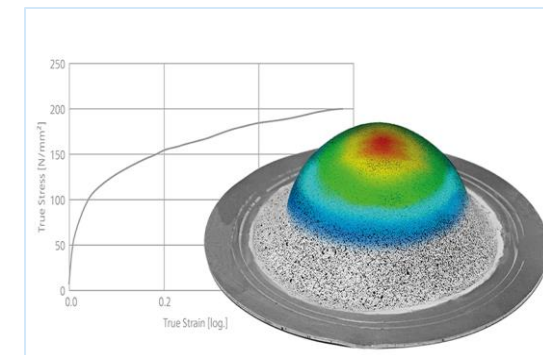
- Qualification of currently available SM under conditions relevant for advanced reactors.
- Enhancing the predictive capabilities of models and computer codes; contributions to the development of design codes.
- Mitigation strategies to reduce the degradation of materials (corrosion, compatibility with coolants).
- Multiscale modeling of materials including: microstructure evolution, plastic flow localization and nano-indentation.



Corrosion studies in liquid Pb environment

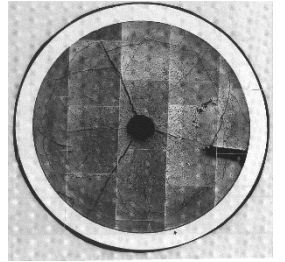


Experimental evaluation of combined effects (stress, environment, irradiation field) on mechanical properties

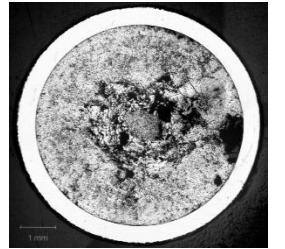


Advanced reactor research activities: fuel, fuel cycle safety

- Development and qualification of MOX for advanced reactors; Pu management and its impact on fuel cycle;
- Improve current recycling of spent fuel and future multiple recycling strategies; fuel processing chemistry and modeling including process development and integration;
- Partitioning and transmutation: basic data acquisition and process development;
- Multi-scale experimental investigations to describe basic mechanisms and processes;
- Improve modelling and fuel performance codes.



$(U_{0.74}Pu_{0.24}Am_{0.02})O_2$
SUPERFACT

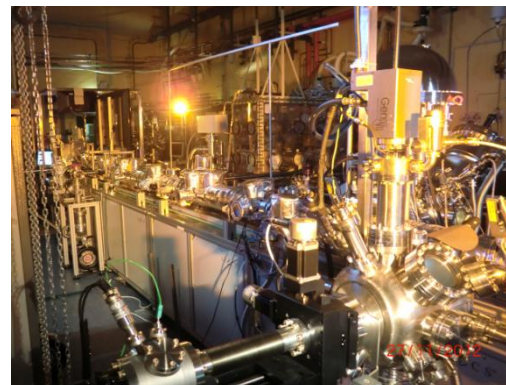


U-19Pu-10Zr-5MA-5RE
METAPHIX

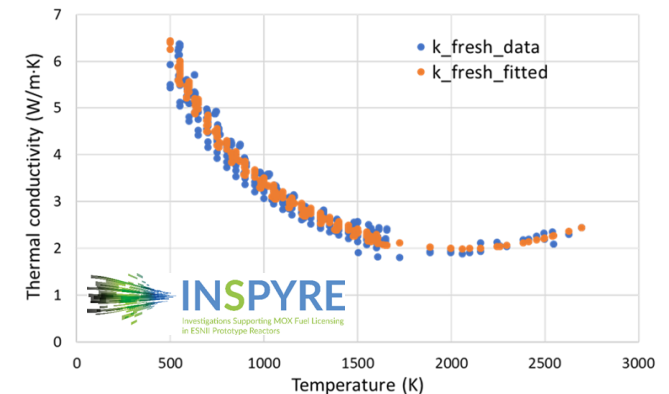
Hot cells



Surface science lab



Minor actinides lab



Thermal conductivity of FR MOX

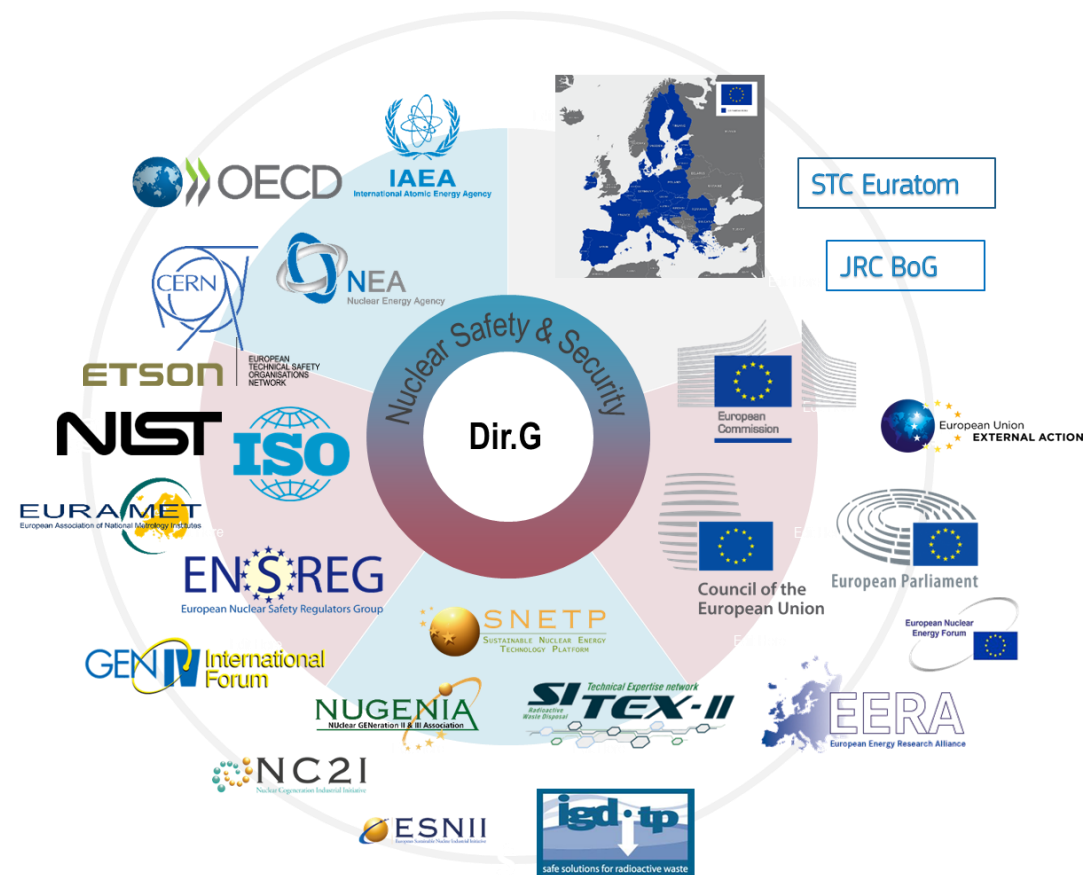
Advanced reactor related projects (examples)

Project acronym and title	Key areas of R&D	Coordinating organization & number of partners	Start date & duration	Total budget / EU contribution
PUMMA – Plutonium Management for More Agility	Define different options for Pu management in Generation-IV systems and evaluate the impact on the whole fuel cycle in addition to safety and performance aspects	CEA (FR) 20 partners (from 12 EU countries incl. CH)	1/10/2020 48 months	€7.0M / €3.8M RIA
SafeG – Safety of GFR through innovative materials, technologies and processes	Gas-cooled fast reactor (GFR) core safety and proliferation resistance, advanced materials and technologies, decay heat removal, standardization and codes, and E&T	VUJE (SK) 15 partners (from 7 EU countries including JP)	1/10/2020 48 months	€4.5M / €3.8M RIA
PASCAL – Proof of augmented safety conditions in advanced liquid metal cooled systems	Safety research on innovative heavy liquid metal cooled reactors, with the ambition to generate evidence that is ready-for-use in the discussions between the ALFRED and MYRRHA designers and the respective safety authorities in the pre-licensing phase.	ENEA (IT) 16 partners (from 9 EU countries incl. associated CH)	1/11/2020 48 months	€4.6M / €3.8M RIA
PATRICIA – Partitioning And Transmuter Research Initiative in a Collaborative Innovation Action	Research on advanced partitioning to efficiently separate Am from spent fuel, on experimental and fuel performance code development work studying the behavior of Am bearing fuel under irradiation and on the safety related research supporting the licensing process of MYRRHA	SCK-CEN (BE) 27 partners (from 12 EU countries incl. CH, US, RU, KR)	1/09/2020 48 months	€9.0M / €6.50M RIA



Partnerships and collaborations

All the nuclear safety research activities of JRC are embedded in partnerships and collaborations with other DG of the European Commission, Member States organizations, networks, technology platforms, international organizations and initiatives



Thank you



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