



SET-Plan Declaration of Intent on Strategic Targets in the context of Action 10: 'Maintaining a high level of safety of nuclear reactors and associated fuel cycles during operation and decommissioning, while improving their efficiency'

Purpose of this document

This document¹ summarises conclusions reached between research and industry stakeholders and those SET-Plan countries that have chosen to take part² in the definition of strategic R&I targets for the SET-Plan Action 10 on 'Nuclear'. With this Declaration of Intent, interested parties agree to act in a coordinated way and to address all relevant issues in order to attain the agreed targets.

These conclusions follow a wide consultation process that involved both research and industry stakeholder organisations (see Annex 1). This document takes into consideration, *inter alia*, the corresponding input papers available on SETIS (<https://setis.ec.europa.eu/towards-an-integrated-SET-Plan>) and the discussion with the SET-Plan countries and research and industry stakeholders that took place on 24 May 2016.

R&I actions to be carried out in order to reach the fission-related targets are expected to be supported primarily through national programmes of interested Member States and by industry. It should be recalled that financial support (if any) via the Euratom Research and Training Programme will continue to be restricted to research addressing safety, waste management, radiation protection as well as education and training, in accordance with the underlying legal framework³.

¹ This document has no legally binding character

² Formal notification received from: BE, CZ, ES, FI, FR, IT, NL, SK, PL & UK. Following the SET-Plan SG meeting on 14 September 2016, other SET-Plan countries are welcome to participate in discussions on targets of interest.

³ Council Regulation (EURATOM) No 1314/2013 of 16 December 2013 on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 Framework Programme for Research and Innovation, OJ L347, 20/12/2013, p.948.

Introduction

The SET-Plan Communication (C(2015)6317) refers to *"Maintaining a high level of safety of nuclear reactors and associated fuel cycles during operation and decommissioning, while improving their efficiency"* in line with the view to contribute to the objective of continuous improvement in safety as presented in the Nuclear Safety Directive⁴. The priority is therefore safety of the current fleet, including LTO (Long-Term Operation of current plants), new-build, management of spent nuclear fuel / radioactive waste, and decommissioning. This involves organisational, operational and regulatory aspects, as well as further research & innovation, the latter often depending on the availability of research infrastructures of pan-European relevance as identified within the latest research and innovation agendas, technology roadmaps, deployment strategies and implementation plans of research and industry stakeholder groups and organisations.

As part of the Energy Union strategy action plan and in line with its obligations under the Euratom Treaty, the Commission recently published a new Nuclear Illustrative Programme (PINIC)⁵, which provides information on planned investments by Member States until 2050 in the full fuel cycle.

Towards 2050 the availability of designs offering increased uranium resource efficiency and lower long-lived waste production may become attractive for utilities. In addition, in view of the increasing requirements for more flexible energy sources and non-fossil fuel process heat, small modular reactors (SMR) and co-generation plants may develop on a shorter timescale.

The present document should be regarded as a catalyst that can stimulate enhanced coordination of national programmes, public and private funding and joint actions in line with the agreed principal themes, which involve not only the specific targets but also, where necessary, the key enabling conditions boosting research and demonstration efforts. Financial support (if any) via the Euratom Research and Training programme will continue to be restricted to research addressing safety, waste management, radiation protection as well as education and training, in accordance with the underlying legal framework⁶.

Finally, Europe can retain technological leadership in the nuclear field, in line with the objective stated in the Energy Union Communication, only if interested Member States⁷ maintain a diverse and well-funded nuclear R&D capability, including education and training aspects. However, it will not be easy for Europe to retain leadership in all areas in view of the significant increase in nuclear generating capacity in other regions of the world. This underlines the importance of international cooperation, especially in areas such as development of advanced and innovative reactors⁸.

⁴ Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations, as amended by Council Directive 2014/87/Euratom, OJ L172, 2.7.2009, p.18.

⁵ 'Programme indicatif nucléaire communautaire', or 'Nuclear Illustrative Programme presented under Article 40 of the Euratom Treaty for the opinion of the European Economic and social Committee', COM(2016)177, 04/04/2016.

⁶ Council Regulation (EURATOM) No 1314/2013 of 16 December 2013 on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 Framework Programme for Research and Innovation, OJ L347, 20/12/2013, p.948.

⁷ The national energy mix is the responsibility of each Member State. Member States can use nuclear technology only in accordance with a comprehensive EU legal framework regarding nuclear safety.

⁸ cf COUNCIL DECISION on extending the Framework Agreement for international collaboration on research and development of Generation IV nuclear energy systems (5297/16 of 1 Feb. 2016, approved 12 Feb. 5936/16)

Key enabling conditions

- Overriding importance attributed to **nuclear safety and a corresponding safety culture** throughout the nuclear sector (including facility design, operation, decommissioning, waste management, emergency preparedness) and also the non-power sector;
- a strict **non-proliferation regime** and the **physical protection of nuclear materials and facilities**, including CBRN threats and cybersecurity;
- synergy between **safety, security and safeguards**, taking into account operability requirements;
- a flexible **electricity grid** catering for all LCEE suppliers;
- concerted efforts to reduce **NPP capital costs**, without compromising on safety, through construction schedule reduction, simplification of design, and construction in series;
- greater standardisation within **the supply chain** to establish a common reference, in particular regarding safety-related issues, between all actors involved in the design, construction and licensing of nuclear facilities;
- harmonisation of **licensing rules, certification and standards**, including mutual recognition by regulatory authorities, streamlining of design approval and harmonised classification schemes;
- stable / predictable **investment conditions**, including availability of appropriate financing schemes;
- assured and diversified **nuclear fuel supplies**;
- a fit-for-purpose system for the **education and training of scientists and engineers** (benefiting from ERC, MSCA or ERASMUS+ grants where appropriate) that ensures skilled personnel are available when needed in all relevant disciplines throughout the nuclear sector (industry, research, regulatory bodies, WMOs, TSOs, etc.) and supports the mobility of these personnel, including through a European Credit System for Vocational Education and Training (ECVET);
- availability of **state-of-the-art research infrastructures** (in particular for materials research, including irradiation facilities, nuclear safety, research reactors and hot cells, including for non-power sector applications such as radioisotope production) that promote ease of access of scientists and engineers from across Europe through appropriate mobility arrangements and that benefit from available funding schemes, both grant- and loan-based, and legal frameworks;
- enhanced **R&D cooperation** between Member States in key areas, not only in multi-disciplinary R&D fields such as radiation protection and geological disposal, but also regarding development of new research infrastructures, waste facilities and advanced reactor systems;
- reinforced **international cooperation** with leading third countries, bilaterally or multilaterally, in key strategic areas.

Specific targets agreed by research and industry stakeholders and interested Member States

1. Safety

- By August 2017, transposition by MS of the Nuclear Safety Directive, followed by timely realisation of the new 'Nuclear Safety Objective' through a clear schedule for implementation;
- by 2020: implementation by MS of relevant actions to improve nuclear safety as follow-up to the stress tests⁹; e.g. agreement on how to manage equipment obsolescence in older plants; validation of safety approach and feasibility of storage solutions for irradiated nuclear fuel;
- by 2025, availability of robust research findings on (i) ageing of structures, materials and components (in particular LTO of NPPs) and (ii) more robust and accident-resistant designs (e.g. passive systems, accident-tolerant fuels, improved containment designs, etc.).

2. Radioactive waste management and decommissioning

- By 2025, the operation in Europe of the world's first deep geological repositories for spent nuclear fuel and/or heat-generating high-level radioactive waste;
- by 2030, the development of a world-leading decommissioning sector, including through R&D on characterisation and conditioning of waste, building on the EU's safety culture and know-how in waste management.

3. Efficiency and competitiveness aspects *(of interest only to countries wishing to maintain nuclear in their low-carbon energy mix over the longer term thereby allowing innovation in safety systems)*

- **Current technology**¹⁰
- **Innovative emerging technologies** – concerns increased efficiency & competitiveness and enhanced safety through design:
 - o By 2025, licensed SMR and/or co-generation (V)HTR design(s) available in the EU, with operating demonstrator(s) by 2030;
 - o by 2030, at least one Generation-IV demonstrator fast reactor in Europe, including associated fuel cycle facilities.

4. Fusion *('implementation plan' already largely in place in view of ITER and the fusion roadmap)*

- ITER construction and operation in line with new baseline;
- DEMO design and construction, and progress towards eventual fusion power plants, in line with the fusion roadmap.

⁹ ENSREG: Compilation of recommendations and suggestions – Peer review of stress tests performed on European nuclear power plants (http://www.ensreg.eu/sites/default/files/Compilation%20of%20RecommendationsI_0.pdf).

¹⁰ For recent information on cost of nuclear electricity, from new-build Gen-III / III+ and LTO Gen-II, refer to, e.g., (i) William D. D'haeseleer "Synthesis on the Economics of Nuclear Energy", Study for the EC, DG Energy, Contract N° ENER/2012/NUCL/SI2.643067, 27 November, 2013 (https://www.mech.kuleuven.be/en/tme/research/energy_environment/Pdf/wpen2013-14.pdf) (ii) Energy Technology Reference Indicator projections for 2010-2050 (<https://setis.ec.europa.eu/publications/jrc-setis-reports/etri-2014>).

Next steps

The interested parties agree to develop within six months a detailed implementation plan – benefitting from the latest research and innovation agendas, technology roadmaps, deployment strategies and existing sectoral implementation plans (Annex 2) – to address the enabling conditions and attain the specific targets, covering joint and/or coordinated actions, involvement of EU (within the limits allowed by the Euratom programme) and national research and innovation programmes, contribution from industry, research organisations and academia, socio-economic aspects and regulatory considerations. In addition, reporting requirements will be addressed in order to enable appropriate monitoring of progress towards the targets.

Annex 1

List of consulted research and industry stakeholder groups with replies

EERA-JPNM, <http://www.eera-jpnm.eu/>

EESC <http://www.eesc.europa.eu/>

EHRO-N, <http://ehron.jrc.ec.europa.eu/>

ENEN, <http://www.enen-assoc.org/>

ENSRA <http://ensra.org>

ENSREG, <http://www.ensreg.eu/>

ESARDA, <https://esarda.jrc.ec.europa.eu/>

ETSON, <http://www.etson.eu/>

EUA-EPEU, <http://www.eua.be/>

Euratom STC (Scientific and Technical Committee)

FORATOM, <http://www.foratom.org/>

IGDTP, <http://www.igdtp.eu/>

MELODI, <http://www.melodi-online.eu/>

SNETP, <http://www.snetp.eu/>

WENRA, <http://www.wenra.org/>

Annex 2

Relevant European platforms, research and industry stakeholder groups, etc. involved in R&D and/or related coordination

(extracted from Annex 1 of Issues Paper – new additions are indicated by shading)

Key research and industry stakeholder platforms, organisations and initiatives:

- the Sustainable Nuclear Energy Technology Platform (SNETP, <http://www.snetp.eu/>), which is the overarching nuclear systems and safety platform encompassing three main pillars related to safety and performance of Generation-II & -III reactors (NUGENIA, <http://www.nugenia.org/>), Generation-IV fast reactor demonstrators (ESNII, <http://www.snetp.eu/esnii/>), cogeneration of electricity and process heat (NC2I, <http://www.snetp.eu/nc2i/>) together with cross-cutting research activities and supporting research infrastructures;
- the Implementing Geological Disposal Technology Platform (IGDTP, <http://www.igdtp.eu/>) focusing on R&D needed to ensure safe geological disposal of spent fuel and high-level heat-generating waste;
- ERDO working group '*Working on a shared solution for radioactive waste*' (<http://www.erdowg.eu/Home.html>);
- the Multidisciplinary European Low Dose Initiative (MELODI, <http://www.melodi-online.eu/>), the platform coordinating the multidisciplinary research on effects of low doses of radiation;
- the European Energy Research Alliance – Joint Programme on Nuclear Materials (EERA-JPNM, <http://www.eera-jpnm.eu/>) which coordinates public sector research on nuclear materials;
- the European Technical Safety Organisations Network (ETSON, <http://www.etsn.eu/>), which has links with SNETP but also has its own position paper on safety of Generation-II & -III reactors;
- NERIS, the European Platform on Preparedness for Nuclear and Radiological Emergency Response and Recovery (<http://www.eu-neris.net/>);
- EURADOS, the European Radiation Dosimetry Group (<http://www.eurados.org/>);
- the European Radioecology Alliance (<http://www.er-alliance.eu/>);
- in the case of magnetic confinement fusion, the European roadmap to fusion electricity (<https://www.euro-fusion.org/eurofusion/the-road-to-fusion-electricity/>) has been agreed by all national labs and institutes in Europe and provides the basis for the EUROfusion Joint Programme (<https://www.euro-fusion.org/>);
- ENEN – the Nuclear Education Network (ENEN, <http://www.enen-assoc.org/>);
- FuseNet – the Fusion Education Network (<http://www.fusenet.eu/>);
- the European Human Resources Observatory for the Nuclear Sector (<http://ehron.jrc.ec.europa.eu/>); and
- the European Observatory on the Supply of Medical Radioisotopes http://ec.europa.eu/euratom/observatory_radioisotopes.html.

Relevant regulatory groups / networks:

- the Western European Nuclear Regulators Association (WENRA, <http://www.wenra.org/>) which is leading in the definition of technical nuclear safety standards;
- the European Nuclear Safety Regulators Group gathering together high-level representatives of EU nuclear regulatory bodies (ENSREG, <http://www.ensreg.eu/>);

Key international initiatives:

- the Generation-IV International Forum (GIF, <https://www.gen-4.org/>) the international body overseeing global cooperation in pre-conceptual design research on Generation-IV systems;
- the Multinational Design Evaluation Programme (<https://www.oecd-nea.org/mdep/>); and
- Nuclear Innovation 2050 (<http://www.oecd-nea.org/ndd/ni2050/>), an initiative of the NEA (Nuclear Energy Agency), that is mapping current nuclear fission R&D programmes and infrastructures, defining R&D priorities to foster innovation, enhancing the long-term contribution of nuclear fission in a low-carbon future, and evaluating potential opportunities for cooperation to implement these priorities.

We can also mention, in the field of nuclear safeguards and security:

- ESARDA (<https://esarda.jrc.ec.europa.eu/> European Safeguards Research and Development Association), considered as the unique network of national research organisations together with the European Commission;
- The European Nuclear Security Regulator Association (<http://www.ensra.org/>).