



EUROPEAN COMMISSION
RTD - Energy
ENER - Renewables, R&I, Energy Efficiency
JRC - Institute for Energy and Transport
SET-Plan Secretariat



SET-Plan Draft 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 records the agreement reached between representatives of European Commission services, stakeholders and interested SET-Plan countries² on the definition of strategic R&I targets for the SET-Plan Action 10 on 'Nuclear'. With this Declaration of intent, the interested parties agree to undertake their best efforts in a coordinated way and to address all relevant issues in order to attain the agreed targets.

This agreement follows consultation with a range of stakeholder organisations (see Annex 1). To the extent possible, this document takes into consideration 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 stakeholders that took place on 24 May 2016.

¹ This document has no legally binding character, and does not prejudice the process or final form of any future decisions by the European Commission.

² *[to be completed]*

Introduction

In the context of the Energy Union, the most important recent development in the area of nuclear is the publication of the latest Nuclear Illustrative Programme (PINIC)³ complementing the corresponding EU Directives and legislative framework supporting current initiatives in the area of research and innovation. The present targets must be seen in the light of the information contained therein, especially new generation capacity and LTO (long-term operation) of current plants.

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"*. The priority is therefore safety and security of the current fleet, LTO, and new-build. 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.

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 EU/MS 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.

Finally, Europe can retain technological leadership in the nuclear field, in line with the objective stated in the Energy Union Communication, only if it maintains a vibrant and indigenous nuclear industry and a corresponding diverse and well-funded nuclear research capability. Though the achieving of the targets presented here will contribute significantly to this goal, 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 reactors.

³ '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', C(2016)177, 04/04/2016

Targets

Key enabling conditions

- Overriding importance attributed to **nuclear safety and to an appropriate safety culture** throughout the nuclear power 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** that allows the integration of large baseload suppliers;
- concerted efforts to reduce **NPP capital costs** through construction schedule reduction, simplification of design, standardisation, and construction in series;
- standardisation of **reactor codes** where necessary to establish a common reference 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 such as contracts for difference, an effective supply chain and a more appropriate carbon price;
- 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 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);
- a conducive **socio-political environment**;
- availability of **state-of-the-art research infrastructures** (in particular for materials research, including irradiation facilities, 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 schemes;
- availability of all potential **EU funding options**, e.g. InnovFin, EFSI (European Fund for Strategic Investments), ESIF (European Structural and Investment Funds) and possible Euratom loans, with ESFRI (and related mechanisms such as ERIC) important in the setting-up of collaborations between MS in the development of new research infrastructures;
- enhanced **joint programming** between Member States in key R&D areas, particularly waste management and advanced systems;
- reinforced **international cooperation** with leading third countries, bilateral or multilaterally, in key strategic areas, especially the development of next generation nuclear technology (e.g. high-temperature co-generation plants).

Specific targets

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 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.);
- by 2020, implementation by MS of all actions to improve nuclear safety as follow-up to the stress tests⁴;

2. Cost of electricity⁵

- Levelised cost of electricity for the latest generation of Light-water Reactors (LWRs) 'first of a kind' new-build twin reactor project on a brownfield site: EUR(2012) 48/MWh to 84/MWh, falling to EUR(2012) 43/MWh to 75/MWh for a series build (5% and 10% discount rate);
- levelised cost of electricity following refurbishment for LTO (10-20 years on average) of the existing Gen-II nuclear power plants integrating post-Fukushima stress tests safety upgrades: EUR (2012) 23/MWh to 26/MWh (5% and 10% discount rate).

3. 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.

4. Advanced and innovative fission reactors

- By 2025, licensed SMR design(s) available in the EU, with operating plant(s) by 2030;
- by 2030, at least one Generation-IV demonstrator fast reactor operating in Europe, including associated fuel cycle facilities (pilot fuel fabrication and processing plants).

5. Fusion

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

⁴ 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)

⁵ For recent information on cost of nuclear electricity, from new-build Generation-III / III+ and LTO Generation-II, refer to, for instance, (i) William D. D'haeseleer "Synthesis on the Economics of Nuclear Energy", Study for the European Commission, DG Energy, Contract N° ENER/2012/NUCL/SI2.643067, November 27, 2013 (https://www.mech.kuleuven.be/en/tme/research/energy_environment/Pdf/wpen2013-14.pdf) and (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 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.

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Annex 1

List of consulted 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.etsn.eu/>
EUA-EPEU, <http://www.eua.be/>
Euratom STC
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, 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 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/>).