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ANNEXES 1 to 2

ANNEXES

to the proposal for a

COUNCIL REGULATION

**on the Research and Training Programme of the European Atomic Energy Community
(2019-2020) complementing the Horizon 2020 Framework Programme for Research and
Innovation**

ANNEXES

ANNEX I

ACTIVITIES

Rationale for the Euratom Programme — paving the way to 2020

By achieving the objectives set out in Article 3, the Euratom Programme will reinforce outcomes under the three priorities of the 'Horizon 2020' Framework Programme, namely excellent science, industrial leadership and societal challenges.

Nuclear power constitutes an element in the debate on combating climate change and reducing Europe's dependence on imported energy. In the broader context of finding a sustainable energy-mix for the future, the Euratom Programme will also contribute through its research activities to the debate on the benefits and the limitations of nuclear fission energy for a low-carbon economy. Through ensuring continuous improvement of nuclear safety, more advanced nuclear technologies could also offer the prospect of significant improvements in efficiency and use of resources and producing less waste than current designs. Nuclear safety aspects will receive the greatest possible attention.

The Euratom Programme will strengthen the research and innovation framework in the nuclear field and coordinate Member States' research efforts, thereby avoiding duplication, retaining critical mass in key areas and ensuring that public funding is used in an optimal way. The coordination will, however, not prevent Member States from having programmes to fulfil national needs.

The strategy to develop fusion as a credible option for commercial carbon-free energy production will follow a roadmap with milestones towards the goal of electricity production by 2050. To implement that strategy, a restructuring of fusion-related work in the Union, including governance, funding and management, must be carried out to ensure a shift of emphasis from pure research to designing, building and operating future facilities such as ITER, DEMO and beyond. That will require a close cooperation between the entire Union fusion community, the Commission and the national funding agencies.

In order to maintain the Union expertise necessary for achieving those goals, the Euratom Programme must further enhance its role in training through the establishment of training facilities of pan-European interest that will deliver dedicated programmes. That will continue to promote the European Research Area and the further integration of new Member States and associated countries.

Activities necessary to achieve the programme objectives

Indirect actions

In order to ensure that the indirect actions of the Euratom Programme mutually reinforce research efforts of the Member States and the private sector, the priorities of the work programmes are to be established on the basis of appropriate inputs from national public authorities and nuclear research stakeholders grouped in bodies or frameworks such as technology platforms and technical forums for nuclear systems and safety, management of ultimate waste and radiation protection/low-dose risk, fusion research, or any relevant organisation or forum of nuclear stakeholders.

- (a) *Supporting safety of nuclear systems (Societal challenges, Excellent science, Industrial leadership)*

In line with the general objective, support to joint research activities concerning the safe operation and decommissioning of reactor systems (including fuel cycle facilities) in use in the Union or, to the extent necessary in order to maintain broad nuclear safety expertise in the Union, those reactor types which may be used in the future, focusing exclusively on safety aspects, including all aspects of the fuel cycle such as partitioning and transmutation.

- (b) *Contributing to the development of safe, longer term solutions for the management of ultimate nuclear waste, including final geological disposal as well as partitioning and transmutation (Excellent science, Societal challenges)*

Joint and/or coordinated research activities on remaining key aspects of geological disposal of spent fuel and long-lived radioactive waste with, as appropriate, demonstration of technologies and safety. Those activities are to promote the development of a common Union view on the main issues related to waste management from discharge of fuel to disposal.

Research activities related to management of other radioactive waste streams for which industrially mature processes currently do not exist.

- (c) *Supporting the development and sustainability of nuclear expertise and excellence in the Union (Excellent science)*

Promoting joint training and mobility activities between research centres and industry, and between different Member and Associated States, as well as support for maintaining multi-disciplinary nuclear competences in order to guarantee the availability of suitably qualified researchers, engineers and employees in the nuclear sector in the Union in the long term.

- (d) *Supporting radiation protection and development of medical applications of radiation, including, inter alia, the secure and safe supply and use of radioisotopes (Excellent science, Societal challenges)*

Joint and/or coordinated research activities, in particular those regarding the risks from low doses from industrial, medical or environmental exposure, on emergency management in relation to accidents involving radiation, and on radioecology, to

provide a pan-European scientific and technological basis for a robust, equitable and socially acceptable system of protection.

Research activities on medical applications of ionising radiation and addressing the operational safety aspects of radiation protection and their utilisation.

- (e) *Moving towards demonstration of feasibility of fusion as a power source by exploiting existing and future fusion facilities (Industrial leadership, Societal challenges)*

Supporting common research activities undertaken by EUROfusion members and any of the entities referred to under paragraph (i) to ensure the swift start of high performance operation of ITER including the use of relevant facilities (including as appropriate JET, the Joint European Torus), of integrated modelling using, among others, high performance computers, and training activities to prepare the next generation of researchers and engineers.

- (f) *Laying the foundations for future fusion power plants by developing materials, technologies and conceptual design (Industrial leadership, Societal challenges)*

Supporting joint activities undertaken by EUROfusion members and any of the entities referred to under paragraph (i) to develop and qualify materials for a demonstration power plant requiring, inter alia, preparatory work for an appropriate material test facility and negotiations for the Union's participation in a suitable international framework for that facility. Such development and qualifications are to make use of all possible levels of the experimental, computational and theoretical capacities available.

Supporting joint research activities undertaken by members of the European Fusion Development Agreement and any of the entities referred to under paragraph (i) that will address reactor operation issues and will develop and demonstrate all relevant technologies for a fusion demonstration power plant. Those activities include the preparation of complete demonstration power plant conceptual designs and exploration of the potential of stellarators as a power plant technology.

- (g) *Promoting innovation and industry competitiveness (Industrial leadership)*

Implementing or supporting knowledge management and technology transfer from the research co-funded by the Euratom Programme to industry exploiting all innovative aspects of the research.

Promoting innovation through, inter alia, open access to scientific publications, a database for knowledge management and dissemination and promoting technology topics in educational programmes.

In the long term, the Euratom Programme is to support the preparation and development of a competitive nuclear fusion industrial sector facilitating the involvement of the private sector as well as SMEs where appropriate, in particular through the implementation of a technology road map to a fusion power plant with active industrial involvement in the design and development projects.

- (h) *Ensuring availability and use of research infrastructures of pan-European relevance (Excellent science)*

Activities supporting the construction, refurbishment, use and continued availability of key research infrastructures under the Euratom Programme, as well as appropriate access to those infrastructures and cooperation between them.

(i) *European fusion programme*

The joint programme of activities implementing the roadmap towards the goal of electricity production by 2050 co-funded through the EUROfusion grant (Programme co-fund action) awarded under Regulation (Euratom) No 1314/2013 to the legal entities established or designated by Member States and any third country associated to the Euratom Programme. The EUROfusion grant may continue to be funded under the Euratom programme. The joint programme may include resources in kind from the Community, such as scientific and technical exploitation of the JET facility in accordance with Article 10 of the Treaty, or the secondment of Commission staff.

JRC direct actions

The priorities for direct actions are to be established through consultation of the policy Directorates-General of the Commission and of the JRC Board of Governors.

The nuclear activities of the JRC must aim to support the implementation of Council Directives 2009/71/Euratom¹ and 2011/70/Euratom², as well as Council Conclusions giving priority to the highest standards for nuclear safety in the Union and internationally.

The JRC must notably contribute to the nuclear safety research needed for safe, secure and peaceful use of nuclear energy and other non-fission applications. The JRC will provide a scientific basis for the relevant Union policies and, where necessary, react within the limits of its mission and competence to nuclear events, incidents and accidents. To that effect, the JRC will carry out research and assessments, provide references and standards and deliver dedicated training and education. Synergies with relevant cross-cutting initiatives will be sought as appropriate, with the aim of optimizing human and financial resources and to avoid duplication of nuclear research and development in the European Union. The JRC activities in these areas will be conducted taking into account relevant initiatives at the regional, Member State or at European Union level, within the perspective of shaping the European Research Area.

(a) *Improving nuclear safety including: nuclear reactor and fuel safety, waste management including final geological disposal as well as partitioning and transmutation; decommissioning, and emergency preparedness*

The JRC will contribute to the development of tools and methods to achieve high safety standards for nuclear installations and fuel cycles relevant to Europe. Those tools and methods will include:

- (1) severe accident analyses modelling and methodologies for assessment of nuclear installations' operational safety margins; supporting the establishment of a common European approach to the evaluation of advanced fuel cycles and designs; and investigation and dissemination of the lessons learnt from operational experience. The JRC will further pursue its 'European Clearinghouse on NPP Operational Experience Feedback' to focus its activities

¹ Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations (OJ L 172, 2.7.2009, p. 18).

² Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (OJ L 199, 2.8.2011, p. 48).

on post-Fukushima nuclear safety challenges, appealing to the Members States' competences in this area;

- (2) minimisation of the scientific uncertainties in the prediction of long-term behaviour of nuclear waste and of the dispersion of radionuclides in the environment; and key aspects of research on decommissioning of nuclear installations;
- (3) exchange with relevant stakeholders for strengthening Union capacity to respond to nuclear accidents and incidents by research on alert systems and models for radiological dispersion in the air, and by mobilising resources and expertise for analysing and modelling nuclear accidents.

(b) *Improving nuclear security including: nuclear safeguards, non-proliferation, combating illicit trafficking, and nuclear forensics*

The area of non-proliferation must receive the greatest possible attention. The JRC will:

- (1) develop enhanced methodologies and detection/verification methods and technologies to support the Community safeguards and strengthen international safeguards;
- (2) develop and apply enhanced methods and technology to prevent, detect and respond to nuclear and radioactive incidents, including qualification of detection technology and development of nuclear forensics methods and techniques in the fight against illicit trafficking in synergies with the global CBRN (Chemical, Biological, Radiological, Nuclear) framework;
- (3) support the implementation of the Treaty on the Non-Proliferation of Nuclear Weapons and Union-related strategies through analysis studies and follow-up of the technical evolution of export control regimes to support relevant Commission and Union services.

(c) *Increasing excellence in the nuclear science base for standardisation*

The JRC will further develop the scientific basis for nuclear safety and security. Emphasis will be given to research on fundamental properties and behaviour of actinides, structural and nuclear materials. In supporting Union standardisation, the JRC will provide state-of-the-art nuclear standards, reference data and measurements, including the development and implementation of relevant databases and assessment tools. The JRC will support the further development of medical applications, namely new cancer therapies based on alpha irradiation.

(d) *Fostering knowledge management, education and training*

The JRC must stay abreast of new developments in research and instrumentation, safety and environmental regulations. To that effect, a rolling investment plan for the scientific infrastructures must be implemented.

In order to maintain the Union at the forefront of nuclear safety and security, the JRC must develop knowledge management tools, monitor Union trends in human resources through its Nuclear Human Resources Observatory and deliver dedicated training and education programmes, covering also decommissioning aspects.

(e) *Supporting the policy of the Union on nuclear safety and security*

The JRC must foster its expertise and excellence in order to provide independent scientific and technical evidence which might be necessary to support Union policy on nuclear safety and security.

As the Euratom Implementing Agent for the Generation IV International Forum (GIF), the JRC will continue to coordinate the Community contribution to GIF. The JRC will pursue and further develop international research cooperation with key partner countries and international organizations (IAEA, OECD/NEA) in order to promote the Union's nuclear safety and security policies.

Cross-cutting activities within the Euratom Programme

In order to achieve its general objectives, the Euratom Programme will support complementary activities (direct and indirect, coordination and stimulating joint programming) that ensure synergy of research efforts in solving common challenges (such as materials, coolant technology, reference nuclear data, modelling and simulation, remote handling, waste management, radiation protection).

Cross-cutting activities and interfaces with the Horizon 2020 Framework Programme

In order to achieve the objectives of the Euratom Programme, appropriate links and interfaces, such as joint calls, will be ensured with the Specific Programme of the Horizon 2020 Framework Programme.

The Euratom Programme may contribute to the Debt facility and Equity facility developed under the Horizon 2020 Framework Programme that will be widened to cover the objectives referred to in Article 3.

International cooperation with third countries and international organisations

International cooperation in nuclear research and innovation, based on shared goals and mutual trust, must continue, with the aim of providing clear and significant benefits for the Union and its environment. As a contribution to the achievement of the specific objectives set out in Article 3, the Community will seek to reinforce the Union's scientific and technical expertise through international cooperation agreements and to promote the access of the Union nuclear industry to new emerging markets.

International cooperation activities will be promoted through multilateral frameworks (such as IAEA, OECD, ITER, GIF), and by the existing or new bilateral cooperation with countries having strong R&D and industrial bases and research installations under operation, design or construction.

ANNEX II

PERFORMANCE INDICATORS

This Annex presents, for each of the specific objectives of the Euratom programme, a number of key performance indicators for assessing results and impacts that may be refined during the implementation of the Euratom Programme.

1. Indicators for indirect actions

(a) Supporting safety of nuclear systems

- The number of projects (joint research and/or coordinated actions) likely to lead to a demonstrable improvement in nuclear safety practice in Europe.

(b) Contributing to the development of safe, longer-term solutions for the management of ultimate nuclear waste, including final geological disposal, partitioning and transmutation

- The number of projects contributing to the development of safe, long-term solutions for the management of ultimate nuclear waste.

(c) Supporting the development and sustainability of nuclear expertise and excellence in the Union

- Training through research - the number of PhD students and postdoctoral researchers supported through the Euratom fission projects.
- The number of fellows and trainees in the Euratom fusion programme.

(d) Supporting radiation protection and the development of medical applications of radiation, including, inter alia, the secure and safe supply and use of radioisotopes

- The number of projects likely to have a demonstrable impact on regulatory practice regarding radiation protection and on the development of medical applications of radiation.

(e) Moving towards demonstration of the feasibility of fusion as a power source by exploiting existing and future fusion facilities

- The number of publications in peer-reviewed high-impact journals.

(f) Laying the foundations for future fusion power plants by developing materials, technologies and conceptual design

- The percentage of the Fusion Roadmap's milestones, established for the period 2014-2020, reached by the Euratom programme.

(g) Promoting innovation and industry competitiveness

- The number of spin-offs from fusion research under the Euratom programme.

- The patent applications generated and patents awarded on the basis of research activities supported by the Euratom programme.
- (h) *Ensuring availability and use of research infrastructures of pan-European relevance*
- The number of researchers having access to research infrastructures through Euratom programme support.

2. Indicators for direct actions

(a) *Impact indicator for JRC policy support*

- The number of occurrences of tangible specific impacts on Union policies resulting from technical and scientific policy support provided by the JRC.

(b) *JRC scientific productivity indicator*

- The number of peer reviewed publications.

The indicators referred to in points (a) and (b) may be represented according to the following Community objectives of direct actions:

- Improving nuclear safety including: nuclear reactor and fuel safety, waste management, including final geological disposal as well as partitioning and transmutation; decommissioning; and emergency preparedness;
- Improving nuclear security including: nuclear safeguards, non-proliferation, combating illicit trafficking, and nuclear forensics;
- Increasing excellence in the nuclear science base for standardisation;
- Fostering knowledge management, education and training;
- Supporting the policy of the Union on nuclear safety and security.