**DRAFT**

**EURATOM**

**WORK PROGRAMMME 2016 – 2017**

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# Introduction

The Euratom Research and Training Programme (2014-18)[[1]](#footnote-2) complements Horizon 2020[[2]](#footnote-3) in the field of nuclear research and training. Its general objective is to support nuclear research and training activities with an emphasis on continually improving nuclear safety and radiation protection, notably to contribute to the wellbeing of EU citizens by participating in the development of a safe, low-carbon, more sustainable and competitive energy system at European level, in both the short and longer term, whilst also addressing other beneficial applications of ionising radiation in the medical and industrial sectors.

By contributing to these objectives, the Euratom Programme shall (i) reinforce outcomes under the three priorities of Horizon 2020 (excellent science, industrial leadership, and societal challenges), and (ii) support the development of the European Energy Union, one of the main objectives laid down in the 'Strategic Agenda for Jobs, Growth, Fairness and Democratic Change' presented by President Juncker in July 2014. In relation to the latter, the Commission Communication on the 'Energy Union Package: A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy'[[3]](#footnote-4), under the pillar on Research, Innovation and Competitiveness states *"Nuclear energy presently produces nearly 30% of the EU's electricity. The EU must ensure that Member States use the highest standards of safety, security, waste management and non-proliferation. The EU should also ensure that it maintains technological leadership in the nuclear domain, including through ITER, so as not to increase energy and technology dependence."*

The present work programme deals with Euratom indirect research actions in both fission and fusion.

Euratom fission research is essentially aimed at enhancing the safety and performance record and improving the sustainability of nuclear energy production technology, contributing to the development of safe and publicly acceptable solutions for the management of radioactive waste and furthering the understanding of the effects of low doses of ionising radiation on humans and the environment in order, notably, to ascertain strategies relevant to radiation protection. This research continues to be guided by the results of the Interdisciplinary Study 'Benefits and Limitations of Nuclear Fission for a Low Carbon Economy'[[4]](#footnote-5), which was presented at the 2013 Symposium of the same name co-organised by the European Commission and the European Economic and Social Committee, in particular regarding the incorporation of social sciences and humanities and the need to consider fission strategies in the context of the overall EU energy mix. In terms of objectives, this research promotes the use in all Member States of high standards of nuclear safety, including in radioactive waste management and radiation protection, and contributes to maintaining European technological leadership and independence in the nuclear domain.

Compared to the Euratom work programme 2014-2015, the fission part of Euratom work programme 2016-2017 places more emphasis on the long-term security of energy supply at EU level with topics on the possible optimisation of the use of resources through further investigation of the safety and feasibility of Generation-IV reactors and closed fuel cycle options, whilst continuing to pay particular attention to the European added value of research on related safety issues. Activities concerning fission safety and radiation protection presented in this work programme are in line with the Council Directive 2009/71/Euratom of 25 June 2009, and its revision 2014/87/Euratom, establishing a Community framework for the nuclear safety of nuclear installations, the 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, and the Council Directive 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation.

Euratom fusion research is aimed at developing magnetic confinement fusion as a new energy source. Following the expiry, at the end of 2013, of the European Fusion Development Agreement (EFDA) and the Contracts of Association between the Commission and national fusion laboratories, and in line with the provisions of the Euratom Research and Training Programme (2014-18) complementing Horizon 2020, the Euratom work programme 2014-2015 set up a new framework consisting of multiannual support (i) to a consortium (EUROfusion) of national fusion laboratories and institutes to implement a joint programme in line with the fusion roadmap (‘Fusion Electricity – A roadmap to the realisation of fusion energy’), and (ii) for the continued operation of JET, the Joint European Torus, as the principal research device exploited under this joint programme. This new approach to fusion research in Europe promotes enhanced integration across Europe in order to ensure the success of ITER and electricity generation from a ‘DEMO’ device around the middle of the century. Fusion research in Europe has always been the best example Europe can offer of a unified research programme, and the establishing of EUROfusion and the continued exploitation of JET maintains and reinforces this unity. The work programme 2014-2015 constituted a 5-year financing decision for both the EUROfusion joint programme (Grant Agreement for a European joint programme) and the 'New JET Operation Contract' (NJOC), and the present work programme 2016-2017 will provide limited additional funding from third party receipts for complementary activities.

International cooperation remains an important element of all Euratom activities and will continue to be implemented under the various multilateral frameworks (OECD/NEA, IEA, IAEA, GIF, etc.), as well as through the bilateral Euratom cooperation agreements with third countries that, under the provisions of the Euratom Treaty, cover all international collaborative activities between EU entities and the third countries in question.

# SECTION A: CALL FOR PROPOSALS *(H2020-NFRP-2016/2017)*

The activities funded by this Work Programme have been developed in accordance with the Council Regulation on the Euratom Research and Training Programme 2014-2018 complementing Horizon 2020. They are organised in six main sections:

1. Support safe operation of nuclear systems
2. Contribute to the development of solutions for the management of ultimate radioactive waste
3. Foster radiation protection
4. Management of research reactor availability in Europe
5. Support to the development of nuclear competences at Union level
6. Fission/fusion cross-cutting actions

Where appropriate, social science and humanities, socio-economic issues and trans-national access to research infrastructures are addressed within each of the six sections.

International cooperation with third countries is promoted through bilateral Euratom cooperation agreements, but also multilateral initiatives such as those under the auspices of the OECD/NEA, IEA, IAEA, GIF, etc. Where necessary and relevant, specific references to international cooperation are made in the work programme sections, but these should not be considered exhaustive. More detailed provisions, notably regarding possible Euratom funding to entities in third counties, are available on the Horizon 2020 webpage[[5]](#footnote-6).

In carrying on the activities proposed in this work programme, due attention should be paid to the dissemination of research results through scientific publications, as well as to the exploitation of research results by the stakeholders concerned.

Proposals are invited against the following topics:

## A - Support Safe Operation of Nuclear Systems

The actions under this section are devised taking into account the European collaborative research activities already supported notably by Euratom and the priorities of the Strategic Research and Innovation Agenda (SRIA) of SNETP[[6]](#footnote-7) and its three pillars NUGENIA[[7]](#footnote-8), ESNII[[8]](#footnote-9) and NC2I[[9]](#footnote-10).

### NFRP 1 – 2016-2017: Continually improving safety and reliability of Generation II and III reactors

*Challenge:* A number of current Generation II reactors are expected to continue operating for a few decades and Generation III should still be in operation one century from now. The objective of this action is to complement where needed earlier investment in research regarding the safety and reliability of Generation II and III reactors, with particular attention to the new requirements of the amended Nuclear Safety Directive (Council Directive 2014/87/Euratom of 8 July 2014 amending the Directive 2009/71/Euratom establishing a Community framework for the nuclear safety of nuclear installations).

*Scope:* Safety and reliability improvements are to be sought in a number of areas, with due consideration to the Strategic Research and Innovation Agenda established by NUGENIA. The action should focus on the following issues: the integrity of structural components in ageing reactors, the knowledge basis for lifetime management of the reactor islands, the management of severe accidents including hydrogen production, the improved modelling of reactor behaviour, the methodology of seismic risk assessment, accident-tolerant fuel, probabilistic safety assessment and fire safety. Aspects such as molten core management as a key element of Generation III reactors are also to be considered. Results obtained as part of this action, shall as much as possible be made public. International cooperation in this area would be beneficial.

*Expected impact:* This action will help industrial stakeholders developing efficient and economically sustainable solutions in response to the new requirements of the amended Nuclear Safety Directive. It will result in reinforced safety features of the generation II and II EU nuclear reactor fleet. This should improve the market profile of EU-based reactor designs and strengthen the competitiveness of the EU nuclear sector in exhibiting safety as an appealing marketing feature.

*Type of action:* Research and innovation actions.

### NFRP 2 – 2016-2017: Research on safety aspects of fast neutron Generation-IV reactors

*Challenge:* The first Generation-IV reactors are expected to be fully operational in the next 25-30 years in various places around the world. In the meantime, all Generation-IV concepts and designs currently under development, both in Europe and worldwide, will need to demonstrate compliance with evolving and ever more stringent safety requirements. In this context, a significant shift in safety is expected from fast neutron reactors and new reactor coolants that should exhibit more favourable behaviour in the case of severe accidents, whilst also offering major advantages in terms of the use of the uranium resource and being potentially more proliferation resistant. This activity will build on the strong operational experience gained in the EU on Generation-IV reactors, whilst ensuring that research and technical expertise on nuclear safety of Generation-IV reactor is effectively shared at EU level. The challenge is also to ensure that all European stakeholders, including civil society, can be represented in the assessment of the status of current developments concerning Generation-IV R&D with respect to expected safety features.

*Scope:* This action is directed at the assessment of the safety improvements of the highest priority fast neutron Generation IV systems and their supporting reactor islands, as identified by ESNII. This includes core parameter optimisation and reactivity control, reliability of automatic shut-down systems, diversified systems of residual power removal without common mode failure, demonstrable natural circulation of cooling fluids in ultimate procedures, improved strategy of confinement modes and severe accident behaviour and mitigation, in-service inspection and repair of safety related components, as well as the related licensing databases. The safety of different fuel cycle options should be investigated, including, dense MOX driver fuel, multiple recycling of plutonium, use of low enriched uranium and transmutation of some minor actinides. Moreover, design and operational features facilitating and improving safety of decommissioning should be addressed. These safety improvements will need to be endorsed by the EU scientific community in view of building-up the main corpus of EU technical standards for Generation IV to be used as the reference to demonstrate compliance with the amended Euratom Safety Directive. The proposed action shall involve standardisation bodies at national and EU level.

*Expected impact:* This action is to draw on the unique expertise and operational experience feedback gained by the EU in Gen IV technology in order to place the EU at the forefront of the development of safety standards for this new generation of reactors, thereby helping EU safety standards to be adopted worldwide. This will ensure deployment of this next generation of reactors in conformity with the recognised stringent European safety standards whilst also boosting EU technological and industrial competitiveness.

*Type of action:* Research and innovation actions.

### NFRP 3 – 2016-2017: Improving the safety of closed nuclear fuel cycle options and fuel developments

*Challenge:* The open fuel cycle uses only a few percent of the energy contained in uranium. This efficiency can be greatly increased through the use of a spent fuel recycling technology, including, in the longer term, multi-recycling strategies. The EU benefits from extensive operational experience in this domain, which is unique in the world. This experience should be exploited and extended to further improve nuclear safety, radiation protection and environmental protection aspects of fuel reprocessing options. This challenge also includes partitioning and transmutation processes for suitable recycling strategies, development and qualification of innovative fuels and claddings for advanced Generation-IV systems.

*Scope:* This action will address research and innovation in fuel cycle chemistry and physics and the optimisation of fuel design in line with the strategic research and innovation agenda and deployment strategy of SNETP, notably for its ESNII component. It should also take account of relevant orientations promoted within the framework of the Generation-IV International Forum (GIF). The focus shall be on integrating installations for interim storage, reprocessing and fuel manufacture including MOX in order to increase the safety of these installations during normal operation and hypothetical accident scenarios. As such, it should include research and innovation for developing compatible techniques for dissolution, reprocessing and manufacturing of innovative new nuclear fuels, including oxides, nitrides and/or carbides. Moreover, this action should aim at further integrating EU activities on partitioning and fuel fabrication and foster the participation of the chemical separation community from European research institutions, educational establishments and industrial players including the EERA[[10]](#footnote-11) nuclear-related research programme, wherever applicable.

*Expected impact:* This action will lead to the provision of more science-based strategies for nuclear fuel management in the EU. It will reinforce the EU leadership in this domain and open up new avenues towards the EU energy security of supply and increased competitiveness. It will allow nuclear energy to contribute significantly to EU energy independence. In the longer term, it will facilitate the management of ultimate radioactive waste management by reducing its volume and radio-toxicity.

*Type of action:* Research and innovation actions.

### NFRP 4 – 2016-2017: Research on the safety of small modular reactors

*Challenge:* Small Modular Reactors (SMR) are considered as an interesting option for certain applications (e.g. small remote electricity network or cogeneration), offer interesting perspectives in terms of export potential and are in principle easier to build and to operate under certain site conditions. The smaller size of the reactor also offers interesting safety features, notably in terms of residual heat removal, but these features may differ significantly from those of large power reactors and need to be further investigated.

*Scope:* This action should provide a set of essential technical specifications, against which compliance of SMRs with the amended Euratom Safety Directive could be tested. The research should also propose the methodology for these tests to be performed, including the experimental validation of essential items of the proposed models of safety demonstration, as well as their effects on the SMR licensing process under various typical field of application. To increase the effectiveness of the initiative, particular attention should be devoted to SMRs concepts that are based on proven technology. Due account should also be taken of decommissioning and spent fuel management of SMRs in the above safety demonstration. International cooperation in this area would be beneficial.

*Expected impact:* This action will allow the EU to establish standards for compliance of SMR to the requirements of the revised Euratom Safety Directive. It will pave the way for robust science-based recommendations to decision makers in this area at EU level. In the longer term, it will also improve the flexibility of nuclear power generation regarding power output and adaptation to local grid and siting conditions, while taking into account the highest safety standards. Ultimately, it will reinforce EU’s commercial prospects and competitiveness in this field.

*Type of action:* Research and innovation actions.

### NFRP 5 – 2016-2017: Materials research for Generation-IV reactors

*Challenge:* Materials research and innovation is at the cornerstone of many technological developments, notably in the nuclear field, where technical qualification and certification are subject to stringent safety criteria. It is therefore of paramount interest for Euratom to support research and innovation in this area, notably for resolving the key last remaining issues regarding the structural materials to be used in Generation-IV reactor concepts under consideration in the EU.

*Scope:* Whilst the EU nuclear materials research community has significant experience and extended knowledge about materials behaviour under conditions typical for Generation-IV reactor concepts, there are still some areas where further research and innovation is needed to reach technological maturity. This applies in particular to changes in materials properties after long-term operation of reactors under fast neutron irradiation and high temperature of the coolant, as well as to the compatibility of the core material with the coolant. This action shall include the refinement of physical models and/or modelling oriented experiments on materials microstructural change and their resulting effects on materials property, as well as advanced micro-structural characterisation techniques. This research and innovation could also include the development, testing and qualification of mitigation strategies involving for example the development of suitable surface engineering concepts (e.g. surface alloying or coating) for current known material deficiencies.

*Expected impact:* This action aims at significant progress regarding the predictive capability of changes in material properties and behaviour and subsequent refinement of Generation-IV reactor design codes. This will help to overcome the bottlenecks in the certification of materials and hence in the development of safety demonstration for Generation-IV reactor technologies. Ultimately, as occurred in past developments, it is expected that a technology shift in materials for the nuclear domain will stimulate similar evolution in other domains of major importance for EU competitiveness.

*Type of action:* Research and innovation actions.

*Additional information regarding the five specific challenges in section A - Support Safe Operation of Nuclear Systems:* The Commission considers that proposals requesting a contribution from Euratom of between EUR 2 and 4 million would allow each of these five specific challenges to be addressed appropriately. Proposals will be ranked in only one budget cluster for these five specific challenges.

The conditions related to these topics are provided at the end of this call and in the Annex 1.

## B - Contribute to the Development of Solutions for the Management of Radioactive Waste

The actions under this section are devised taking into account the European collaborative research activities already supported notably by Euratom and the priorities of the Strategic Research and Innovation Agenda (SRIA) of IGD-TP[[11]](#footnote-12).

### NFRP 6 – 2016-2017: Addressing remaining priority R&I issues for the first-of-the-kind geological repositories

*Challenge:* There is a broad consensus in Europe and worldwide that Deep Geological Repository (DGR) is the safest practical solution for the final disposal of high- and intermediate-level long-lived ultimate radioactive waste, including vitrified waste from the reprocessing of spent nuclear fuel, spent fuel if this is considered waste in national programmes, and possibly other long-lived wastes. Thanks to a concerted and long-term strategy, Europe has acquired a clear leadership in this domain and will host the world's first such repositories, which are expected to become operational around 2020-2025. But there still are some technological issues to be resolved for this to become reality.

*Scope:* This action will address the last remaining key R&I issues in view of the construction and operation in the EU of the first DGR, notably with respect to validating data and performance. The focus shall be on topics of high priority and European added value, which were raised in safety reviews and identified in the SRIA of IGD-TP. It concerns notably the disposal of new and unconventional fuels, the validation of the properties of engineered barrier materials and the confirmation of the integrated performance of engineered barrier systems. A further goal is to identify the aspects of these projects that could be amenable to the transfer of knowledge and technology to other countries or regions. Moreover, the action shall propose first draft of harmonised cost structure for DGR similar to the existing and internationally recognised International Structure for Decommissioning Costing (ISDC) of nuclear installations.

*Expected impact:* This action will contribute to the further progress in resolving remaining technological innovation issues important in the actual implementation of the planned geological repositories in the EU, thereby consolidating the EU leadership in this domain. The involvement of countries with less mature programmes alongside the more advanced national programmes will stimulate and foster the cooperation amongst EU Member States in this important domain and hence facilitate steps towards decision making and implementation of DGR in many more Member States.

*Type of action:* Research and innovation actions.

### NFRP 7 – 2016-2017: Research and innovation on the overall management of radioactive waste other than high-level waste and spent fuel.

*Challenge:* The disposal of high-level waste, spent fuel and long-lived ultimate radioactive wastes coming from the nuclear fuel cycle has been the subject of research for many decades, including in the Euratom Framework Programmes. Less common radioactive waste types and forms present specific challenges as regards their long-term management. High added value can be obtained from joint research and innovation actions at EU level in improving or developing knowledge and methods for management of these wastes.

*Scope:* This action will address R&I in view of further improving the management of radioactive waste generated by the nuclear industry other than high-level waste, spent fuel and long-lived waste. This concerns, for example, unconventional or legacy waste, operational wastes, such as fuel claddings, waste arising from repair or maintenance and decommissioning/dismantling waste. The action would encompass the characterisation, quality control and checking and treatment of these radioactive wastes, particular attention being paid to the minimising of their volume and toxicity and the facilitating of their handling and management. This action should be undertaken in close cooperation with the operational stakeholders concerned, notably the waste management organisations, to facilitate the early uptake of the results in the development of disposal solutions. International cooperation in this area would be beneficial.

*Expected impact:* This action will lead to the further refinement of the EU policy on radioactive waste management. It will help develop new or improved solutions for the management of radioactive waste other than high-level long-lived ones and spent fuel, with the perspective of economy and efficiency gains, for example in the dismantling of nuclear installations. It will strengthen EU integration for addressing an important remaining challenge from the use nuclear energy.

*Type of action:* Research and innovation actions.

### NFRP 8 – 2016-2017: Pan-European knowledge sharing and development of competence on radioactive waste management

*Challenge:* The Radioactive Waste Management Directive (2011/70/Euratom) requires each Member State to, *inter alia,* adopt a national programme for the management of radioactive waste, including the carrying out of the necessary research. It is thus important for the Euratom research and training programme to contribute to the wider development of R&D and managerial competences in the field of radioactive waste management at EU level. In this respect, particular attention shall be paid to the needs of Member States with little or no practical experience in this area.

*Scope:* This action will aim to further develop scientific, technical and managerial knowledge and competences in the area of radioactive waste management at pan-European level, encompassing the whole range of waste types and forms and origins. The focus should be on the development and transfer of knowledge and competence not on the actual elaboration and harmonisation of national strategies and programmes. The action should build on the body of knowledge already acquired and complement the training and guidance material developed in earlier Euratom and national programmes. It will include the production of hands-on guidance documents on management aspects and state-of-the-art reports covering the various scientific, technical and economic aspects of radioactive waste management, including geological disposal solutions. It should also propose a methodology to assess the potential and opportunities for transfer of knowledge, competence and technology between radioactive waste management programmes. The action should be directed at the concerned institutional and operational stakeholders with the objective to help them develop strategies, plan and prioritise RD&D actions and develop national programmes adapted to the varying situations and local conditions that exist across the EU. The action should involve specialised research and training organisation, as well as the IGD-TP as source of knowledge and competence.

*Expected impact:* This action will help to consolidate and extend the knowledge base and competences at pan-European level in the area of radioactive waste management. This in turn will help Member States developing their national programme for radioactive waste management including the supporting research and development actions, which is central to the implementing of the Radioactive Waste Management Directive. It should also pave the way to the coordinated and integrated implementation of joint or shared RD&D activities and facilities in any future Joint Programming action of MS RD&D programmes at EU level.

*Type of action:* A Coordination and Support Action.

*Additional information regarding the three specific challenges in section B - Contribute to the Development of Solutions for the Management of Radioactive Waste:* For the specific challenges NFRP 6 and 7 above, the Commission considers that proposals requesting a contribution from Euratom of between EUR 2 and 4 million would allow these specific challenges to be addressed appropriately. Proposals will be ranked in only one budget cluster for these two challenges. With regard to the specific challenge NFRP 8 above, the Commission considers that proposals requesting a contribution from Euratom of between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately.

The conditions related to these topics are provided at the end of this call and in the Annex 1

## C - Foster radiation protection

The action under this section is devised taking into account the European collaborative research activities already supported notably by Euratom and the priorities of the Strategic Research and Innovation Agendas (SRIA) of MELODI[[12]](#footnote-13) and partner associations in radiobiology, radio-ecology, dosimetry, risk management[[13]](#footnote-14), complemented recently by the signature of Memoranda of understanding with five medical associations[[14]](#footnote-15). The harmonious working together of these different scientific communities and the coherent integration of their activities is being sought through the recent setting up of a European Joint (EJP)[[15]](#footnote-16) programme in the area.

## This area is also partly addressed in NFRP 13 below.

### NFRP 9 – 2017: Impacts of low dose radiation exposure from medical procedures

*Challenge:* A better understanding of the effects of low dose ionising radiation on human health is essential to help lifting uncertainty on the radiation risk resulting from a number of medical and nuclear industry practices. A reinforced cooperation between the medical and nuclear sectors in this area is highly desirable and will be mutually beneficial. It will allow the formulation of science-based recommendations to decision-makers and practitioners in the respective sectors in view of the effective protection of people and fine-tuning of the necessary precautionary measures.

*Scope:* This action should allow significant progress to be achieved in the understanding of radiation effects, thanks to high quality data being collected during the medical use of ionising radiation, notably by performing radiation epidemiology studies of people undergoing radiology procedures. The action shall also consider creating a centralised and structured repository for imaging meta-data, the latter being integrated with health databases. The action shall build-on the above-mentioned signature of memoranda of understanding between MELODI and a number of relevant European medical associations and shall involve contributions from public health and/or healthcare organisations. The principal objective will be to provide science-based recommendations to decision-makers and practitioners in the respective sectors. The results should therefore be presented and discussed with relevant stakeholder groups with the view to stimulate the debate, in their respective spheres, on the possible refinement of their procedure for the protection of the concerned persons (doctors, patients, technicians and operators). The effective involvement of the different actors mentioned above and notably the interaction with MELODI will be considered during evaluation. International cooperation in this area would be beneficial.

*Expected impact:* This action will allow significant progress to be achieved in the interaction between the radiation protection and medical scientific communities at EU level, leading to cross-fertilisation of research efforts and the provision of more consolidated and robust science-based policy recommendations to decision makers in the respective sectors. In the longer term, these efforts will translate into additional or improved practical measures in view of the effective protection of people in the medical and nuclear sectors. Ultimately, the risks from radiation will be better appraised and the necessary precautionary measures will be better weighted in order to adequately and appropriately protect people, whilst not penalising unduly some activities through unnecessary protective and over-costly measures, which might then lead to some revision of the relevant regulatory frameworks.

*Type of action:* Research and innovation actions.

*Additional information:* The Commission considers that proposals requesting a contribution from Euratom of between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately.

The conditions related to this topic are provided at the end of this call and in the Annex 1.

**D - Management of research reactor availability in Europe**

### NFRP 10 – 2017: Support for the EU security of supply of nuclear fuel for research reactors

*Challenge:* The security of supply of nuclear fuel for research reactors in the EU is a key element of the availability of such reactors in the EU, which is essential for, notably, material research, isotope production, silicon doping and education and training purposes.

*Scope:* This action shall involve the EU based research reactor fuel manufacturer, EU research centres and interested EU research reactor operators to investigate the future needs for fuel manufacturing and the appropriate European response to guarantee the security of supply of nuclear fuel for research reactors. This research shall include the fuel design requirements for each reactor for which European operators do not possess relevant data, the safety-related technical requirements of fuel manufacturing, storage, transport, and reprocessing. The technical, legal and economic conditions for the long-term sustainability of EU-based fuel-manufacturing model for research reactors shall also be investigated as well as the long term supply of LEU.

*Impact:* This action will secure the supply of nuclear fuel for research reactors in Europe. In doing so, this action will also reinforce the security of supply of medical radioisotopes like Molybdenum-99 and the availability, in the EU, of an adequate neutron irradiation capacity for the needs of material testing. Ultimately, this action will contribute to the addressing two of key challenges of Horizon 2020 in the sectors of energy (material testing that is essential for nuclear safety) and health (in preventing the shortage of medical radioisotopes).

*Type of action:* Research and Innovation actions.

*Additional information:* The Commission considers that proposals requesting a contribution from Euratom of between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately.

The conditions related to this topic are provided at the end of this call and in the Annex 1.

**E - Support the development of nuclear competences at EU level**

### NFRP 11 – 2017: Support for careers in the nuclear field

*Challenge:* This action aims at addressing the difficulties encountered with the maintenance and renewal of well-educated and trained nuclear researchers and professionals, especially because of high retirement expectations and low renewal rates in countries with a tradition of nuclear installations and of a strong need for further specialised training in emerging nuclear energy countries.

*Scope:* Special attention is to be devoted to the further implementation, in the nuclear and relevant medical *and* industrial sectors, of initiatives to attract new talents in the nuclear field and develop competences and expertise over and above the academic curricula. This could be achieved through further proposals of "Euratom Fission Training Schemes", based on ECTS and ECVET mechanisms. This should be complemented by the setting up of summer schools and other such temporary teaching actions by experts notably from industry at technical universities to raise awareness and perspectives of a nuclear career while also taking stock of practical actions to be implemented in terms of training curricula. The aim is to respond to the needs of nuclear industry, regulatory bodies and TSOs. Also important are the so-called nuclear activities of proximity, which include medical applications, the non-nuclear industry and the transport of radioactive materials. Links should be established with the "European Nuclear Education Network" (ENEN) and the different Euratom fission science and technology platforms. International cooperation in this area would be beneficial and will be considered during evaluation.

*Expected impact:* This action will revive the interest of the young generation for careers in the nuclear sector (in particular, reactor safety, geological disposal, radiation protection).

*Type of action:* Coordination and Support Actions.

*Additional information:* The Commission considers that proposals requesting a contribution from Euratom of between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately.

**F - Fission/fusion cross-cutting actions**

### NFRP 12 - 2016-2017: Fission/fusion cross-cutting research in the area of multi-scale materials modelling

*Challenge:* As the fusion programme progresses towards the ultimate goal of electricity generation, there are increasing opportunities for synergies in a wide range of areas that are common with fission. The present topic is to encourage closer integration of research efforts between fission and fusion research communities in the domain of multi-scale modelling in research on material properties and the development of new materials.

*Scope:* Multi-scale modelling of a range of materials-related phenomena (e.g. microstructural evolution during synthesis or processing of materials, and degradation mechanisms under specific conditions pertinent to the nuclear fusion and fission technologies) plays an increasingly important role in the required in-depth understanding of the microstructural processes in materials of interest, and is expected to be an efficient and effective way to address key materials-related issues. For example, the predictability of models is of paramount importance and would need to be addressed by this action. Proposed modelling approaches would need to be supported by robust verification means, including where necessary appropriate irradiation campaigns. The contribution to the development of codes and standards is also encouraged. Only proposals that clearly demonstrate substantial benefit for both fission and fusion, that include actors from both communities, and that complement the existing research efforts in both domains will be retained.

*Expected impact:* This action will help the cross-fertilisation in nuclear materials research between the two main fields of activity represented by fission and fusion and will result in a better general understanding and critical mass in the discipline as a whole. In turn, it will help overcome bottlenecks that are limiting developments in fission and fusion, including in technology areas with safety relevance.

*Type of action:* Research and innovation actions.

*Additional information:* The Commission considers that proposals requesting a contribution from Euratom of between EUR 2 and 4 million would allow this specific challenge to be addressed appropriately.

The conditions related to this topic are provided at the end of this call and in the Annex 1.

### NFRP 13 - 2016-2017: Cross-cutting support to improved knowledge on tritium management in fission and fusion facilities

*Challenge:* Tritium in the environment and its health impacts are a concern. Indeed, whilst discharges of most radionuclides from fission installations are decreasing, as a result of the use of new techniques of effluent decontamination, tritium discharges are increasing owing to new nuclear fuel management modes and the lack of detritiation capability. Discharges are also anticipated from fusion installations once these start operating as nuclear facilities. Further research is necessary to assess and mitigate impacts of such discharges and potentially to limit them.

*Scope:* This action should assess technologies to minimise tritium permeation at source and to capture and store tritium from treatment of metallic waste and liquid and gaseous effluents, e.g. using photo-synthesised polymers. This action should also include (i) an assessment of the tritium inventory in both fission and fusion systems using state-of-the-art modelling tools for tritium migration studies, e.g. from primary to secondary systems between which tritium may pass, (ii) refinement of the knowledge on outgassing and release mechanisms, radiotoxicity, radioecology, radiobiology, dosimetry and metrology of tritium, and (iii) engineering solutions for detritiation techniques (metals, liquids and gasses) and waste management to meet the stringent regulations in force in the EU. International cooperation in this area could be beneficial, e.g. with Canada and Japan, and this will be considered during the evaluation.

*Expected impact:* This action will contribute to the solution of a number of key issues in the management of tritium in fission and fusion facilities that will satisfy regulatory requirements and thus minimise environmental and possible subsequent health effects. It will pave the way for robust science-based policy recommendations to decision makers in this area at EU level.

*Type of action:* Research and innovation actions.

*Additional information*: The Commission considers that proposals requesting a contribution from Euratom of between EUR 2 and 3 million would allow this specific challenge to be addressed appropriately.

The conditions related to these topics are provided at the end of this call and in the Annex 1.

Conditions for the call

Opening date(s)[[16]](#footnote-17): 30/09/2015

Deadline(s)[[17]](#footnote-18):

|  |  |
| --- | --- |
| All Topics NFRP  | 17/09/2016 at 17:00:00 Brussels time  |

Indicative budget:

EUR 48,39 million from the 2016 budget

 EUR 57,35 million from the 2017 budget[[18]](#footnote-19)

|  |  |  |
| --- | --- | --- |
| Topics | 2016EUR million | 2017EUR million |
| NFRP 1-5 | 48,39 | 4 |
| NFRP 6-7 |  | 20 |
| NFRP 8 |  | 2,65 |
| NFRP 9 |  | 9 |
| NFRP 10 |  | 7,70 |
| NFRP 11 |  | 6 |
| NFRP 12 |  | 5[[19]](#footnote-20) |
| NFRP 13 |  | 3 [[20]](#footnote-21) |
|  | 48,39 | 57,35 |

All topics - single stage procedure

Eligibility and admissibility conditions: The conditions are described in parts B and C of the Annex 1 to the work programme, with the following exceptions:

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part G of the Annex 1 to the work programme.

Evaluation procedure: The procedure for setting a priority order for proposals with the same score is given in part G of the Annexes.

The full evaluation procedure is described in the relevant guide[[21]](#footnote-22) published on the Participant Portal.

Indicative timetable for evaluation and grant agreement:

|  |  |  |
| --- | --- | --- |
|  | Information on the outcome of the evaluation(*single stage*) | Indicative date for the signing of grant agreements |
| All topics | Maximum 5 months from the final date for submission | Maximum 8 months from the final date for submission |

Consortia agreements: In line with the Rules for Participation and the Model Grant Agreement, participants in Research and Innovation Actions or in Innovation Actions are required to conclude a consortium agreement prior to grant agreement.

## OTHER ACTIONS

### B.1: Support for fission research & innovation (R&I) investment projects of pan-European relevance through the InnovFin instrument

***NOTE: The following text will be reviewed and expanded, notably regarding the selection procedure, in accordance with the template for* Innov*Fin related actions***.

*Challenge:* To support fission R&I related investment projects of pan-European relevance.

*Scope:* The Euratom fission programme will set aside 10 million/year over the next three years to support fission R&I investment projects, typically in relation to the construction or refurbishing of research infrastructure, specialised equipment or technology demonstrators. This Euratom financial contribution will be matched by a corresponding contribution from the European Investment Bank (EIB), which together could have an overall leverage effect of around six in terms of volume of EIB loans that will be devoted to innovative fission R&I projects. The volume of loan attributed to a particular project will be determined on a case-by-case basis by the EIB on the basis of an in-depth analysis of the project consortium composition and business plan and associated revenue streams. In this process the Euratom contribution could be "pooled" with Member States' contribution to particular project. This investment is expected to support at least three projects identified by Member States in the fission domain.

*Expected impact:* This action will help creating the incentive for essential investment projects to be realised in the fission domain at a time fission energy is expected to play a significant role in the Energy Union.

Type of action: Financial instrument - Innov*Fin*

Indicative timetable: Projects could be submitted within the next two to three years.

Selection procedure: The selection procedure of the European Investment Bank will be applied. When necessary, technical advice will be supplied to the bank by the Commission.

*Indicative budget:* EUR 10 million from each of the 2016 and 2017 budgets.

### B.2: Prize - Innovation SOFT

*Challenge:* Fusion research encompasses innovation in the domains of physics and technology in a wide variety of specialisations. Fusion researchers are constantly challenging the scientific state-of-the-art and improving the technology thereby creating the conditions for innovation, much of which can be exploited in other science and industrial sectors for the benefit of society. A fundamental basis of Horizon 2020 is the drive and support for innovation across the product development chain from research to market. In this context the researcher plays a critical role. This prize is being offered to highlight and reward the excellence in innovation that can be found in fusion research as well as the quality of the researchers and industries involved.

*Scope:* Following the successful running of this contest in coordination with SOFT 2014 (Symposium on Fusion Technology), it will be rerun in coordination with the next SOFT in 2016. As in 2014, there are no specific categories for this prize. Participants are free to submit an application concerning any physics or technology innovation that has been or is being developed in magnetic confinement fusion research and that has a market potential or has been taken up (or recognised) by industry to be further developed for the market. In a change from the first edition in 2014, the contest is no longer limited to the European research programme and participants are welcome from all ITER partner countries.

*Expected impact:* By awarding the ‘SOFT Innovation Prize’, the Commission will showcase innovations in this research sector giving visibility to the most dynamic, forward-looking and innovative researchers, research teams or industrial participants. This visibility will provide greater potential for valorisation of the research, and the contest will stimulate the research community globally to develop a stronger innovation and entrepreneurial culture in fusion research. The increased competition though a worldwide contest will stimulate EU research and innovation in particular.

*Type of action:* The form of funding will be through recognition prizes to a total value of EUR 0.0875 million (Prize - 1st prize: EUR 0.050 million, 2nd prize: EUR 0.025 million and 3rd prize: EUR 0.0125 million from the 2016 budget).

*Eligibility criteria:*

The contestant must be a researcher or research team involved in the Euratom fusion research programme or a national programme in an ITER partner country, or an industrial participant benefitting from the ITER project. Example of proof: *To be decided.*

The researcher, research team or industrial participant has acquired permission from the owner of the intellectual property rights to submit an application. The owner of the IPR should comment on the state of the IPR: free or contractually embedded, and name of eventual contractor/s.

The submission should consist of a complete application for the 'SOFT Innovation Prize' including:

* a technical description of the innovation;
* a state-of-the-art assessment of the innovation (using a publicly available patent database such as the EPO Espacenet);
* an account, in general terms, of the market potential for the exploitation of the innovation;
* the contribution that the prize could provide for the exploitation of the innovation.

For the detailed information on the general conditions, applicable law, and exclusion criteria, please refer to the Rules of Contest for prizes in Annex 1.

Contestants may at any time be required to submit official proof to support claims made under any of the above eligibility criteria.

*Award criteria:*

* Originality and replicability: the idea should be innovative, original and a first-of-a-kind use of the technology in industry or in the domain of application.
* Technical analysis: the application should include patent information on the state-of-the-art in the associated technology field (using a publicly available patent database such as the EPO Espacenet).
* Clarity: the description should be clear, logically presented and well-illustrated.
* Further exploitation and planned use of the prize money: the application should present an awareness of all relevant innovation aspects and include identification of the market needs and business opportunities and how the prize money could contribute to the successful exploitation and further development of the innovation.

*Date of publication of the contest:* 1 January 2016, 12:00:00 Brussels local time

*Date of opening of the contest:* 1 January 2016, 12:00:00 Brussels local time

*Deadline to submit applications:* 15 April 2016, 17:00:00 Brussels local time

*Announcement of winners:* September 2016 (at SOFT 2016, Prague, Czech Republic)

*Evaluation procedure:* The evaluation of the application is carried out by the Commission with the assistance of up to 6 independent experts.

In a first stage, Commission staff will carry out a pre-screening of all received applications. Each application will be checked against the eligibility criteria outlined in the Euratom work programme 2016-2017.

In a second stage, a panel of independent experts will perform an evaluation of all eligible applications against the award criteria outlined in the Euratom work programme 2016-2017. Experts act in a personal capacity and not as representatives of their country, employer or any other entity. They sign an expert contract, including a declaration of confidentiality and absence of conflict of interest before starting their work. Confidentiality rules must be adhered to at all times, before, during and after the evaluation.

The Commission reserves the right not to select a winner if no suitable entries are received or proposed by the panel. The Commission allocates the applications to individual experts, taking account of the fields of expertise of the experts, and the absence of conflicts of interest. At the beginning of the evaluation, the experts will be briefed by the Commission on the evaluation procedure, the experts' responsibilities, the issues involved in the particular area/objective, and other relevant matters.

### B.3: External expertise

*Challenge:* This action will support the use of appointed independent experts for the evaluation of project proposals and, where appropriate, for the monitoring of running projects as well as for the evaluation of entries submitted to prize contests.

*Type of action:* Expert contracts

*Indicative budget:* EUR 0,44 million from the 2016 budget.

### B.4: Expert group for interim evaluation of the Euratom Research and Training Programme 2014-2018

Challenge: In accordance with Article 22(1) of the Council Regulation (Euratom) No 1314/2013 of 16 December 2013 on the Euratom Research and Training Programme (2014-2018), the Commission shall carry out, with the assistance of independent experts, an interim evaluation of the Euratom Programme on the achievements, at the level of results and progress towards impacts, of the objectives and continued relevance of all the measures, the efficiency and use of resources, the scope for further simplification, and European added value. The objective of this action is to establish a panel of independent experts to carry out this evaluation with assistance of supporting experts. A special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest

*Type of action:* Expert contracts

Indicative timetable: 4th quarter 2016 – 1st quarter 2017

*Indicative budget:* EUR 0.15 million from the 2016 budget.

### B.5: International cooperation with targeted countries

*Challenge:* To pursue focussed cooperative actions with specific third States in support to the implementation of the Euratom Programme policy, covering the exchange of scientific and technical nuclear expertise through participation of technical experts in bilateral programmatic discussions under the legal framework of bilateral Euratom cooperation agreements in fission and fusion research.

*Scope:* The targeted countries are Ukraine due to its the possible future association to the Euratom Programme and China as a major player and competitor in the nuclear sector.

With regard to Ukraine

* Fission - This action will principally target radiological data, decommissioning and diversification of nuclear fuel for VVERs. This will *inter alia* facilitate the alignment of Ukraine with European best practices regarding safety, whilst giving EU feedback from Ukraine's experience in operating VVERs.
* Fusion - This action will aim to consolidate the Ukrainian initiative to align the Ukrainian fusion programme to the European Fusion Roadmap and to identify effective contributions to the EUROfusion scope of work.

With regard to China

* Fission - This action will notably focus on the promotion of an effective dialogue in the area of nuclear safety and on the further implementation of the foreseen cooperation on the use of large Chinese research infrastructures, in particular related to severe accident R&I, as well as on education and training programmes.
* This action will further develop the identified priority areas of the programmatic objectives of the China-Euratom fusion work programme for further consideration into the EUROfusion scope of work. Particular focussed areas are the new Chinese Fusion Engineering Testing Reactor (CFETR), the JET programme, and specific physics and technology topics e.g. pulse operation, heat exhaust, and divertor configuration & performance.

*Expected impact:* These actions will help to strengthen the bilateral cooperation on challenges of common interest between Euratom and these two key third countries both in the fission and fusion research areas. In particular, they will (i) promote Ukraine's integration into the fission research programme and its alignment with the European Fusion Roadmap (ii) spread European nuclear safety culture and best practices.

*Type of action:* Expert contracts.

*Type of action:* Expert contracts

Indicative timetable: second quarter 2016 – fourth quarter 2017

*Indicative budget:* EUR 0.15 million from the 2016 budget and EUR 0.15 million from the 2017 budget.

### B.6: Studies for the interim evaluation of fission and fusion indirect actions under Euratom Research and Training Programme 2014-2018

The objective of this action is to provide input for the interim evaluation of the Euratom Research and Training Programme 2014-18 as well as the preparations of the impact assessment for the proposal for extension of the Euratom Programme for the two years 2019 & 20. Studies will need to provide evidence for indirect actions in fission and fusion on the achievements, at the level of results and progress towards impacts, of the objectives and continued relevance of all the measures, the efficiency and use of resources, the scope for further simplification, and European added value.

*Type of action:* Public procurement – service contract for a study

*Indicative timeframe:* 1st quarter 2016 – 1st quarter 2017

*Indicative number of direct service contracts:* 2

*Indicative duration:* 12 months

*Indicative budget:* EUR 0.5 million from the 2016 budget.

## SECTION C: BUDGET OVERVIEW[[22]](#footnote-23)

|  |  |  |
| --- | --- | --- |
| Item | 2016 Budget, EUR million | 2017 Budget EUR million |
| **Calls** |
| Call H2020-NFRP-2016/2017Nuclear Fission and Radiation Protection  |  48,39 | 57,35 |
| **Other Actions** |  |
| B.1 Support for fission research infrastructures of pan-European relevance through the InnovFin instrument | 10 | 10 |
| B.2 Prize - Innovation SOFT | 0,09 |  |
| B.3 External expertise | 0,44 |  |
| B.4 Expert group for interim evaluation of the Euratom Research and Training Programme 2014-2018 | 0,15 |  |
| B.5 International cooperation – Expert discussion and exchange in support to the implementation of the Euratom Programme policy | 0,15 | 0,15 |
| B.6Studies for the interim evaluation of fission and fusion indirect actions under Euratom Research and Training Programme 2014-2018 | 0,5 |  |
| **Estimated total budget** | ***59,72[[23]](#footnote-24)*** | ***67,5[[24]](#footnote-25)*** |

1. Council Regulation (Euratom) N°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 [↑](#footnote-ref-2)
2. Regulation (EU) No 1291/2013 of the European Parliament and of the Council of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC [↑](#footnote-ref-3)
3. COM (2015) 80 final [↑](#footnote-ref-4)
4. <http://www.eesc.europa.eu/?i=portal.en.events-and-activities-symposium-on-nuclear-fission> [↑](#footnote-ref-5)
5. <http://ec.europa.eu/research/horizon2020/index_en.cfm> [↑](#footnote-ref-6)
6. Sustainable Nuclear Energy Technology Platform [↑](#footnote-ref-7)
7. Nuclear Generation II and III Association [↑](#footnote-ref-8)
8. European Sustainable Nuclear Industrial Initiative [↑](#footnote-ref-9)
9. Nuclear Cogeneration Industrial Initiative [↑](#footnote-ref-10)
10. European Energy Research Alliance (EERA) [↑](#footnote-ref-11)
11. Implementing Geological Disposal Technology Platform [↑](#footnote-ref-12)
12. Multidisciplinary European Low Dose Initiative [↑](#footnote-ref-13)
13. To be completed [↑](#footnote-ref-14)
14. To be completed [↑](#footnote-ref-15)
15. CONCERT [↑](#footnote-ref-16)
16. The Director-General responsible may decide to open the call up to one month prior to or after the envisaged date of opening [↑](#footnote-ref-17)
17. The Director-General responsible may delay this deadline by up to two months. [↑](#footnote-ref-18)
18. The budget amounts for 2017 are subject to the availability of the appropriations provided for in the draft budget for 2017 after the adoption of the budget for 2017 by the budgetary authority or if the budget is not adopted as provided for in the system of provisional twelfths. [↑](#footnote-ref-19)
19. This budget figure consists 50% contribution from fusion part of third party receipts. The budget amounts are subject to the availability of the appropriations. [↑](#footnote-ref-20)
20. This budget figure consists 50% contribution from fusion part of third party receipts. The budget amounts are subject to the availability of the appropriations. [↑](#footnote-ref-21)
21. See: <http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/pse/h2020-guide-pse_en.pdf> [↑](#footnote-ref-22)
22. The budget amounts for 2016 & 17 are subject to the availability of the appropriations provided for in the draft budgets for 2016 & 17 after the adoption of the budgets for 2016 & 17 by the budgetary authority or if the budget is not adopted as provided for in the system of provisional twelfths [↑](#footnote-ref-23)
23. This estimation includes also third party receipts covering fusion part of the proposed activities. These budget amounts are subject to the availability of the appropriations. [↑](#footnote-ref-24)
24. This estimation includes also third party receipts covering fusion part of the proposed activities. These budget amounts are subject to the availability of the appropriations. [↑](#footnote-ref-25)