Medium Term Strategy (2022-2029) for Agency Support to Member States in the area of Small Modular Reactors and their Applications

I. Introduction

The Agency's statutory objective is to "...seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world" and "...ensure, so far as it is able, that assistance provided by it or at its request or under its supervision or control is not used in such a way as to further any military purpose". The Agency has pursued and adapted its programme of work within the framework of its Statute to meet the evolving needs and development goals of its Member States.

As far as Small Modular Reactors (SMRs) and their applications are concerned, Member States are asking for the Agency's consistent and coordinated support related to all aspects of SMRs' development, deployment, and oversight.

The Standing Advisory Group for Nuclear Energy and the Commission of Safety Standards have also stated that concerted and coordinated action by the entire Agency is necessary to provide effective and efficient support to Member States and stakeholders interested in the early deployment of SMRs and their related electric and non-electric applications.

To respond to such requests, the Agency engaged in a comprehensive and holistic effort to establish an Agency-wide Platform on SMRs and their applications. The Platform aims at supporting Member States in the early deployment of SMRs, including in accelerating their technology development and demonstration, enhancing their readiness level, and analysing their competitiveness with respect to other clean energy technologies. At the same time, the Platform ensures that high standards of safety, security, and safeguards are considered at all stages.

The Agency-wide Platform on SMRs and their applications was established in April 2021 by the IAEA Director General with the purpose of coordinating the Agency's activities on SMRs and their applications and providing a "one-stop shop" for Member States and stakeholders.

Comprising a high-level Steering Committee (SC) and a Platform Implementation Team (PIT), the Platform involves all relevant Departments and Offices reporting to the Director General. It includes expertise from the entire Agency, encompassing all aspects relevant to the development, early deployment, and oversight of SMRs and their applications.

As stated in paragraph 9 of the Terms of Reference of the SMR Platform, one of the functions of the Steering Committee is to

> *develop a medium-term strategy for Agency-wide support to Member States for the development and early deployment of SMRs, including safety, security, and safeguards considerations throughout the technology's lifecycle and amongst a broad range of stakeholders, while also recognising longer-term considerations*

At its first meeting in May 2021, the SC tasked the PIT to propose strategic objectives of the Medium Term Strategy (MTS). In order to develop the MTS, the PIT applied the following methodology:

- First an environmental scan was performed to identify Member States' needs and gaps in the IAEA programme;
- Based on the environmental scan, the IAEA strategic objectives in the medium-term were established and defined;
- The document should also describe the expected outcomes in Member States if strategic objectives are being met, along with the associated risk analysis.

Strategic objectives are achieved thanks to appropriate projects which can be already existing or identified through a gap analysis. This was done with the help of an environmental scan as well as analysis of existing projects.

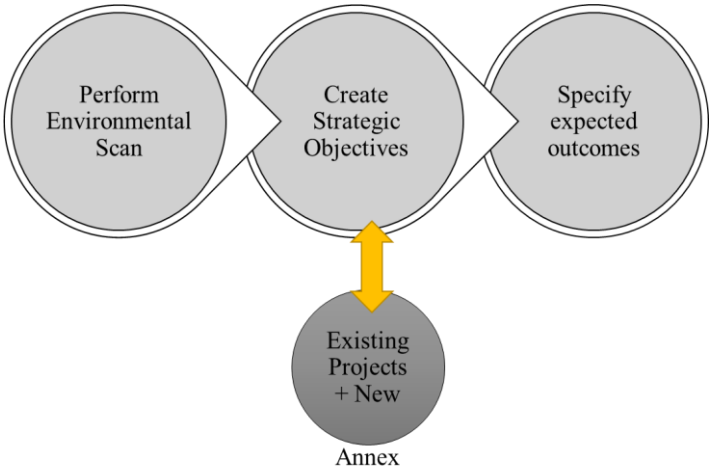

Figure 1 Methodology to create Medium Term Strategy

At the second meeting of the SC in October 2021, the Chair of the PIT presented the methodology used to develop the MTS and to identify the 7 strategic objectives discussed in the third section of this document. The SC endorsed the methodology and the strategic objectives and requested the PIT to identify key stakeholders and draft a summary for each strategic objective.

This document summarizes the work done by the PIT and the SC to develop an MTS for SMRs and their applications covering the period 2022-2029, with emphasis on facilitating the near-term deployment of this advanced reactor technology (i.e., FOAK or demonstration plant by 2030 and orders for commercial facilities in next decade), while recognizing long-term considerations.

In line with the Agency's Statute and subject to the decisions of the Agency's Policy-Making Organs, which are the basis and the guidance for the Agency's activities, the MTS for SMRs and their applications will serve as a strategic direction and roadmap for the Secretariat to prepare an implementation plan for the period covered by it. Also taking into account the on-

going and planned relevant projects (see annex I), the implementation plan will identify priorities for the four P&B biennia covered by this MTS.

The Annex of this MTS includes the current and planned projects supporting the different strategic objectives. It is an important part of the MTS and should be a living document – to be updated regularly on the basis of environmental scans as well as of a gap analysis. The strategic objectives might remain the same (or can be updated if necessary), but the projects supporting the objectives will change with time according to the Member States' needs.

II. Environmental Scan

To understand the technological advances in SMRs and identify how the Agency can support their technology development and rapid increase of their technology readiness level, towards early demonstration and broad deployment, the Department of Nuclear Energy reviewed the outputs and outcomes of several technical and consultancy meetings conducted in past years, analysed the General Conference resolutions and SAGNE recommendations of the last 10 years, surveyed the ongoing initiatives in several Member States, followed the advances in all major international forums (OECD-IEA and NEA, GIF, EC, NICE, IFNEC, etc.) and systematically consulted the Technical Working Group on small and medium sized or modular reactors (TWG-SMR). Interest in Small Modular Reactors is increasing and expected to grow in both expanding and embarking countries. It is expected that Member States will request IAEA support in the areas of, but not limited to: supply chain, codes and standards, advanced manufacturing, design engineering, generic user requirements and criteria, standardization and harmonization of industrial and legal and regulatory approaches, deployment strategies, market analysis, human resource development, etc.. There is a need to enrich the studies on understanding the major differences of SMR technology as compared to the currently deployed nuclear power plants, and other advanced reactor systems. This will ensure better understanding of the areas that need specific attention as well as allocation of resources. There is also a need to enhance the involvement of all stakeholders at early stages of development, collect lessons learned and experience from developers and designers, borrow knowledge from other industries, and establish priorities. A comprehensive assessment of energy markets and financial schemes as well as economics is also essential for Member States to make an informed decision, in particular in the case of SMRs that are supposed to rely on different deployment models.

To understand the main safety, security and regulatory challenges, the Department of Nuclear Safety and Security undertook a systematic identification of the safety, security and regulatory implications of SMRs and their impact on current approaches to safety and security, including the safety standards and security guidance. This work included the input of 150 experts from 30 Member States involved in the development of these technologies. The review found that the safety standards are generally applicable to SMRs. However, the review also identified some applicability considerations. There are parts of the safety standards that may not apply to non-water cooled SMRs. These are focused on large, land-based water-cooled NPPs where interpretation may be difficult or not possible. For most cases, issues identified may deserve additional work but may not need to be reflected in the safety standards. These applicability

considerations informed the environmental scan and the development of the strategic objective related to safety and security.

Furthermore, to understand the main regulatory challenges in the deployment of these novel technologies compounded by the innovative deployment models proposed by several vendors/designers, the SMR Regulators' Forum, composed by several Member States with experience in regulating SMRs, is working on common positions to facilitate regulatory cooperation in the pre-licensing and licensing processes of SMRs. This is considered a preliminary step towards the goal of safety and security requirements harmonization. The work of the SMR Regulators Forum supports identification of safety related issues that may challenge regulatory reviews and provides suggestions to the IAEA including revisions to or the creation of new IAEA documents and changes to international regulatory codes and standards.

Finally, the Department of Technical Cooperation, to define its strategy in coming years, has analysed the current portfolio of the national, regional and interregional TC projects related to SMRs and their applications, especially the ones involving newcomer countries and other developing countries which could benefit from the transfer of knowledge from well developed technology holder countries. This is an important step to raise awareness on SMR technologies, safety and their applications and to respond to the needs of newcomer countries in deploying SMRs through TC project assistance. It promotes technology development and transfer to recipient countries and enhances infrastructure and capacity building.

III. Strategic Objectives

Strategic objectives are designed to ensure timely, relevant, and consistent IAEA contributions to address the needs and gaps identified in the previous section on environmental scan. Each strategic objective has a short definition and is linked to the existing and planned projects (in Annex) to support that objective, as well as to requirements of new projects to fill the gaps. The existence of ongoing projects for each strategic objective provides evidence that the Agency, and in particular the Platform on SMRs and their applications, is already actively working on all the identified strategic objectives.

The identified strategic objectives also take into account the scope and objective of the parallel Nuclear Harmonization and Standardization Initiative (NHSI) aimed at developing common approaches in both the industrial and regulatory fields. The definition of the strategic objectives incorporates relevant key enablers of the NHSI.

The Medium-Term Strategy 2022-2029 sets out the following strategic objectives:

A. Support Member States to become knowledgeable customers and make an informed decision on whether to embark on or expand nuclear power based on SMRs

Support Member States in accessing and understanding technical, policy and infrastructure information relevant to making an informed decision for near-term deployment of Small Modular Reactors – while comprehending the responsibilities and obligations essential to implementing a safe, secure, efficient, and reliable long-term nuclear power programme – and

enabling them to become a knowledgeable customer. The Agency can support in the identification of infrastructure practices/proposals through a follow-up on the developments of the industry as well as enable objective and informed analyses comparing different business cases for deploying SMRs. By assisting Member States in performing techno-economic analyses, using energy modelling and planning tools, assessing sustainability scenarios, conducting comparative analyses with other low-carbon sources of energy and analysing non-electric applications of SMRs, the Agency will also facilitate the decision making.

Stakeholders:

Member States/Recipient Countries (Embarking and Expanding), Developer Countries/Technology Developers, OECD Nuclear Energy Agency, OECD International Energy Agency, EC and EURATOM, Foratom, International Framework for Nuclear Energy Cooperation, Nuclear Innovation Clean Energy Future (NICE-Future), ASEAN, AFCONE, the Arab Atomic Energy Agency (AAEA), World Nuclear Association, World Association of Nuclear Operators, Governments/NEPIOs, Owner Operators, Regulatory Bodies, technical support organizations, and academia.

B. Support industrial preparedness for Small Modular Reactors and their applications, including related fuel cycles

Support Member States in ensuring that the considered SMR options have a high Technology Readiness Level (TRL), including for the front and back ends of the fuel cycle, and can rely on a supply chain meeting potential customers' engineering codes and standards. For that purpose, the Agency will regularly review the industrial preparedness of SMR designs, including progress in addressing technical issues that may be raised through early engagement with regulators, prototype testing and demonstration plants, including demonstration of non-electric applications (supply of heat or hydrogen for example), industrial supply chain with modular construction and advanced manufacturing capabilities. The Agency will facilitate enhanced collaboration between many technology holders working on SMRs, including standardization and harmonization of the industrial standards and approaches[1], which will help the wider deployment of designs across Member States. The Agency will also support the development of generic user requirements and criteria, i.e., high level specification which would help vendors to develop designs that find their market while making sure utilities' expectations are in line with what is technically possible. Finally, the Agency will support workforce development for the operation of SMRs.

Stakeholders:

SMR technology holders and developers, designers and vendors, operators, utilities including non-traditional end-users interested in non-electric applications of SMRs, SMR fuel and fuel cycle service suppliers, technical support organizations, international standard organizations, regulators.

[1] Supporting Nuclear Harmonization and Standardization Initiative (NHSI)

C. Promote, support, and develop research and innovation

Promote research, development and innovation and support Member States in addressing their related needs relevant to the remaining open issues to facilitate near-term deployment of SMRs and their applications. By implementing well focused Coordinated Research Projects and selecting strategic Collaborating Centres, the Agency will also support the further development of SMR technologies and related fuel cycles for their medium and long-term deployment. Through the Agency's Technical Cooperation programme and other E&T platforms and activities, the Agency will provide technical assistance to Member States and create essential forums for disseminating information on technological developments. The forums could facilitate the transfer of technical knowledge amongst other national and international organizations.

Stakeholders:

National Labs, R&D organizations, technology developers, technical support organizations, and universities.

D. Supporting establishment of institutional, legal, and regulatory frameworks for the safe and secure deployment, operation, closure, and decommissioning of SMRs, including the management of spent fuel and waste

Support Member States involved in development, deployment, and operation of SMRs in achieving strong and sustainable nuclear safety and security (including the interfaces between safety, security, and safeguards: 3S) throughout the lifetime of the SMR – from design to decommissioning. The Agency will support Member States by addressing specific features of SMRs that may impact safe and secure deployment, operation, and decommissioning. For example, these include: the use of different fuel or coolant materials than conventional water-cooled nuclear power plants; factory fabrication of SMR modules and on-site shipping; increased autonomous operation; and application of different deployment models[2]. The Agency will encourage and support Member States in developing and implementing in a coordinated, efficient, and sustainable manner their nuclear safety, security, and safeguards infrastructure, including an appropriate legal and regulatory framework, with sufficient consideration for the SMR characteristics. The consideration of the safety and security infrastructure will also cover the governmental, managerial, technological, human resource, industrial and stakeholder support that is required to ensure the safety and security of an SMR programme as well as their responsible deployment. The Agency will ensure the applicability of IAEA publications such as safety standards and security guidance to SMRs and promote their application through SMR tailored capacity building programmes and advisory services. Such capacity building and advisory services will also be coordinated with safeguards (e.g., through INIR missions or IWP) so to help the Member States to strengthen its safeguards infrastructure and to facilitate compliance with its safeguards agreement. Finally, the Agency will promote harmonized regulatory approaches between national regulatory bodies, including

[2] Deployment model is understood as the approach taken for the deployment of an SMR that will impact the general ownership of the SMR, the responsibility for the lifetime of the SMR including operation, decommissioning and managing of the spent fuel and radioactive waste and the responsibility for liability in case of nuclear accident.

a common set of internationally recognized requirements[1], while recognizing national responsibilities for safety, security and safeguards.

Stakeholders:

Regulatory bodies, technical support organisations, industry, research organisations, governmental organisations, international organisations.

E. Prepare effective and efficient Agency safeguards

The SMRs considered for deployment in most Member States will be required to be safeguarded[3], regardless of their types of technologies, development status, size, proliferation resistance features, or supplier State of origin. These SMRs, including their technology, design, plant layout, and supply arrangements, will require the development of new safeguards approaches, and potentially new safeguards technology, by the Agency. To reduce the risk of operator burden and project delay, SMR developers and customers are encouraged to engage in early discussion of safeguards requirements with the Agency – a concept known as Safeguards by Design (SBD). SBD, is the process of including the consideration of international safeguards throughout all phases of a nuclear facility project, from the initial conceptual design to facility construction and into operations, including design modifications and decommissioning. SBD does not introduce new safeguards requirements for the State, but rather presents an opportunity to facilitate the cost-effective implementation of existing requirements, with benefits for all stakeholders. SBD integrates with other aspects of design: considerations of safety, security, and safeguards (3S) is an important element of the design, construction, commissioning, operation, and decommissioning stages of SMRs.

Stakeholders:

State regulators, State or regional safeguards authorities, designer/vendor, supplier, facility operator.

F. Support international cooperation on SMRs

Increase international cooperation with traditional partner organizations with a mission and relevant activities in the field of SMRs, as well as with non-traditional partners, including other UN agencies, which can favour synergies with international organizations and initiatives committed to pursuing decarbonisation policies and other related SDGs. International cooperation will also be sought in the areas such as harmonization of safety and security approaches, increased regulatory cooperation in joint design assessment and standardization of industrial approaches[1]. The transboundary movement of transportable SMRs will also require guidance at the international level.

[3] Agency safeguards are implemented for all States with a safeguards agreement in force with the Agency. Under the NPT, for example, each non-nuclear-weapons State (NNWS) party to the Treaty must conclude a comprehensive safeguards agreement (CSA) with the Agency which requires the application of safeguards on all nuclear material in all peaceful nuclear activities within its territory, under its jurisdiction or carried out under its control anywhere. CSAs are in force for 177 NNWSs party to the NPT.

Stakeholders:

OECD Nuclear Energy Agency, OECD International Energy Agency, European Atomic Energy Community, EU DG ENER, FORATOM, Generation IV International Forum, International Framework for Nuclear Energy Cooperation, Nuclear Innovation Clean Energy Future, World Nuclear Association, World Association of Nuclear Operators, Western European Nuclear Regulators' Association, International Institute for Applied System Analysis, International Renewable Energy Agency, UN Department of Economic and Social Affairs, UN Framework Convention on Climate Change, UN Industrial Development Organization, Electric Power Research Institute, European Utility Requirements Organization, International Organization for Standardization, American Society of Mechanical Engineers.

G. Provide effective knowledge/technology transfer through technical cooperation

Support the IAEA Member States' specific, need-based requirements for the development and deployment of SMRs and strengthen their technical capabilities. Also, the associated applications of SMRs could be country/region specific, and this would require development of targeted expert missions, workshops, and capacity building distinctive to the pertaining needs of national/regional priorities, plans or strategic frameworks. Through its TC programme, the Agency will facilitate increased access to SMR technology, support, knowledge sharing and building, will support reinforcing scientific networks, and will help build Member States' capacity to develop a basis for evidence-based decision making in a range of important areas.

Stakeholders:

All IAEA Member States contributing to TC programme.

IV. Expected Outcomes in Member States

The achievement of the above strategic objectives will be assessed by the degree to which the outcomes of the Agency's programme meet and satisfy Member States' priorities, requests and needs.

The Agency - through its programmes, sub-programmes and projects related to SMRs and their applications and under the overall coordination of the agency-wide Platform on SMRs and their applications - will continue to pursue its multifaceted strategic objectives, while ensuring an appropriate balance among all activities of the Agency.

V. Annex: Relevant ongoing and planned IAEA projects, activities and initiatives supporting the strategic objectives

This annex consists of a short description of the relevant ongoing and planned projects, activities and initiatives within the Agency that support each strategic objective. They do not necessarily represent the specific tasks of the SMR Platform which however, according to paragraph 11 of its ToR, reviews and identifies ways to "ensure the consistency, coordination, and optimization of the Agency's programmatic activities on SMRs and their applications and provide advice and recommendations to the DG and DDGs, as needed."

During the formulation of the implementation plan, these projects will support the prioritization of the IAEA activities on SMRs to be implemented between 2022 and 2029, according to the established strategic objectives. Future unplanned activities whose implementation is based on the defined strategic objectives, will be included in the Annex once approved under one of the Planning and Budgeting cycles (2024-25, 2026-27, 2028-29) within the tenure of this Medium Term Strategy.

A. Support Member States to become knowledgeable customers and make an informed decision on whether to embark or expand nuclear power based on SMRs

Projects/activities/initiatives:

- Technical Working Group on Small Medium-sized or Modular Reactors, providing advice to DDG-NE on:
    - Design, technology development and deployment of current small and medium-sized or modular reactor concepts, including microreactors;
    - Programme assessment, systems analyses, research and development, design, construction, operation and maintenance;
    - Industrial standardization and harmonization, including codes & standards and generic user requirements and criteria;
    - Impact of the advanced fuel cycles and fuel options on reactor design;
    - Techno-economics and socio-environmental assessment for near term deployments; and
    - Development of infrastructure to facilitate deployment of SMRs both for electric and non-electric applications;
- Review the major documents in the field of infrastructure development such as revising the Milestones Approach to consider the features of SMRs and review the "Evaluation Methodology to support INIR missions focused for countries with nuclear power programmes" based on SMRs. Develop new workshops and training courses under TC INT 2021 and support on nuclear power infrastructure development focused on SMRs. Update documents in the Nuclear Power Bibliography that need to consider the infrastructure for SMRs differently. The Integrated Word Plans (IWPs) will be revisited to reflect appropriate changes for SMRs.
- Reactor Technology Assessment methodology which, when applied objectively and consistently throughout the development of a national nuclear power programme, enables the decision makers to eventually choose the NPP type that will best fulfil the

national policy objectives that may also include a set of utility requirements and criteria. It has been recently updated to incorporate the case of small and medium sized or modular reactors (SMRs) and their broad applications (electricity production, non-electric applications, hybrid energy systems) both among newcomer countries and in those countries with expanding nuclear power programmes.

- ARIS database and biennial publication on Advances in Small Modular Reactor Technology Developments (SMR ARIS Booklet). Both outputs provide Member States with an extended and, respectively, concise overview of the latest status of SMR designs. The ARIS database also supports the IAEA activities on Reactor Technology Assessment.
- Technology Roadmap for Small Modular Reactor Deployment, intended to provide Member States with a set of generic roadmaps which can be used in the deployment of small modular reactors. These roadmaps are based on the latest inputs from Member States currently pursuing this technology. Emphasis is placed on the activities of owners/operators who drive the demand and requirements for the reactor designs, the designers who develop the technologies, and the regulators who establish and maintain the regulatory requirements that owners/operators should meet.
- Technology Roadmap for commercial deployment of nuclear hydrogen, in order to provide Member States with a useful management tool for evaluating, planning and strategizing the production of clean hydrogen by using energy, in the form of heat and electricity from SMRs, and exploring all the actions needed for decision makers and stakeholders towards implementing the production of hydrogen using nuclear energy
- Strengthening Member States' understanding of the issues related to the industrialization of advanced nuclear fuel cycle technologies including pyro-chemical processing and advanced aqueous partitioning methods that would co-recover actinides.
- Expert mission on "Using SMRs including Economic Analysis for Electric Power Generation, and Nuclear Desalination", and workshop on "Nuclear Desalination and Non-Electric Application Using SMRs" for the country of Jordan.

B. Support industrial preparedness for Small Modular Reactors and their applications, including related fuel cycles

Projects/activities/initiatives:

- Industrial track of the Nuclear Harmonization and Standardization Initiative (NHSI): developing common industrial approaches by technology holders and user requirements and criteria by operators, consistent with fair global competition, intellectual property rights protection, and not hampering innovation and continuous improvement
- Support nuclear industry in activities related to development of codes and standards, design engineering, testing and manufacturing of components for small modular reactors. The activity is aimed at identifying key enabling technologies and features of SMRs, including serial production of components, engineering for design

simplification, design standardization, and manufacturing for modular construction. It also addresses the opportunities and challenges posed by advanced manufacturing methods and techniques and their application for SMR structure systems and components.

- Develop a guidance document that provides a framework to cover any near-term deployable SMR designs, based on identified specific requirements and criteria associated with the need of SMR technologies for various energy market niches. The activity will consider key technology attributes of SMRs and Member States' specific needs and conditions, with feedbacks from Member States by conducting exchange of information, sharing experience and expertise, and discussions on the development of guidance on preparing generic user requirements and top-tier criteria for small modular reactor technology for near term deployment
- CRP on Economic Appraisal of Small Modular Reactors Projects: Methodologies and Applications (2020 – 2024). The CRP discusses technical-economic assessment approaches for advanced reactor concepts currently under development for near-term deployment. The focus will be on small modular reactors (SMR), including micro-reactors.
- CRP on Technologies Enhancing the Competitiveness and Early Deployment of Small Modular Reactors (2022 – 2025). This CRP focuses on identifying and enhancing understanding of the families of enabling technologies with potential to either reduce the installation cost and schedule of SMRs or better suit the user needs (e.g. with a higher flexibility or non-electric applications) and thus facilitate the deployment scheme of SMRs and favour their early deployment. Identification of these technologies and finding a way to assess them will help the nuclear industry put development effort where it is most needed and agree on codes and standards evolutions if they need to be developed for these technologies.
- Understanding and addressing the factors affecting the design, fabrication and in-pile behaviour of innovative nuclear fuels and materials for SMRs (development of an IAEA NES on "Nuclear Fuel Technologies for Liquid Metal Cooled Fast Reactors", and of an IAEA TECDOC on "Coated Particle Fuels for High Temperature Gas-Cooled, Small Modular Reactors").

C. Promote, support and develop research and innovation

Projects/activities/initiatives:

- Activities on digitalization as well as use of advanced techniques like Artificial Intelligence (AI) to support development and deployment of advanced reactors.
- CRP on Experimental Facilities and Prototype Testing Needs for Validation of Tools for Small Modular Reactor Design Developments. This CRP will focus on the identification of component-effect, separate-effect and integral-effect testing needs through establishment of experimental facilities to validate computer codes for design

and safety analyses required for SMR design and technology developments. The testing activities are those required for licensing and facilitating near term deployment.

- CRP on Technical Evaluation and Optimization of Nuclear-Renewable Hybrid Energy Systems. This CRP which is based on the outcomes of the NES "Nuclear-Renewables Hybrid Energy Systems", aimed at further advancing the state-of knowledge pertaining to modelling, simulation, and analysis approaches for design and optimization of nuclear - renewable HES and is intended to support development of data and analysis, via both computational tools and validation through experimental demonstration, with the goal to advance these systems toward commercial deployment.
- CRP on Role of Nuclear Cogeneration within the Context of Sustainable Development. Provide techno-economics examination and investigate drivers and challenges of various nuclear cogeneration options in the context of the urgent actions to be taken to promote sustainable development, including mitigation of climate change and provision of potable water without carbon emissions. Various reactor technologies will be considered, including the existent operating nuclear fleet, advanced and Gen IV systems and small modular reactors.

D. Support establishment of institutional, legal and regulatory frameworks for the safe and secure deployment, operation, closure and decommissioning of SMRs, including the management of spent fuel and waste

Projects/activities/initiatives:

- Regulatory track of the Nuclear Harmonization and Standardization Initiative (NHSI): Developing harmonized regulatory approaches between national regulatory bodies, including a common set of internationally recognized requirements, while maintaining national responsibilities for safety and security
- Applicability of the IAEA Safety Standards to non-water cooled reactors and SMRs. High-level assessment of the applicability of the IAEA Safety Standards to the entire lifetime of non-water-cooled reactors (NWCRs) and Water Cooled (WC) Small Modular Reactors (SMRs). The NWCRs considered are High Temperature Gas Cooled Reactors (HTGRs), Sodium Fast Reactors (SFRs), Lead Fast Reactors (LFRs) and Molten Salt Reactors (MSRs), including their SMR types. The review also considered some aspects of the transportability of these technologies including transportable nuclear power plants (TNPPs). The final Safety Report will provide an overview of areas of non-applicability, gaps and areas for further consideration of the totality of relevant safety standards to NWCRs and SMRs.
- Ensuring the safe deployment of innovative reactors. To support a safe, secure and sustainable implementation of innovative reactors in Member States through the development of (i) a detailed technical proposal for the review, update and development of safety standards requirements and/or recommendations to facilitate applicability and implementation for Non-WCRs and SMRs (ii) IAEA publications (e.g. Safety Reports or Technical Documents) and (iii) a knowledge management repository platform to

facilitate information exchange and use of regulatory and operating experience (OPEX) and capacity building on innovative reactors.

- SMR Regulators' Forum: The SMR Regulators' Forum, created in March 2015, provides enabling discussions among Member States and other stakeholders to share SMR regulatory knowledge and experience. The Forum enhances nuclear safety by identifying and resolving common safety issues that may challenge regulatory reviews associated with SMRs and by facilitating robust and thorough regulatory decisions.

- CRP on Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment. The CRP discusses approaches and methodologies for determining the need for off-site Emergency Preparedness and Response, including the size of EPZs for SMRs taking account the enhanced safety performance of SMRs and evaluating design-specific, defence-in-depth and site-specific technical basis.

- CRP on the Design and Performance Assessment of Passive Engineered Safety Features in Advanced Small Modular Reactors. The CRP addresses four key topics associated with the use of passive safety features in water-cooled reactors: (i) separation and independence of reactor trip and safety system actuation logics; (ii) diversity and redundancy for depressurizing the reactor coolant pressure boundary to facilitate safety injection during a high-pressure transient; (iii) diversity and redundancy of core cooling; and (iv) options and approaches for assuring containment structural integrity.

- Development of a TECDOC on SMR security, which will describe the specific characteristics of SMRs from nuclear security point of view and the specificities of the implementation of security measures in SMRs, including case studies from relevant Member States, via conduction of consultancy meetings and a Technical Meeting for the development of TECDOC on SMR security

- CRP on enhancing security of SMRs. The CRP focuses on the specific features and characteristics of SMRs as how these will affect the main aspects of design, development and implementation of nuclear security measures for SMRs.

- Safety, security and safeguards by design of SMRs: establish a framework for the 3S integration in the design of nuclear facilities

- INPRO case study for the deployment of factory fuelled SMRs. Examine, in detail, legal and institutional issues for export deployment of a particular type of Transportable Nuclear Power Plant i.e. factory fuelled, tested and sealed reactor, and investigate other aspects of transportable and modular reactor facilities.

- Comprehensively analyse the relevant legal considerations and issues related to the deployment of SMRs.

- Legislative Assistance Programme: Provide tailored legislative assistance to Member States addressing the legal aspects related to the deployment of SMRs.

E. Prepare effective and efficient Agency safeguards

Projects/activities/initiatives:

- In order to identify the key technical challenges for safeguards implementation involving advanced or novel SMRs, the Department of Safeguards initiated in 2018 a Member State Support Program (MSSP) task on SBD for SMRs. This task involves early discussions of facility design between the Agency, designer, and State authority, and is important for ensuring that the IAEA will be adequately prepared to safeguard these facilities. Additionally, SBD interactions may contribute to better understanding and awareness of infrastructure, regulatory and other activities needed for effective safeguards implementation by Member States and industry, thus avoiding potential challenges to IAEA-Member State cooperation in safeguards implementation. At the moment, several types of SMRs such as floating reactor, molten salt reactors, integral PWRs, modular high temperature gas-cooled reactors and Micro scale reactors, are under consideration. External guidance on SBD implementation is available in several NE-Series documents addressing various aspects of the nuclear fuel cycle.

F. Support international cooperation on SMRs

Projects/activities/initiatives:

- Cooperation between IAEA SMR Platform and European SMR Partnership coordinated by EC DG ENER.

- Development of new Practical Arrangements or MoUs with all the organizations/initiatives mentioned as stakeholders under this strategic objective, or revise the existing ones by introducing specific topics/activities related to SMRs and their applications.

G. Provide effective knowledge/technology transfer through technical cooperation

Projects/activities/initiatives:

- Interregional TC project INT2023 *Supporting Member States' Capacity Building on Small Modular Reactors and Micro-reactors and their Technology and Applications as a Contribution of Nuclear Power to the Mitigation of Climate Change*. The duration of this project is four years (2022 – 2025). This project will deliver workshops, training courses, review missions, scientific visits and expert missions which will address capacity building and transfer of knowledge on different aspects of SMRs and MRs and their applications: technology development and assessment, deployment issues, development of legislation and regulations, licensing, safety assessment, economy including investment schemes, fuel cycles, waste management, decommissioning, infrastructures.

- Interregional TC project INT2021 *Supporting Member States Considering or Planning to Introduce or Expand Nuclear Power Programmes in Developing the Sustainable National Infrastructure Required for a Safe, Secure and Peaceful Nuclear Power Programme*.