International Project on
Innovative Nuclear Reactors and Fuel Cycles
(INPRO)
NENP/INPRO Section

TERMS OF REFERENCE

INPRO Collaborative Project

LEGAL AND INSTITUTIONAL ISSUES
OF PROSPECTIVE DEPLOYMENT OF FUSION FACILITIES

AN INTERDISCIPLINARY STUDY SUPPORTED BY THE IAEA AND INPRO
MEMBER STATES AND INTER-DEPARTMENTAL IAEA COOPERATION

12.04.2022

UPDATED 23.09.2022 AND 24.01.2023

ToR INPRO Study FUSION
## Content

1. Summary.............................................................................................................. 3  
2. Rationale.............................................................................................................. 4  
3. Overall objective................................................................................................. 5  
4. Specific objectives............................................................................................... 5  
5. Scope of work....................................................................................................... 6  
6. Expected outputs................................................................................................. 7  
7. Expected outcome............................................................................................... 7  
8. Deliverables.......................................................................................................... 7  
9. Resources............................................................................................................. 7  
10. Organization of work and participants............................................................... 8  
10.1 Organization of work......................................................................................... 8  
10.2 Participants........................................................................................................ 8  
10.3 Role and responsibility of each participant..................................................... 8  
10.4 Representatives of participants......................................................................... 8  
10.5 Communications............................................................................................... 8  
11. Milestones and duration..................................................................................... 9  
12. Status of participation......................................................................................... 10  
    References........................................................................................................... 12  

Attachment 1 Contact details.................................................................................. 12
INPRO Collaborative Project

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1. SUMMARY
International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) initiated a Collaborative Project (CP) to perform an Interdisciplinary Study on “Legal and Institutional Issues of Prospective Deployment of Fusion Facilities” to support interested Member States in planning to license, construct and operate First-of-a-kind (FOAK) commercial fusion powered facilities and integrated fusion-fission systems within the next decades.

The study’s aim is to contribute to the synergies in technology development between nuclear fission and fusion for energy production with a focus on non-technical aspects for sustainable deployment. INPRO’s cross cutting work in advanced nuclear system analysis and evaluation provides a framework to accelerate the deployment of fusion power plants.

Responding to the interest in Member States expressed at the 30th INPRO Steering Committee meeting in October 2021, the INPRO Secretariat decided to launch a new INPRO collaborative project – an INPRO study on “Legal and Institutional Issues of Prospective Deployment of Fusion Facilities”. The study developed from recommendations of INPRO Member States, the IAEA General Conference (GC) resolution and the Standing Advisory Group for Nuclear Energy (SAGNE) which support this project.

The study considers technical aspects of synergies with fission organized by the Nuclear Power Technology Development Section (NPTDS) within the division of nuclear power, as well as information about fusion technologies from the division of Physical and Chemistry Sciences from the Nuclear Application department (NAPC).

The expectation is there will be discussions on the legal aspects regarding the use of fusion energy at ICNL-2022 – First International Conference on Nuclear Law: The Global Debate, April 25-29, 2022, organized by the IAEA Office of Legal Affairs (OLA), as well as at other OLA meetings.

The Departments of Nuclear Safety and Security and Nuclear Sciences and Applications developed and is in the process of implementing a detailed programme of work on safety and regulation of fusion facilities, including international legal aspects. The development of this work has the full cooperation of OLA.
The project will produce a technical report in the IAEA Nuclear Energy Series or TECDOC series, documenting the results of the study with respect to a variety of activities in the IAEA Member States. It shall avoid duplication of similar fusion project activities in other IAEA departments. To fulfill this purpose, this Terms of Reference (ToR) outlines areas covered by ongoing work in other IAEA departments to document how to avoid potential duplication.

The implementation of this collaborative project “INPRO Study on Legal and Institutional Issues of Prospective Deployment of Fusion Facilities”. will be an activity under Task 2 “Innovations” in Project 1000151 of the IAEA Programme & Budget 2022 – 2023.

Expected duration of the study is from 2022-2024. Table 1 lists the milestones of this collaborative project.

2. RATIONALE

INPRO is a membership-based project that supports its members in their long-term planning and collaboration on innovations in nuclear power reactors, fuel cycles and institutional approaches to promote the sustainable development of nuclear energy. INPRO currently has 43 members – 42 IAEA Member States along with the European Commission (EC). Several other countries participate on a working level or as an observer [1].

The IAEA Programme 1.1 Nuclear Power provides a forum for technology users and holders to jointly consider innovations and supports Member States in their long-term planning through INPRO. The programme also supports Member States’ activities in cross-cutting areas in technology development between nuclear fission and nuclear fusion for energy production, and integration of a nuclear energy systems with other clean energy sources.

The IAEA is in a position to identify and analyse from an international perspective the possible synergies potentially applicable to fusion technologies, including fission systems, particle accelerators, and other energy technologies. The expectation is that increased cooperation between various technical communities will lead to the exchange of experiences with relevant technologies and the transfer of knowledge. This should be useful for the development and future deployment of fusion energy systems.

INPRO supports IAEA Member States in their long-term planning related to advanced and innovative nuclear energy systems, scenario modelling, analysis, and sustainability assessment using the INPRO Methodology. Additionally, INPRO facilitates dialogue, cooperation, and collaboration among Member States in their respective roles as nuclear energy technology developers, suppliers, and customers. Technical and institutional innovations are essential for nuclear energy to play a role in meeting future global energy needs in a sustainable fashion.

Exploring legal issues and institutional arrangements that play an important role in the development of sustainable nuclear energy systems and possible synergies with fusion based technologies is an important task of INPRO in supporting Member States in their pursuit of innovations in nuclear power plants (NPP), nuclear energy systems, and other innovative energy systems.

INPRO developed the service package “Analysis Support for Enhanced Nuclear Energy Sustainability” (ASENES) [2]. The main purpose of this service is to facilitate capacity building in Member States aimed at strengthening the competence and skills of national experts for evaluation of alternative nuclear energy evolution scenarios and collaborative
arrangements, and for formulation of strategic plans towards development and deployment of sustainable nuclear energy including innovative fuel cycles and technologies.

This ASENES service is available to all Member States that determined nuclear energy is a suitable option for meeting their future energy needs and intend to embark on or expand their already implemented nuclear energy programme. The ASENES service also allows technology holders to evaluate future market potential for their nuclear energy technologies or to identify priority areas for innovations and R&D in nuclear energy technologies which can include fusion based facilities and integrated fusion-fission systems.

Hence, there was a strong interest in Member States expressed at the 30th INPRO Steering Committee meeting in October 2021, to support interested Member States in planning to license, construct, and operate prototypes of fusion based facilities and integrated fusion-fission systems within the next decade. INPRO initiated a Collaborative Project (CP) to perform an Interdisciplinary Study on “Legal and Institutional Issues of Prospective Deployment of Fusion Facilities”.

3. OVERALL OBJECTIVE

The overall objective of the INPRO study on “Legal and Institutional Issues of Prospective Deployment of Fusion Facilities” is to support the fusion community in its effort to accelerate the development and implementation of fusion based facilities and integrated fusion-fission systems within the next decades, with the early identification of possible gaps in long-term sustainability and needed capabilities utilizing INPRO assessments and analyses.

Achievement of the overall objective will be through cooperative work on cross cutting issues performed by the IAEA and INPRO Member States along with inter-departmental IAEA cooperation.

4. SPECIFIC OBJECTIVES

The following are the specific objectives of the study.

1. Discuss the long-term sustainability issues for prospective deployment of fusion based facilities with a focus on non-technical aspects.

2. Consider application of INPRO methodology and approaches for long-term sustainability assessment of overall elements of innovative energy systems with fusion based facilities.

3. Review legal and institutional issues, factors, and challenges, then identify gaps considering the current international instruments and national nuclear legislation and regulations. These issues may include:

   3.1. Nuclear safety issues, including specific issues covered as part of the synergies in the Nuclear Power and Technology Development Section (NPTDS), options for new regulatory concepts that may apply to fusion, covering the lifecycle of a fusion facility, taking into consideration ongoing works already covered by the IAEA departments on Nuclear Safety and Security (NS), Nuclear Sciences and Applications (NA) and OLA.

   3.2. Legal aspects including liability (international conventions, national legislation and regulations)

   3.3. Nuclear security issues
3.4. Safeguards and non-proliferation issues
3.5. Key export/import concerns
3.6. Comprehensive infrastructure issues

4. Identify the main drivers and impediments to the implementation of fusion based facilities.

4.1. Fusion potential for nuclear waste transmutation
4.2. Potential for manufacturing efficiencies via “Gigafactory” production of fusion facilities
4.3. Need to address climate change
4.4. Capacity building
4.5. Human resources development
4.6. Licensing timelines
4.7. Insurance challenge
4.8. Describe for documentation of the state of the technology the various fusion designs, including current public-sector and more recent private sector design concepts

This INPRO study will coordinate with the following IAEA ongoing technical work (avoiding duplication and ensuring one-house approach):

- Technological synergies between fission and fusion (NENP)
- Technical definition of fusion facilities and classification (NS/NA/OLA)
- Technical document on regulations for fusion facilities (NS/NA/OLA)
- Applicability of safety standards to fusion facilities (NS/NA)
- Market analysis on enabling technologies for fusion (NA)

5. SCOPE OF WORK

The scope of work includes the following activities.

1. Review and critical analysis of previous experience in the development of national legislation and infrastructure, including not just for power generation but also facilities with analogous technical and operational aspects to fusion (e.g., particle accelerators, target irradiation for isotope production, etc.)
2. Engage with those pioneering new fusion concepts to understand what they see as key risks to deployment and exploring what new regulatory concepts can address those risks while still providing assurances in the areas of public safety and security.
3. Identify key issues for further analysis from the perspective of the use of INPRO tools NESA and ASENES and national approaches as well as applying other tools of relevance.
4. Identify relevant policy choices on a global and regional level in different scenarios.
5. Define the areas of specific non-technical scope.
6. Assign responsibilities.
7. Draft the study’s overall scope and analysis of the results to include the following items:
7.1. Analysis and conclusions regarding gaps in legal and institutional aspects of the prospective deployment of fusion based facilities, and new capabilities to be explored and developed.

7.2. Analysis of various experiences in the development of legislation, (including liability,) regulatory framework, key export/import issues, safeguards considerations, nuclear security concerns, nuclear safety and licensing

7.3. Analysis of the infrastructure of planned fusion facilities and the drivers and implementation existing, e.g., in the areas of economics, human resources development, capacity building, etc.

8. Deliver the final report of the INPRO Study.

6. EXPECTED OUTPUTS

The outputs of the collaborative project would be:

(1) Documentation of the study on “Legal and Institutional Issues of Prospective Deployment of Fusion Facilities”

(2) Conclusions of practical value identifying gaps in legislative and institutional aspects with recommendations for addressing the gaps

(3) Recommendations on further considerations and studies.

7. EXPECTED OUTCOME

It is anticipated that the collaborative project will contribute to enhanced capability in Member States to plan, license, construct, and operate prototypes of fusion based facilities and integrated fusion-fission systems within the next decades. The study aims to create a cross cutting community to address common issues with fission and fusion power source deployment.

8. DELIVERABLES

IAEA Nuclear Energy Series Technical report or an IAEA TECDOC Series publication on the results of the study on “Legal and Institutional Issues of Prospective Deployment of Fusion Facilities”; with a global perspective, and authorship and concurrence from IAEA, INPRO Member States, along with IAEA inter-departmental cooperation.

The target audience of the report includes national technical experts working in INPRO Member States with plans to license, construct, and operate prototypes of fusion based facilities and integrated fusion-fission systems within the next decades. Additionally, this collaborative project will support INPRO Member States interested in performing a sustainability study on facilities based on fusion energy.

9. RESOURCES

Each participating country and corresponding representatives will fund their own contributions and expenses for manpower deployed to this project. The Agency will limit travel and participation support to representatives of countries eligible for IAEA support under a Technical Cooperation programme.
This project will inter alia consider available knowledge and resources and related ongoing activities by the Office of Legal Affairs (OLA), Nuclear Power Technology Development Section (NPTDS), Nuclear Knowledge Management Section (NKMS), Division of Physical and Chemical Sciences (NAPC), Nuclear Safety of Nuclear Installation (NSNI), Safeguards Division of Concepts and Planning (SGCP), Safeguards Division of Information Management (SGIM), Division of Nuclear Fuel Cycle and Waste Technology (NEFW), International Project on Innovative Nuclear Reactors and Fuel Cycles Section (INPRO), and other departments interested in fusion energy.

Table 2 contains organizational details on the contributors to the study.

10. ORGANIZATION OF WORK AND PARTICIPANTS

10.1. ORGANIZATION OF WORK

This study can use the framework of the INPRO study on legal and institutional issues of transportable factory fabricated nuclear power plants (NPP) as an example of where the legal issues and institutional arrangements play an important role in the development of sustainable nuclear energy systems. Using this study as a guide, INPRO can use the exploration of these difficult deployment issues to identify possible synergies with pinpointing the possible legal issues and institutional issues that will occur in fusion-based technologies and signal where the gaps may exist.

The study will engage INPRO Member States to support their pursuit of innovations in NPP and nuclear energy systems.

10.2. PARTICIPANTS

INPRO will pursue broader participation of all interested institutions of the IAEA Member States that have an interest or an impact from developing and implementing fusion energy. Additionally, INPRO will focus on cooperation with IAEA divisions/sections: Office of Legal Affairs (OLA), Nuclear Power Technology Development Section (NPTDS), Nuclear Knowledge Management Section (NKMS), Division of Physical and Chemical Sciences (NAPC), Nuclear Safety of Nuclear Installation (NSNI), Safeguards division of Concepts and Planning (SGCP), Safeguards division of Information Management (SGIM), Division of Nuclear Fuel Cycle and Waste Technology (NEFW) and other departments that could have an impact.

10.3. ROLE AND RESPONSIBILITY OF EACH PARTICIPANT

Each participant will perform the activities assigned in this ToR, along with those identified during the project implementation to achieve the overall objective, the specific objectives and the outcome of the study, according to available means.

10.4. REPRESENTATIVES OF PARTICIPANTS

Each Member State will communicate in writing to the INPRO Secretariat the nomination of its responsible personnel to perform the activities assigned in these Terms of Reference (ToR) with the following information that includes business coordinates (institution, organization, position, post address, telephone/s, fax and email). Also, there is a recommendation that all Member States identify an alternative representative for cases in which the first person responsible is not available. The INPRO Secretariat will provide the alternative representative with copies of the most relevant information distributed among the participants unless there is a request for additional information. A
further recommendation is to keep nominated representatives unchanged during the duration of the project (approximately 2 years). Nevertheless, when there is a need to change a representative, there will be a communication to the INPRO Secretariat as soon as possible.

IAEA/INPRO will provide support to the participants through the responsible officers of the Collaborative Project, Mr Alexander Bychkov a.bychkov@iaea.org and Mr Mikhail Khoroshev m.khoroshev@iaea.org by facilitating task definition, coordination and meetings along with timely access to the study documents and software, which may include necessary training upon request to properly utilize all the INPRO and IAEA tools available.

10.5. COMMUNICATION

Communications and information will be transmitted by electronic correspondence allowing for reductions in travel expenses. Nevertheless, there is consideration for several technical and consultants’ meetings that may be necessary for reaching the objectives of the collaborative project.

11. MILESTONES AND DURATION

A summary of the milestones and duration for this INPRO Collaborative Project are in Table 1. During the technical meeting, 6-10 June 2022, the participants will develop the implementation plan covering performance of activities, the participants involved and the corresponding schedules. Provisional status of participation is in Table 2.

Table 1. Milestones and duration of the INPRO Fusion collaborative project (2022-2024)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Status</th>
<th>Output</th>
<th>Estimated Cost (k€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2022 – Kick-off Consultants’ Meeting</td>
<td>Convened on 28.02-03.03.2022</td>
<td>Draft Terms of Reference, preliminary scope of work</td>
<td></td>
</tr>
<tr>
<td>2022 – First Consultants’ meeting</td>
<td>19-23.09.2022</td>
<td>Review of intermediate results. New participants</td>
<td></td>
</tr>
<tr>
<td>2023 – Series of working groups meetings</td>
<td>16.01-16.02.2023</td>
<td>Review materials of the Study report (technical report NES/TECDOC)</td>
<td></td>
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<tr>
<td>2023 – Second Consultants’ meeting</td>
<td>21-24.02.2023</td>
<td>Review a draft of the Study report (technical report NES/TECDOC)</td>
<td></td>
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<tr>
<td>2023 – Technical meeting</td>
<td>3-6.04.2023</td>
<td>Review of the First draft of the technical report final draft of the NES/TECDOC</td>
<td></td>
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<tr>
<td>2023 – Preparation of final draft NES/TECDOC for publication, editing, online consultations with stakeholders</td>
<td>May-Sept 2023</td>
<td>Draft Technical Report (NE Series/TECDOC)</td>
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<tr>
<td>Event Description</td>
<td>Considered Date</td>
<td>Outcome</td>
<td></td>
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<tr>
<td>2023 – Third Consultants’ meeting</td>
<td>Oct 2023</td>
<td>Final draft of the technical report (NES/TECDOC)</td>
<td></td>
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<tr>
<td>2023 Presentation at the 32nd INPRO Steering Committee meeting</td>
<td>Nov 2023</td>
<td>Review by interested stakeholders</td>
<td></td>
</tr>
<tr>
<td>2023 Finalisation of the document based on the results of the review</td>
<td>Nov 2023</td>
<td>Final draft of the technical report approved</td>
<td></td>
</tr>
<tr>
<td>2024 – Submission of the final draft to NE DCT (for internal review), then to Publications Committee</td>
<td>Jan 2024</td>
<td>Final Draft submitted for publication</td>
<td></td>
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</table>
# 12. STATUS OF PARTICIPATION

### Table 2. Status of participation in drafting report

<table>
<thead>
<tr>
<th>Chapter N°, Section N° / Group N°</th>
<th>SPECIFIC CHAPTER</th>
<th>PARTICIPANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapters 1, 2 Group 1</td>
<td><strong>Introduction</strong> and <strong>The long-term sustainability issues</strong> of prospective deployment of fusion based facilities beyond fusion’s technical aspects. <strong>Consider also:</strong> <strong>Limited INPRO NESA using KIND approach</strong> <strong>Fission-fusion energy systems</strong> <strong>Fusion potential for nuclear waste transmutation</strong></td>
<td><strong>Expected/requested members:</strong> Francesco Romanelli, Univ. of Rome, &quot;Tor Vergata&quot;, Italy - lead author Luigi DI Pace, Italy - lead author Alexander Bychkov, INPRO, IAEA Mikhail Khoroshev, INPRO, IAEA Vladimir Artisyuk, ROSATOM Nicholas Terranova, ENEA, Italy Sehila M. Gonzalez de Vicente, NAPC, IAEA Scott Hsu, DOE, USA Galina Fesenko, INPRO expert Carolynn Scherer, INPRO, IAEA Anzhelika Khaperskaia, NEFW, IAEA, communicates issues with section 4.1 Robert Stiegltiz, KIT, Germany – interacts with section 4.3 <strong>Invited:</strong> Sachin Desai, Helion Energy Inc. Michael Hua, Helion Energy Inc Ana Gomez Cobo, NAPC, IAEA Matteo Barbarino, NAPC, IAEA Gian Franco Federici, Fusion for Energy, F4E</td>
</tr>
<tr>
<td>Chapter 3 Group 2</td>
<td><strong>Legal issues and challenges.</strong> <strong>Introduction:</strong> Review of legal issues, factors and challenges and identify gaps considering the current international instruments and national nuclear legislation, including aspects of fusion related to the following topics.</td>
<td><strong>Expected/requested members:</strong> Sally Forbes, UKAEA, UK Sachin Desai, Helion Energy Inc., USA Robert Jennings, UKAEA, UK Michael Hua, Helion Energy Inc., USA Alexander Bychkov, INPRO, IAEA Konstantina Voukelatou, FSN-ING, Italy Mikhail Khoroshev, INPRO, IAEA Samuel Wurzel, DOE/ARPA-E, USA Laetitia Grammatico, ITER Organization Chencheng Liang, OLA, IAEA Camille Scotto-De-Cesar, OLA, IAEA Nataliia Aksenova, St Petersburg State University, Russia <strong>Invited:</strong> Amy Roma, Hogan Lovells US LLP, USA</td>
</tr>
<tr>
<td>Section 3.1 Group 3</td>
<td><strong>Nuclear safety issues, Regulatory concepts, classification</strong> <strong>Specific issues covered as part of the</strong></td>
<td><strong>Expected/requested members:</strong> Sally Forbes, UKAEA, UK – lead author Alexander Bychkov, INPRO, IAEA Mikhail Khoroshev, INPRO, IAEA</td>
</tr>
</tbody>
</table>
| Section 3.2 | Legal aspects, liability  
(international conventions and instruments, national legislation, etc.) | Expected/requested members:  
Sachin Desai, Helion Energy Inc., USA – lead author  
Alexander Bychkov, INPRO, IAEA  
Mikhail Khoroshev, INPRO, IAEA  
Laetitia Grammatico, ITER  
Michael Hua, Helion Energy Inc., USA  
reports issues to section 4.7  
Samuel Wurzel, DOE/ARPA-E, USA  
Chenchen Liang, OLA, IAEA  
Camille Scotto-De-Cesar, OLA, IAEA  
Nataliia Aksenova, St Petersburg State University, Russia  
Robert Stieglitz, KIT, Germany |
| Section 3.3 | Nuclear security | Expected/requested members:  
Robert Jennings, UKAEA, UK – lead author  
Alexander Bychkov, INPRO, IAEA  
Mikhail Khoroshev, INPRO, IAEA  
Sally Forbes, UKAEA, UK  
reports issues to Chapter 4 Introduction  
Sachin Desai, Helion Energy Inc., USA  
Michael Hua, Helion Energy Inc., USA  
Rich Hawryluk, DOE, USA  
Kristof Horvath, MAFA/NMS-NSNS, IAEA  
Tariq Majeeed, MAFA-NSNS, IAEA  
Heather Looney, MAFA-NSNS, IAEA |
| Section 3.4 | Safeguards and non-proliferation  
IAEA Safeguards & National Safeguards arrangements  
What is currently applicable to fusion – e.g., fusion-fission hybrid (contains nuclear material); reporting obligations of international | Expected/requested members:  
Michael Hua, Helion Energy Inc., USA – lead author  
Alexander Bychkov, INPRO, IAEA  
Mikhail Khoroshev, INPRO, IAEA  
Stephen Adams, DOE, USA, reports issues to Chapter 4 introduction  
Carolynn Scherer, INPRO, IAEA  
Sachin Desai, Helion Energy Inc., USA. |
<table>
<thead>
<tr>
<th>Section 3.5</th>
<th><strong>Key export/import issues</strong> addressing related non-proliferation concerns</th>
</tr>
</thead>
</table>
| **Expected/requested members:** | Alexander Bychkov, INPRO, IAEA – lead author  
Mikhail Khoroshev, INPRO, IAEA  
Stephen Adams, DOE, USA  
Carolynn Scherer, INPRO, IAEA  
Sachin Desai, Helion Energy Inc., USA  
Michael Hua, Helion Energy Inc., USA  
Michael Joseph Ford, PPPL, USA  
Natalia Aksenova, St Petersburg State University, Russia, reports issues to Chapter 4 introduction  
Malin Ardhhammar, SGIM, IAEA  
Fatma Elif Aksoy, OLA, IAEA |

| Section 3.6 | **Comprehensive infrastructure issues**  
Project and Quality management systems implementation  
Basic Framework to Support the Pre-Feasibility Study  
Intellectual property rights, Public acceptance, Development of technical capability, Transfer of knowledge, Other |
| **Expected/requested members:** | Konstantina Voukelatou, FSN-ING, Italy – lead author  
Alexander Bychkov, INPRO, IAEA  
Mikhail Khoroshev, INPRO, IAEA  
Luigi DI Pace, Italy  
Sachin Desai, Helion Energy Inc., USA  
Michael Hua, Helion Energy Inc., USA  
Samuel Wurzel, DOE/ARPA-E, USA  
Nicole Virgili, NPTDS, IAEA  
John Roberts, NKMS, IAEA, interacts with section 4.4  
Tea Billic, NKMS, IAEA  
Carolynn Scherer, INPRO, IAEA  
Nicholas Terranova, ENEA, Italy  
Francesco Romanelli, Univ. of Rome, "Tor Vergata", Italy  
Robert Stieglitz, KIT, Germany  
**Invited:**  
Vladimir Kriventsev, NPTDS, IAEA  
Satoshi Konishi, Kyoto University, Japan |

| Chapter 4 | **Main drivers and impediments** to fusion implementation |
| **Introduction** | Main drivers and impediments to fusion-based facilities implementation |
| **Expected/requested members:** | Vladimir Artisyuk, ROSATOM, Russia  
Sehila M. Gonzalez de Vicente, NAPC, IAEA  
Robert Stieglitz, KIT, Germany  
John Roberts, NKMS, IAEA  
Pedro Dieguez Porras, NENP, IAEA  
Sachin Desai, Helion Energy Inc., USA  
Samuel Wurzel, DOE/ARPA-E, USA  
Laetitia Grammatico, ITER |
<table>
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<tr>
<th>Section 4.1</th>
<th><strong>Fusion potential for nuclear waste transmutation</strong></th>
<th>Expected/requested members: Vladimir Artisyuk, ROSATOM, Russia – lead author Alexander Bychkov, INPRO, IAEA Mikhail Khoroshev, INPRO, IAEA Nicole Virgili, NPTDS, IAEA Anzhelika Khaperskaia, NEFW, IAEA interaction with Chapters 1 and 2 Vladimir Kriventsev, NPTDS, IAEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2 Group 3</td>
<td><strong>Manufacturing scale-up and “Gigafactory” production of fusion facilities</strong></td>
<td>Expected/requested members: Sehila M. Gonzalez de Vicente, NAPC, IAEA – lead author Alexander Bychkov, INPRO, IAEA Mikhail Khoroshev, INPRO, IAEA Sachin Desai, Helion Energy Inc., USA Michael Hua, Helion Energy Inc., USA Rich Hawryluk, DOE, USA Luigi DI Pace, Italy Sergey Sinegribov, SEC NRS, Russia, interacts with section 3.1 Anton Kuryndin, SEC NRS, Russia Invited: Ana Gomez Cobo, NAPC, IAEA Matteo Barbarino, NAPC, IAEA</td>
</tr>
<tr>
<td>4.3 Group 1</td>
<td><strong>Fusion’s role in the adaptation to the climate change</strong></td>
<td>Expected/requested members: Robert Stieglitz, KIT, Germany – lead author, interacts with Chapters 1 and 2 Alexander Bychkov, INPRO, IAEA Mikhail Khoroshev, INPRO, IAEA Sachin Desai, Helion Energy Inc., USA Michael Hua, Helion Energy Inc., USA</td>
</tr>
</tbody>
</table>
### 4.5 Group 3
#### Licensing timelines

**Expected/requested members:**
- Sachin Desai, Helion Energy Inc., USA – lead author
- Alexander Bychkov, INPRO, IAEA
- Mikhail Khoroshev, INPRO, IAEA
- Michael Hua, Helion Energy Inc., USA
- Rich Hawryluk, DOE, USA
- Paula Calle Vives, NSNI, IAEA
- Francesco Romanelli, Univ. of Rome, "Tor Vergata", Italy
- Konstantina Voukelatou, FSN-ING Italy

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### 4.6 Group 2
#### Insurance challenges

**Expected/requested members:**
- Laetitia Grammatico, ITER – lead author
- Alexander Bychkov, INPRO, IAEA
- Mikhail Khoroshev, INPRO, IAEA
- Chenchen Liang, OLA, IAEA
- Sachin Desai, Helion Energy Inc.
- Michael Hua, Helion Energy Inc., interacts with section 3.2
- Samuel Wurzel, DOE/ARPA-E, USA
- Nataliia Aksenova, St Petersburg State University, Russia

**Invited:**
- INLEX group of experts

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### 5 Analysis and generalization of the study results

- TBD
- Francesco Romanelli
- All

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### 6 Conclusions

- TBD
REFERENCES


