



Manual for SEAKNOT Mobility Programme

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Abbreviations

| | |
|---------|--|
| ERMSAR | European Review Meeting on Severe Accident Research |
| E&T | Education and Training |
| ExB | Executive Board |
| K2T | Knowledge and Knowhow Transfer |
| KNOS | Knowledge Spreading |
| LWR | Light Water Reactor |
| MSc | Master of Science |
| MUSA | Management and Uncertainties of Severe Accidents |
| NPP | Nuclear Power Plant |
| NUGENIA | Nuclear Generation II & III Alliance |
| PhD | Philosophy Doctor |
| PIRT | Phenomena Identification Ranking Table |
| R&D | Research and Development |
| SA | Severe Accident |
| SADD | Severe Accident Database Directory |
| SAINET | Severe experimental Accident Infrastructure NETWORK |
| SAP | Severe Accident Phenomenology |
| SARNET | Severe Accident Research NETWORK |
| SEAKNOT | SEvere Accident research and KNOWledge management for LWRs |
| SNETP | Sustainable Nuclear Energy Technology Platform |
| SMR | Small Modular Reactor |
| TA | Technical Area |
| UaSA | Uncertainties and Sensitivity Analysis |
| WP | Work package |



The SEAKNOT Project - SEvere Accident research and KNOWledge management for LWRs

Severe Accidents dominate the risk associated to the commercial production of nuclear energy and a vast amount of research has been done for decades to practically eliminate SAs with potential for large radiological releases of fission products. At present, there are several factors that might drastically affect the existing capabilities of investigating, and eventually, managing these events, above all the knowledge and know-how acquired for decades are at risk of being lost as many specialists have already retired or are in the process. Furthermore, many of the old archives and experimental data about SA are at risk of being lost forever if not proper measures are initiated, as human and technological means to do experimental and modelling research on the matter are being reduced. At the same time, new approaches for the SA assessment are being explored (Uncertainties and Sensitivity Analysis UaSA, as in the EURATOM H2020 MUSA project, or the application of Artificial Intelligence in the H-EUROPE ASSAS project) and the thorough comprehension of results demands involvement of senior experts more than ever, together with the progressive involvement of new younger experts.

Therefore, it is the appropriate time to deeply review and document the existing background in SA field and to project it into the future through the identification of safety-significant remaining needs. By putting in place the best resources to conduct any needed additional research and by articulating the most efficient ways to induce the younger generations of scientists and technicians to face near- and mid-term research challenges, the use of the current SA background must be ensured. Furthermore, the preservation of the relatively high level of European expertise on SA, particularly on simulations of experiments, will be crucial for nuclear safety of the present and future European nuclear fleet.

This vision, at the basis of the SEAKNOT project, requires conducting a sound critical assessment of the current state-of-the-art and to figure out how to effectively address the near- and mid-term needs in the field of SA to enable nuclear technology to keep and increase its current level of safety while accommodating forthcoming technological changes.

Officially started 1 October 2022, the Horizon Europe SEAKNOT project, under the EURATOM grant agreement No 101060327, will last 48 months. The project is coordinated by CIEMAT Madrid and gathers 17 partners from 10 European countries. The specific objectives of SEAKNOT are:

- To carry out a sound and critical analysis of the current knowledge on SAs. Based on it, recommendations will be given on the way forward to significantly reduce risks associated with existing (Gen II and Gen III) and forthcoming nuclear technologies (SMLWRs & ATFs).
- To identify the future experimental research needs required to support and further optimize SA mitigation measures, and even the “practical elimination” of the consequences associated with an extended core melt or a spent fuel damage. All the water-cooled nuclear reactors in operation in EU with current and/or advanced technologies will be considered. An assessment of the EU SA experimental facilities regarding the current and future research needs will be also included, along with the proposal of an experimental infrastructure platform.
- **To strengthen the background and skills of young generations in the SA field**, by a range of dissemination and communication activities in which a mobility programme will be the



backbone of an efficient Knowledge and Know-how Transfer (K2T) from senior scientists and engineers, together with the organization of short Courses about Severe Accident Phenomenology (SAP).

Therefore, two major outputs will come out from SEAKNOT:

- A Roadmap for SA research in the next decade to efficiently reduce safety uncertainties soundly base on a Phenomenology Identification and Ranking Table (PIRT), a SA Database Directory (SADD) and a network of SA infrastructures (SAINET).
- Reinforcement of K2T to the nuclear technology forthcoming workforce.

Introduction to SEAKNOT education and training activities

At present time, when some of the knowledge acquired in the SA field is at risk of being lost (as many specialists are retiring) and new approaches for the SA assessment (as the UaSA) are being explored, it seems an appropriate timing to articulate the most efficient ways possible to bring young generation on board to face the new research challenges in this field and, at the same time, preserving the high level of European expertise. Therefore, it is of utmost relevance to pass the current State-of-the-Art on SA - deriving from the SEAKNOT technical WPs - onto the generations who are inheriting such legacy. Furthermore, through specific actions, associated to the mobility of young students and scientists, some necessary key elements will be added to the SA assessment using the most advanced analytical tools and/or their contribution in experimental setups.

In a few words, the main expected outcomes for Education and Training (E&T) aspects from the planned activities in SEAKNOT will be:

- a strengthening of background and skills of young generations in the SA field, by a range of dissemination and communication activities in which an internal mobility programme will be the backbone of an efficient Knowledge and Knowhow transfer (K2T) from expert senior scientists and engineers together with the SAP Course and the new edition of the SA Textbook, collecting the updating of the knowledges from the SEAKNOT technical WPs.
- the internal/external Communication, Dissemination and Exploitation activities of the whole project, with particular emphasis on the transfer of the SEAKNOT technical outcomes beyond the project's partners towards the international scientific community by the ERMSAR Conferences but also towards as many stakeholders as possible and to the generic public to raise awareness of nuclear energy.

These Research and Innovation (R&I) activities will also permit the exploitation of the project results in further research activities other than those covered by SEAKNOT, as in PhD thesis, and in the development of new safety standards but also will concretise the impact of the research activities in the SA field for societal challenges as the maintenance of knowledge and the acceptability of nuclear energy.

Specific E&T actions will be developed in the Working Package 4 (WP4) KNOS (Knowledge Spreading):

- **Organization of the SAP Courses (SAP).** In the framework of past EU Research and Development Framework Programmes, the SARNET network of excellence was launched in 2004 with the aim to better coordinate the national efforts in Europe in the SA research area. In 2013, SARNET was fully integrated in the NUGENIA Technical Area N°2 (TA2), Severe



Accidents, emphasizing the search for more efficient and innovative mitigation measures which has focused most of research since the Fukushima Daiichi accident. Under this general SNETP/NUGENIA TA2 framework, two editions of the SAP short course (one week) will be organized for SA K2T. This SAP course, from its first edition in 2006, represents one of the first international courses offered to train or to complete the training of person recently involved in the SA field, focusing on the dissemination of the knowledge gained on SA in the last two decades with a program covering the SA phenomenology, progression, and mitigation in current LWRs of Gen. II and III, but also the different design solutions in Gen. III Nuclear Power Plants (NPP) and SMRs.

Lectures for these Courses will be given by international experts from major Nuclear Institutes, Industries and Universities working on the SA topic, with a strong involvement of the SEAKNOT partners. A special focus will be on the Fukushima-Daiichi Severe Accident, but the course will also include background lectures on NPP safety and SA codes and their uncertainties will be also addressed.

Two editions of the SAP course have been foreseen in SEAKNOT, in June 2023 organized by UPM in Madrid and in summer 2025 by FZJ Jülich. The organization of a residential SA Campus is also foreseen.

- **SA Textbook (SATEXT)** A new edition of the textbook "*Nuclear Safety in Light Water Reactors - Severe Accident Phenomenology*", edited in 2011 under the frame of the SARNET FP6 project, is foreseen. This reference textbook is at the moment the only one-stop resource on how to assess, prevent, and manage severe nuclear accidents in LWRs but needs updates on the latest thought on LWR nuclear safety and new acquired knowledges on SA.

The new edition will be characterized by substantial additions and updates, stemming from the EU expertise gained after the Fukushima accident and from the SEAKNOT activities. The book will be a textbook for students and young researchers in the field and not a handbook or a compendium of all the research in the field, but rather it will be written to impart understanding and knowledge about the complex physics of a SA.

- **Internal mobility exchange programme**, described in the following, aimed at training young researchers and PhD/Master students from consortium organizations through delegations (with a duration from 1 to 6 months) in the SEAKNOT partners' laboratories to enhance the exchanges and the dissemination of knowledge. Additionally, the presence of these young students or researchers in international conferences, workshops, and seminars to present some SEAKNOT results, will be also supported. Supporting the participation to the two SAP Courses will be also considered.

The SEAKNOT Mobility Program

The internal mobility program, managed by University of Pisa (UNIP) in WP4, aims fundamentally at training young researchers and PhD/MSc students from consortium organizations through delegations (with a duration from 1 to 6 months) in the SEAKNOT partners' laboratories to enhance the exchanges and the dissemination of knowledge in the area of SA. These mobility actions could be also useful for the MSc students to achieve the requirements of the European Master of Science in Nuclear Engineering (EMSNE) certification, delivered by the European Nuclear Education Network (ENEN) Association to certify the highest quality standards of nuclear engineering education and the European dimension pursued achieved by the EMSNE laureate.



Additionally, the presence of SEAKNOT young researchers in international conferences, workshops, and seminars to present some results obtained through their research activities in SEAKNOT, will be also supported. A non-exhaustive list of possible “focus” conferences includes the main international conferences in nuclear field as ICONE, NURETH, ANS Meetings and ICAPP but also specific ones as the next ERMSAR 2024 and 2026 Conferences, organized in the framework of the project, or the meetings of the national nuclear societies. About this particular action, it has to be highlighted that the **possible participation to general conferences will be supported only for the presentation of research results obtained in SEAKNOT and this support will have to be acknowledged in the presentation.**

Supporting the participation in SAP Courses will be also considered.

Thus, SEAKNOT will publish an internal call for the mobility of these figures at the beginning of 2023 to promote 1) technical exchanges around “SEAKNOT infrastructures”¹ and 2) for the participation to SEAKNOT workshops, conferences, seminars, and SAP courses. The planned total budget for these mobility actions (€ 120,000.00), as stated in the Project GA, has the following distribution:

- Conferences, seminars or SEAKNOT workshops participation € 25,000.00
- SAP Course fees € 20,000.00
- Delegation mobility cost € 75,000.00

The target of this mobility program is “*young PhD/MSc students and researchers*” from SEAKNOT organizations only. The grants are due to “**internal mobility**”: only personal or students from SEAKNOT organizations will be eligible to be granted for these actions (into a partner laboratory or for a conference/workshop related to the project matters), after the approval of the SEAKNOT Executive Board ExB (see the flowcharts for the different application types at the end of this report) about the specific objective of the action. It is worth highlighting that SEAKNOT does not support experimental activities. In case a mobility grant is given for a young research/student to conduct some experimentation in some partner lab (different from her/his organization) within the SEAKNOT scope, the experimentation is financially supported by the organization host and SEAKNOT will only pay the grant to the researcher/student organization.

It is indicatively foreseen to attribute a grant of max 7,500 euros as financial contribution per long visit (about 1,000 euros for month plus the travel expenses). This amount is not fixed and will be approved by the SEAKNOT ExB after being re-assessed on a case by case basis by the Project Coordinator and the WP4 leader.

About the participation to conferences, seminars, workshops and SAP courses, the SEAKNOT grant will cover the registration fees plus travel and subsistence expenses, with an indicative maximum of 2,000 euros for each action, again with the evaluation of the application by the SEAKNOT ExB.

In summary, according to the above budget distributions and planning, it is foreseen that the total number of participations sponsored by SEAKNOT in conferences and workshops would be between 8 and 12, and this same number is foreseen for courses participation. As for internal mobility, about 10 to 15 “long” actions might be allocated within the SEAKNOT budget.

About the selection of these internal grants, it will be based on a simple decision flow, detailed in the following paragraphs and in the flowcharts:

¹ “SEAKNOT infrastructure” refers to all R&D modelling and simulation tools, including the access to experimental facilities, offered for the purposes of a training according to the local rules of the host.



- Grant request by the student/young researcher, also signed by her/his organization.
- Check of the technical bases of the request (WP4 and SEAKNOT coordinators).
- Proposal for a SEAKNOT ExB decision.
- ExB decision on acceptance/reject to be made.

Who can apply?

The SEAKNOT internal grants offer short training/formation periods (at least 2 weeks, max 6 months for the training mobility, and max 1 week for the mobility actions related to the participation to SAP courses/ workshop/conferences/seminars) for consortium MSc/PhD students, early career researchers, engineers and technicians. In particular, the participation to the call is limited to:

- a) Master students in nuclear related courses of EU Universities;
- b) First Stage Researcher R1 (Up to the point of PhD);
- c) Recognized Researcher R2 (PhD holders or equivalent who are not yet fully independent).

R1 and R2 levels are intended as described in the European Commission EURAXESS initiative <https://euraxess.ec.europa.eu/>. Indicatively R2 researchers are early career professionals (up to 10 years of experience).

For these internal mobility actions related to temporary stays in SEAKNOT partners' laboratory both the applicant and the host organization shall be members of SEAKNOT, so the applicants shall be employed or have other formal arrangement at one of the SEAKNOT member organizations.

For mobility actions related to the participation to SAP courses, congress, seminars and workshop, the applicant organization shall be members of SEAKNOT.

How to apply?

- 1) Fill-up the suitable application form available at the end of this document (for a “temporary stay action” or for a “participation action”), including motivation for the action plus additional information as the description of the training proposal (consisting of summary, methods, a detailed planning over time and anticipated results) or the workshop / congress / seminar description and the possible proposed contribution by the applicant to the specific event;
- 2) Provide a confirmation letter from the applicant organisation stating the applicant effective enrolment²;
- 3) Provide a confirmation letter from the host organisation stating its willingness to host the applicant for a specific period of time (only for the temporary stay actions);
- 4) Applicant's short CV.

² it designates any individual working/enrolled as non/permanent employee within a SEAKNOT member-organization inside EU. For mobility actions the applicant organization shall be member of SEAKNOT.



Application submission

This is an open call as long as SEAKNOT financial resources for mobility are available. All the mobility actions must be closed before June 30, 2026 (Month 45) of SEAKNOT so that the mission report is submitted latest by July 31, 2026 (Month 46) and can be evaluated until September 30, 2026 (Month 48).

Applications with the required documentation shall be sent to the SEAKNOT WP4 leader, prof. Sandro Paci (UNIFI) sandro.paci@unipi.it

Evaluation

The SEAKNOT Coordinator and the WP4 leader will carry out a first, formal eligibility screening for these applications.

Then SEAKNOT ExB will perform the evaluation of the applications during its formal meetings that occurs with a frequency of 2 months approximately, also fixing the total amount of the cost reimbursements. All applications received 15 days before each meeting will be evaluated within the following one. Thus, it is expected that all applications be evaluated within 0.5 to 3 months.

Typical binding criteria in the selection by SEAKNOT ExB will be:

- The temporary stay or the conference/seminar/course/workshop topic is in line with the SEAKNOT goals.
- The applicant possible contribution to the conference/workshop/seminar is related to SEAKNOT activities.
- The application form is consistently filled up, with sufficient details and justifications.
- The requested budget is well justified (e.g., reasonable transport and accommodation costs, reduce conference fees for student, etc.).
- The prevision to have a journal paper publication at the end of a long-term stay (more than 3 months).
- The duration of the temporary stay is confirmed by both the employee and the host organizations.

When a grant application is approved by the SEAKNOT ExB, a confirmation letter will be sent to the applicant.

Costs reimbursement rules

The applicant has to submit to SEAKNOT WP4 leader a **final short temporary stay/participation report** (5-10 pages) at the latest 30 days after the end of the mobility action. The SEAKNOT ExB will evaluate these reports during its formal meetings. All reports received 15 days before each meeting will be evaluated within the following one.

The final report shall be:

- summarising the lessons learnt and the results obtained during the temporary stay (the draft of the journal paper can be accepted as final report of the stay), or



- a copy of the contribution to the event for the mobility actions related to the participation to a conference/SEAKNOT workshop/seminar, and
- a **copy of the participation certificate** for SAP courses/conferences/workshop/seminars.

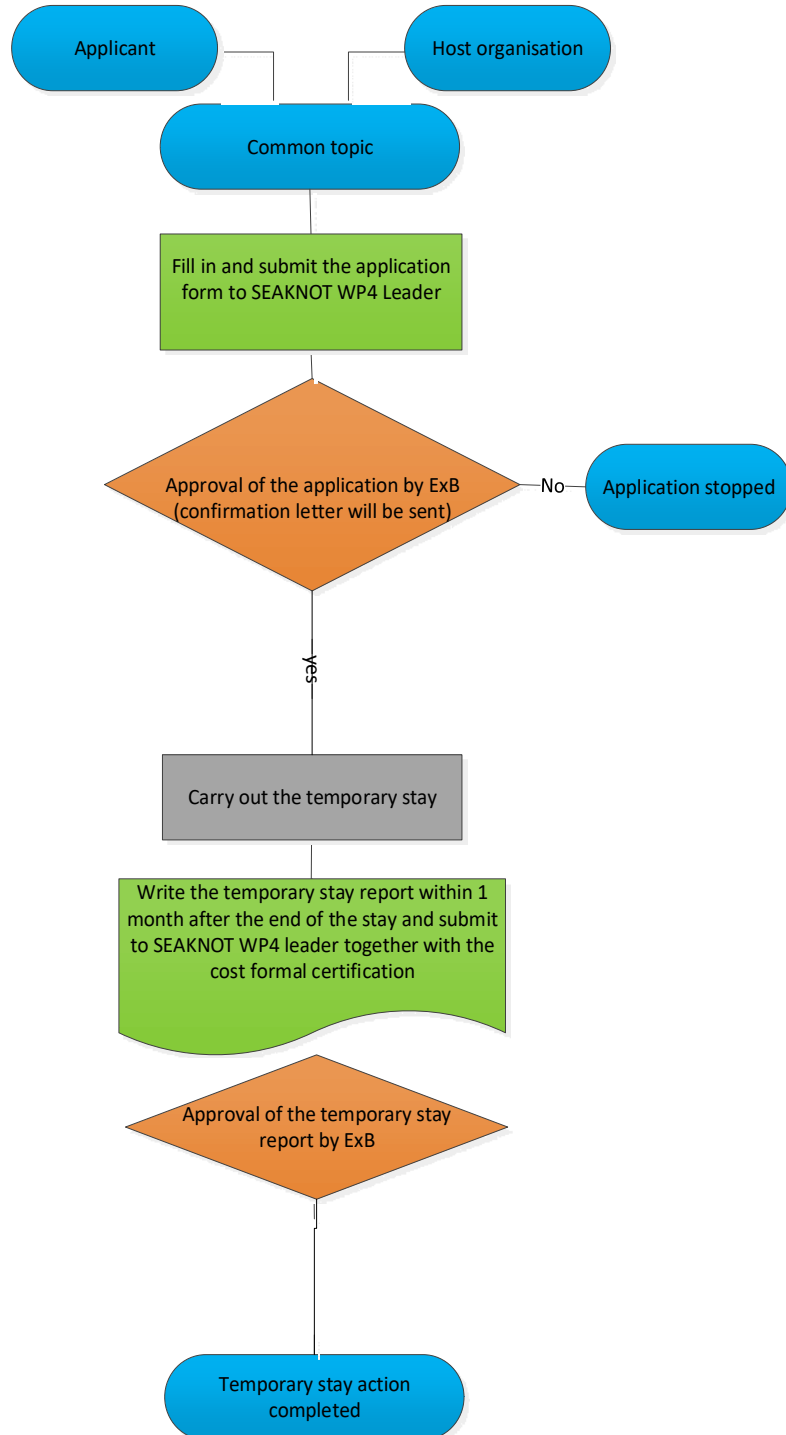
SEAKNOT reserves the right to publish on the SEAKNOT public website, fully or partially, the final training report.

The organisation of the applicant has to submit a **formal certification** to Pisa University, corresponding to the total amount to be transferred from UNIPI budget. This costs reimbursement request, based on the internal rules of the applicant organization, shall correspond to fees, travel and accommodation costs based on original receipts to be archived by the organization for possible future audits. This amount has to be lower or equal to the total amount fixed by the SEAKNOT ExB at the time of the approval of the mobility action proposal.

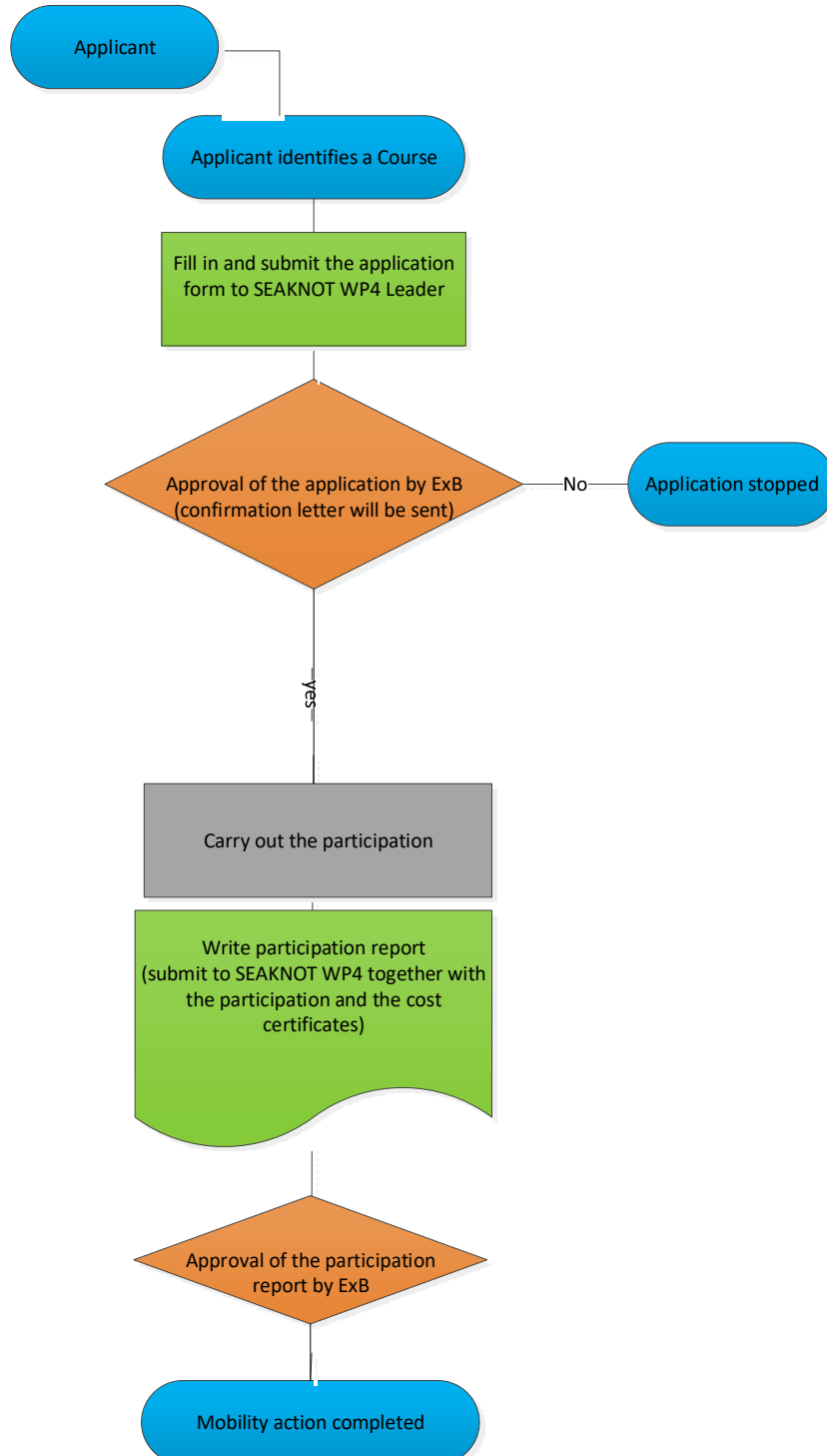
The mobility reimbursement will be transferred to the applicant organization at the end of each financial period only if all these actions will be completed and the final temporary stay/participation report approved by the SEAKNOT ExB.

No direct reimbursement or contribution anticipation will be possible towards the applicant or to the host organization by UNIPI or CIEMAT.

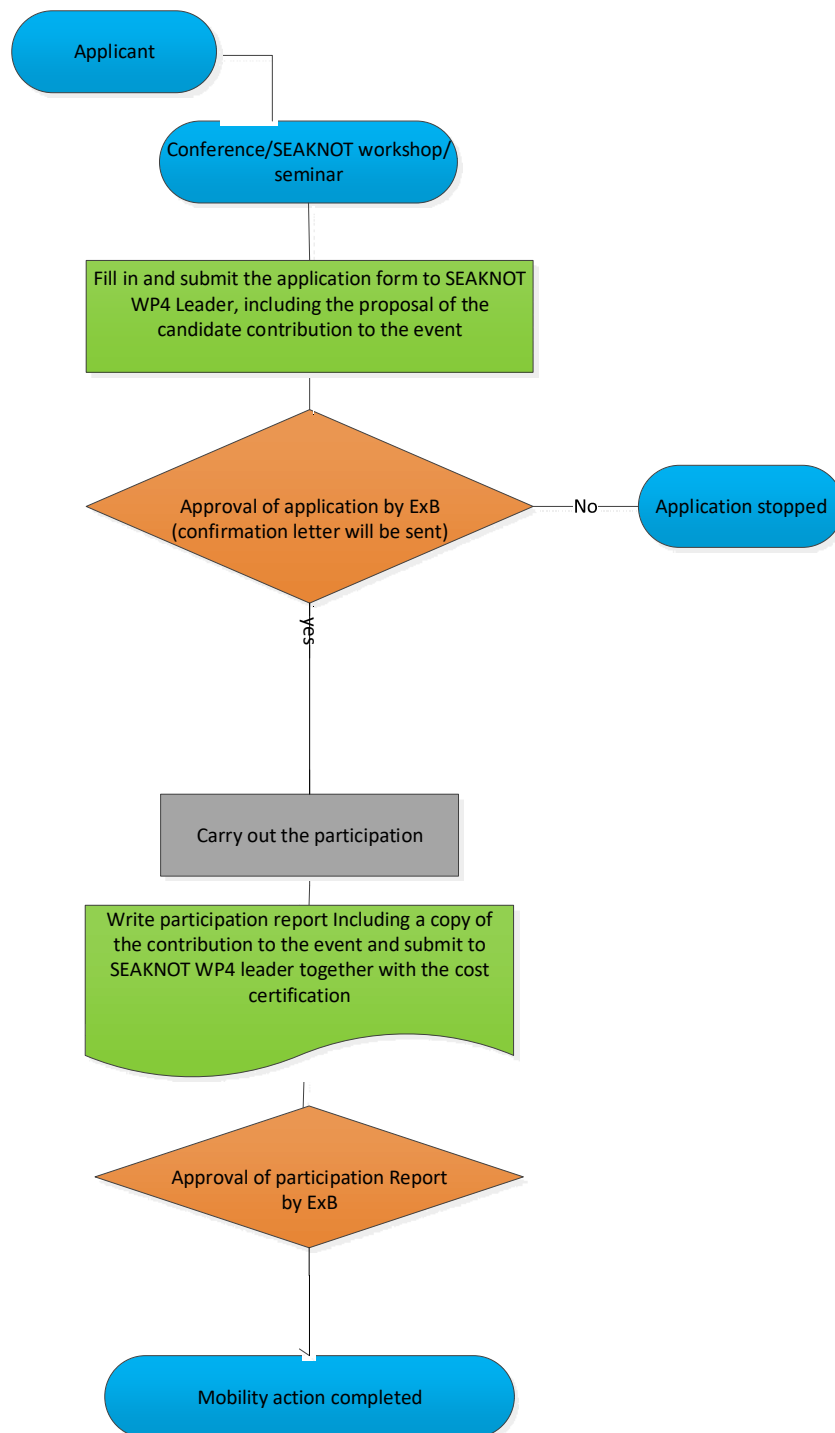
Flow chart of the application process for a temporary stay



Flow chart of the application process for SAP course participation



Flow chart of the application process for Conference/SEAKNOT workshop/seminar participation





Application form for a grant allocation (temporary stay)

| APPLICANT | |
|-----------------|------------|
| Family name: | Institute: |
| First name: | Country: |
| Position*: | E-mail: |
| Contact Person: | E-mail: |

| HOST ORGANISATION | |
|-------------------|------------|
| Contact person: | Institute: |
| Position*: | Country: |
| E-mail: | |

| PRACTICAL INFORMATION ON THE TEMPORARY STAY | |
|---|-------------------------|
| Date of application: | Time period (in weeks): |
| Starting date: | End date: |
| Topic of the temporary stay: | |
| Estimated costs (Euro): | |
| Amount of the allocation requested: | |

| SIGNATURES (NAME + DATE) | |
|--------------------------|--|
| Applicant: | Applicant Organization Contact person: |

* *Master or PhD students/Researcher / engineer / technician + profession*



Application form for a grant allocation (participation)

| APPLICANT | |
|-----------------|------------|
| Family name: | Institute: |
| First name: | Country: |
| Position*: | E-mail: |
| Contact Person: | E-mail: |

| Conference/Workshop/Seminar/Course info | |
|---|------------|
| Title : | Organizer: |
| Location : | Country: |
| Period : | Website: |

| PRACTICAL INFORMATION ON THE MOBILITY ACTION | |
|--|------------------------|
| Date of application: | Time period (in days): |
| Starting date: | End date: |
| Title of the contribution to the event (blank for a Course): | |
| Estimated costs (Euro): | |
| Amount of the allocation requested: | |

| SIGNATURES (NAME + DATE) | |
|--------------------------|--|
| Applicant: | Applicant Organization Contact person: |

* *Master or PhD students/Researcher / engineer / technician + profession*



Short CV of the APPLICANT (max 200 words)

| |
|--|
| |
|--|



MOTIVATION

Explain why and how the temporary stay /participation is important for the candidate and what is the added value for the host organisation, taking into account the SEAKNOT objectives

Candidate

**Host organisation motivation (for a mobility actions related to a temporary stay) or
Conference/Workshop/Seminar/Course description and Contribution title and authors**



ADDITIONAL INFORMATION:

Description of the temporary stay proposal consisting of summary, methods, planning of activities over time and anticipated results (only for temporary stay actions)

Summary

Methods

Anticipated results