



ESARDA
European Safeguards Research & Development Association

WORLD CAFÉ report – STRESA 2019

IMPLEMENTATION of the RG2019 ACTIONS and ROADMAP

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EXECUTIVE SUMMARY

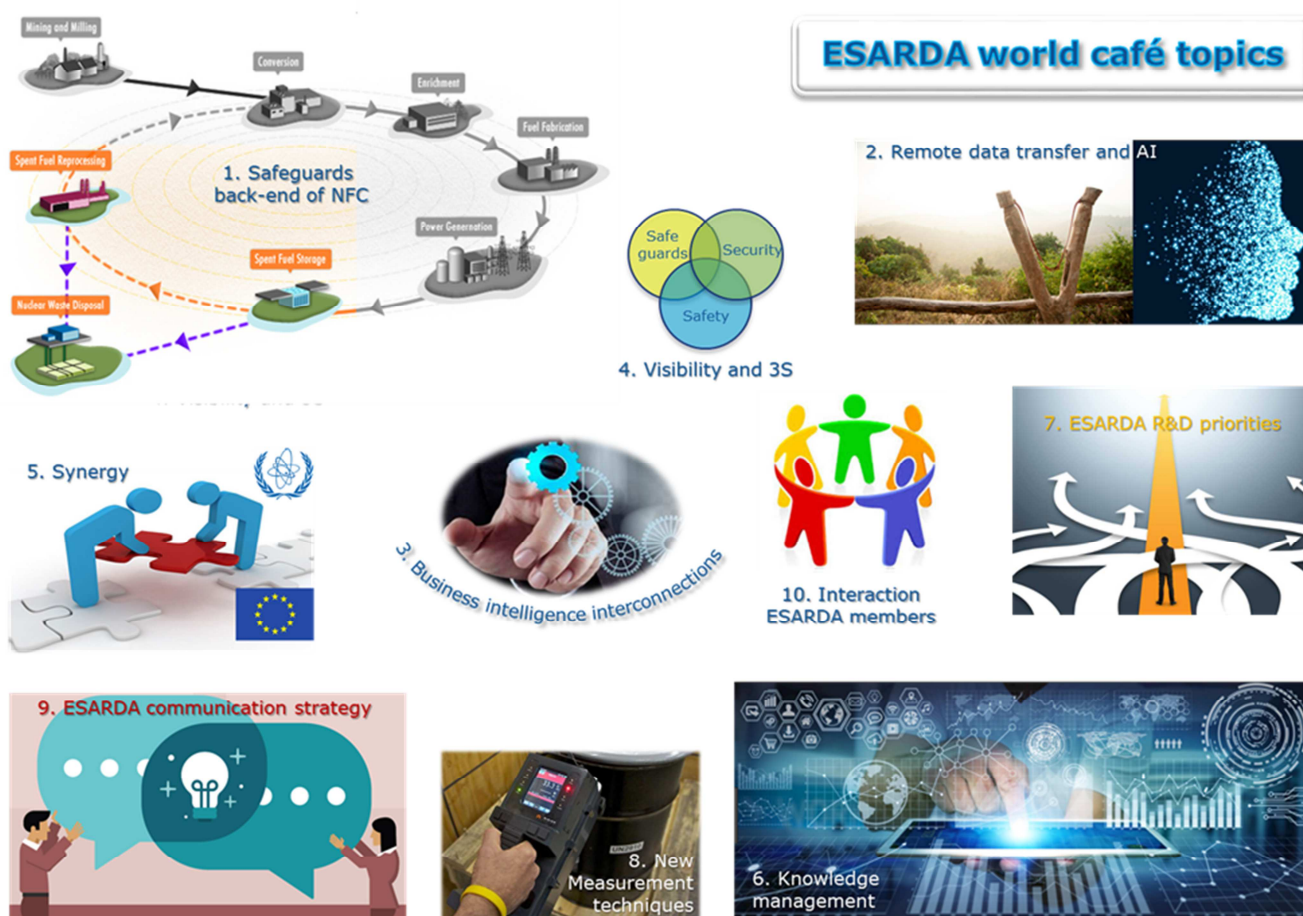
This report presents the outcome of the ESARDA 50th anniversary symposium World Café discussions. The participants in the World Café gave clear indications of the way forward and were encouraged to take personal ownership of the ESARDA Reflection Group 2019 (RG2019) road map actions. Ways of implementation of actions and impact broadening are proposed in this report, which is available for download from the ESARDA web-site (<https://esarda.jrc.ec.europa.eu/>).

The RG2019 was established by the ESARDA Executive Board to assess the future strategic direction, in light of current, upcoming, and future safeguards and non-proliferation challenges. The RG2019 discussed and drafted, prior to the ESARDA's 50th anniversary Safeguards Symposium, **ten sets of actions** related to ESARDA's short-term priorities, long-term priorities, and organisational structure, aimed at improving quality, effectiveness and efficiency of European and international nuclear safeguards.

The implementation of these ten sets of actions is only possible with the **engagement of organisations and individuals taking ownership of well-defined tasks**, within their fields of expertise and beyond.

To this end, a World Café was held to harness the collective intelligence of over 200 participants with the ultimate goal that participants take ownership of the RG2019 roadmap and contribute actively to its implementation, ideally by **taking over one or more actions in their personal agenda**.

The ten World Café topics were derived from the ten RG2019 actions, and distilled into workable and practicable discussion topics. The World Café participants expressed their wishes, discussed the challenges and finally put forward relevant actions for the implementation of these ten World Café topics.



This report collects the **outcome** of these discussions, and highlights **actions** that were raised across a number of topics – expressing widespread views in the safeguards community – as well as the advent of specific and less-obvious actions, stimulated by creative thinking during discussions over uncharted territories.

The summary of all the actions put forward in the World Café, relative to the ten discussion topics, are discussed in the body of this report. Additionally, Annex 3 summarises the World Café actions and those actions identified by the RG2019 and not put forward by the World Café participants, in terms of short term and medium term priorities

In Annex 3, short term priority actions are highlighted in green and medium term priority actions in yellow. For completeness and in order to give the full picture of the World Café discussions, also the actions identified by the ESARDA Executive Board as *beyond ESARDA's mandate although of scientific or operational interest* are reported. These are highlighted in red and will not be implemented by ESARDA. However, should any progress on them become evident in another framework, it can be communicated to ESARDA as constituting valuable information.

This World Café report complements the RG2019 considerations and feeds into the finalisation and visualisation of the road map and the timeline.

The impact of the World Café is discussed with a clear driving force: **the consensus among participants that ESARDA should set actions in terms of creating opportunities for visibility, funding and outreach.**

The main outcome can be summarised as follows:

- The World Café participants strongly envisaged establishing a new dedicated WG on advanced business data analysis and visualisation.
- Additionally, ESARDA should invest more joint (research) efforts to overcome political and technical limitations, fostering communication, education, and share technologies to unlock the 3S potential.
- Synergies on several dimensions – between safeguards authorities, nuclear and non-nuclear research institutions, regulators, operators, industry and safety and security – are considered indispensable for keeping ESARDA abreast of developing technologies in a changing world.
- Finally, ESARDA as a European Association must be aware of and take into account the political context and public concerns throughout the planning and execution of its R&D activities.

The ESARDA World Café co-chairs will support a systematic follow-up of all actions in line with the ESARDA rules and procedures, and in liaison with the ESARDA WGs, the ESARDA executive board, and the RG2019 roadmap.

YOUR 5 STEPS TO THE IMPLEMENTATION OF THE RG2019 ACTIONS

YOU are invited to engage in fostering ESARDA's relevance for the next decade.



1. Please identify the topic(s) that you would like to contribute to, and select out of the actions highlighted in **green** and **yellow** in ANNEX 3 - ESARDA WORLD CAFÉ AND RG2019 ACTIONS. When choosing an action it is highly recommended to consult also the associated wishes and challenges reported in the section 'ESARDA WORLD CAFÉ – THE 10 TOPICS'.
2. Inform your respective WG chair/vice-chair of the action(s) you have chosen. In case you are not yet associated to any of the existing ESARDA WGs, please contact the respective World Café facilitator(s) of the topics you have chosen via: JRC-esarda@ec.europa.eu.
3. The ESARDA WG chairs and the World Café facilitators will assist in coordinating and facilitating any commitment of individuals or groups, also in view of implementing cross-cutting actions, particularly those spanning across different WGs. They will also advise you in case your organisation requires more information on your selected topic, its relevance and potential impact.
4. If appropriate, the ESARDA Executive Board will consider establishing new dedicated WGs.
5. For any other questions please do not hesitate to contact your World Café co-chairs.

The actions identified as *beyond ESARDA's mandate although of scientific or operational interest* are highlighted in **red**. However, should any progress on them become evident in another framework, it can be communicated to ESARDA as constituting valuable information. To facilitate your choice, all the actions put forward by the World Café participants relatively to the ten World Café topics, completed by the actions arising from the RG2019, are listed in the **Annex 3** to this report.

FOSTERING ESARDA'S RELEVANCE FOR THE NEXT DECADE STEP BY STEP

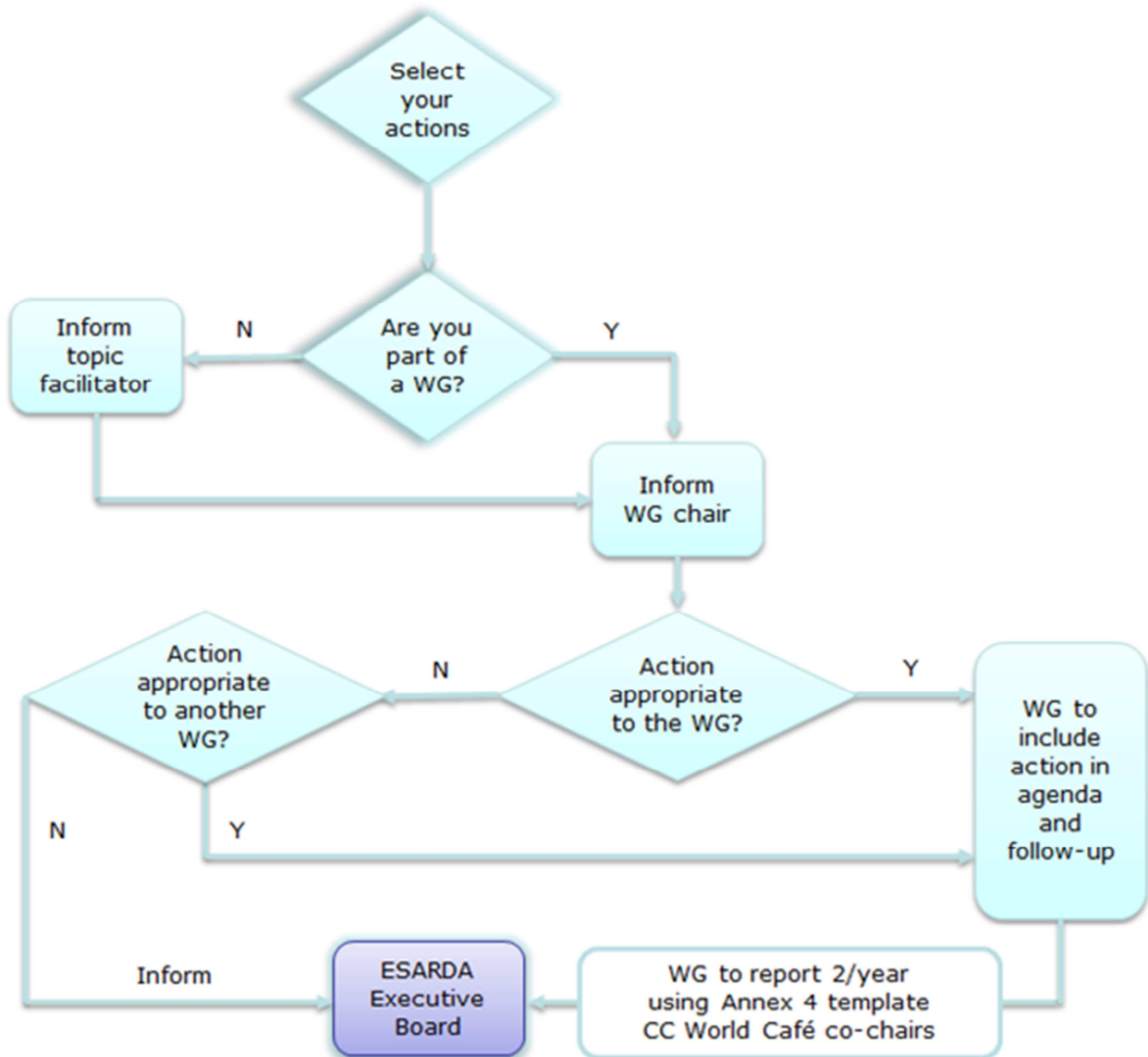


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LIST OF ACRONYMS AND ABBREVIATIONS

- AFCONE – African Commission on Nuclear Energy
- AI – Artificial Intelligence
- ANNETTE - Advanced Networking for Nuclear Education and Training and Transfer of Expertise
- AWE - Atomic Weapons Establishment
- CTBTO - Comprehensive Nuclear-Test-Ban Treaty Organization
- CTE - Comité Technique Euratom
- CoK - Continuity of Knowledge
- EC, DG ENER - European Commission, Directorate-General Energy
- EC, DG JRC – European Commission, Directorate-General Joint Research Centre
- ENEN – European Nuclear Education Network
- ESARDA - European Safeguards Research and Development Association
- FANC – Federal Agency for Nuclear Control in Belgium
- HAEA – Hungarian Atomic Energy Authority
- IAEA – International Atomic Energy Agency
- INMM – Institute of Nuclear Materials Management
- ISTC - International Science and Technology Center
- ITV-2010 – International Target Values 2010 for Measurement Uncertainties in Safeguarding Nuclear Materials
- NSG – Nuclear Suppliers Group
- PIV – Physical Inventory Verification
- R&D – Research and Development
- RG2019 - ESARDA Reflection Group 2019
- SCK•CEN – Belgian Nuclear Research Centre
- SFOE – Swiss Federal Office of Energy
- SSM - Swedish Radiation Safety Authority
- STUK - Radiation and Nuclear Safety Authority in Finland
- US-DOE – United States Department of Energy
- WINS - World Institute for Nuclear Security

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INTRODUCTION

ESARDA, the European Safeguards Research and Development Association, is comprised of European organisations actively involved in the Research and Development of Nuclear Safeguards [1]. ESARDA brings together international nuclear safeguards experts to foster, advance and harmonise R&D in the area of nuclear safeguards. Providing a forum for exchanges between nuclear facility operators, safeguards authorities and research scientists, ESARDA significantly contributes to raise the safeguards professional standards.

ESARDA's asset consists in the parties, associated and individual members, collaborators as well as representatives from non-member organisations such as IAEA, ABACC, APSN and INMM, who regularly take part in ESARDA's activities. The success of ESARDA strongly depends on the commitment of each organisation and the voluntarily engagement of each member actively involved in the research and development of nuclear safeguards.

ESARDA REFLECTION GROUP - RG2019

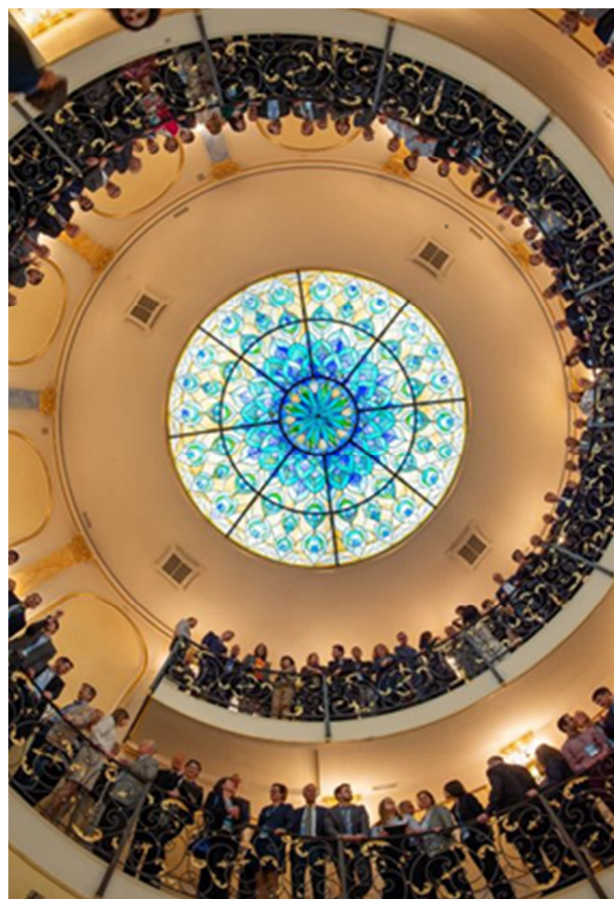
The Reflection Group 2019 (RG2019) was established by the ESARDA Executive Board to assess the future strategic direction, in light of current, upcoming, and future safeguards and non-proliferation challenges. Through the review of ESARDA's short-term priorities, long-term priorities, and organisational structure, the RG2019 drafted a roadmap to improve quality, effectiveness and efficiency of international nuclear safeguards. The RG2019 roadmap, specific to ten sets of actions, demands for an adequate implementation [2]. This is only possible with the engagement of organisations and individuals working against actions and well-defined tasks, both within their fields of expertise and beyond.

This way, the nuclear safeguards community will explore new ideas whilst using the ESARDA exchange platform to the best of its potential.

WORLD CAFÉ ON RG2019 ROADMAP at the ESARDA 50th anniversary symposium

Marking the 50th anniversary of ESARDA, the Safeguards Symposium held in Stresa in May 2019 [3] was setting the scene for a World Café. This interactive session, designed to harness the collective intelligence of over 200 participants, was the first step to implement the RG2019 roadmap and take the recommendations to the next level.

The World Café was established as a forum for discussion, with the ultimate goal that participants take ownership of the RG2019 roadmap and contribute actively to its implementation, ideally by **taking over an action in their personal agenda**.



THE WORLD CAFÉ APPROACH

World Café is a **knowledge-sharing workshop method**, aimed at engaging participants in several rounds of small-group discussions. Each group is guided by a facilitator to interact in a defined procedure, express their points of view and develop new ideas.

All World Café participants are exposed to several topics, and deal with a specific question at a time, switching tables periodically and getting introduced to the previous discussion at their new table by the facilitator.

The facilitators moderate and guide the discussion over the first specific question. After a set time, the participants change table and continue the discussion on the next question related to a different topic. A total of three questions are proposed in relation to each of the World Café topics. The aim of such interactive session is to get to know different perspectives, identify challenges and establish concrete recommendations to recognize goals, connections and actions. The professional setting allows to listen carefully, to question, to discuss constructively and to solve problems together. All stakeholders are given a forum to express their opinions and ideas, to find common goals and strategies and thereby to awaken their willingness to participate in the further implementation of the joint recommendations in the broadest sense.

The 3 World Café @ESARDA 2019 questions

To follow up on the RG2019 roadmap and recommended actions, the World Café co-chairs translated the ten sets of actions identified by the RG2019 into **ten discussion topics**.

Building up on previous ESARDA World Café experiences [4], and given the RG2019 outcome, the workshop co-chairs designed a set of questions tailored for the ESARDA Symposium, which are reported in the figure to the right. This representation was used as visual aid to inform the participants and the facilitators beforehand and throughout the conference.

The approach was considering the following factors:

- ESARDA made a **survey** among its members that fed into the RG2019 report, actions and roadmap. Therefore, the RG2019 already established the state of art and put forward its wish list in the form of the ten sets of actions [2].
- The ESARDA **RG2019 report** was **distributed to all participants** before the symposium. The World Café facilitators, as well as all the participants, were informed prior to the symposium to comfortably handle the set of ten actions and challenges (Cf. ANNEX 1 and ANNEX 2), as the starting point of the World Café discussions



- Starting from the World Café question 1 'wishes', the facilitators were able to focus on **why a certain action is on the RG2019 wish list**. This way, the first round was intended to harvest the hidden motivations, meaning, and sensibility of participants in the World Café in respect to the ESARDA RG2019 roadmap.
- A number of symposium participants did not express their views in the survey, and the RG2019 may not have represented the full spectrum of ESARDA members and collaborators. Distinguished guests at this 50th anniversary, not party to ESARDA, were also invited to feed into the discussion.
- One of the pending RG2019 actions (*collect feedback from stakeholders not addressed via the CIRCABC survey and/or during the annual meeting, such as INMM, IAEA, ABACC, facility operators, universities, and education networks*) was addressed by the participation of representatives from those stakeholders in the World Café.

Therefore, **the World Café focused on the implementation of the RG2019 actions also reflecting on the inevitable challenges while, taking as granted their state of the art.**

The mechanism of the ESARDA World Café

In two rooms, about 200 people were organised in pre-selected groups of up to ten individuals, and each group was associated to a facilitator. Each of the facilitators was attributed to a discussion table and associated to one of the four World Café co-chairs. Therefore, in each of the two rooms, two co-chairs and ten facilitators discussed within the groups the World Café topics.

Participants discussed, within their group and in three rounds, the three particular questions (**Wishes, Challenges, Actions**) related to three out of the ten World Café topics. Therefore, each participant contributed to the collective input towards the future implementation of the main RG2019 priorities. The following figures report the visual aids utilised to ensure a clear understanding of the mechanism and a fruitful engagement of all participants.

ESARDA RG2019 SHORT TERM PRIORITIES (2019-2024)

are driven by the requirements of current EC safeguards policy and its near-time evolution, and resource constraints in implementing safeguards. Progress on their implementation will be reviewed during each Executive Board meeting and reported at each annual meeting to the ESARDA members. Similarly the ESARDA WG chairs will report on the implementation of the respective ROADMAP actions that have been taken on by their WGs at the bi-annual meetings hosted by DG ENER. Achievements in the implementation of short term priorities will be shared with the public via the ESARDA Bulletin (or a new tool).


ESARDA RG2019 MEDIUM TERM PRIORITIES (2019-2029)


will be very strongly influenced from further technological developments and the introduction of novel technologies. Progress on the implementation will be reviewed during each Executive Board meeting and reported during each bi-annual meeting hosted by DG ENER in Luxembourg to the ESARDA members.

THE RG2019 IMPLEMENTATION OF ESARDA STRUCTURES AND OPERATION


of procedural nature will be regularly reviewed by the ESARDA Executive Board. The implementation of operational Actions will be reviewed in all the ESARDA WGs and reported

2 rooms

2 co-chairs per room 

5 facilitators per co-chair 

Group of 5 to 10 participants per facilitator

Groups visit 3 tables and deal with 3 topics and 3 questions 



Starting from **Table I**, indicated in **green** on the conference badge, each individual discussed the first question (**Wishes**) related to the topic allocated to their respective **Table I** facilitator, for 20 minutes.

Then participants moved to their **Table II**, indicated in **red** on the badge, to discuss the second question (**Challenges**), related to another topic, with the facilitator allocated to their respective **Table II**. This facilitator briefed the new group on the outcome of question 1 discussed with the previous group and moderated the discussion continuing on question 2. After 20 minutes participants moved to their **Table III**, indicated in **blue** on their badge, to discuss the third question (**Actions**), related to yet another topic, with the facilitator allocated to their respective **Table III**. One more time, facilitators briefed the groups on the outcome of questions 1 and 2 discussed by the previous two groups, and moderated the discussion continuing on question 3.

Different perspectives

From the facilitator perspective (see ANNEX 2), it was instrumental to welcome the participants, connect different people and ideas, encourage every person's contribution. By asking powerful questions, possibly not immediately relevant from the participants' perspective, facilitators identified reasoning patterns, trends, limitations and creative potential.

As groups changed, participants carried - consciously and unconsciously - conversational threads from one topic to the next. This deepened the discussions but also held the risk of losing focus. For this reason, it was important that facilitators shared the essence of their prior table conversation in a brief and concise way with the next group. Within the freedom of their personal style, facilitators allowed time for silence and reflection, fostered ideas cross-fertilisation, represented key concepts visually, honoured the social nature of learning, encouraged also the more silent group members to express their thoughts, and helped group members notice that individual conversations contribute to a larger field of collective wisdom.

Participants in the World Café (see ANNEX 1) felt inspired to contribute and appreciated that their contribution became part of the collective knowledge. This way, the collective intelligence of all participants highlighted needs, challenges and ways forward cross cutting the ten topics structure proposed by the World Café co-chairs. During the discussions, each participant was encouraged to take ownership of the ESARDA priorities and to take in their agenda one or more respective actions. This translated into concrete recommendations, activities and actions aiming at implementing - while challenging - the RG2019 roadmap. This aspect, as well as the overlap between actions that were proposed across several topics, will be discussed further on in this report.

At the end of the session, the World Café co-chairs collected the facilitator's feedback and points of view on specific topics as well as on other RG2019 priorities and their implementation actions. Subsequently, a first brief summary of the World Café results was presented at the closing plenary session to all the ESARDA symposium participants and structured for subsequent publication.



This report provides details on the outcome of the ESARDA symposium World Café, proposes actions ownership, and reflects on ways of implementing and following them up, as well as broadening their impact and is available for download at the ESARDA web-site.

ESARDA WORLD CAFÉ – THE 10 TOPICS

The ten discussion topics were derived from the ten sets of recommended actions put forward in the RG2019 report. Thus, the World Café focused on the most salient challenges stemming from the priorities identified by the Reflection Group.

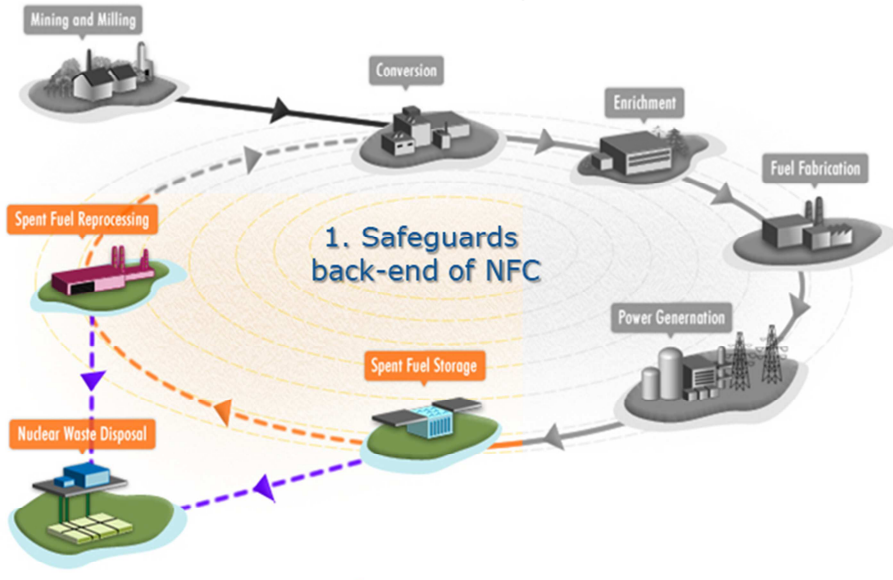
The table below reports the list of ten topics and 20 facilitators, which were invited to lead the discussions on the basis of their recognised expertise in the field and their active contribution and involvement in ESARDA.

	World Café Discussion Topic	Facilitators
1	Strengthen the safeguards approaches at the back-end of the nuclear fuel cycle	Mentor MURTEZI
		Lars HILDINGSSON
2	Optimise inspection resources exploiting the potential of remote data transfer and artificial intelligence	François BONINO
		Árpád VINCZE
3	Promote use of business intelligence and interconnected databases/tools	Simone CAGNO
		Juha PEKKARINEN
4	Enhance the visibility of nuclear safeguards work and promote 3S	Elina MARTIKKA
		Julie ODDOU
5	Support the synergy between Euratom and IAEA	Thomas JEFFREY
		Nicole ERDMANN
6	Develop knowledge management	Riccardo ROSSA
		Quentin MICHEL
7	Define ESARDA medium and long-term R&D priorities in line with future and emerging technologies (FET)	Zoe GASTELUM
		Keir ALLEN
8	Develop measurement techniques for safeguards, decommissioning and waste management	Stefano VACCARO
		Alice TOMANIN
9	Develop and implement an ESARDA (internal and external) communication strategy	Christos KOUTSOYANNOPOULOS
		Walid M'RAD DALI
10	Facilitate interaction between ESARDA members	Fausto MEDICI
		Rožle JAKOPIC

The following section reports the essence of the discussions, for each of the World Café ten topics and each of the three questions.

The feedback from the pair of facilitators leading parallel sessions (handling the same topic in the two different rooms) was merged.

ESARDA world café topics

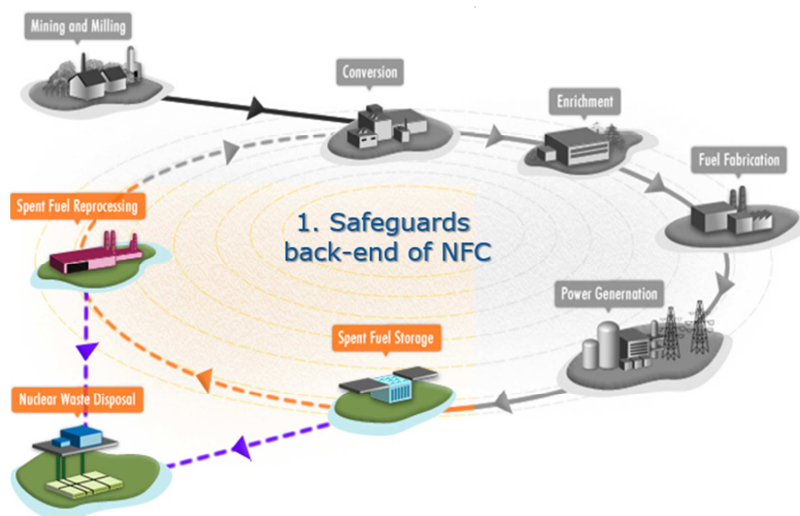


4. Visibility and 3S



Topic 1. Strengthen the safeguards approaches at the back-end of the nuclear fuel cycle

Recent political trends originated new safeguards challenges at the end of the nuclear fuel cycle. This requires development, pilot testing and smart safeguards measures for facilities such as encapsulation plants and final repositories, and activities such as screening of sites after closure.



FACILITATORS:

Mentor Murtezi EC, DG ENER, Luxembourg – **Lars Hildingsson** SSM, Sweden



Topic 1 – Wishes

- Thorough characterisation of spent fuel assemblies and casks prior to final disposal
- Assurance of retention and that all material is under safeguards
- Investment in safeguards monitoring techniques for closed geological repositories, such as antineutrino detection
- Facility-specific and state-specific safeguards approaches
- Simplification of safeguards approach at interim storages
- Data availability & completeness, integrate spent fuel data from facility operators
- Information and knowledge preservation (source data/history of fuel/latest verification)

in long-lasting data banks

- National responsibilities relative to their nuclear liability (reprocessing, interim storage, final repository)
- A method (to be found in the future) to neutralise spent fuel material

Topic 1 – Challenges

- Improve isotopic data integrating models, measurements, simulations and declarations
- Strategy to identify, preserve and retrieve relevant information
- Work out new methods to verify and seal spent fuel
- Improve and automatise long-term process monitoring
- Strategy to effect a compromise between Continuity of Knowledge (CoK) and required presence of staff on site
- Adapt to new reactors and new waste and recycling paths
- Retrievability
- Find out when/if to terminate safeguarding final repositories
- Share of costs and budget allocations
- Long-term monitoring
- Integrate information from safety & security into safeguards
- International consensus across political institutions, public, operators, inspectorates
- Environmental challenges, stability of barriers (rock, containers,...)
- Trade off efficiency and number of repository sites

Topic 1 – Actions

- 1.1. **Facilitate** safeguards-driven regulatory goals
- 1.2. **Perform** R&D on new and existing proliferation-resistant fuel types
- 1.3. **Engage** to integrate the back-end approach in fuel design
- 1.4. **Ensure** safeguards by design for new facilities
- 1.5. **Determine** acceptable risk and find pragmatic compromises
- 1.6. **Implement** financial incentives to create back-end tailored solutions
- 1.7. **Develop and apply** new safeguards concepts & techniques for re-verification of casks, spent fuel verification, geological repositories verification (assurance of no-tempering) – including muon and antineutrino tomography
- 1.8. **Set** univocal targets for the required accuracy
- 1.9. **Simplify** CoK by means of real safeguards by design on casks along the spent fuel life cycle
- 1.10. **Develop** seals for transport casks that can be both applied and removed by the operator
- 1.11. **Establish** CoK processes
- 1.12. **Integrate** all inspection findings, including state-specific (IAEA) and facility-specific (EC)
- 1.13. **Review** safeguards policy against states back-end approach: reprocessing, final repository, shipment, transfer of ownership, other options
- 1.14. **Issue** univocal and coherent safeguards guidance per state & facility type

- 1.15. **Engage early** in instrument development and training of staff
- 1.16. **IAEA and EURATOM to join efforts** on novel technologies applicable to safeguarding the back-end of the nuclear fuel cycle
- 1.17. **Promote** research on transmutation of spent nuclear fuel
- 1.18. **Investigate** potential to use decay heat from spent fuel as an energy source



Topic 2. Optimise inspection resources exploiting the potential of remote data transfer and artificial intelligence

Develop and exploit the potential of remote observations and data collection, transfer, and analysis. This includes artificial intelligence and machine learning to enhance current safeguards implementation measures, and headquarter activities such as data analysis, as well as in-field activities such as sampling schemes. Consideration must be given to cybersecurity and long term data stability and usability.



FACILITATORS:

Árpád Vincze HAEA, Hungaryⁱⁱⁱ – François Bonino CTE, France



Topic 2 – Wishes

- New "real time" data transfer required to verify absence of misuse/diversion
- Mutual-respect relationship between inspectorates and operators
- Foresee remote observations in design for new facilities
- Secure transfer of authenticated data, such as measurement results, seal IDs, surveillance
- Data-set eligible for remote transfer negotiated with operators and states
- Process data by Artificial Intelligence (AI) algorithms to verify accountancy declarations, automatise inspection approaches, and reduce both number of inspections and routine measurements
- R&D focused on reducing inspection time
- Improved speed, security and reliability of data transmission
- Robotics to verify seals, spent fuel and handling highly-active samples
- AI training on where and how to best apply it

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Topic 2 – Challenges

- Selection and sensitivity of data
- Equipment maintenance
- Ensuring data integrity
- Cybersecurity and data protection/confidentiality
- Use algorithms where data are stored
- Robots for engineering, and contamination;
- Fall-back mechanism when failure
- Spent fuel disposal: technology not available
- Remote locations (small modular reactors – SMR)
- Moving of resources from inspectorates to technological platforms
- Political or operator reluctance; trust of operators in robots and AI
- Nuclear safety and security requirements
- Verification effectiveness: non detections vs. false alarms
- Cost

Topic 2 – Actions

- 2.1. **Develop** AI analysis tools to overcome human data-interpretation bias
- 2.2. **Adapt** tools to the analysed data sets
- 2.3. **Perform** statistical evaluation of existing data
- 2.4. **Initiate** research projects **focusing** first on few test cases to prove feasibility
- 2.5. **Develop** standards for declarations
- 2.6. **Review** approaches of other industries and **exchange** expertise
- 2.7. **Demonstrate** how R&D and AI can help to introduce random PIV
- 2.8. **Inform and educate** to overcome reluctance
- 2.9. **Create** an ESARDA **Working Group** on improved techniques and **develop** benchmark data
- 2.10. **Investigate, negotiate** and **define** requirements for remote data monitoring and transmission beneficial to all stakeholders



Topic 3. Promote use of business intelligence and interconnected databases/tools

Develop, validate and promote use of geographic information systems & enhanced data visualization and interconnected databases for mapping, storing, presenting, analysing safeguards-relevant data, including outreach to the business intelligence and (big) data community.



FACILITATORS:

Simone Cagno EC, DG JRC (Ispra), Italy – **Juha Pekkarinen** EC, DG ENER, Luxembourg



Topic 3 – Wishes

- Data management and integration at different levels
- Sharing of R&D data
- Data mapping, grouping, sorting, validation
- Quality checks
- Machine learning and AI
- Automation of data collection and analysis
- Engagement/availability of data scientists
- Define user communities
- Reduce workload of inspectors in data analysis while gaining value and quality
- On-site analysis to exchange between inspectorates only the relevant information

Topic 3 – Challenges

- Data infrastructure, management (format, location), security (protocols and IT tools)
- Access rights, information sensitivity and flow
- Harness digital transition and open to innovation
- Connect and break silos (big data, emerging technologies, AI, blockchain, automation) across communities (communication, understanding, awareness)
- Maintain knowledge and keep abreast of technology innovations

- Information assurance – control of human bias
- Human resources and change of inspector's profile - define the role of the analyst
- Legal aspects
- Operator/national consent and feedback to operators
- Costs

Topic 3 – Actions

- 3.1. **Define** data formats
- 3.2. **Start** strategic ESARDA/INMM approach on data analysis, benchmarking, comparison
- 3.3. **Launch** a pilot project as a test case on a real-life topic
- 3.4. **Make** stakeholders aware of what is available/possible
- 3.5. **Reach out** to the data analysis community via participation at and/or invitation to dedicated workshops and conferences
- 3.6. **Attract** experts of data science to engage
- 3.7. **Provide** dedicated funding
- 3.8. **Manage** knowledge on business and data analysis, organise trainings
- 3.9. **Evaluate** the creation an of an **ESARDA Working Group** on business intelligence and data analysis



Topic 4. Enhance the visibility of nuclear safeguards work and promote 3S

Engage with industry, academia and policy makers to enhance ESARDA visibility, promote cooperation between Euratom and state authorities on management of waste and small holders, and promote 3S synergies between safeguards, safety and security and as such also further contribute to the peaceful application of nuclear energy as a low-carbon energy form.



4. Visibility and 3S

FACILITATORS:

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Julie Oddou CTE, France



Topic 4 – Wishes

- Make safeguards attractive
- Summer schools – early engagement and outreach to young generation
- Better understanding between security and safeguards communities
- Foster nuclear 3S culture - 3S certificate
- Synergies between safeguards and security organisations
- Exposure beyond nuclear fora
- Awareness and more visibility to increase R&D on safeguards
- Public understanding
- More transparency, more publications – taking into account data sensitivity
- Advertising on TV and social media – positive messages

Topic 4 – Challenges

- 3S by itself is a challenge - 3S encompasses many different areas
- Different legal frameworks with similar applied technologies
- Rather negative public perception around the nuclear energy domain
- Limitation due to information sensitivity and technical complexity
- Clash between communication transparency and information confidentiality

- Gap of technologies for safeguards purposes
- 3S certificate – how to motivate universities?
- Safeguards is not part of the problem but part of the solution

Topic 4 – Actions

- 4.1. **Foster** international cooperation between EU and non-EU actors
- 4.2. **Cooperate** with organisations such as **INMM** and **WINS** (World Inst. for Nuclear Security)
- 4.3. **Exchange** and **align** research on emerging technologies with the nuclear security and safety communities
- 4.4. **Develop** 3S approaches for new reactor types
- 4.5. **Facilitate** communication and understanding by issuing a 3S glossary
- 4.6. **Organise** events gathering policy makers, universities, research&technology, youth...
- 4.7. **Enhance** education efforts (European Nuclear Education Network (**ENEN**), Advanced Networking for Nuclear Education and Training and Transfer of Expertise (**ANNETTE**),...)
- 4.8. **Share** technical expertise and techniques via 3S platforms/events
- 4.9. **Organise** a workshop on 3S
- 4.10. **Hold** dedicated panels on actual and hot topics of interest
- 4.11. **Communicate** better ESARDA's scope, structure and activities
- 4.12. **Create** an App or/and use Apps to make safeguards more visible



Topic 5. Support the synergy between Euratom and IAEA

Support the liaison between the safeguards authorities exploring room for increased safeguards implementation cooperation while maintaining the ability to draw independent conclusions.

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Nicole Erdmann EC, DG ENER, Luxembourg



Topic 5 – Wishes

- Synergy does not mean the same as mixing the different goals
- Each organisation should stay refrained to their individual mandates, separate budgets and maintain independency
- Enhanced sharing and use of joint data, format and platforms (software)
- Align requirements for format files for Additional Protocol (AP) declarations; reporting technology
- Enhanced sharing of conclusions using modern IT tools
- Outreach to other communities, such as data science
- Use R&D and technology developments but do not mix it with e.g. security
- Alignment of technology needs – technology acceptance criteria the same for both (example EC in favour, IAEA not in favour to a certain NDA detector)
- Cooperation on all technical areas and develop jointly a safeguards technical standard
- Going beyond safeguards – R&D/technology in other fields
- More trust in verification results obtained via "one job – one person" principle
- More trust: longer IAEA notification time for Complementary Accesses would improve EC inspectors safety
- Clear and transparent communication and implementation: why 2 inspectors – no trust ?
- Redundancy – organisations acting alone – greater efficiencies results being taken on board also by the other organisation

- Joint training in fields of overlap
- Staff exchange - secondments

Topic 5 – Challenges

- Difference in objectives - because the objectives of the 2 organisations are not the same the conclusions are not always the same
- Financial support for the organisations is different, including for laboratories
- No mixing with arms control (politically sensitive)
- Same basic vocabulary to ensure consistent reporting
- Encryption problems
- AP reporting is not well understood – side and non-side letter states, nuclear and non-nuclear weapon states, Protocol Reporter 3 (PR3)
- List on what to share on inspections
- Better collaboration on technology and relative acceptance criteria: validation process for joint equipment lengthy and less flexible
- R&D technology providing organisations (e.g. EC,..) struggle with the concept of MS-Support Programme and related acceptance procedure
- State Level Approach may not be a help (different types of "control") to a state but could help co-operators via more transparency with the state
- Information sharing – lack of transparency
- Agreement of license holder to share information
- Other nuclear inspections
- Human resources (HR) practices
- Monopoly / niche market

Topic 5 – Actions

- 5.1. **Streamline** equipment approval process
- 5.2. **Define** target criteria for equipment testing, similar to International Target Values (ITV-2010)
- 5.3. **Share** historical safeguards relevant information
- 5.4. **Share** reports, random attendance by IAEA/EC
- 5.5. **Evaluate** jointly inspection results
- 5.6. **Review** and **harmonise** policy related to exemption of nuclear material from safeguards
- 5.7. **Build** trust via joint guidelines
- 5.8. **Establish** protocol proposals at ESARDA level
- 5.9. **Organise** joint recognised (certificate) training exercises (e.g. NDA,..)
- 5.10. **Promote** mutual understanding and communication
- 5.11. **Exchange** staff, i.e. national experts to the EC, CFE (cost free expert) to the IAEA
- 5.12. **Establish** working groups beyond EC-IAEA current formal mechanisms – discuss openly cross-disciplinary
- 5.13. **Share** better scientific information – more ESARDA / IAEA interaction – technical workshops/meetings



Topic 6. Develop knowledge management

Develop a functioning management of knowledge including specific outreach activities to other communities and networks, promoting R&D and careers in nuclear safeguards and non-proliferation, and extending the ESARDA Membership diversity (concept of operating the ESARDA Young Generation Group).



FACILITATORS:

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Topic 6 – Wishes

- Highlight usefulness of safeguards
- Change perception and message to make safeguards more attractive
- Include safeguards in education - more connections with Universities and schools - provide material to universities if available
- Organise ESARDA open days (or other activities) at Universities or other institutions
- More connections with ENEN (European Nuclear Education Network)
- Mailing list with all ESARDA members
- Make activities known to all ESARDA + “obligation” to forward to colleagues
- Improve Nuclear Safeguards & Security Ed. and Training (NUSASET) tool, make it known
- No fees or reduced fees for students
- Young generation career track at conferences
- Student best paper competitions
- Ties with political sciences, international relations,...
- Show diversity of people working in safeguards – give example of role models "famous"

people" known in safeguards

- See safeguards as capital investment
- Knowledge Management (KM) is not only safeguards but multi discipline and not a secret club collaboration with and input from other communities is also part of safeguards
- Control the turnover-related loss of knowledge
- Safeguards does not evolve quickly – priorities need to be set

Topic 6 – Challenges

- Legal framework
- How to communicate to academia and authorities?
- How to motivate academia and authorities – in exchange of what ?
- How to define the baseline and the processes ?
- How to identify the appropriate 'tools' ?
- Collective knowledge and experience from previous conferences
- Quality management
- Qualified people able to offer training, courses and material, mentorship
- Gender balance/issues
- Outreach to people beyond nuclear
- Career paths in safeguards
- Travel permissions to conferences
- Reach over to young generation – students not aware of advantageous energy mix including nuclear energy

Topic 6 – Actions

- 6.1. **Introduce** visiting fellowships – cross fertilisation between different disciplines
- 6.2. **Modernise** CIRCABC and consider consolidating exchange platforms
- 6.3. **Organise** student paper competitions
- 6.4. **Investigate** possibilities for funding and financial support
- 6.5. **Create** a safeguards knowledge dataset
- 6.6. **Create** a database of opportunities (organisations, job opportunities, fellowship,...)
- 6.7. **Make** publications available via open access
- 6.8. **Share** information and 'hands-on' experiences on safeguards work/inspections
- 6.9. **Talk** about safeguards in *back to school* events
- 6.10. **Go beyond** "technical", target policy makers and more
- 6.11. **Attend** meetings and pass on the message collect feedback beyond safeguards
- 6.12. **Make** risk assessment/management for loss of knowledge (nuclear knowledge) and **control** the turnover-related loss of knowledge



Topic 7. Define ESARDA medium and long-term R&D priorities in line with future and emerging technologies (FET)

Define medium and longer term R&D priorities for ESARDA in line with FET such as AI, data analysis, block chain, robotics global system science [5], behavioural sciences, biotechnologies, new materials, nanotechnologies, quantum technologies, *green* technologies, arts & science and more. Stimulate *out-of-the box* thinking also in view of safeguarding innovative reactors systems and fuel cycles.



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Topic 7 – Wishes

- Social Sciences
- Data analytics – use wealth of existing data and long term storage of data
- Creation of a data lab
- Safeguards for new reactor types and GEN IV reactors
- Trained data analysts – experts in data interpretation from various technologies
- Examine approaches and techniques for safeguarding dry storage casks
- R&D for geological repositories verification (strategies and techniques)
- Encapsulation plants – repacking materials – interim storage
- New technologies for waste processing and decommissioning - verification of low & medium level waste – it is as safety issue and in how far a safeguards issue ?
- Integration of new technologies - funding to support the R&D for emerging technologies
- UF₆ flow monitoring
- Basement detector
- Portable mass spectrometer

- Wearable technologies for inspector support
- Blockchain and AI and facial recognition to detect deception
- Particle swarm optimisation for NDA
- Robotics and drones
- Positive messaging

Topic 7 – Challenges

- Must be implementable and wanted – usability – need for specific applications
- Legal agreements involving safeguards authorities, states and facilities
- Emerging technologies' reliance on international funding
- R&D cost/benefit while safeguards budget is decreasing
- Requires more investment in cyber security
- Operator mind-set, cooperative or rather willing to follow own, unique way
- States cannot be obliged to comply, need for negotiations
- Space for new facilities (NIMBY – Not in my back yard)
- Conflicts with security practices
- Evolving workforce, need for new hybrid skill set, people vs. robots, training needs change
- Lack of knowledge of deployment conditions
- Changing cultural norms regarding access to places & data
- Sensitivity of data – storage must be robust against “dual use” and industrial espionage
- Security authentication (drone, data transmission)
- Needs for infrastructure, including security
- Risk of hidden bias within software and AI
- Timing for deployment of a new technology in safeguards are out-of-phase with industry
- Safeguards market attractiveness to industry
- Quantifying effectiveness of new methods – ensuring relevance to safeguards mission
- Impatience of inspectorates when R&D is not ready, despite foggy specifications
- New facilities means new verification techniques and new types of experts
- Need to become more efficient with existing facilities ad tasks
- Long term consequences, social sciences, debate over repositories location

Topic 7 – Actions

- 7.1. **Break** silos and incentivise structures
- 7.2. **Need** to focus on R&D for situations others are not thinking about
- 7.3. **Establish** cross-cutting **WG's** on inter-disciplinary aspects of emerging technologies
- 7.4. **Foster** dialogue involving technical experts, operators, regulators (get people in one room)
- 7.5. **Outreach** and **exchange** with other industries – data is everywhere, cross fertilisation
- 7.6. **Consider** processes to develop and adopt new technologies from other industries
- 7.7. **Broaden** view points and become more multi-disciplinary, **engage** social sciences
- 7.8. **Use** new IT tools, robotics, AI

- 7.9. **Prioritise** R&D wishes, establish criteria and focus on top priorities
- 7.10. **Establish** requirements for new technologies
- 7.11. **Educate** and raise nuclear awareness from public relation perspective to improve perception
- 7.12. **Involve** operators and R&D staff in new approaches
- 7.13. **Engage** with operators for training, acceptance of new technology, test new R&D, ensure benefit to operator, and create opportunities for joint use
- 7.14. **Communicate** that ESARDA is on the right track



Topic 8. Develop measurement techniques for safeguards, decommissioning and waste management

Develop, validate and promote the application of characterization techniques that are of mutual benefit for safeguards, decommissioning and waste management. Managing small quantities of nuclear materials in different matrices might lead to the definition of exemption levels for fissile materials under safeguards.



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Topic 8 – Wishes

- Remote monitoring
- Reliability & improvement of existing instruments
- Reduce human intervention (robotics) in containment and surveillance, maintaining CoK
- Pay attention to keep the human factor
- Automation for collection of data
- (Re)verification of (closed) spent fuel casks: Muon tomography, nuclear resonance fluorescence, gamma-ray active absorption, fast neutron mapping, BU modeling
- In-field quantification of small fissile material amounts in waste: beyond point model, high eff. coincidence, neutron interrogation, gamma tomography

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Topic 8 – Challenges

- No technique is fit for all needs
- Highly active materials yielding significant amounts of ionising radiation
- Licensing (safety, environment, radiation protection, ...)
- Timely (in-field) verification
- Early stage of technologies and readiness levels
- Instrument dimensions and portability (prototypes vs. in-field applications)
- Each sensor should be authenticated and checked for robustness
- Required measurement time
- Move from dedicated development to industrial products
- Difficult to reach out to industry
- Political acceptance of remote monitoring in nuclear installations
- Costs - low budget
- Lack of scenario-specific nuclear standards
- Lack of common EC-IAEA approval criteria

Topic 8 – Actions

- 8.1. **Define** clearly the tasks
- 8.2. **Link** the needs of IAEA, EURATOM, nuclear operators, and political dimension to support programme activities and ESARDA
- 8.3. **Develop** improved measurement data handling, statistical integration
- 8.4. **Make** a technical survey
- 8.5. **Organise** feasibility studies and **make** a cost benefit analysis
- 8.6. **Get** appropriate funding and R&D resources
- 8.7. **Develop** techniques, such as AI, that limit the need for measurement standards
- 8.8. **Define** a comprehensive and transparent protocol for data declaration and evaluation in remote monitoring
- 8.9. **Facilitate** the transition from prototype to field implementation
- 8.10. **Explore** synergies with security and safety
- 8.11. **Create** incentives (e.g. tax) for industries working in safeguards
- 8.12. **Reach-out** to universities and educate the public on nuclear safeguards
- 8.13. **Reach-out** to cybersecurity field

Topic 9. Develop and implement an ESARDA (internal and external) communication strategy

This includes communications to attract new members, ESARDA welcome package, guidance for WG chairs, improved website, ESARDA document repository CIRCABC. Modernise social media exposure and provide integrated solutions. Engage with external stakeholders to increase visibility of ESARDA, including promotion, communication, dissemination, continuation and foresight of ESARDA success stories.



FACILITATORS:

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Topic 9 – Wishes

- ESARDA stakeholders are: suppliers, academia, member states, operators, inspectorates
- ESARDA on LinkedIn, Facebook etc.
- App per WG and/or for the whole ESARDA
- Update and modernise ESARDA website – interactive ESARDA web-site
- More publications on the ESARDA website
- Forum on ESARDA website
- Improve CIRCABC
- ESARDA membership programme
- Hire professionals to promote ESARDA
- ESARDA ambassadors
- Nominate spoke-persons within members' organisation to promote ESARDA
- ESARDA award for master students
- Competition for the best safeguards idea of the year

- WG chairs outreach – frequent reporting of the different WGs
- Organise WGs/workshops in countries that are less represented in ESARDA
- More operators' involvement
- Attract younger generation – ESARDA to attend career days at universities
- Best PhD/paper award during symposia
- Publications / newsletter

Topic 9 – Challenges

- Retain safeguards knowledge to bridge gaps
- Lack of motivation (busy with 'domestic' work)
- Relatively small community
- Limited safeguards awareness/attractively in this field
- Limitation in resources, money and time
- Decline in all aspects of nuclear education and in job opportunities in nuclear
- Exploit CO₂-free aspect of nuclear to attract younger generation
- Transparency concerns due to public perception of nuclear issues
- Convince public of safe/sound handling of nuclear waste
- Safeguards shift to back end of the nuclear fuel cycle in Europe
- Convince operators to contribute more for their own benefit/advantage
- Security of information

Topic 9 – Actions

- 9.1. **Put** a communication strategy for safeguards in place with smart goals
- 9.2. **Adjust** the communication plan to different audiences
- 9.3. **Communicate** scientific risk/based "divorce from nuclear fear" for the general public
- 9.4. **Update** the ESARDA web-site more frequently
- 9.5. **Investigate** possibilities to use the media (newspaper, TV,...) to spread news on ESARDA and ESARDA's activities
- 9.6. **Celebrate** ESARDA/safeguards success stories
- 9.7. **Find** funding for nuclear safeguards ESARDA
- 9.8. **Find** mechanisms for national support programmes to provide funding for ESARDA
- 9.9. **Promote** ESARDA at university levels (awards, prizes, grants,...)
- 9.10. **Attend** career days at universities
- 9.11. **Strengthen** further ESARDA-INMM cooperation
- 9.12. **Promote** the creation of safeguards chapters
- 9.13. **Highlight** and value what is different in ESARDA and INMM
- 9.14. **Promote** the concept of and find ESARDA ambassadors



Topic 10. Facilitate interactions between ESARDA members

Motivate ESARDA WG members to engage and guarantee a fair distribution of WG tasks (e.g. in the production of ESARDA Technical sheets) and foster synergies between ESARDA WGs

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10. Interaction
ESARDA members



Topic 10 – Wishes

- Database on people competences
- Cooperation across WGs – joint WG activities
- Collaboration on technical level with other organisations, such as INMM, ABSN
- Joint ESARDA/INMM symposium
- ESARDA Bulletin peer reviewed SCOPUS journal
- Improved CIRCABC/website – interactive – forum
- Library (relevant/updated)
- Technical sheets
- List of relevant events of interest to ESARDA
- ESARDA course – new courses – massive open online course (MOOC)
- Topical, dedicated workshops, and multidisciplinary workshops on facility basis
- ESARDA members should have more meetings at facility sites and visit them
- Incorporate modern communication technologies, use VC to foster exchanges beyond those requiring physical attendance
- Office 365: Manage Tasks with Microsoft To-Do
- Social media – slack, chat platforms, webinar

Topic 10 – Challenges

- Different focus – transparency openness between members
- Data protection, data security (social media)
- Resources (human, funding, time)
- Travel authorisation, approval from hierarchy
- Differences in culture and political understanding/differences
- Understanding each other's needs (academia, authorities, operators,...)
- Establish priority events
- Availability/harmonisation of tools

Topic 10 – Actions

- 10.1. **Connect** via video conferences
- 10.2. **Improve** different tools to facilitate interaction between members
- 10.3. **Familiarise** with the new CIRCABC
- 10.4. **Get** adequate funding, consider eligible activities, projects, events
- 10.5. **Add** library website
- 10.6. **Create** a newsletter
- 10.7. **Create** sponsorship for conferences/symposia
- 10.8. **Combine** events
- 10.9. **Organise** focused facility-hosted, multidisciplinary meetings with site visit
- 10.10. **Establish** more formal topical platforms for broader participation
- 10.11. **Communicate** to management the benefit of participating in ESARDA
- 10.12. **Make** suggestions how social media could help ESARDA
- 10.13. **Hold** joint WG meetings and **organise** joint WG activities



MOST SALIENT AND CROSS-CUTTING ACTIONS

The outcome of the discussions around the ten World Café topics showed **clear trends** and a **certain degree of conformity in the identified challenges and the recommended actions**. It is noteworthy that such commonalities resulted from the diversity of wishes triggered by the wide-ranging RG2019 set of actions. This bears the evidence that ESARDA could address most of its challenges tackling a limited number of key issues, exploiting synergies, potential and impact. Some of the actions cross-cutting across a large fraction of the World-Café topics are related to the Euratom–IAEA synergy, to the need for an inter-disciplinary WG dedicated to business data analytics, and to external funding to support ESARDA's activities.

In addition to the actions put forward by the World-Café participants, the ESARDA Executive Board proposed during its meeting in October 2019 the functional arrangement of the most salient actions reported in the table below. This is mostly based on the World-Café output, as well as on additional elements such as the RG2019 roadmap, the IAEA Action Plan resulting from the 2018 IAEA Safeguards Symposium [6], and the recent VCDNP study "*IAEA Safeguards – Staying Ahead of the Game*"[7]. In this functional formulation of the World-Café actions, the Executive Board identified three major **action streams**. For each stream, two coordinators (Executive Board Members) are in charge of following-up the information on the implementation, by linking to the ESARDA working groups, receiving the information from the World Café co-chairs and reporting regularly in the Executive Board meetings.

I. Design, Development, Test and Validation of innovative safeguards approaches with specific technical objectives

- Back-end of nuclear fuel cycle (spent fuel management, encapsulation, final disposal)
- Decommissioning and Waste Management (e.g. safeguards termination criteria)
- New reactor types, materials, fuels and fuel cycle facilities (e.g. SMRs, ADS)

II. Modernise the way safeguards is implemented (i.e. inspection toolkit, data processing, remote monitoring etc.)

- Use of AI, machine learning and numerical modelling for multiple signals analysis
- Exploit the potential of remote monitoring and control, considering cyber security concerns etc. (incl. e.g. the potential of DLT)
- Enhanced data analysis (modern business analytics) and use of modern data science tools

III. Enhance the visibility of nuclear safeguards and reach out to young generations and new partners

- Enhance synergies with safety, security, strategic trade control and their respective nuclear communities, enhancing communication
- Embrace the Young Generation by fostering educational and knowledge management activities including specific, also international, outreach initiatives
- Promote collaboration between inspectorates, with traditional partners (SSAC, ESARDA, INMM, nuclear research institutes and operators) and reach out to additional, non-traditional partners (incl. e.g. IT, cognitive sciences)

CREATIVE AND UNEXPECTED ACTIONS

Another interesting outcome of the World Café was the appearance of specific and less-expected actions during the discussions. These were not based on a large consensus as those reported in the previous section, but were nevertheless suggested by individuals even though their implementation would possibly face 'insurmountable' challenges. This expression of creative thinking is considered a great asset of the World Café approach as it paves the way for discussions over uncharted territories.

I. Share information and 'hands-on' safeguards experiences

- Organise **open-day** site visits on the theme *a day in the inspector's shoes* involving inspectors, scientists, ESARDA chairs, operators and regulators
- Target for these type of visits primary/secondary **schools**, university students, young professionals, policy makers, and reach **beyond the nuclear field**
- Invite pupils together with their families to attend relatively safe nuclear measurements such as environmental radioactivity or **dummy inspections** in the field

II. Open a dialogue with social sciences such as anthropology, archaeology, communication studies, economics, history, musicology, human geography, jurisprudence, linguistics, policy, psychology, public health, and sociology

- Make efforts towards **cross fertilisation**, discuss and develop solutions together
- Consider a **test-bench event** with representatives from social sciences and ESARDA
- Discuss national responsibilities relative to **states nuclear liability**
- Suggest how **social media** and *crowd funding* could facilitate outreach and help ESARDA
- Look for **role models**, both observing other approaches and presenting ours

III. Raise awareness over benefits of nuclear as part of the energy mix

- Hold dedicated panels on hot and **controversial topics**
- Promote research on **transmutation** of spent nuclear fuel
- Investigate potential to use **decay heat** from spent fuel as an energy source
- Communicate to the public a **risk assessment** on *divorce from nuclear energy*
- Perform risk assessment on **loss of knowledge** in nuclear

WHAT CAN I DO AND HOW?

As a result of the World Café process, participants in the World Café, ESARDA members, collaborators and supporters are now **invited to engage in the step by step implementation in support of the RG2019 priorities**. Each of us is encouraged to contribute to at least one action associated with the World Café and RG2019 priorities, and **take it over in the personal agenda**.

The ESARDA World Café actions at a glance

To facilitate your choice and to invite you to engage in fostering ESARDA's relevance for the next decade, all the actions put forward by the World Café participants relative to the ten World Café topics, together with additional actions identified by the RG2019, are listed in **ANNEX 3 - ESARDA WORLD CAFÉ AND RG2019 ACTIONS**.

In Annex 3, short term priority actions are highlighted in **green** and medium term priority actions in **yellow**. For completeness and in order to give the full picture of the World Café discussions, also the actions identified by the ESARDA Executive Board as *beyond ESARDA's mandate although of scientific or operational interest* are reported. These are highlighted in **red** and will not be implemented by ESARDA. However, should any progress on them become evident in another framework, it can be communicated to ESARDA as constituting valuable information.

You are invited to identify the topic(s) that you would like to contribute to, and to make your choice out of the actions highlighted in green and yellow. When choosing an action it is highly recommended to consult also the associated wishes and challenges reported in the previous section *ESARDA WORLD CAFÉ – THE 10 TOPICS*.

The detailed 10 sets of actions identified by the ESARDA Reflection Group and the roadmap/timeline for their implementation is given in the RG2019 report [1, 2].



KEY ESARDA ACTORS

ESARDA has established standing Working Groups dealing with various technical subjects. They are the key bodies of ESARDA. Each Working Group has a Chair and a Vice-chair whose responsibility it is to ensure that the Working Group achieves its objectives. Therefore the implementation of the World Café and RG2019 actions will be coordinated via the ESARDA WGs [8] and the ESARDA Executive Board [9].

The ESARDA community is well aware that, for the time being, any engagement within ESARDA is fully voluntary. Therefore, your commitment and professionalism are highly appreciated. Since you own the actions you and the other participants put forward at the World Café and understand their relevance and potential impact, you are in the best position to ensure the required support of your organisation in fulfilling the actions.

Following the work of the RG2019 and the ESARDA World Café, this is the right time for ESARDA to pursue current successful activities, reach out to new ones, and push the envelope to possibly implement funding mechanisms.

WHOM TO CONTACT ?

After you have selected one or more actions you would like to contribute to, **please contact your respective WG chair(s)**. In case you are not yet associated to any of the existing ESARDA WGs please contact the respective World Café facilitator(s) of the topics you have chosen. The ESARDA WG chairs and the World Café facilitators will assist in coordinating and facilitating any commitment of individuals or groups, also in view of implementing cross-cutting actions spanning across different WGs. They will also advise you in case your organisation requires more information on the selected topic, its relevance and potential impact. They are your liaison to the ESARDA Executive Board and to the institutions and colleagues that are currently not associated to ESARDA.

At the same time, the WG chairs will encourage their WG members to engage and take ownership of the attributed actions.

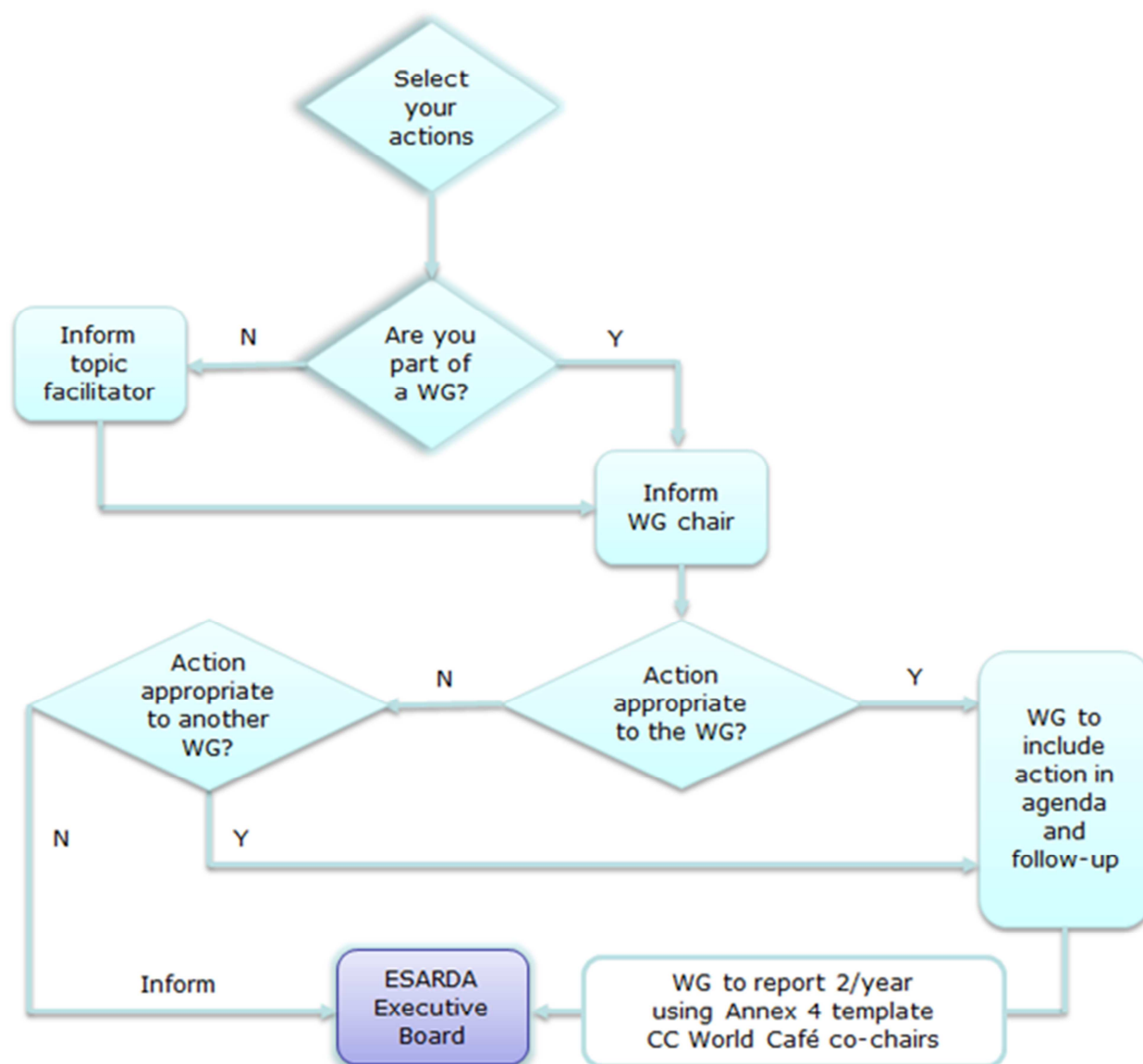
If appropriate, the ESARDA Executive Board will consider establishing new dedicated WGs for research or organisational needs, or to be able to reach out to communities beyond ESARDA.

As mentioned above, the actions that, despite their scientific or operational relevance, are considered beyond ESARDA's mandate are highlighted in red in ANNEX 3 - ESARDA WORLD CAFÉ AND RG2019 ACTIONS and will not be implemented. Furthermore, there is a **risk** that, despite all our efforts, not even all the actions highlighted in green or yellow can be implemented within an appropriate time frame.

Therefore, we invite you to see the World Café as the beginning of a common journey, where each of us has the **opportunity** to get involved and make an impact in fields of interest, and in line with well-defined upcoming challenges.

SYSTEMATIC FOLLOW-UP OF ALL ACTIONS

The World Café co-chairs will support the systematic follow-up of all actions in line with the ESARDA rules and procedures, and in liaison with the ESARDA WGs and the ESARDA Executive Board.



Flow chart on how you can foster ESARDA's relevance step by step

As a first step, this report will be presented to the ESARDA Executive Board and Steering Committee and subsequently made publicly available. The ESARDA Executive Board members, the Steering Committee members, the RG2019 members, the ESARDA World-Café co-chairs and facilitators, and the WG chairs and vice-chairs will each take the responsibility to **contribute to at least one action**. The WG chairs will twice a year provide updates to the Executive Board, copying in the World Café co-chairs, on the status of their individual actions and of those attributed to members of their working groups.

Finally, the World Café facilitators will regularly report to the WG chairs about their own engagement and in how far they could facilitate the engagement of others. This will also be reported by the WG chairs twice a year to the Executive Board, with copy to the World Café co-chairs.

To harmonise the reporting of the WG chairs to the Executive Board, and to facilitate the systematic follow-up of all actions, the WG chairs will use the template in Annex 4 to transmit their bi-annual progress status on the implementation of the ESARDA RG2019 roadmap.

POTENTIAL AND IMPACT

World Café is a transparent mechanism with very high potential. It enables organisations and individuals to commit to well-defined actions and tasks with respect to their fields of expertise and their mandates, while following their curiosity and imagination. Therefore, this World Café report complements the RG2019 considerations and feeds into the finalisation and visualisation of the road map and the timeline [2]. The immediate impact of the World Café is that the ESARDA Executive Board and Steering Committee – by the World Café co-chairs and facilitators, the ESARDA WGs, and each contributing individual – have received further consensus to adopt the RG2019 ROADMAP and a wealth of energy to implement it.

WORLD CAFÉ FEEDBACK

The ESARDA members and participants have fully engaged in the World Café, lively discussing the actions identified by the RG2019. This is quite evident from the number of actions put forward towards each of the ten specific World-Café topics. Furthermore, the two 2-hour parallel sessions proved instrumental to break down the RG2019 recommendations in accessible actions that the ESARDA WGs (current and future) could take on in realistic timeframes.

The World Café participants felt encouraged to actively contribute, think out of the box, suggest actions in line with RG2019 views but also additional ones, often research oriented and beyond the scope of the RG2019. Examples are the concept of **ESARDA ambassadors** or investigating **particle swarm optimisation for NDA**. Some other actions had only a marginal visibility in the RG2019 but were emphasised by the World Café participants, such as **communicating that safeguards supports peace and climate** (Paris agreement).

The voluntary engagement in contributing to identified action is driven by individuals' personal interests, availability, competences and ambitions. The World Café engaged participants in anticipating possible challenges that could be initially perceived as discouraging. In fact, this is a first methodical step to define actions that partly already respond to these challenges, and explore possible ways of taking them into account. As a consequence, ESARDA either possesses or can develop new means to realise its mandate, while remaining relevant for the next decade and beyond (What do we really want? Where do we want to be?).



European School Varese - Nuclear Art Works

BEYOND ESARDA AND THE WORLD CAFÉ

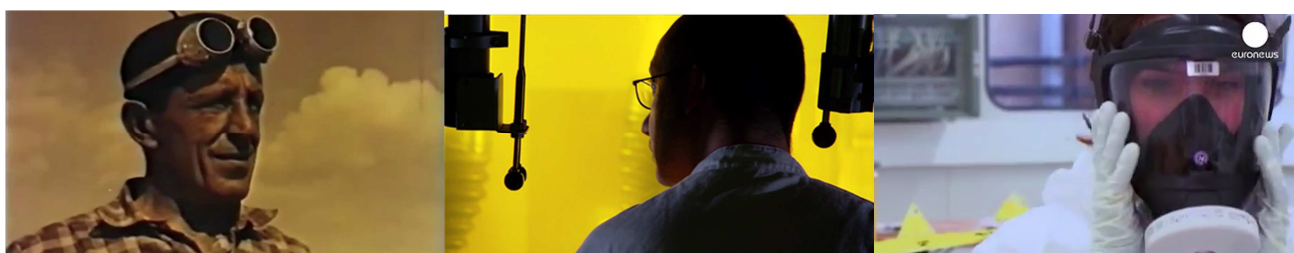
The World Café co-chairs would like to invite the reader to reflect together on the fact that **ESARDA is an association of European organisations that was founded 50 years ago to advance and harmonise R&D in the area of nuclear safeguards**. The association today aims at preserving its relevance and influence in the evolving political, economic, social, and ecological context.

The interests, roles, objectives and mandates of the various ESARDA stakeholders may differ. Therefore, ESARDA seeks to provide results and products that can satisfy multiple demands. Moreover, ESARDA will continue to be constrained by the voluntary nature of the association and reliance upon its members' activities.

How can we then best approach the implementation of the actions put forward by the RG2019 and the World Café participants with the view of enhancing the awareness and visibility of nuclear safeguards, increasing synergies, and reaching out to the young generation and to experts beyond the nuclear fields?

ESARDA's ambitious and challenging vision for preserving its relevance calls for a combination of structured as well as creative ideas and approaches. Nuclear safeguards affects various scientific, technical, political, sensorial and emotional spheres. These are intrinsic to the perception of risk, cooperation, peace and prosperity, all of which have substantially contributed to ESARDA's success over 50 years.

Emotional intelligence was therefore engaged by means of the *ESARDA and art* initiative. For the first time, pupils from the European school in Varese were invited to exhibit and present their art work around nuclear safeguards during the symposium's opening plenary. The *ESARDA and art* video installations, celebrating ESARDA's 50th anniversary, invited the Symposium attendants to consider that *"Scientists, researchers and artists have one thing in common, namely to reveal and communicate their insights in understanding and describing the world around us"*^v



ESARDA 50th anniversary Video by Aaron McKinnon

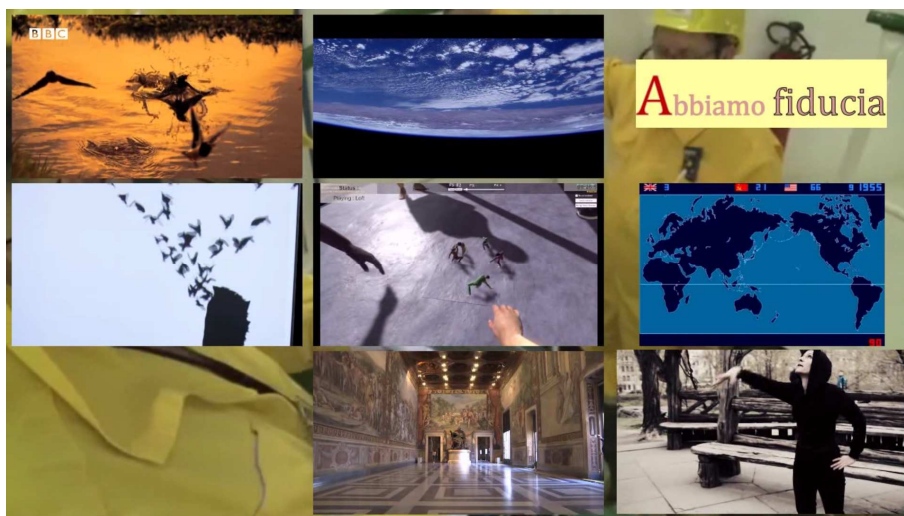
The key for sustainable success is to build on the work done so far and to extend the cooperation networks. ESARDA is not alone in this attempt as it is closely interacting with its stakeholders on this matter. As an example of synergies and elements of reflection having the potential to amplify the RG2019 and World Café outcomes we invite you to note:

- Report of the IAEA Symposium on international safeguards, with ideas for actions as well as challenges to topics that have also been put forward in the World Café, such as AI, robotics, blockchain, small modular reactors [6]
- International Conference on Climate Change and the Role of Nuclear Power [10, 11]

^v †David Featherstone, Professor of Biology and Neuroscience

- Awareness of upcoming safeguards challenges – Euratom perspective as transmitted to the RG2019.
 - Decommissioning of individual nuclear installations [12]
 - Deep geological repositories[13]
 - Small holders - Technologies of mutual benefit to give incentive to the cooperation of State Authorities would be very desirable [14]
 - Closeness of Euratom Safeguards operations to their political mandate. The constant dialogue and cooperation between safeguards institutions and the research community can pave a new safeguards way and respond to future challenges in line with the driving policy framework.
- Nuclear Communicator's Toolbox [15]
- 50th anniversary ESARDA Bulletin [16]

ESARDA, as a European association, needs to take into account also the five current Commission recommendations - strength in unity – for the EU's next strategic agenda [17] and the political guidelines for the next European Commission 2019-2024 [18, 19] and the proposed 'way of linking Horizon Europe with the people'[20, 21]. Furthermore it is relevant for EURATOM and ESARDA that the European Commission is considering to undertake a revision of the EURATOM treaty, last amended in 1957 [22]. ESARDA also should stay informed on bottom-up initiatives and public concerns related to nuclear energy, climate, ecological and social aspects. In principle, the political agenda and any public initiatives are beyond ESARDA's 'mandate' but must be considered for R&D development and outreach for ESARDA to maintain its relevance and influence over the next decade and beyond. Outreaching in many aspects was explicitly identified by the World Café participants being beneficial for ESARDA and having a tangible impact for all its stakeholders. This shows clearly that participants in the World Café are convinced that ESARDA is in the best position to drive a cultural change, establishing dialogue and cooperation as driving forces, and ensure clear benefits for all parties and stakeholders. By implementing the well defined actions, operators could gain transparency and a lower inspection burden, regulators could gain in efficiency and confidence, while scientists would get a better insight on real safeguards needs. Further, by taking into account policy frameworks and public concerns, ESARDA facilitates top-down safeguards governance by a bottom-up proof-of-concept.



Video installation *ESARDA 50 years* by Karin Casteleyn and Yetunde Aregbe

CONCLUSIONS

This World Café at the 50th anniversary of ESARDA **owned its success to all the committed participants and facilitators**. The lively brainstorming, discussions and analyses were highly appreciated and resulted in a comprehensive list of actions for the ten World Café topics in line with the ESARDA RG2019 priorities. This report provides all the details on the World Café's outcome, encourages action ownership, describes ways of implementation, follow-up and broadening the impact.

The next step is for each of us to engage voluntarily and actively in one or more actions to ensure the relevance of ESARDA for the years to come.

Thank you all very much !



World Café – thank you all

'ESARDA is on the right track'

*'Safeguards is not part of the problem
it is part of the solution'*



ANNEX 1 - INVITATION OF THE WORLD CAFÉ PARTICIPANTS



ESARDA SYMPOSIUM WORLD CAFÉ ON THE RESULTS OF THE ESARDA REFLECTION GROUP

Dear participant, you are cordially invited to take part in the World Café scheduled to take place on ESARDA Symposium day 1, Tuesday 14th May, from 16.00 to 17.30, at Regina Palace, Stresa (IT). The World Café was designed to follow up on the work of the ESARDA Reflection Group, RG2019, established to review the ESARDA short and medium term priorities and organisational structure.

The principle and mechanism of World Café

World Café is a knowledge-sharing workshop method, aimed at engaging participants in several rounds of small-group discussions. Each group is guided by a facilitator to interact in a defined procedure, express their points of view and develop new ideas. The overall objective of such interactive session is to identify challenges and establish concrete recommendations and actions on the way forward. The aim is that all participants contribute actively to future implementation of the main RG2019 priorities, which have been translated into the ten World Café topics and are pictured overleaf. Ideally as an outcome each participant should feel encouraged taking ownership of one or more actions in his/her agenda associated with one or more of the RG2019 priorities.

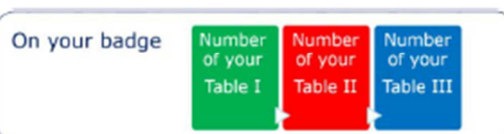
Participants will discuss, in three rounds in groups of up to ten individuals, the three particular "questions" (**Wishes**, **Challenges**, **Actions**) related to three out of the ten World Café topics. This way, each participant is contributing to the collective input towards the future implementation of the main RG2019 priorities.

Starting from **Table I**, (number indicated in **green** on your conference badge), you will discuss in your group the first question (**Wishes – What do we really want and why?**), related to the topic that is allocated to your respective **Table I** facilitator, for 20 minutes.

Then you move to your **Table II** (number indicated in **red** on your badge, to discuss the second question (**Challenges – What are the challenges?**), related to another topic. The facilitator will brief the group on the outcome of question 1 discussed by the previous group and moderate the discussion continuing on question 2.

After 20 minutes you move to your **Table III** (number indicated in **blue** on your badge) to discuss the third question (**Actions – What do we need to do?**), related to a third topic, with the facilitator allocated to your respective **Table III**. The facilitator will brief the group on the outcome of questions 1 and 2 discussed by the previous two groups, and moderate the discussion continuing on question 3.

The collective intelligence input provided by the participants will be transformed into concrete recommendations, activities and actions on the way forward to implement the RG2019 priorities.



Indicate the sequence of 3 tables for you to discuss



2 rooms	
2 co-chairs per room	
5 facilitators per co-chair	
Group of 5 to 10 participants per facilitator	
Groups visit 3 tables and deal with 3 topics and 3 questions	

ANNEX 2 – GUIDELINES FOR THE WORLD CAFÉ FACILITATORS



ESARDA SYMPOSIUM WORLD CAFÉ ON THE RESULTS OF THE ESARDA REFLECTION GROUP

TUESDAY 14TH MAY 2019, 16.00-17.30, REGINA PALACE, STRESA

Guidelines for the World Café facilitators

Dear facilitator, thank you for accepting to take this leading role. We are pleased to share with you these guidelines on the World Café mechanism, logistics and tips to facilitate the discussions. We are equally pleased to invite you to a working lunch with the World Café co-chairs, on Tuesday 14th May 12:30-14:00, prior to the World Café session.

The Principle of World Café

World Café is a knowledge-sharing workshop method, aimed at engaging participants in several rounds of small-group discussions. Each group is guided by a facilitator to interact in a constructive way, and people express their point of view and develop new ideas.

At the Symposium, this approach was chosen to engage about 200 symposium participants in a collaborative thinking process to follow up the work of the Reflection Group, RG2019, established to review the ESARDA priorities and organisational structure. To this end, the facilitators will put forward their specific topics through the three World Café questions.

The overall objective of such interactive session is to identify **challenges** and establish **concrete recommendations** and **actions** on the way forward. Under your guidance, all participants should take **ownership** of the implementation of RG2019 priorities, translated into the ten World Café topics pictured below. The target outcome is that each participant feels encouraged taking in their agenda one or more actions associated with RG2019 priorities.

World Café Mechanism and Logistics

Each of the 20 facilitator is attributed one of the ten World Café topics, and one of the 20 numbered tables and whiteboards. Therefore, **facilitators never change their topic/table**.

Starting with the **first group** of up to ten individuals - identified by the **green number** on the conference badge - facilitators will moderate the discussion on the **first question, Wishes**, relative to their topic, for 20 minutes.

The 3 World Café questions

Wishes

What do we really want and why?
Where do we want to be?

Challenges

Limitations and obstacles:
What may not work?
Where are unpaved roads?

Actions

Recommendations:
What can we do as individuals,
organisations, ESARDA members?
How do we get there?


Then groups change table, and facilitators work with a **second group**, identified by the **red number** on their conference badge. The facilitators discuss the **second question, Challenges**, relative to the **same topic**, while the group changes both question and topic. Therefore, facilitators must brief the new group on the outcome of question 1 discussed by the previous group and moderate the discussion continuing on question 2.

After 20 minutes, groups change tables once again, and facilitators work with a **third group**, identified by the **blue number** on their conference badge. The facilitators brief the new group on the outcome of questions 1 and 2 discussed by the previous two groups, and moderate the discussion continuing on question 3, **Actions**.

This way, at each table three groups will feed into one topic at three different levels (the 3 questions), providing a collective intelligence input that – once organised by facilitators and World Café co-chairs – will turn into concrete recommendations and actions on the way forward to implement the RG2019 actions.

Two *mirror sessions* will run in parallel in the two rooms (Verdi II and Azalea), with participants working on the same 10 topics in either room.

You will collect the group's feedback on whiteboards or flip charts using **green, red, and blue** markers relatively to **Q1, Q2, and Q3**. During the World Café the co-chairs will announce in a timely manner when groups must **wrap-up the discussion on a specific question and then rotate**.

2 rooms	
2 co-chairs per room	
5 facilitators per co-chair	
Group of 5 to 10 participants per facilitator	
Groups visit 3 tables and deal with 3 topics and 3 questions	



At the end of the session, the World Café co-chairs will collect your feedback and your point of view on your specific topic as well as on other RG2019 priorities and their implementation actions. Subsequently, the World Café co-chairs will consolidate all feedback in a way suitable for presentation at the closing plenary and for publication in the non-peer-reviewed issue of the ESARDA Bulletin.

Leading the discussions

As a basic World Café principle, participants should feel encouraged to contribute, and appreciate that their contribution breeds the collective knowledge.

You as a facilitators are the host at your table. It is your task to welcome the participants, connect different people and ideas, encourage every person's contribution, ask powerful questions, including questions that would have not come easily to participants' mind of being relevant to the topic, and identify respective patterns.

At group changes, participants carry consciously and unconsciously conversational threads from one topic to the next, which deepens the discussion but can also bear a risk of losing focus. It is therefore important that facilitators share the essence of their table conversation so far in a brief and concise way with the next group.

Within the freedom of your personal style, allow time for silence and reflection, foster ideas cross-fertilisation, represent key concepts visually (this document is an example), honour the social nature of learning, encourage also the more silent group members to express their thoughts, and help group members notice that individual conversations contribute to a larger field of collective wisdom.

Above all, ensure that you yourself enjoy the session while the ESARDA community benefits from your skills and expertise.



ANNEX 3 - ESARDA WORLD CAFÉ AND RG2019 ACTIONS

Legend:

Short term priorities – Medium term priorities – Beyond ESARDA's mandate but of scientific/operational interest

Topic 1 Strengthen the safeguards approaches at the back-end of the nuclear fuel cycle

Actions

- 1.1. **Facilitate** safeguards-driven regulatory goals
- 1.2. **Perform** R&D on new and existing proliferation-resistant fuel types
- 1.3. **Engage** to integrate the back-end approach in fuel design
- 1.4. **Ensure** safeguards by design for new facilities
- 1.5. **Determine** acceptable risk and find pragmatic compromises
- 1.6. **Implement** financial incentives to create back-end tailored solutions
- 1.7. **Develop and apply** new safeguards concepts & techniques for re-verification of casks, spent fuel verification, geological repositories verification (assurance of no-tempering) – including muon and antineutrino tomography
- 1.8. **Set** univocal targets for the required accuracy
- 1.9. **Simplify** Continuity of knowledge (CoK) by means of real safeguards by design on casks along the spent fuel life cycle
- 1.10. **Develop** seals for transport casks that can be both applied and removed by the operator
- 1.11. **Establish** Continuity of knowledge (CoK) processes
- 1.12. **Integrate** all inspection findings, including state-specific (IAEA) and facility-specific (EC)
- 1.13. **Review** safeguards policy against states back-end approach: reprocessing, final repository, shipment, transfer of ownership, other options
- 1.14. **Issue** univocal and coherent safeguards guidance per state & facility type
- 1.15. **Engage early** in instrument development and training of staff
- 1.16. **IAEA and EURATOM to join efforts** on novel technologies applicable to safeguarding the back-end of the nuclear fuel cycle
- 1.17. **Promote** research on transmutation of spent nuclear fuel
- 1.18. **Investigate** potential to use decay heat from spent fuel as an energy source
- RG2019_action_1.3 **Give attention** to proper safeguards for the transport of loaded final storage containers

Topic 2 Optimise inspection resources exploiting the potential of remote data transfer and artificial intelligence

Actions

- 2.1. **Develop** AI analysis tools to overcome human data-interpretation bias
- 2.2. **Adapt** tools to the analysed data sets
- 2.3. **Perform** statistical evaluation of existing data
- 2.4. **Initiate** research projects **focusing** first on few test cases to prove feasibility
- 2.5. **Develop** standards for declarations
- 2.6. **Review** approaches of other industries and **exchange** expertise
- 2.7. **Demonstrate** how R&D and AI can help to introduce random PIV

2.8. **Inform and educate** to overcome reluctance

2.9. **Create an ESARDA Working Group** on improved techniques and **develop** benchmark data

2.10. **Investigate, negotiate** and **define** requirements for remote data monitoring and transmission beneficial to all stakeholders

RG2019_action_6.2 **Explore** to what extent the internet of things, distributed and self-organising networks of sensors, smart data and equipment, and the use of distributed ledger technology etc. are suitable tools to support the implementation of nuclear safeguards with less inspector presence on site in future

RG2019_action_6.3 **Develop** and **promote** the use of augmented reality, ambient intelligence, enhanced self-localisation, virtual reality tools, next generation of robotics, for future in-field inspections

RG2019_action_2.3 Address security issues, in particular cybersecurity, data traceability and immutability in the collection, transfer, storage and handling of safeguards-relevant data

Topic 3

Promote use of business intelligence and interconnected databases/tools

Actions

3.1. **Define** data formats

3.2. **Start** strategic ESARDA / INMM approach on data analysis, benchmarking, comparison

3.3. **Launch** a pilot project as a test case on a real-life topic

3.4. **Make** stakeholders aware of what is available / possible

3.5. **Reach out** to the data analysis community via participation / invitation dedicated workshops and conferences

3.6. **Attract** experts of data science to engage

3.7. **Provide** dedicated funding

3.8. **Manage** knowledge on business and data analysis, organise trainings

3.9. **Evaluate** the creation of an **ESARDA Working Group** on business intelligence and data analysis

RG2019_action_3.2 **Consider** the benefits of using geographic information systems & enhanced data visualisation and interconnected databases for mapping, storing, presenting, analysing safeguards data (with due attention to the sensitivity and/or classification of certain types of information)

Topic 4

Enhance the visibility of nuclear safeguards work and promote 3S

Actions

4.1. **Foster** international cooperation between EU and non-EU actors

4.2. **Cooperate** with organisations such as **INMM** and **WINS** (World Inst. for Nuclear Security)

4.3. **Exchange** and **align** research on emerging technologies with the nuclear security and safety communities

4.4. **Develop** 3S approaches for new reactor types

4.5. **Facilitate** communication and understanding by issuing a 3S glossary

4.6. **Organise** events gathering policy makers, universities, research & technology, youth...

4.7. **Enhance** education efforts (European Nuclear Education Network (**ENEN**), Advanced Networking for Nuclear Education and Training and Transfer of Expertise (**ANNETTE**),...)

4.8. **Share** technical expertise and techniques via 3S platforms/events

- 4.9. **Organise** a workshop on 3S
- 4.10. **Hold** dedicated panels on actual and hot topics of interest
- 4.11. **Communicate** better what ESARDA is doing
- 4.12. **Create** an App or/and use Apps to make safeguards more visible
- RG2019_action_5.4 **Contribute** to the transparent and recognized positioning of European safeguards in the policy context with EU Member States

Topic 5 Support the synergy between Euratom and IAEA

Actions

- 5.1. **Streamline** equipment approval process
- 5.2. **Define** target criteria for equipment testing, similar to International Target Values (ITV-2010)
- 5.3. **Share** historical safeguards relevant information
- 5.4. **Share** reports, random attendance by IAEA / EC
- 5.5. **Evaluate** jointly inspection results
- 5.6. **Review** and **harmonise** policy related to exemption of nuclear material from safeguards
- 5.7. **Build** trust via joint guidelines
- 5.8. **Establish** protocol proposals at ESARDA level
- 5.9. **Organise** joint recognised (certificate) training exercises (e.g. NDA...)
- 5.10. **Promote** mutual understanding and communication
- 5.11. **Exchange** staff, i.e. national experts to the EC, CFE (cost free expert) to the IAEA
- 5.12. **Establish** working groups beyond EC-IAEA current formal mechanisms – discuss openly cross-disciplinary
- 5.13. **Share** better scientific information – more ESARDA / IAEA interaction – technical workshops/meetings

Topic 6 Develop knowledge management

Actions

- 6.1. **Introduce** visiting fellowships – cross fertilisation between different disciplines
- 6.2. **Modernise** CIRCABC and consider consolidating exchange platforms
- 6.3. **Organise** student paper competitions
- 6.4. **Investigate** possibilities for funding and financial support
- 6.5. **Create** a safeguards knowledge dataset
- 6.6. **Create** a database of opportunities (organisations, job opportunities, fellowship...)
- 6.7. **Make** publications available via open access
- 6.8. **Share** information and 'hands-on' experiences on safeguards work / inspections
- 6.9. **Talk** about safeguards in back to school events
- 6.10. **Go beyond** "technical", target policy makers and more
- 6.11. **Attend** meetings and pass on the message collect feedback beyond safeguards
- 6.12. **Make** risk assessment/management for loss of knowledge (nuclear knowledge) and **control** the turnover-related loss of knowledge
- RG2019_action_4.2 **Review, revise and implement** the initial concept of operating a Young Generation Initiative within ESARDA
- RG2019_action_4.4 **Assure** knowledge transfer from the retiring generation to the young generation through the development of an effective knowledge management concept.

Topic 7 Define ESARDA medium and long-term R&D priorities⁶ in line with future and emerging technologies (FET)

Actions

- 7.1. **Break** silos and incentivise structures
- 7.2. **Need** to focus on R&D for situations others are not thinking about
- 7.3. **Establish** cross-cutting **WG's** on inter-disciplinary aspects of emerging technologies
- 7.4. **Foster** dialogue involving technical experts, operators, regulators (get people in one room)
- 7.5. **Outreach** and **exchange** with other industries – data is everywhere, cross fertilisation
- 7.6. **Consider** processes to develop and adopt new technologies in other industries
- 7.7. **Broaden** view points and become more multi-disciplinary; **engage** social sciences
- 7.8. **Use** new IT tools, robotics, AI
- 7.9. **Prioritise** R&D wishes, establish criteria and focus on top priorities
- 7.10. **Establish** requirements for new technologies
- 7.11. **Educate** and raise nuclear awareness from public relation perspective to improve perception
- 7.12. **Involve** operators and R&D staff in new approaches
- 7.13. **Engage** with operators for training, acceptance of new technology, test new R&D, ensure benefit to operator, and create opportunities for joint use
- 7.14. **Communicate** that ESARDA is on the right track
- RG2019_action_6.5 **Stimulate** 'out-of-the box' thinking and encourage engaging with global system science, behavioural sciences, social media, crowdsourcing, all-information analysis, arts & science, etc. to bring in new ideas into safeguards
- RG2019_action_7.3 **Keep** ESARDA's R&D **abreast** of possible new and or advanced concepts of nuclear facilities which might require adapted or new safeguards approaches (e.g. small modular reactors, Generation IV, and safeguards for accelerator driven systems like Myrrha)
- RG2019_action_8.2 **Follow-up** closely in which aspects ESARDA could support (new) sensitive nuclear fuel cycles from a safeguards and non-proliferation point of view, including transportable NPPs, pyro-processing, molten salt reactors etc.

Topic 8 Develop measurement techniques for safeguards, decommissioning and waste management

Actions

- 8.1. **Define** clearly the tasks
- 8.2. **Link** the needs of IAEA, EURATOM, nuclear operators, and political dimension to support programme activities and ESARDA
- 8.3. **Develop** improved measurement data handling, statistical integration
- 8.4. **Make** a technical survey
- 8.5. **Organise** feasibility studies and **make** a cost benefit analysis
- 8.6. **Get** appropriate funding and R&D resources
- 8.7. **Develop** techniques, such as AI, that limit the need for measurements standards
- 8.8. **Define** a comprehensive and transparent protocol for data declaration and evaluation in remote

⁶ The medium/long term attribute of these R&D priorities refers to the expected time span to be accomplished. Elseways, the short/long term colour coding is intended to discern the actions requiring immediate attention.

monitoring

8.9. **Facilitate** the transition from prototype to field implementation

8.10. **Explore** synergies with security and safety

8.11. **Create** incentives (e.g. tax) for industries working in safeguards

8.12. **Reach-out** to universities and educate the public on nuclear safeguards

8.13. **Reach-out** to cybersecurity field

RG2019_action_5.3 **Promote** the collaboration between inspectorates and State authorities, e.g. also in the area of characterization of waste from nuclear decommissioning and with small holders.

RG2019_action_7.1 **Evaluate** techniques to screen final disposal sites after closure.

RG2019_action_7.2 Develop, validate and promote the application of characterisation techniques that are of mutual benefit for safeguards, decommissioning and waste management, which might lead one day to the definition of exemption levels of fissile materials from safeguards

Topic 9 **Develop and implement an ESARDA (internal and external) communication strategy**

Actions

9.1. **Put** a communication strategy for safeguards in place with smart goals

9.2. **Adjust** the communication plan to different audiences

9.3. **Communicate** scientific risk/based "divorce from nuclear fear" for the general public

9.4. **Update** the ESARDA web-site more frequently

9.5. **Investigate** possibilities to use the media (newspaper, TV,..) to spread news on ESARDA and ESARDA's activities

9.6. **Celebrate** ESARDA / safeguards success stories

9.7. **Find** funding for nuclear safeguards ESARDA

9.8. **Find** mechanisms for national support programmes to provide funding for ESARDA

9.9. **Promote** ESARDA at university levels (awards, prizes, grants,...)

9.10. **Attend** career days at universities

9.11. **Strengthen** further ESARDA – INMM cooperation

9.12. **Promote** the creation of safeguards chapters

9.13. **Highlight** and value what is different in ESARDA and INMM

9.14. **Promote** the concept of and find ESARDA ambassadors

RG2019_action_8.1 **Support and exchange** with 'nuclear newcomer' countries i.e. those without pre-existing nuclear safeguards infrastructure.

RG2019_action_9.1 **Issue** a final version of the rules and procedures, describing in more detail the working methods; revise the ESARDA agreement as appropriate to assure that operational practices based on the rules and procedures are in compliance; prepare additional documents to better explain the ESARDA agreement as well as rules and procedures to the ESARDA community, e.g. ESARDA welcome package for new members, guidance document for WG chairs about tasks & duties, etc...

RG2019_action_9.3 **Evaluate** the opportunities of a peer-reviewed, SCOPUS indexed, open-access journal supplementary to a monthly/bi-annual ESARDA Newsletter/Report

Topic 10 Facilitate interaction between ESARDA members

Actions

- 10.1. **Connect** via video conferences
- 10.2. **Improve** different tools to facilitate interaction between members
- 10.3. **Familiarise** with the new CIRCABC
- 10.4. **Get** adequate funding, consider eligible activities, projects, events
- 10.5. **Add** library website
- 10.6. **Create** a newsletter
- 10.7. **Create** sponsorship for conferences symposia
- 10.8. **Combine** events
- 10.9. **Organise** focused facility-hosted, multidisciplinary meetings with site visit
- 10.10. **Establish** more formal topical platforms for broader participation
- 10.11. **Communicate** to management the benefit of participating in ESARDA
- 10.12. **Make** suggestions how social media could help ESARDA
- 10.13. **Hold** joint WG meetings and **organise** joint WG activities
- RG2019_action_9.4 **Develop guidance** on organising, hosting and evaluating ESARDA annual meetings/symposia
- RG2019_action_9.5 **Implement** a harmonised mechanism for ESARDA Reflection Group actions progress review; including a mechanism to follow-up on open issues from the ESARDA membership survey on ESARDA's activities and future priorities
- RG2019_action_10.1 **Envisage** modernisation approaches for the open ESARDA symposium, such as the use of live-web streaming and interactive/participatory session formats and tools

ANNEX 4 – TEMPLATE WG PROGRESS STATUS REPORT

Working Group NAME

WG Chair: Name
WG vice-Chair: Name

Implementation of the ESARDA RG2019 roadmap

Progress report Semester 1, 2020

**Follow up of WG-related Actions originated by the RG2019,
complemented by the ESARDA 41st Symposium World Café**

On behalf of the Working Group NAME, I have the honour to transmit to the ESARDA Executive Board the half-yearly progress status report.

The annex to this report accounts for the state of play relative to the actions – originated by the RG2019 and ESARDA World Café – that are under the responsibility of this WG.

Yours faithfully,

Name and Signature

ANNEX A - RG2019 Actions - progress status WG NAME

ID⁷	Action	Owner	Affiliation
#	TEXT	TEXT	TEXT
Progress status (free text) including reference dates and state of play			
#	TEXT	TEXT	TEXT
Progress status (free text) including reference dates and state of play			

Extend and fill the table as appropriate.

Ready-to-use soft-copy of the template



WG progress status
report on RG2019 rc

⁷ Action ID as reported in Annex 3 of the World café report.

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