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Expert Group on the Application of Robotics and Remote Systems in the Nuclear Back-end (EGRRS)

Mandate

The Nuclear Energy Agency (NEA) Expert Group on the Application of Robotics and Remote Systems in the Nuclear Back-end (EGRRS) was created in 2019 to advise member countries on the leading and emerging issues related to facilitating the implementation of robotic and remote systems (RRS) in radioactive waste management, decommissioning and legacy management at the national and international levels. The expert group develops comprehensive analyses reflecting the range of its membership, from academia, industry and governmental agencies.

Main findings

The first mandate of the EGRRS investigated the history, status of implementation, and barriers to the adoption of RRS and made a preliminary study of the cost-benefits of RRS in the nuclear back-end. This work culminated in the publication of a first report (NEA, 2023). Building on this work, the second mandate of the EGRRS was developed to focus on three follow-up topics presented below.

Regulatory pathway

The group collected ten international regulatory case studies to conceptualise guidance on the regulatory licensing of innovative RRS and to challenge the perception that regulation is the main bottleneck to the adoption and implementation of innovative RRS in nuclear energy. Some insights on the opportunities for improving the licensing process are as follows:

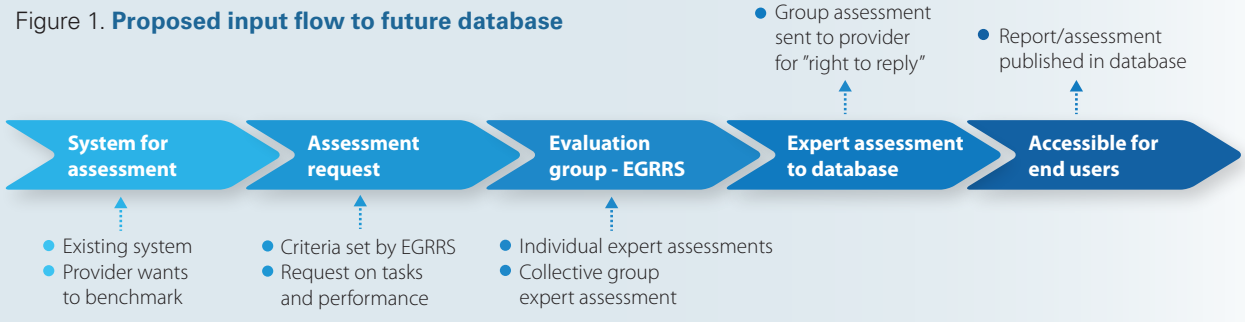
- Initiating the engagement with the relevant regulators after the completion of the investment decision could create licensing challenges.
- Lessons learnt exercises involving regulators and licensees could provide a positive way to reflect on challenges and opportunities emerging from licensing.
- Using inactive mock-ups (including digital twins) or active-demonstrators, or both, could provide a good opportunity to de-risk the final licensing of a full-scale plant involving innovative solutions.
- By implementing the defence-in-depth principle, solutions imported from other less hazardous industries can be safely deployed in the nuclear sector, e.g. by placing a modest claim on a novel solution and consequently reducing the substantiation/licensing effort.
- In most cases, regulators appreciate the opportunities offered by robotics and remote systems in a nuclear environment, e.g. in terms of reducing the risk to operators, making operation more consistent and speeding up risk remediation at nuclear legacy sites.

A flowchart sketching the process to support licensing of innovative solutions will be available in an upcoming report (NEA, forthcoming).

Benchmarking

Much of the work in nuclear waste management and decommissioning is currently done by hand. Manual labour is associated with hazards and exposure to risks for personnel. To enhance the use of robotics and remote systems, additional information is required to support regulatory bodies, decision

Figure 1. **Proposed input flow to future database**



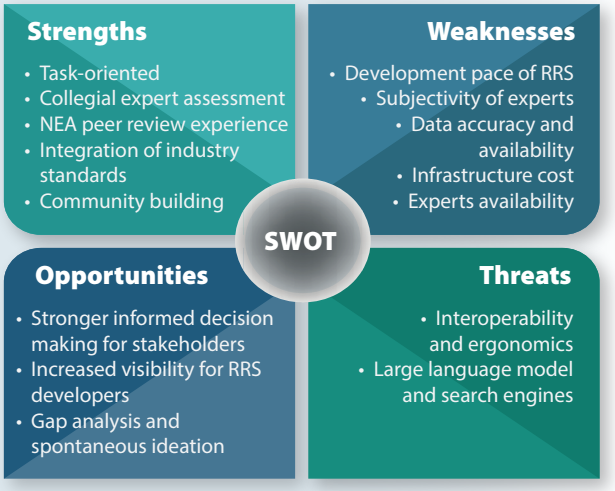
makers, programme managers and project leaders in their assessment and decision processes. Applying traditional benchmarking approaches to the nuclear sector has proved challenging as each country and nuclear site operates under distinct interpretations of international regulations, unique local cultures, and diverse technical challenges.

To overcome these challenges, the proposed benchmarking approach involves circumventing site-specific differences and focusing on the fundamental tasks associated with decommissioning and waste handling. By emphasising task-centric evaluations, it is possible to gain valuable insights and make meaningful comparisons that transcend the complexities arising from divergent regulations, cultures and technical aspects across nuclear sites.

To limit bias while performing the assessment, the EGRRS will rely on its member countries' experts and will further draft its assessment guidelines by drawing from the NEA experience in setting up international peer reviews (NEA, 2005, 2014).

The EGRRS is currently setting the scope of the database and testing its concept.

Figure 2. **SWOT analysis of the benchmarking database concept**



The long-term goal is to host such a database on the NEA website and provide expert input within the next few years.

Cost benefit analysis

A cost-benefit analysis (CBA) is a systematic process used to analyse and evaluate which methods, systems or decisions to make and which to forgo. What separates CBA in the nuclear back-end from a "standard" CBA is that the incentive is not to make money through a return on investment, but rather to spend less money and perform the same action with reduced risks and costs.

The proposed methodology is to focus on the achievements of a given output with a defined safety target (e.g. a desired interim state or end state) and to compare the safety and cost implications of different technical choices and configurations, by assuming that all options share the same (minimum) requirements for safety.

The group applied the simplified subtractive CBA methodology to case studies in radioactive waste sorting, reactor demolition and radiation surveying. The methodology clearly justified the use of RRS. More details will be available in the upcoming EGRRS report (NEA, forthcoming).

Future directions

The EGRRS is an expert group with a long-term outlook. Its mandate will evolve with the trends in RRS development and the needs of NEA member countries. For example, the EGRRS has started work with a new focus on human factors, investigating how to help more professionals receive training in robotics to meet the RRS needs of the nuclear sector, as it grows rapidly as a low-carbon source of energy.

The EGRRS regularly collaborates with other NEA groups such as the Working Party on Technical, Environmental and Safety Aspects of Decommissioning and Legacy Management (WPTES), and with expert communities hosted by other organisations such as the International Atomic Energy Agency or the European Commission.

References

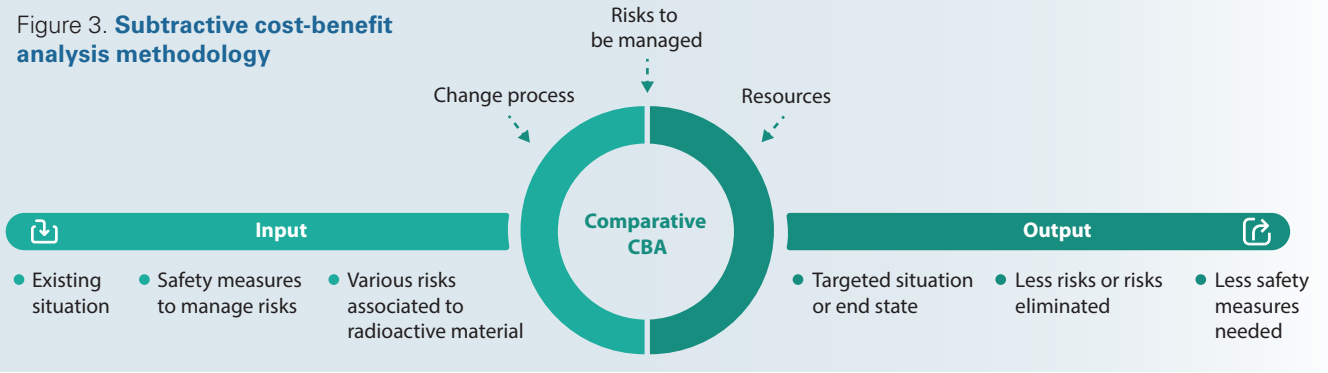
NEA (forthcoming), *Supporting Implementation of Robotics and Remote Systems in the Nuclear Back-end*, OECD Publishing, Paris.

NEA (2023), *Status, Barriers and Cost-Benefits of Robotic and Remote Systems Applications in Nuclear Decommissioning and Radioactive Waste Management*, OECD Publishing, Paris, www.oecd-nea.org/jcms/pl_77051.

NEA (2014), *Guide for International Peer Reviews of Decommissioning Cost Studies for Nuclear Facilities*, OECD Publishing, Paris, www.oecd-nea.org/jcms/pl_14896.

NEA (2005), *NEA International Peer Reviews in the Field of Radioactive Waste General Information and Guidelines*, OECD Publishing, Paris, www.oecd-nea.org/jcms/pl_18274.

Figure 3. **Subtractive cost-benefit analysis methodology**



For information on EGRRS and its publications and events, visit: www.oecd-nea.org/egrrs.

Contact the NEA at: rwmd-egrrs@oecd-nea.org