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Towards Optimized Use of Research Reactors in Europe – Summary and Results

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ABSTRACT

The TOURR project is a response to the challenge of coordinating the optimization of the exploitation of available research reactors (RR) in Europe. Therefore, its primary objective is to develop an overall strategy for research reactors in Europe and prepare the ground for its implementation.This strategy is linked with an assessment of the current status of the European research reactors fleet and an estimation of future needs. This includes a plan for a possible upgrade of the research reactor fleet and a plan to maintain the fleet. Based upon the results tools for optimal use of the research reactors fleet will develop and awareness of decision-makers and the public on the role of research reactors will be risen.

In order to build up a strategy, the degree of exploitation in different RR applications was determined using a questionnaire. Initial data acquired from the questionnaire is available in D1.1 – "Database of the European RR fleet" on the ENEN (European Nuclear Education Network) Website. Gaps and opportunities have been identified via statistical analysis and interpretation of the data.

A SWOT (Strengths, Weaknesses, Opportunities, and Threats) revealed that the RR in Europe is diverse and this is a richness. It also implies though that different facilities have different priorities and applications. Improving exchange and communication across the fleet is essential. Furthermore, an overall lack of personnel had been pointed out by the RR which answered the questionnaire. Education and Training in nuclear remain of utmost importance to prevent losing the know-how and keep the nuclear research sector alive and competitive.

The paper summarizes the main findings of the TOURR project obtained so far and indicate future steps

1 INTRODUCTION

The TOURR project kicked off in October 2020 as an Euratom funded coordination action. It will be concluded in September 2023 after 36 months of implantation. In extreme synthesis, the ambition of TOURR is to secure access and availability of RRs as a vital part of the European Research Area and to support stable supply of medical radioisotopes. TOURR primary objective is to develop a strategy for RR in Europe and prepare the ground for its implementation. [1]

2 TOURR IN THE FRAME OF EUROPEAN ACTIVITIES

TOURR project is listed among the outcomes of **SAMIRA**[1] (Strategic Agenda for Medical Ionising Radiation Applications) and specifically under the pillar 'Securing the supply of medical radioisotopes' under **ERVI**[2] (European Radioisotope Valley Initiative).

TOURR consortium is made of 9 partners, out of which 6 Research Reactors (RR) and 1 research centre (see Fig1). Thanks to the consortium composition, TOURR could have access to a very complete view of the European RR fleet in all nuances: strengths, weaknesses, opportunities and threats.

Figure 1- TOURR Consortium

3 MAIN FINDINGS

TOURR primary objective was to develop a strategy to optimise the use of RR in Europe and to provide some tools to implement the same strategy.

The "optimisation strategy" has been issued in the form of a report and will soon be made publicly available after the project closure.

The 'tools' which have been realised consist of an online platform for RR. The platform will be made public (once the beta testing will be completed) and accessible via the ENEN website[3]. It will be kept online and updated also after the end of the TOURR project.

[1] https://energy.ec.europa.eu/topics/nuclear-energy/radiological-and-nuclear-technology-health/samira-action-plan_en

[2] https://energy.ec.europa.eu/system/files/2023-01/Consultation%20results%20report%20Rev%20C.pdf

[3] www.enen.eu

3.1 Optimization Strategy for Research Reactors in Europe

The work on the "Optimisation Strategy" started from the very beginning of the TOURR project, with the creation and distribution of a questionnaire to all RR in Europe [2]. The response rate was very high (84%) and allowed the consortium to assess the status of the European RR fleet. Three Gap analysis have been performed and a SWOT analysis completed the process. See Fig 2.

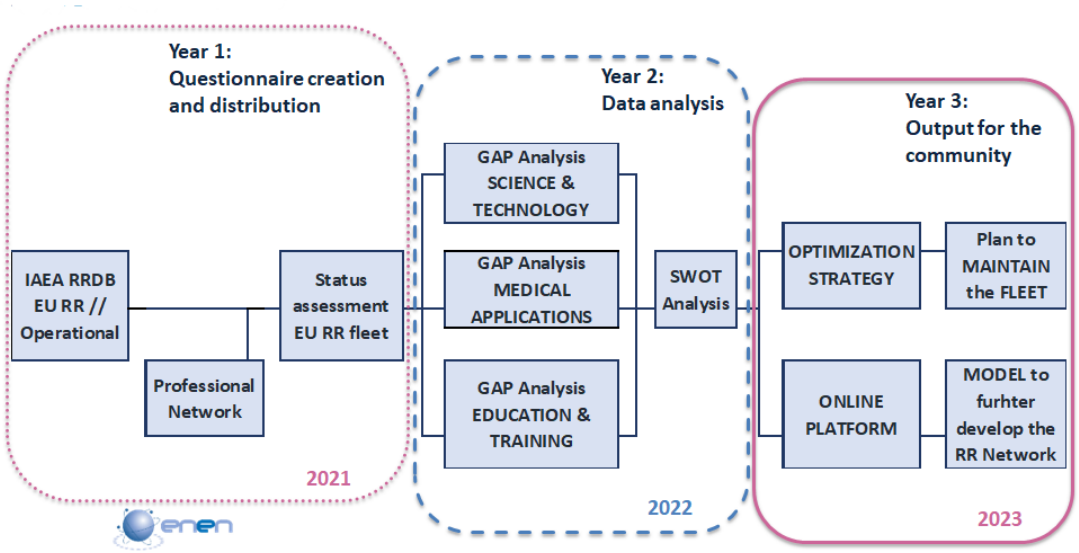

Figure 2 TOURR along the years - main steps

The main findings of the data analysis, although not entirely surprising, strengthened the conviction that better communication and exchange are needed among RRs.

In extreme synthesis the key findings of the SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis can be summarized as follows (see also Fig.3):

STRENGTHS:
- High level of expertise in the European research reactor sector.
- A diverse fleet of European RR fleet (from critical assemblies to high neutron flux and material testing reactors).
- The flexibility of certain RRs to be utilized within new and exciting fields (Chemical processing, Fuel cells, hydrogen storage, small modular reactors, circular economy, transition to zero carbon society, etc).

WEAKNESSES:
- Lack of communication between different RR operators.
- Uneven utilisation among various RR
- Relatively low average utilization.
- With the expansion of renewable energy sources, the need for silicon doping and high flux reactor will increase.

OPPORTUNITIES:
- Expand the utilization of the current RR with increased funding and manpower.
- Increase the communication among RR (lack of time is complementary to lack of customers). RR could solve "each other problems" if put in contact.
- Research in new fields (chemical processing, fuel cells, hydrogen storage, etc).

THREATS:
• The threat of losing knowledge and competence as current highly skilled and educated personnel is aging (NAA[4], PGNAA[5], Nuclear Data Measurements and Theory, benchmark experiments, etc).
• Ageing of current RR fleet, as the average age of RRs is 56 years. The threat of losing current capabilities and new opportunities.
• The threat of losing knowledge and competence as an application is not being performed (gemstone coloration, geochronology, gamma irradiation).
• The threat of not building new RR (no RR services available in the future)

Figure 3 TOURR main findings, SWOT Analysis

When combining the key findings in strategic actions, it is possible to:

- Combine STRENGHTS and OPPORTUNITIES
  - Using RR flexibility for research in new fields
  - Using expertise to construct new RR for testing new nuclear technologies
  - Foster collaboration across other projects and networks

- Mitigate WEAKNESSES with OPPORTUNITIES
  - Creating a platform to increase communication between RR
  - Enhancing the cooperation between academia and medical sector (hospitals)
  - Increasing RR utilization by promoting research in new fields

- Use STRENGHTS to overcome THREATS
  - Promoting educational platforms to transfer expertise to younger generations
  - Conceiving New European Multipurpose Research Reactor
  - Modernizing of the EU RR fleet

- Tackle WEAKNESSES and THREATS
  - Build new RR accessible to all EU states
  - Retention and attraction of nuclear-educated people

[4] NAA = Neutron Activation Analysis
[5] PGNAA = Prompt Gamma Neutron Activation Analysis

Hence it can be concluded that some efficient means of communication if put in place would be beneficial for the RR community, and in general, education needs to be prioritized to keep the availability of expert personnel operating the European fleet. (See Fig.3)

3.2 TOURR Platform for Research Reactors

The purpose of the platform is to provide information about the use of RRs in terms of:

- science and technology
- production of radionuclides
- education and training activities.

The idea behind the platform is not to replicate what exists already (i.e. the IAEA Database) but to go beyond the collection of technical details and rather describing the RRs in a more descriptive approach of the RRs capacity.

The main goal is to showcase what are the RRs applications in each of the mentioned domains. The platform shall allow for enhanced and potential new utilization of the RR; create a pool of resources resulting in cost reduction in case of similar needs, avoiding duplications of efforts to enhance scientific excellence.

The platform will include the identification of available infrastructures, characterization of these infrastructures as well as a continuously updated overview of the available capacities and corresponding abilities of the participating RR operators. It will be a website which will allow RRs to be registered in and share information both with other RRs and with the end users. It will be easier to coordinate the ‘offer’ with the ‘demand’ on all aspects, once all the information is gathered on the same online tool. It will also facilitate an easy contact between potential users and reactor operators. It will be based on the model of open user facilities where research reactor operators interact with their potential users to match resources with needs. [3]

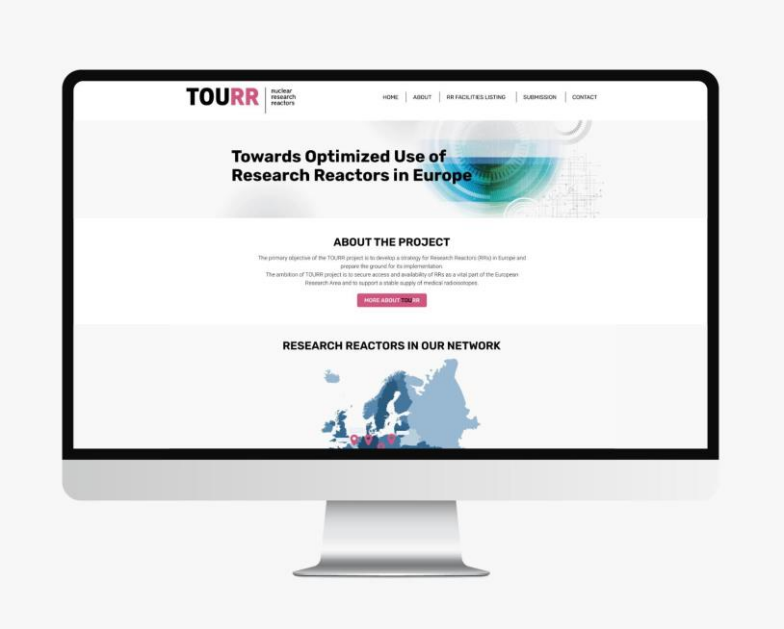

Figure 4 TOURR Platform, Homepage preview

The Platform will have the following structure: the initial sought sitemap for the website will consist of a hierarchical structure of website pages that are accessed from the Home page

(see fig.4) that shows fundamental information of the TOURR Project, giving the users the option to further navigate into other pages of the Website.

The “catalogue” of RR can be filtered (see Fig.5) by categories and users will be able to find specific RR with a specific capabilities. All RR facilities names will be hyperlinked taking the user to a more detailed description of the facility in object and provide contact information.

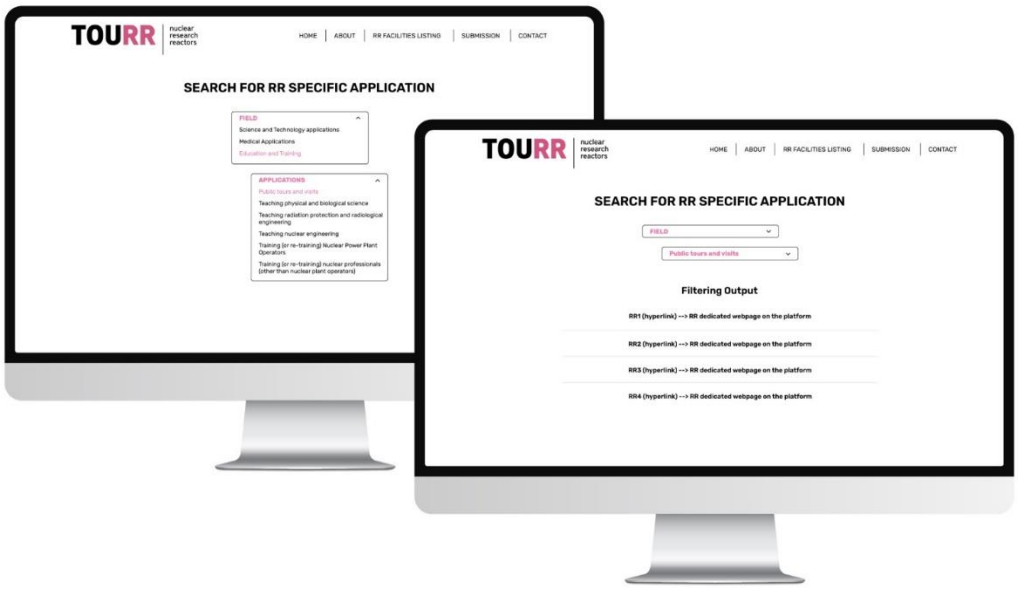

Figure 5 TOURR Platform, filtering function

4 CONCLUSIONS

The TOURR project is approaching its conclusion after 3 years of implementation. The consortium was able to assess the status of the European RR fleet, process it under all aspects of a SWOT analysis and propose a strategy to optimize the use of the European RR. Furthermore, a platform has been developed and made available online to allow RR to better communicate with each other but also with the end users. Both the strategy and the online platform are intended to be made public and they will shortly be after the formal closure of the TOURR project.

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