Periodic Reporting for period 1 - LD-SAFE (Laser Dismantling Environmental and Safety Assessment)

Summary of the context and overall objectives of the project

The main conventional cutting techniques used up to now are limited effectiveness. To improve safety, radiation protection, waste management, cost and time aspects for the forthcoming power reactor decommissioning, the development of innovative cutting tools seems necessary and represents an immense challenge. Among innovative technologies which could be used, the laser cutting technology is one of the most promising in this context in comparison with conventional cutting techniques.
currently used.
The LD-SAFE project will assess the maturity of laser cutting technology for dismantling pressure vessels and internals of nuclear power reactors. The project aims to demonstrate that the laser cutting technique applied to dismantling allows meeting technical and safety challenges in a more efficient and economical way than conventional cutting techniques.

To meet the goals and the requested impacts, the project is structured into 7 Work Packages covering a project time of 4 years.

This project proposes an innovation which could enhance the safety, economic and technical aspects of one of the most challenging task of power nuclear reactor dismantling.

It also has the opportunity to support European nuclear field in remaining a step ahead in the development of this technology by achieving a world first laser dismantling of a power nuclear reactor.

**Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far**

**LD-SAFE organization:**

An Advisory Board completes the LD-SAFE organization to provide an external point of view on the project. It is composed of 3 groups: Expert Group, End User Group and Support Group.

- **End User Group:** ENGIE, SCK-CEN, JAEA, Belgoprocess, EDF (DP2D), SOGIN, IGNALINA NPP, LEI, Bel V, KTE, GRAPHITECH, DSRL.
- **Expert Group (1 person by organization):** GRS, PYLA/ALPHANOV, EDF (DP2D), DSRL.
- **Support Group:** JEPIC, EPRI, European Commission, VTT, BASE.

**WP1 - Analysis of the reactor dismantling with laser cutting:** Analysis of the different reactor components in combination with the selection of conventional cutting techniques: advantages and drawbacks of main conventional cutting techniques (thermal, mechanical and hydraulic). Analyze of the reactor components (RPV/RVI) for PWR and BWR.

Specifications for the laser cutting system: laser technology description, highlighting the cutting performance criteria. Preliminary safety rules and principles have been considered.

Specifications for the safety tests of WP2: summary of safety related challenges raised by laser in a matrix of safety requirements to ensure that are covered by WP3 and WP4. Definition of the inputs needed for the WP2 laboratory tests.

Specifications for the demonstrator, including a conventional technique for comparison: Identification of the most challenging piece to be cut into the reactor and describing the specifications for the mock-up in relation with the conventional technique band saw.

**WP2 - Laboratory tests and calculations:** carry out laboratory trials and calculations on 3 specific tasks:

Laser beam residual power: design of an experimental set-up and implementation in CELENA facility of specific instrumentation to characterize laser beam residual power.

Secondary emissions: aerosols: definition of measurement needs and identification of aerosol metrology. Feasibility of implementation of aerosol sampling close to particle generation (particle size distribution, concentration and sampling for TEM analysis). First feedback on aerosol generation during laser cutting using nitrogen vs. compressed air assist gas.

WP3 - Protection of workers and environment: carry out a Technology Qualification of the Laser System in relation with the protection of the workers and of the environment in a nuclear decommissioning environment.

Technology Appraisal Report: Establish the Goals for the Technology to which the Technology Qualification will be assessed against. Complete a Technology Qualification Workshop with all partners to define the full laser system decomposition, its maturity in a Nuclear Decommissioning Environment and identification of the risks to be used for TQ Plan.

Technology Qualification Plan: definition of the tasks to be completed to reduce the technology uncertainties identified in the Technology Appraisal Report.

Statement of Endorsement: sign off on the TQ Plan.

WP4 - Safety assessment: development of a risk analysis and a generic safety assessment (including an independent review) for the implementation and the use of the laser technology for the cutting of the reactor components.

Risk analysis: the preliminary risk analysis was performed following the structure and methodology of IAEA SRS 77, Safety Assessment for Decommissioning, and thus, setting the base for the development of the generic safety assessment.

Additionally, the compilation of information from WP2/WP3 has been started (summary of risks identified during WP2 and WP3).

WP5 - Case studies and demonstrator: development of a demonstrator (in air and underwater) for the dismantling of PWR and BWR power nuclear reactor components (RPV / RVI) using the laser cutting technology (on representative mock-ups and validation of this technology in operational environment.

Start-up: development of a case study for the demonstrators and the design and the procurement of the reactor laser cutting system for the demonstrator; Preparation of the in-air demonstrator (at CEA Marcoule).

WP6 - Dissemination and exploitation activities: development of a project identity and creation of a dedicated project website and social networks; Description of our dissemination activities and the planning of future actions (press release, videos, newsletter, various publications, etc.). Several events were performed to present the LD-SAFE project to the Advisory Board and the public:

-1st Technical Workshop (by videoconference - Confidential data) – December 9, 2020

-Participation to 5 conferences (public presentations): SFEN DEM 2021 in Avignon (France); Spanish Nuclear Society in Granada (Spain); ICOND 2021 in Aachen (Germany); BASE symposium – SafeND in Berlin (Germany); WNE 2021 – LD-SAFE workshop (public session) in Paris, France.

-IPR management, exploitation strategy and commercial assessment: plans for Exploitation of the Result (D6.3) and a Data Management Plan (D6.9) have been written with the contribution of all partners.
WP7 - Project management:
To monitor the progress of all partners’ activities and share our results to the Expert Group, periodic meetings have been performed with the main interlocutors of the project.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

The global ambition of the LD-SAFE is to provide the tools to the European industry to create a robust world-leading decommissioning sector based on EU safety culture and know-how. Therefore, two main impacts have been expected at the end of the project:

• An economic impact: European End Users would save significant costs on the long run by using the laser cutting technology assessed during the LD-SAFE project.
• A societal impact: The LD-SAFE project proposes an innovation driven by safety and favoring technology jobs attracting young workers.

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