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Environmental Technology Verification

Environmental Technology Verification (ETV) of the FFW process

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Summary

The overall aim of the FFW project is to obtain liquid (diesel) and gas (synthetic natural gas) fuels starting from olive and olive oil residues via synthetic processes, namely Fischer-Tropsch and methanation, both via gasification. In order to do so, a complex process needs to be undergone, and Work Package 6 was focused on the assessment of the environmental feasibility of the technology involved. In order to promote the technologies developed within the project, the Environmental Technology Verification was achieved to highlight the innovative aspects and the environmental added-value of the technology and therefore show the potential to reach markets.

The ETV process was applied to the EIFER Molten Salt Reactor (MSR) technology developed within the Work Package 3 (Task 3.3), used for syngas cleaning from the biomass gasification.

The main objectives of this Deliverable 6.3 were the following:

- Show an introduction to the concept of Environmental Technology Verification and define the reasons why its application in this particular project was required.
- Present the company RINA in charge of the verification: the Verification Body.
- Show the results of the Eligibility Assessment for the selected technology.
- Conclude on the ineligibility of the selected technology to the ETV programme at this stage of the technology development.

Contents

Figures

1 Introduction

The overall aim of the FFW project is to use agricultural waste, mainly residues from olive farming and olive oil production, for the generation of ready-to-use fuels, namely synthetic natural gas (SNG) and diesel, which would be primarily used for energy production for oil manufacturing and as transportation fuel for olive farming.

The FFW project is based on several innovative processes developed according to the project goals and scope. The Environmental Technology Verification programme aims to promote technologies, which are pioneering and efficient on an environmental point of view.

This document presents the Environmental Technology Verification EU programme and shows the conclusions for the elected technology: the Molten Salt Reactor (MSR) developed by EIFER to clean the syngas from biomass gasification.

2 Introduction to the Environmental Technology Verification concept

Currently, a technology that performs well above normal standards or that presents an innovative approach to solve an environmental problem can face difficulties in penetrating the market due to lack of independent and credible evidence of its advantages. On the other hand, technology purchasers or investors committed to finding the best solution for their situation are often faced with non-comparable, incomplete or non-trustworthy performance information when assessing the available choices on the market. In order to improve the penetration of innovative environmental technologies into the EU and eventually global markets, the European Commission together with the Member States launched the EU Environmental Technologies Verification pilot programme (ETV) in December 2011. The primary goal of this initiative is to provide independent and credible information on new environmental technologies, by verifying that performance claims put forward by technology developers and vendors are complete, fair and based on reliable test results (ETV, 2016).

The concept of the Environmental Technology Verification programme is to offer a verification procedure to cutting edge environmental technologies that may otherwise find it difficult to establish their environmental added value. The verification procedure allows for an independent assessment and validation of the manufacturer's claims on the performance and environmental benefits of their technology. The information produced by the verification is public and can be used to compare performance parameters and therefore becomes an extremely useful tool to convince third-parties of the merits of a technology, potentially enhancing its market value and acceptance (ETV, 2016).

It is important to highlight that the ETV is neither a label nor a certification scheme; it ensures that the claims are as structured and complete as possible so as to present a clear assessment of the entire technology's potential and value, but it does not evaluate the technology's performance against standard or pre-defined criteria. The information provided, in the form of a Statement of Verification, gives the possibility for direct and objective comparison between different technologies reducing the risk on adopting new technologies and encouraging informed and sound investments. ETV results could be used to prove compliance with any relevant legislation, to underpin a bid in public tendering, to convince investors or customers of the reliability of performance claims and to avoid having to repeat demonstrations for different users (ETV, 2016).

2.1 ETV Structure

The structure for the EU ETV Pilot Programme revolves around the close interaction between proposers (i.e. technology manufacturers), SMEs, technology representatives, and

organisations fulfilling the role of Verification Bodies that carry out the verification procedure. Verification Bodies can only act within the ETV Programme if they have received accreditation from their National Accreditation Body under the standard of ISO 17020. The Technical Working Groups (TWGs) ensure a harmonious implementation of the programme by bringing together experts nominated by Verification Bodies and Commission appointed experts and together they provide guidance to the implementation and development of the Programme. The Stakeholder Forum gathers the opinions and advice from all ETV followers and stakeholders, which is then transmitted to the Steering Group, composed by members of all participating Member States and observers, so that it can properly fulfil its leading role in the implementation of the Programme. Figure 1 shows an overview of the ETV structure.

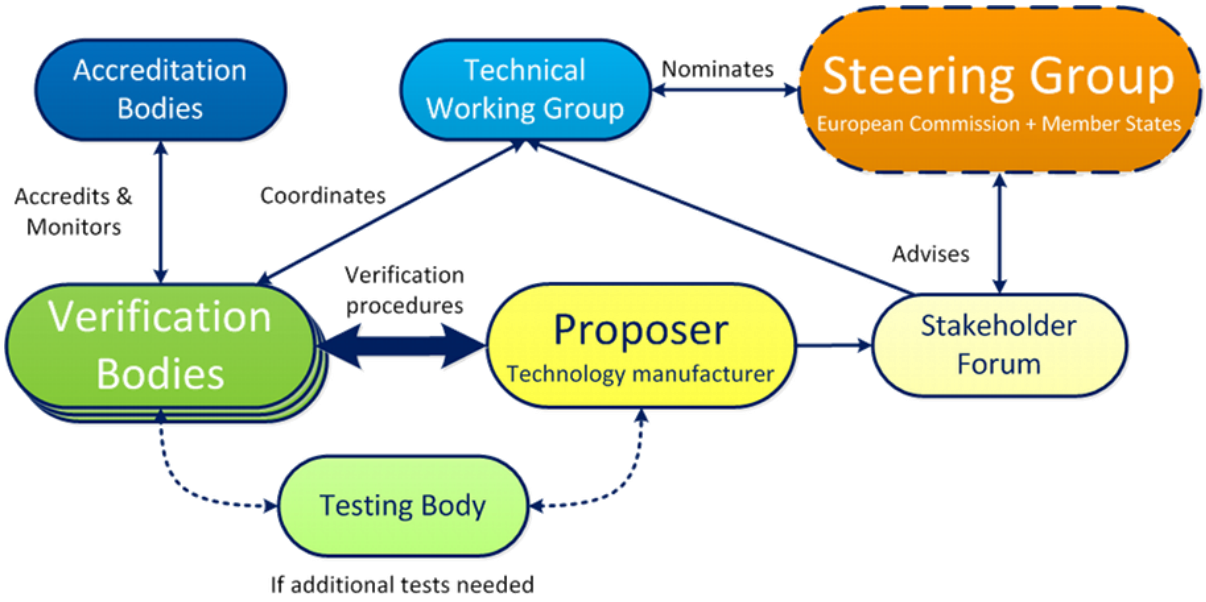

Figure 1. ETV Structure (*ETV, 2016*).

2.2 Eligibility step of a technology to be assess by the ETV

All ready-for-market technologies, which show a potential for innovation and environmental benefits can be proposed under ETV. Initially, the scheme will cover the following technology areas (ETV, 2016):

- Energy technologies;
- Water treatment and monitoring technologies; and
- Material, wastes & resources technologies.

The FFW project is located in the first category.

The eligibility criteria are more detailed in the following sections.

2.3 ETV procedure

The verification assessment is divided in a number of steps or phases. Figure 2 shows the overall procedure.

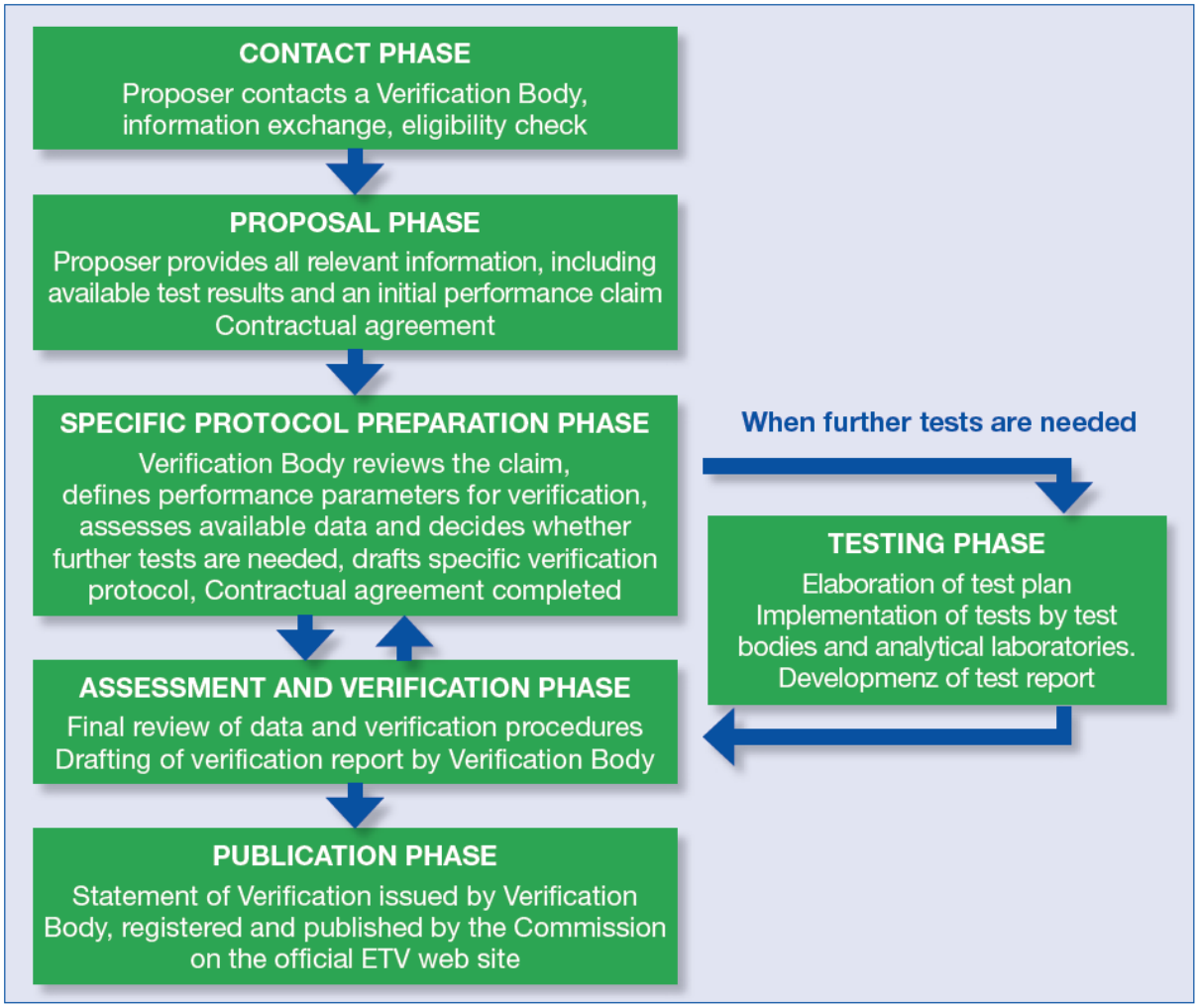

Figure 2. General procedure of the ETV (*ETV, 2016*).

The starting point for verification is a **contact** between the proposer and a Verification Body to check the eligibility of a technology proposed for verification. The proposer fills in a 'quick scan' document, which is then reviewed by the Verification Body. The information requiered for this documents are the following (ETV, 2016):

- Description of the technology and its intended application;
- Stage of the technology development i.e. if it is ready for market;
- Initial performance claim expressed by quantifiable parameters;
- Whether the technology has already been verified and the result of this verification;
- Information on available test data relevant for the claim.

The Verification Body evaluate if the technology falls in the scope of the EU ETV Pilot Programme, if it is ready for commercialization, if the performance claimed potentially meets the user needs and is in line with legal requirements and if it shows some technological innovation.

Based on the quick scan results, the Verification Body either recommends the technology for a full verification or not. In case of a positive result, it give a first indication about the complaxity and cost of the verification.

Once the eligibility of a technology for verification is confirmed by the Verification Body, the proposer prepares a full ETV **proposal**. The full proposal include the following criteria:

- Contact data of the proposer and the Verification Body;
- Technical documentation including at least the following elements:
  - General description of the technology,
  - Conceptual design, user manual and if necessary for understanding, manufacturing drawings and schemes of components, sub-assemblies, circuits, etc.,
  - Descriptions and explanations necessary for the understanding of those drawings and schemes and operation of the technology,
  - Standards or technical specifications applied in full or in part,
  - Results of design calculations made, examinations carried out etc.,
  - Test reports if available.
- Initial performance claim together with the specification of conditions of use or testing under which the claim is applicable and any relevant assumptions made;
- Intended application of the technology described in terms of matrix, purpose and technical conditions.

The technical documentation shall make it possible to understand the technology, revise the performance claim and to assess the adequacy of the technology design with the performance claim.

The initial performance claim should be ambitious yet realistic and should include the uniquefeatures of the technology which distinguish it on the market. Moreover, the performanceclaimed for a given technology should reflect the market requirements for the specifiedapplication and operational conditions.

The verification agreement concludes the contracting procedure after the proposal. This agreement define the conditions of the ETV (verification parameters, requierements, testing, measurement and calculation methods, etc.) and the obligations of both the proposer and the Verification Body.

Upon successful completion of the contact phase and proposal phase the next steps in the procedure are related to the development of the **specific verification protocol**, which shall include the following information:

- Summary description of the technology, its intended application and associated environmental impacts;
- Definition of verification parameters (revised performance claim);
- Requirements on test design and data quality;
- Requirements on test and measurement methods, definition of calculation methods for performance parameters;
- Description of the way in which operational, environmental and additional parameters are to be dealt with in the verification process;
- Assessment of existing data and conclusions on the need or not for additional tests or measures.

Initially, the specific verification protocol is drafted by the Verification Body. The technical performance parameters proposed in the initial claim together with the description of the intended application are reviewed by the Verification Body in order to ensure that the parameters are verifiable, able to be proven with an adequate precision, and that the specified operational conditions are consistent with the professional practices observed for a given technology area and the technology application. The claim of the technology performances may evolve during the verification process, such as the verification parameters. Once an agreement on the performance parameters to be verified is reached, the Verification Body develops the protocol. This document specifies the requirements on the processes from which the test data has been acquired (e.g. testing methods), the required quality of the test data, measurement and calculation methods (e.g. how the test data is processed into performance parameters), among others.

At this point and according to the data available, the Verification Body evaluate if the assessment result is positive and adequate to prove the claim. If not, additional tests are required and the test plan is established (testing laboratory, test plan, etc.).

The Verification Body collects all performance data (i.e. both: accepted existing data if provided by the proposer and test data from the additional tests), and assesses: if the whole set of data is accurate and complete to verify the claimed performance, if it has been produced under the required procedures as defined in the specific verification protocol. It also reviews the procedures followed. Based on the final assessment of data and revision of the applied procedures, the Verification Body determines the final performance claim which can be considered verified under the EU ETV Pilot Programme.

The verification report together with the Statement of Verification are key products of the verification procedure determining the performance of a technology verified under the EU ETV Pilot Programme.

The **Verification Report** is a comprehensive summary of all verification activities carried out throughout the entire process. Its main parts include:

- Detailed description of the technology and its application;
- Verified performance;
- Operational conditions under which the declared performance is achieved;

- Measurement uncertainties and relevant assumptions taken into consideration during the verification process;
- Description of the tests performed and the obtained results;
- Final assessment of all data from the test report and from acceptable existing data prior to verification;
- Quality management and control procedures applied.

The verification report is drafted by the Verification body, while the proposer is responsible for approving it. Under the EU ETV Pilot Programme, the report is owned by the proposer. It may be published if the proposer agrees. This issue should be regulated by the contract for verification closed between the verification body and the proposer.

The **Statement of Verification** is a summary of the verification report. It is a short document of approximately 4 pages that includes the following information:

- Summary description of the technology verified, complete denomination or reference number, purpose and conditions of use;
- Verified performance and the operational conditions under which it is achieved;
- Summary of the procedures followed by the Verification Body, and by test bodies where relevant, to verify the claim, including the statistical confidence range on specifications where applicable;
- Any other information necessary to understand and use the performance claim; this may include information not verified under the EU ETV Pilot Programme, however this should be clearly stated and explained.

The Statement of Verification is a key output of the EU ETV Pilot Programme to be used by the proposer in any dealings with other organizations, for marketing purposes and for official approval. It may become part of the technical documentation of the verified technology.

The Statement of Verification is drafted and, after approval of the proposer, issued by the Verification Body, who signs it and transfers to the European Commission services for publication. The document has a registration number, an ETV logo and a date of issuance.

3 Presentation of the Evaluation Body

The Environmental Technology Verification was led by the inspection company RINA SERVICES accredited for the ISO standard 17020 (General criteria for the operation of various types of bodies performing inspection) and the extension of the accreditation to the EU ETV pilot programme for all technology areas (Water treatment and monitoring; Materials, wastes and resources; Energy technologies).

3.1 RINA's History

In 1861, the classification society Registro Italiano Navale was established in Genoa, Italy and united the regional fleets under a single flag to cover the risk of loss and damage to the hull and rigging of sailing vessels. The society grew quickly and started its international expansion in 1885 opening an office in Shanghai, China. After the first Word War, the first international agreements were signed with the British Corporation Register, the American Bureau of Shipping and Teikoku Kaiji Kyokai, for mutual representation in the respective countries and harmonization of the rules and regulations. Between 1956 and 1960, RINA had new mutual agreement with other classification registers: the International Institute of Welding (IIW), the International Standardization Organization (ISO), the International Electrotechnical Commission (IEC) and the International Ship Structures Congress (ISSC).

In 1968 RINA founded the International Association of Classification Societies (IACS) with six other registers: American Bureau of Shipping, Bureau Veritas, Det Norske Veritas, Germanischer Lloyd, Lloyd's Register of Shipping and Nippon Kaiji Kyokai.

In the 70's, RINA expended its activities to the industrial field to adapt itself to the changes in the merchant marine needs and in 1999 Registro Italiano Navale changed to RINA S.p.A., a joint-stock company set up in Genoa to perform assessments, inspections, certification and research into materials, projects, technologies, products and installations. The services delivered to the maritime market and to the other production sectors are consistent with national, EU and international laws, in fulfilment of undertakings assigned by public administrations or by other authorities.

In 2009, RINA SERVICES S.p.A. was established and all operations, licenses and accreditations dealing with classification, certification, test and inspections were transferred to RINA SERVICES S.p.A.

In 2014, RINA had 163 offices in 60 countries, with an operational network of more than 2.750 employees, whose hard work helped to generate an over 330 million euro turnover.

3.2 RINA SERVICES S.p.A.

RINA SERVICES S.p.A. and its subsidiaries work with organizations on their pathway to growth, to help them become more competitive, giving partners the opportunity of verifying the safety of their processes, assets and products through a third party, independent company. The proposed solutions are targeting organizations that operate in every market area to certify the quality, safety and durability of their performance. The sectors covered by the services are the marine, environment and energy, infrastructures, transport and logistics, quality and safety and agri-food sectors.

RINA is a member of the Board of Directors of the International Confederation of inspection and certification organizations (CEOC), of the Italian association of certification, inspection, testing and calibration societies (CONFORMA) and of the federation for Italian certification of company quality systems (CISQ), which represent the main certification companies in Italy.

Lastly, through CISQ, RINA has endorsed the multilateral agreement of The International Certification Network (IQNet), the largest international certification network for quality, environment and safety management systems.

4 Eligibility Assessment – Quick Scan

The eligibility check is the first assessment made by the Verification Body, based on the "Quick Scan document" provided by the proposer at the beginning of the verification procedure.

As it was state before, the aim of the Quick Scan is to enable the Verification Body to assess the suitability of the technology for verification, and to give a first indication about the complexity and range of costs for a full verification. Where appropriate, the Verification Body first provides advice on the drafting and completeness of the Quick Scan. The Quick Scan is assessed by the Verification Body using the following eligibility criteria:

- Clarity of the technology description; verifiability and specificity to the technology of the performance claim elements;
- Suitability of the technology with the scope of the ETV pilot Programme;
- Readiness for the market (i.e. if the technology is available on the market, or if not, if it is available at a stage where no change affecting performance is likely to be implemented before introducing the technology onto the market)
- Environmental added-value of the technology;
- Suitability with the user needs in terms of functionality, claimed performance and environmental added-value;
- Respect of the applicable legal requirements;
- Level of technological innovation.

4.1 Selected technology

The list of all the technologies developed within the project was established by Vertech during the first years of the project. The possibilities to perform the Environmental Technology Verification was investigated for the following technologies:

- Olive waste drying (WP2);
- Olive waste pelletization (WP2);
- Gasification and Water Gas Shift optimization (WP3 & WP5);
- Syngas cleaning using a Molten Salt Reactor (WP3);
- Fischer-Tropsch synthesis optimization (WP4 & WP5);
- Methanation reaction for SNG production (WP4 & WP5);
- Catalysts production (WP4).

Some of these technologies were removed from the list due to they did not present innovative aspects (e.g. drying and pelletizing technologies), their development level was too low (at laboratory scale for instance, such as catalysts production) or because they were not owned by the consortium partners (e.g. Fischer-Tropsch synthesis). After a consensus with the partners involved in the project, the most suitable technology for this kind of evaluation developed in the project was selected. In this sense, the Molten Salt Reactor (MSR) technology developed by EIFER within the Work Package 3 (in the Task 3.3) for syngas cleaning from biomass gasification was chosen for the Environmental Technology

Verification as it well fitted the scope of the ETV programme. In this sense, Vertech contact with the evaluation body RINA and stablished a link with the technology owner (EIFER) in order to start with evaluation process. In the same line, Vertech followed the information exchanges during the next steps.

Syngas from gasification of carbon-rich feedstock is used for power generation, as well as for the production of synthetic fuels and commodity chemicals. The level of cleaning required depends greatly on the syngas end-use application, ranging from heat or power applications to the production of synthetic fuels. A broad range of techniques is developed to reduce or remove the contaminants in raw product gas, some techniques focus on a single contaminant while others are able to remove multiple contaminants simultaneously. Tar removal forms a major challenge in the effort to make these syngas valorisation technologies technically and commercially feasible. Tar removal methods can be divided into two categories: (1) primary methods or treatments inside the gasifier, and (2) secondary methods or hot gas cleaning after the gasifier. Despite improved primary measures, a gas cleaning process will still be needed. Hot gas cleaning avoids cooling of syngas; so far, hot tar removal is based on catalytic or thermal cracking of these tars.

The main purpose of the MSR technology is the tars removal from biomass syngas at high temperatures. Molten salts are solid at standard conditions of temperature and pressure, but enter in a liquid phase at high temperature. Molten salts have both catalytic and thermal effects on tar removal. Catalytic effects can be increased by dissolving tar cracking catalytic materials in the molten salts. Therefore, the amount of tars in a syngas is decreased after passing molten salt mixture. Additionally, molten salts are also capable to dissolve inorganic gaseous impurities by absorption. Consequently, inorganic impurity concentration is also decreased after passing molten salt mixture.

4.2 Quick scan result

The Quick Scan had been submitted for evaluation to the evaluation body RINA. This document was strictly analyzed in order to validate all the eligibility criteria of the ETV. The Verification Body concluded that *“the EIFER Molten Salt Reactor (MSR) technology is not yet ready for the market. The technology is still at a pilot scale and the upscaling can influence several aspects: heat transfer; fluid dynamics; reactor design; therefore, performance will be influenced. At this readiness level the technology is not eligible for ETV Verification.”*

The full version of the Quick Scan document is available in the **Annex** of this report.

Considering the conclusions provided into the Quick Scan, the ETV process cannot be followed for this technology, reason why the final evaluation was not possible to finalized at this stage of the project.

5 Conclusions

The Environmental Technology Verification task was started when the project was already well advanced (more than two years after the beginning date). At this moment, the development of several technologies was already move forward but not totally complete. Due to the length of the ETV process, one technology had to be selected in order to achieve the verification in the time frame of the project. With the support of all the partners, one technology was selected. Among all the technologies developed within the FFW project, the EIFER Molten Salt Reactor technology was the most likely to be validated by the Environmental Technology Verification programme. The choice was made on several criteria: the innovation, the expected performances especially on environmental aspects, the level of development and the coverage of the technology by international standards or regulation.

During the eligibility check, the evaluation body RINA evaluated that the EIFER Molten Salt Reactor technology is not mature enough to apply for the ETV verification. The expected Technology Readiness Level (TRL) to suit the ETV programme is quite high (8 or 9) corresponding to a technology already on the market or close to be (technology completed and qualified). The EIFER Molten Salt Reactor is currently developed at a pilot scale. To come closer to the market, a full-scale demonstration unit have to be tested until the completed validation of the technology. It can be estimated that the EIFER Molten Salt Reactor is missing a few months or years of development to reach a commercial scale. When this level will be achieved, the technology could candidate again to the ETV programme.

6 References

ETV, Environmental Technology Verification. (2016). EU Environmental Technology Verification. Pilot Programme. http://iet.jrc.ec.europa.eu/etv/. Last accessed on March 2016.

RINA. (2016). RINA Services S.p.A. http://www.rina.org/en. Last accessed on March 2016.

7 Annex

MRS Quick Scan.