4.2 ANNEX II – 2020 Calls for non-JU members – Topic descriptions

4.2.1 S2R-OC -IP1-01-2020 Support to Development of next generation of Traction systems (TD1.1)

SPECIFIC CHALLENGE

The Traction Drive sub-system is one of the main sub-systems of a train as it moves the train converting energy from an electrical source (directly or via a chemical source) into a mechanical one.

The physical domains to master are multiple: electrical, mechanical, thermal, and control. A large number of norms and regulations have to be taken into account for traction systems design, manufacturing, validation and certification.

There are two main specific challenges concerning traction systems:

- to master technologies breakthrough developments like SiC semi-conductors applied to different railways traction applications and wheel independent rotating wheels for HST;
- to develop and contribute to implementing new methodologies, tools, norms & standards of noise, reliability, virtual validation and certification, smart maintenance.

Apart from the existing ongoing or finished traction CFM projects (PINTA / PINTA2) complementary work via this Open Call is launched to support the future improvement of the high TRL level S2R JU traction demonstrations on trains done by the S2R JU Members, preparing also future S2R JU key work on domains like digitalisation applied to Traction, environmental sustainability (especially carbon free traction systems preparation) or reinforcement of standardisation to lower complexity and costs.

SCOPE

In order to address the challenges described above, proposals should address all the following work streams, in line with the S2R MAAP:

Work-stream 1: 3D additive manufacturing and new manufacturing technologies

3D printing used in Traction is expected to reduce cost and planning on R&D prototypes and to allow higher technical performances to mechanical parts. Investigation on potential also for serial manufacturing, part manufacturing in Service business will be done.

Today R&D prototyping is long and costly. Moreover certain parts with high technical performances are not designed because not manufacturable with classical production means. Opening the 3D printing capabilities will open high technical performances in some parts (e.g. cooling systems) while reducing cost an duration of prototyping. Serial manufacturing could benefit from this technology (as already implemented in the avionic sector).

The objective of the work is to investigate this new opportunity to reduce the Traction Capital Cost KPI and improve technical performance (TRL 3).

The main expected results are:

- new processes (design, manufacturing, validation),
- new technologies (powders, 3D printing machines),
- better understanding of the potential benefit of 3D Printing on Traction active components (e.g. motor including sensors) and parts.

Work-stream 2: Wireless Dynamic Charging for urban vehicles based on SiC semi-conductors

The combination of high frequency SiC devices with dynamic wireless charging will increase the efficiency and the transmission distance of wireless charging systems. With an optimized coil design the transmission can be carried out while the vehicle is moving.

The Energy efficiency and Reliability/Availability Traction KPIs are targeted because of better recharging solutions than currently available.

New work is needed in this domain because the transfer efficiency of wireless charging systems increases with frequency and due to the frequency limits of current Silicium Traction devices, the benefits of wireless charging are not actually exploited to their best.

The objectives is TRL 3 on the design of a high efficient wireless dynamic charging system to supply a tramways power train and to charge the batteries of catenary free tramways while the vehicle is moving.

The main expected results are:

- downsizing the on board energy storage system,
- reduction of the demanded peak power,
- full catenary free operation.

Work-stream 3: Investigations on reliability of traction components and lifetime mechanisms

The main content of the work is the reliability and lifetime tests executed by an independent laboratory for power semiconductor devices. The work is a supporting action for the S2R-CFM-IP1-01-2020 and could help the S2R JU into the standardisation activities.

Reliability and Maintenance costs KPIs are targeted to be improved.

The objectives (TRL 4) are to receive basic data and define validated lifetime models for power semiconductor devices (especially SiC) based on the measurements.

The main expected results are: validated lifetime models which can be implemented into engineering tools for reliability and lifetime calculation depending on the specific train operation

Work-stream 4: Big Data, Artificial Intelligence (AI) applied to Traction systems smart and predictive maintenance.

The intention is to share knowledge from non S2R JU Members experts on data mining and AI with the future Traction CFM projects (S2R-CFM-IP1-01-2020).

The work is targeting reliability improvement and maintenance costs reduction.

In more detail, to handle the huge amount of data generated by smart maintenance applications (including sensor data), expertise in the field of Data Mining and AI is needed. This expertise will help to evaluate the requirements and structure for the data collection to ease the use of Data Mining & AI to get added value knowledge out of the rough data.

The aim is to consider the respective methods of Data Mining & AI taking into account the input that the S2R JU complentary IP1 CFM project will provide during the project execution.

The main objectives (TRL 4) are a support to choose a certain concept on Smart Maintenance helping to improve predictive maintenance on traction power conversion components.

Studies on different Data models and selection on different AI methodologies, advantages/disadvantages of approaches and link with train data normalisation (studied at train level) are expected.

Proposals answering to this topic can also make use of PhD thesis.

The S2R Joint Undertaking considers that proposals with a duration of 30 months would allow this topic to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals with another duration.

COMPLEMENTARITY

As specified in section 2.3.1 of AWP 2020 in order to facilitate the contribution to the achievement of S2R objectives, the options regarding 'complementary grants' of the S2R JU Model Grant Agreement and the provisions therein, including with regard to additional access rights to background and results for the purposes of the complementary grant(s), will be enabled in the corresponding S2R JU Grant Agreements.

The action that is expected to be funded under this topic will be complementary to the actions that are expected to be funded under the following topics:

- S2R-CFM-IP1-01-2020

The action stemming from this topic will also be complementary to actions carried out within the following projects:

- IMPACT-2 (GA 777513)

EXPECTED IMPACT

Expected global Traction OC Impact: The most significant benefits from the action as a result of the new approach breakthroughs in Traction domains are an extension on know-how in different fields like R&D methodology, technologies, approaches and norms to support CFM Traction TD1.1 work and bring complementary improvement on several Traction KPIs : Life Cycle Cost reduction (capital cost, energy, maintenance), reliability improvement, noise reduction.

What is expected -from the global seven work-streams- the following indicative values improving the S2R JU Traction TD demos

- Additional -20% Traction manufacturing Cost and -50% of R&D parts prototypes manufacturing planning.
- Additional -5% of Energy Cost on traction power
- Additional +10% of power semi conductors reliability/maintenance cost reduction

Type of Action: Research and Innovation Action (RIA)