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Project Plan for the CEN Workshop on "NEXTOWER Very high temperature accelerated ageing of flat ceramic specimens by concentrated solar power"

Workshop
to be approved during the Kick-off meeting to be held in Almería (Spain) on 4 March 2020

1. Status of the Project Plan

This initial draft Project Plan is published to engage interested stakeholders to participate in the CEN Workshop and will be approved in the kick-off meeting of the Workshop. The draft Project Plan follows the requirements in CEN-CENELEC Guide 29.

2. Background to the Workshop

Concentrated solar power (CSP) is an important building block in installing a secure, competitive and sustainable energy system.

Today, the diverse solar thermal energy solutions commercially available differ with respect to concentration technology, receiver type and shape, nature of the heat transfer fluid (HTF) and capability to store thermal energy, to turn it later into process heat or electricity on demand.

However, more cost-effective solutions are required for a wider-scale deployment of the CSP technology.

Novel functional materials and material combinations throughout the manufacturing chain are therefore needed to enhance the efficiency of solar energy harvesting beyond that of the current state-of-the-art technologies.

Advanced materials solutions for NEXTgeneration high efficiency concentrated solar power (CSP) TOWER systems (NEXTOWER) project is a four year research project funded by the European Commission which aims at demonstrating **high-performance durable materials** for the next generation of concentrated solar power (CSP) air-based **tower systems**, making them commercially competitive in the energy market beyond 2020.

The main objetives of NEXTOWER are:

1. **Durable solar receivers**. Develop new mechanically tough and highly thermally conductive ceramic receivers, working under extreme thermal cycling without failure at a maximum materials temperature of at least 800°C and delivering over 20 years of continued operations

2. **High temperature steels for thermal storage by liquid lead**. Develop coextruded-tubes and liner technologies from proprietary corrosion-resistant alumina forming steels (FeCrAlby SMT) to build high-capacity, high-efficiency lead-based heat storage that can work with high temperature receivers to supply gas turbines or industrial processes, thus expanding the boundaries of CSP technology

3. **New SOLEAD demo of CSP with lead loop.** Set up a full scale CSP demonstrator (**SOLEAD**) for unprecedented field testing of materials for CSP lead-towers, encompassing a large solar receiver (ca 4 m2, 100 tiles, up to 500 KWth for parallel testing of several receiver types) interfaced to a single-chamber lead storage pool, in turns connected to a secondary "heat sink".

4. **Field testing will run for 12 months** with lead at average 700°C for full proof at TRL 6 of all materials and for input data for levelized cost of energy (**LCOE**) and Life Cycle Assessment (**LCA**) computations.

5**. Proving long term operations**: Non-destructive testing and multi-scale modeling are inter-twinned synergicallyto optimize resources and provide predictive engineering tools based on unique ICE multilevel approach

6. **Exploitation and Standardization**: NEXTOWER will establish and maintain an exploitation culture throughout the project, treating IPR in a way that maximizes impact, and addressing the integration of NEXTOWER with the standardization system.

Within the objetive 6, the first activity carried out was the identification of the relevant ISO/IEC, CEN/CLC Technical Committees: a report was circulated to the partners, so that they could give feedback to UNE. Then, the list of relevant committees was reduced to:

- ISO/TC 206 Fine ceramics
- CEN/TC 184 Advanced ceramics
- ISO/TC 17 Steel
- CEN/TC 459 ECISS European Committee for Iron and Steel Standardization:
    - CEN/TC 459/SC 1 Test methods for steel (other than chemical analysis)
    - CEN/TC 459/SC 2 Methods of chemical analysis for iron and steel
    - CEN/TC 459/SC 5 Steels for heat treatment, alloy steels, free-cutting steels and stainless steels
- IEC/TC 117 Solar thermal electric plants

Furthermore, two standars were identified as reference for NEXTOWER:

- EN 821-2:1997 Advanced technical ceramics - Monolithic ceramics – Thermophysical properties - Part 2: Determination of thermal diffusivity by the laser flash (or heat pulse) method. (CEN/TC 184)

- ISO 18755:2005 “Fine ceramics (advanced ceramics, advanced technical ceramics) - Determination of thermal diffusivity of monolithic ceramics by laser flash method” (ISO/TC 206).

By using the above two standards in some tests, one NEXTOWER partner identified some gaps in their requirements, and so UNE started to contact with the ISO/TC 206 and CEN/TC 184 officers to propose an amendment to both standards – which are not identical. After reviewing the issue, CEN/TC 184 decided not to modify EN 821-2:1997, but wait till the revision of ISO 18755, in order withdraw the EN standard, replacing it with the future ISO 18755.

Regarding ISO 18755, it was under Systematic Review with deadline for voting by 2nd of December 2019, and, depending on the support, an amendment will be added – together with other modifications – to fit with NEXTOWER needs.

Another standardization activity has been proposed, relating a new procedure, developed for the purposes of NEXTOWER (but applicable to future developments). The procedure is called “Very high temperature accelerated ageing of flat ceramic specimens by concentrated solar power”, and by the moment there is not any standard covering this treatment. The solution proposed by UNE was a CWA, to ensure that both NEXTOWER gets the benefits of standardization processes, and the standards community can benefit from the standardizacion NEXTOWER´s results.

3. Workshop proposers and Workshop participants

The Workshop proposer is UNE, the Spanish National Standards Body as partner of NEXTOWER consortium responsible for the standardization aspects. Other partners of NEXTOWER are: BEWG (BEWG Warrant Group, Belgium); LIQ (LiqTech International, Denmark), SST (Sil'Tronix Silicon Technologies, France), CALEF (Consorzio CALEF, Italy), CertiMac (Italy), ENEA (National agency for new technologies, Energy and sustainable economic development, Italy), POLITO (Politecnico di Torino, Italy), URM1 (Universita degli Studi di Roma La Sapienza, Italy), WTO (Walter Tosto SpA, Italy), CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Spain), ICAMCYL (Fundación ICAMCyL, Spain), R2M (R2M Solution Spain), KTH (KTH Royal Institute of Technology), SMT (Sandvik Materials Technology, Sweden), EngiCer (Switzerland), UOXF (the Chancellor, masters and scholars of the university of Oxford).

Participation in the Workshop is open to anyone, and the opportunity to participate is widely advertised in advance by its proposers and by CEN and CENELEC and their member bodies.

Since one of the activities of NEXTOWER is the identification of additional stakeholders, the invitation to the kick-off meeting will be sent to already identified stakeholders from related and impacted sectors such as: Manufacturers, University, Laboratories, R&D, Standardization, etc.

Simultaneously CEN and CENELEC will publish the CWA Project Plan “**Very high temperature accelerated ageing of flat ceramic specimens by concentrated solar power**” and the invitation to the kick-off meeting through the CEN and CENELEC channels.

4. Workshop scope and objectives

This Workshop aims to develop a CEN Workshop Agreement on Very high temperature accelerated ageing of flat ceramic specimens by concentrated solar power, comprising the following steps and requirements:

4.1 Development of a specific test platform for very high temperature accelerated ageing of flat ceramic specimens by concentrated solar power

Some requirements for this platform are:

- The platform shall have a support capable of holding or maintaining the samples without taking away degrees of freedom for thermal expansion, avoiding causing stresses that lead to fracture. It is recommended to work in a horizontal position, so that gravity favors the subjection of the samples without applying additional forces.
- For this purpose, it is recommended to use spotlight installations in which the energy supply is vertical, such as vertical solar furnaces, beam downs, or fresnell lenses. In the case of horizontal axis solar furnaces, the use of a redirecting mirror is recommended, which allows the treatment of the samples in the horizontal plane.
- The support surface shall allow the samples to cool down homogeneously. This is achieved with porous supports or with holes that allow the passage of the working fluid, in the case of air.
- The compatibility between the material of the samples to be tested and the support or clampling material shall be checked.

4.2 Operation

- Heating: Heating shall be carried out as homogeneously as possible on the total surface area of the samples. For this purpose, in the case of point focus solar systems, the following is recommended:
    - In the case of central receiver installations: operate the heliostat field in such a way that the flow map is as homogeneous as possible, working in the focal plane deemed appropriate according to its flow map to homogenize the flow over the samples.
    - In the case of parabolic discs: work in the most homogeneous focal plane, according to the surface of the samples. It is considered positive that this flow map can be measured with the appropriate equipment.
    - In the case of solar furnaces: the flow would be optimized with a flow homogeniser. In any case, work should be carried out in the focal plane that is considered most suitable for homogenising the flow according to the surface area of the samples.
    - In the case of a fresnell lens, work in the focal plane that is deemed most suitable to uniform the solar flow on the surface of the samples.

In all cases, it is considered positive that this flow map can be measured with the appropriate equipment. All samples should be adapted to the size of the focus and should not exceed the area where the flow has a homogeneous distribution.

- Heating and/or cooling rate: The heating rate will be given by the working limits of the material of the sample itself, and the heating rates indicated by the manufacturer shall not be exceeded.
- Thermal gradient inside the sample shall be taken into account.
- Cooling: cooling shall be as rapid as possible, within the test conditions and the maximum limits of the sample. Forced cooling is recommended for accelerating ageing, according to the most demanding actual operating conditions in a point focus system, which would correspond to sudden intermittence of the energy flow due to the presence of clouds, or quick start or stop situations.
- Number of cycles: the number of cycles for an accelerated estimation of the real behaviour of years of operation, putting the sample in limit working conditions through thermal cycling, will be the result of multiplying the number of days to be determined by a cycle/day, which would correspond to the start and stop of the system due to the daily solar cycle itself. To this amount, a proportional value should be added, corresponding to what would be the interruption of the energy flow due to the presence of clouds.
- Temperature measurement: There are different methods, direct and indirect for temperature measurement. By using concentrated solar energy, and the measurement of temperature being one of the current lines of research being developed, it is understood that there may be novel methods that are not contrasted. An intercomparison between methods is recommended to contrast the temperatures recorded in accelerated aging tests.

4.3 Analysis

The analysis of samples and validated parameters for the determination of the degradation of ceramic samples under real operating conditions shall be done, taking into account the test results.

5. Workshop programme

The working language during the Workshop will be English. The CWA will be drafted and published in English.

The aproximate duration of this workshop is 8-10 months. During the Workshop lifetime, several face-to-face and on-line meetings are foreseen depending on the project evolution.

The programme to reach the CEN Workshop Agreement comprises the following steps:

1. Organisation of the kick-off meeting

2. The kick-off meeting will be organized in March 2020, to plan the CEN Workshop Agreement. The kick-off meeting will:

- approve the Workshop Project Plan;
- discuss the first draft of outline of the CWA;
- select the project team, Workshop chair and designate the secretariat;
- solicit for source documents from the different participating countries.

3. In the preparatory meeting, the project team will review source documents, compare these with the results of the different work packages (WP) in the NEXTOWER project.

4. The Workshop secretariat will organize the first CEN Workshop plenary meeting for all registered participants.

5. An internal reviewing period will be carried out to allow for inclusion of comments from Workshop participants to ensure consensus is reached on the content.

6. The proposers intend to organize a 60-day Public comment phase. In case consensus is reached on the content of the draft CWA after the internal reviewing period, the public comment phase will not be initiated.

7. A second plenary meeting for registered Workshop participants will be organised for the resolution of the comments received during the 60-day public comment phase, if apply.

8. The chairman will check by correspondence that a consensus has been reached on the final draft of the CWA.

9. When the consensus is met, the CWA will be sent to the CEN-CENELEC Management Centre for publication.

In the following table could be found an intended work schedule:

Activities	**Intended Dates**
Workshop Kick off meeting CWA open to any interested party	4 March 2020, Almería (Spain)
Draft CWA “” for internal reviewing period	April 2020
CEN Workshop Plenary meeting for registered participants for resolution of comments	June 2020
Public comment phase on Draft CWA	August 2020
CEN Workshop Plenary meeting for registered participants for resolution of comments	September 2020
Publication CEN Workshop Agreement “”	November 2020 Madrid – UNE premises

6. Workshop structure

6.1 CEN Workshop Chairperson

A proposal for the chairperson will be made by the Workshop proposers; he/she or any other candidate nominated during the period of publication of this Project Plan or at the Kick-Off will be approved at the Kick-off meeting by the parties present. His / her responsibilities include:

- Chairing the CEN Workshop meetings,
- Monitoring the progress of the CWA,
- Interface with CCMC regarding strategic directions, problems arising, external relationships, etc.
- Guides the work towards consensus.

6.3 CEN Workshop Secretariat

The CEN Workshop Secretariat is providing the formal link to the CEN system. The following main activities will be carried out by the Workshop Secretariat:

- Is responsible for administrative tasks of the CEN Workshop Agreement
- Forming the administrative contact point for CWA project,
- Makes and follows up on action lists,
- Ensures that the Workshop Agreement follows the directives,
- Administrating the liaison with relevant CEN and CENELEC TCs, if applicable.

7. Resource requirements

All costs related to the participation of interested parties in the Workshop´s activities have to be borne by themselves.
There will be no fee for registered participation in this Workshop.

UNE will provide the Workshop secretariat – subject to formal approval of the Project plan at the kick-off meeting.
The NEXTOWER project (funded under the Horizon 2020 Framework Programme) will contribute to the drafting of the CWA.

8. Related activities, liaisons, etc.

As mentioned in clause 2, some standards from ISO/TC 206 and CEN/TC 184 have been considered. However, the intended scope of this CWA does not overlap with any of their projects or standards.

9. Contact points

Proposed Chairperson:
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