

## **Exhibit F. Annex Outline**

**[Annex Number]**

### **IEA SHC Rating and Certification Procedures - *Advanced Solar Thermal Testing and Characterization for Certification of Collectors and Systems***

#### **1. Definitions**

New and emerging technologies. Solar thermal technologies which are under development and do not yet have standards and processes for testing, for measurement or for certification in place that effectively address products that use the technology.

Existing Technologies. Solar thermal technologies and products where standards and processes for testing, for measurement, or for certification are in place.

#### **2. Purpose and Objectives**

This proposed international collaboration will develop, where needed, new test procedures and characterization methods for addressing the certification of both conventional and advanced solar thermal products. It will leverage the knowledge from existing Tasks/Technical Committees/Certification Groups as a base for the development of work in this task, inviting these groups to participate in order to produce the inputs for harmonisation of testing and certification for existing and emerging technologies; to optimize the time and resources companies, laboratories and certification bodies expend on testing and certification; while still assuring consumer protection and providing credible information on solar heating and cooling benefits.

#### **3. Subtasks**

Three main subtasks are planned for this task, each with more specific activities and proposed projects designed to accomplish their major objectives. The work in each subtask will be closely coordinated and shared with other groups and organizations involved in testing and certification. Some of the significant areas for coordination include the results of recent CEN/TC 312 meetings which created a resolution regarding revision of EN12975-1 and 2 and implementation of M/369 which recommended:

- work on unglazed collectors to refine performance test conditions and prediction and improve sky temperature measurement;
- requirements and test methods for collector components;
- quality tests for evacuated tubes;
- improved exposure—accelerated ageing tests of collectors;
- annual energy output.

Action on the resolution will be considered in order to avoid duplication of effort and to leverage other work. ISO/TC180 is also considering progress made in Europe over the last decade and their relevance to updating ISO 9806.

The New Generation of Solar Thermal Systems (NEGST) also has recommendations and analysis directly related to these subtasks addressing:

- collector components (absorber surface durability, polymeric materials, quality testing of reflector materials and anti-reflective coatings),
- collectors (performance and quality testing of evacuated tubes, exposure testing, flow rate and flow distribution in flat plate collector tests, uncovered collectors, performance testing of air collectors, IAM determination and application of present standards to tracking and concentrating collectors)

- Storage/controller/system standards (parameter identification, principles and concepts to apply in developing store test methods, simulation models and test methods for stores with external heat exchanger, controllers, combi-systems, cooling)
- Solar fluids
- Life-Cycle Assessment

The three main subtasks and their main objectives are:

- Subtask 1: New and Emerging Technologies. Testing and certification research and information dissemination for new and emerging technologies to develop draft standards to be presented to ISO/TC 180, to propose certification schemes to the competent Certification Bodies, and to promote round robin tests to refine existing test procedures, in cooperation with researchers, industry and certification bodies involved in these technologies.
- Subtask 2: Existing Technologies. Testing and certification research and information dissemination for existing technologies to identify the weaknesses in existing test standards and certification methods, inconsistencies in their application, and significant gaps.
- Subtask 3: Ongoing Information Dissemination and Coordination. Establishing ongoing information dissemination and communications to provide necessary information and feedback among participants to speed adoption of standardised testing and harmonized certification

**Subtask 1:** New and Emerging Technologies Activities and Projects. For areas that are covered by existing or completed IEA Tasks, the first step will be to coordinate with these tasks to find out what is still missing between the work of those existing tasks and a full qualification standard and certification scheme for that technology.

Activity 1 – PV/Thermal Collectors

Project 1 - Integrated Photovoltaic–Thermal System (IPVTS): To elaborate a state-of-the-art white paper in cooperation with IEA-SHC Task 35, to promote round robin tests, to draft a requirements standard, to draft a qualification tests standard, and to draft a certification schema.

Activity 2 – Polymeric Collectors

Project 1: To elaborate a state-of-the-art white paper in cooperation with IEA-SHC Task 39, to promote round robin tests, to draft a requirements standard, to draft a qualification tests standard, develop common standards and the basis for accelerated UV testing and accelerated aging in general, and draft a certification schema.

Activity 3 – Concentrator Collector for Medium Temperatures

Project 1: To elaborate a state-of-the-art white paper that draws on existing performance testing and research, to promote round robin tests, to draft a requirements standard, to draft a qualification tests standard, and to draft a certification schema.

Project 2: Defining the limits/boundaries of solar thermal within the context of building integration, what is solar thermal in the contexts of storage, cooling, heating, as well as quantification for incentives, quantity and quality of heat, due diligence assessments, ranges of tolerance/acceptable uncertainty, bands of acceptability.

Activity 4 – Concentrating Solar Power (not SHC...)

Project 1: In cooperation with the CSP groups, share information that is relevant to heating, cooling and power. To elaborate a state-of-the-art white paper, to promote round robin tests, to draft a requirements standard, to draft a qualification tests standard, and to recommend certification schema for systems where it is appropriate. For systems where certification is not appropriate work with industry to develop/transfer best practices in field measurement and collector performance characterization.

**Subtask 2:** Existing Technologies. The activities and projects in this subtask revisit testing and certification processes for established technologies, as compared to the new and emerging technologies where testing and certification processes are still in development. By examining current practices, weaknesses in existing methods can be identified and improved, gaps in existing methods and processes can be identified and redressed, and inconsistencies in the application of existing methods and processes can be reduced by sharing information and promoting harmonization of procedures.

#### Activity 1 – Air Heating Collectors

Project 1: For closed loop collectors examine common practices for testing and certification of existing collectors as applied by Bodycote, Fraunhofer ISE and others (5 collectors already certified by SRCC using ASHRAE, 3 tested by ISE using modified EN12975) to identify issues in ASHRAE 93/96, how collectors are certified by SRCC, Solar Keymark and Australia. Examine how growing markets would benefit from more information on performance and better tests. Characterize issues involved in passive/active building integration of systems. Collect test procedures and promote round-robin tests, recommend changes in requirements and certification schema for different types of collectors as needed.

Project 2: For open loop collectors examine common practices for testing and certification of existing collectors as applied by Bodycote and others, and research at NREL and elsewhere. Coordinate with SRCC on applications for certification which are in process. Examine how growing markets would benefit from more information on performance and better tests. Characterize issues involved in passive/active building integration of systems. Collect test procedures and promote round-robin tests, recommend changes in requirements and certification schema for different types of collectors as needed.

#### Activity 2 – Concentrating Collectors

Project 1: Convene active parties (either virtually or face-to-face) engaged in Alanod meeting, IEA research, and recently formed SRCC standards subcommittee to develop improved methods for measurement, characterization and testing to coordinate efforts, characterize strengths and weaknesses of existing approaches embodied in ASTM905 efficiency test methods.

Project 2: Research and assess applicable research conducted on fresnel, linear, dish, fixed mirror collectors, and other novel configurations (e.g, fixed receiver, either line or point) conducted in Europe, Australia, and U.S. to determine their applicability to measurement and testing needs of current solar thermal products. Research testing and measurement issues involved in trackers for concentrating collectors.

Project 3: Research current approaches and develop new procedures and standards as needed for in-situ testing, for example placement and calibration of environmental monitoring, time periods for collection, approaches to normalizing and extrapolating collected data over system lifetime, etc. CEN/TC 312 meetings created a resolution regarding revision of EN12975-1 and 2 and implementation of M/369 recommended clarifying how present standards apply to tracking and/or concentrating collectors. Action on the resolution will be considered in order to avoid duplication of effort and to leverage other work.

#### Activity 3: Qualification and Safety Testing

Project 1: Survey current laboratory approaches to qualification testing to identify inconsistencies, gaps, and problems and develop recommendations for research or improved practices to resolve issues, including topics such as hail testing (incident angles, ice vs. steel balls, type/handling of ice [clear, opaque, cracks,...], test to failure approaches) and moisture.

Project 2: Research (with input from multiple test laboratories, industry and certification bodies) whether quality ratings and degradation estimates are feasible based on tests and their implications for system life, lifetime performance, reliability and warranties.

Project 3: Survey current practices in safety-related testing and certification to identify issues. Work will include mounting structures; lightning protection, working fluids and other topics raised by growing installations in varied locations, and will address what is appropriately addressed in component and system testing and certification versus building codes and installer responsibility.

#### Activity 4: Component/Material Substitution and Extrapolating Size

Project 1: Research how component and material substitution should be addressed in testing and standards, including when substitutions should be considered significant enough to require new testing and standards. For example with change in glass thickness from 4 to 3.2 mm, substituting thicker aluminium for copper on absorber fins, fin bonds going from fused to mechanical, the substitution of Grundfos pumps for Wilo pumps. Heat transfer fluids are also an issue, for example in the U.S. heat transfer fluids in systems with single-wall heat exchangers

must be certified by the Food and Drug Administration (FDA) as food-grade, while in Europe standards are different.

Project 2: Research on how to extrapolate changes within a model line. For example, how to treat changes in the size and or number of collectors even though their “construction” is identical, or tank volume changes (with same stratification devices if any are used). There has been work on procedures that use a complex mapping of solar fraction vs area/volume by simulation, with variations for climate, draw volume, and other factors. Another approach is to “test at extremes” and interpolate. Examining various approaches and determining their strengths and weaknesses will provide laboratories, industry and certification bodies with better, more standardized approaches to deal with sizing issues.

#### Activity 5: Current System Tests and Standards

Project 1: Analyze current issues in flat plate collector testing and certification including wind speed dependence and comparability of ratings when tested at different wind speeds, whether infrared effects explain some of the variations in outdoor and indoor testing (note that the Germans use a “cold baffle”- two glazings with cool air passing between; this will be very useful to see what the bias is in their testing, versus FSEC/Bodycote that do not attempt to alter the IR flux), and how the most recent changes in the EN12975 series of standards apply to these issues. The research will also involve a comparative analysis of how standards are applied in different countries and whether there are inconsistencies or differences that should be resolved to promote harmonization of standards and certification.

Project 2: Research testing procedures applied to passive systems and examine challenges in producing comparable results for separable thermosiphon systems versus ICS and non-separable thermosiphon systems, and evacuated tube collectors, including challenges in calculating IAM.

#### Activity 5: Simulation and Testing

Project 3: Conduct a review of component test simulation tools to identify any issues in their application to current SHC technology, and opportunities to adapt to new applications. CTSS, Dynamic System Test, Input-Output, and recent regression modelling results for using measured data to determine parameters in models will be investigated.

Project 4: Research testing and measurement standards applied to combi-systems, identify conditions used in ratings, and share information needed to create/apply common certification methods across participating countries.

**Subtask 3:** Ongoing Information Collection, Dissemination and Coordination. The activities and projects in this subtask are intended to provide the information and feedback among participants, industry, testing labs and certification bodies needed to help standardize and improve testing and promote harmonization across countries in testing and certification.

#### Activity 1: Development of a roadmap on testing and certification.

Project 1: Develop a roadmap of solar thermal technology testing and certification processes to serve as a guide to how tests and standards are applied and how they relate to certification, and to identify gaps, inconsistencies and weaknesses along with approaches to addressing problems.

#### Activity 2: Analysis and public dissemination of benefit indicators.

Project 1: Examine value and application of test and certification results to quantification of environmental benefits including carbon footprint, lifecycle disposal and recycling issues, energy payback calculations, and others suggested in the course of research. Recommend further research in areas where benefits estimates are inadequately supported by testing and characterization efforts, and recommend improvements that could strengthen the technical basis for environmental benefits estimates. Although these benefits measures depend on basic performance information, there are questions concerning how well current measures support these benefits estimates and how the scientific basis for them could be improved to help industry in gaining public and policy support.

Project 2: Examine the relation between test and characterization information and consumer perceptions of issues such as “comfort” to identify areas where existing test and measurement data are inadequate for quantifying these issues, and to recommend improvements that could strengthen estimates of “comfort” and other performance issues. An example would be the differences users

sense between hydronic, forced-air and radiant space conditioning systems and how solar systems perform in these different applications.

Activity 3: Development of efficient means of communication for the results of the overall task including the Internet, promotion of web conferences and meetings, and other tools identified in the course of the task.

Project 1: Identify existing groups working in the subject of technology, testing and standardization and establish links with these groups to engage them in communications and harmonization effort.

Project 2: Develop a communication plan for the target audiences that draws on the current IEA-SHC communication plan to further target industry, standards and certification bodies, testing laboratories, and other supporting organizations.

Project 3: Prepare and maintain a web page that includes work in progress in addition to final deliverables for projects with implications for testing and standardization, with material open to outside groups or limited to participants as appropriate.

Project 4: Establish an alert system for information on relevant decisions and data from IEA tasks, TC standardization groups, and certification bodies (Solar Keymark, SRCC, Office of Australian Renewable Energy Regulator) to actively notify interested parties of developments rather than relying on their searching for the information.

Project 5: Establish a regular forum for participants and outside persons to pose questions or make suggestions regarding testing and certification processes so that developers of new technologies have an entry point into the testing and certification process, and existing technology practitioners have a place to raise questions or provide input.

Project 6: Organize joint meetings in conjunction with Solar Keymark networking or other events (Standardization Technical Committee meetings) to promote ongoing action to harmonize standards, testing and certification. Organize more meetings with broad international appeal and dispersed locations like ISES meetings. Work to make standards and testing a distinct track in larger meetings.

- (a) *Main activities*
- (b) *Sub-activities*
- (c) *Workshops and seminars*
- (d) *Participants and/or experts' meetings*
- (e) *Publications/Newsletters]*

#### **4. Expected Results/Deliverables**

*[Provide a short description of the specific results and/or deliverables expected from the carrying out of the activities under this Annex. If feasible, indicate also the schedule of achievement of such results and/or deliverables and the expected budget for the implementation of this Annex.]*

#### **5. Rights and Obligations of Participants**

*[Provide a short description of the specific rights and obligations of the Participants in this Annex, in addition to those already contained in the main body of the Implementing Agreement. If applicable, indicate the allocation of work among the Participants, if the Annex is task-shared or cost-shared, the funding obligations of Participants, if any, etc.]*

#### **6. Management**

*[Provide a short description of the management structure and functioning of the activities under this Annex in addition to those already indicated in the main body of the Implementing Agreement. In particular, specify, if applicable:*

- (a) *The identity of the entity or individual responsible for the management and for the leadership of the activities carried out under this Annex;*
- (b) *The Operating Agent's rights, obligations and responsibilities in addition to those indicated in the main body of the Implementing Agreement and the organisation of the work under this Annex (regarding, for instance, his remuneration and reimbursement of expenses, the preparation of a detailed programme of work and budget in consultation with the Participants under this Annex, the preparation and distribution of assessments, reports, newsletters or other information, the organisation of meetings, workshops, seminars, training sessions, the preparation of guidelines for the work to be carried out under this Annex, the management of a common fund, if any, etc.);*
- (c) *Operating Agent's meetings;*
- (d) *The rights, obligations and responsibilities of Task Leaders and Sub-task leaders, if any (see examples under letter (b) above);*
- (e) *The content and schedule of assessments, reports to be submitted by the Operating Agent and by the Task and Sub-task leaders to the ExCo, the Working Party, the CERT and/or the IEA, newsletters.]*

#### **7. Admission, Participation and Withdrawal of Participants**

*[Provide a description of specific terms and conditions of admission, participation and withdrawal of Participants in this Annex, if any, in addition to those already indicated in the main body of the*

*Implementing Agreement. For instance, regarding the secondment, assignment or exchange of personnel, the supply or exchange of equipment, etc.]*

## **8. Information and Intellectual Property**

*[Provide a description of the specific terms and conditions for the use, communication, publication, reproduction, licensing and/or sale of the information, data and/or inventions produced under this Annex and of any intellectual property rights in connection to this Annex. As a matter of example, indicate:*

- (a) contractual, commercial, customary or legal restrictions in connection with proprietary information and intellectual property rights, including any confidentiality obligation;*
- (b) the allocation of intellectual property rights among current and future Participants, including for the case of withdrawal of a Participant or of the termination or expiry of this Annex;*
- (c) any exclusive or non-exclusive licenses.]*

## **9. Entry into Force, Term and Extension**

This Annex shall enter into force [on [date] upon the date the IEA Executive Director received the second Notice of Participation], and shall remain in force [for a period of [number] years/until [date]. At the conclusion of that period, this Annex can be extended by at least two Participants, acting in the Executive Committee, for a period to be determined at that time, provided that in no event shall the Annex continue beyond the current term, or actual termination, of the Implementing Agreement.