SMB/3321/R

STRATEGIC POLICY STATEMENT

IEC/TC or SC	Secretariat	Date
TC 82	USA	June 2005

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Title of TC
Solar photovoltaic energy systems

A. Background

TC 82 was established in 1981. Its scope reads as follows:

To prepare international standards for systems of photovoltaic conversion of solar energy into electrical energy and for all the elements in the entire photovoltaic energy system.

In this context, the concept "photovoltaic energy system" includes the entire field from light input to a solar cell to and including the interface with the electrical system(s) to which energy is supplied.

NOTE 1: It is recognized that there is some common interest between TC 47 and TC 82, therefore these two Committees shall maintain liaison.

NOTE 2: Solar cells, except those used in the generation of power, which are specified as components for purposes of direct trade are excluded from the scope of TC 82.

It is recognised that there will be common areas of interest between TC 82 and other technical committees such as TC 8, TC 21, TC 22, TC 57, TC 64, TC 88 and TC 105. Therefore, all interested parties should be vigilant for such overlapping interests and be prepared to share expertise and avoid conflict and duplication of effort. A joint working group has been already established with TC 21 for storage batteries used in PV systems, and a joint co-ordinating group with TC 21, TC 88 and TC 105. TC 82 will be exploring closer interaction with other committees, including TC 4 (small hydro-electric), TC 8, TC 22, TC 57, TC 64 and TC 77 (EMC).
The relatively small number of industry experts against the backdrop of a rapidly growing and highly competitive global marketplace mandate TC 82 coordination and resource leveraging with organizations outside of the IEC. To that end, TC 82 has established liaisons with the European Union's PV Joint Research Centre (JRC) at Ispra (Category A), the International Energy Agency (IEA) PVPS (photovoltaic power system) co-operation programme (Category A), and the Global Approval Program for Photovoltaics (PV GAP) (Category A).

B. Environment

B.1 Business environment

PV is a new technology that challenges the conventional approach to energy sources and power systems (e.g. fossil fuel powered generators, transmission lines and grid extensions). PV has already proven itself cost effective in many off-grid applications. It is also an industry sector where R&D still plays an important role as it is a hybrid of the semiconductor and energy related industries

International development funding agencies are increasingly incorporating PV systems into their aid projects for many applications including lighting, water pumping, vaccine cold chain facilities, communications and rural electrification.

Stand-alone PV systems are being deployed throughout the industrialised and developing world on a commercial scale. PV grid connected systems are rapidly increasing in numbers supported by government sponsored programmes in Australia, Europe, Japan and the USA. The bulk of these systems are located on residences and public/commercial/industrialised applications. Installations of large scale centralized PV power stations, typically owned by utilities, continue very slow rate, although using large amounts of PV with each installation.

B.2 Market demand

Product demand – The PV industry has exhibited a steady growth rate of over 15% per year over the past 20 years, with accelerated growth rates ranging around30- 40% in the industrialised nations over the past 4 years. Today the global market demand for PV exceeds $5 Billion annually. Manufacturers have aggressively scaled up to address this demand. Near term forecasts suggest a close match between supply and demand. The market for PV has developed in both industrialised countries and in the developing countries where off-grid and hybrid village grid electrical services are now becoming available to thousand of remote villages. Such rural populations of developing countries without the benefits of grid connections can obtain an electrical supply from stand-alone PV systems with their inherent advantages of modularity and independence from imported fuels.

Standards demand – Initially, PV standards were developed by a number of countries and standards organisations due to their immediate need for standards and the lack of IEC published documents. Many of these early standards and qualification procedures were developed as part of the procurement process for national and international PV demonstration programmes. However, with the current level of PV standards published by the IEC reaching nearly 30 in number with another 10 or so nearing IEC publication, the incentive and need for local countries to prepare their own standards has dramatically diminished. Many IEC standards are now available for referencing, or are being accepted as National Standards in the various countries.

B.3 Trends in technology and trade

Crystalline silicon photovoltaic modules are still the dominant commercial type, but thin film photovoltaic modules have improved considerably and have established a substantial market in consumer products.

Many types of thin film amorphous silicon and other compounds such as CdTe, CIS and $CuInSe_2$ are now available. Applications for these include building facades, which serve as architectural features as well as power producing elements.

Beyond the PV module, there are also host of trends involving the other components and overall system design required to translate the power produced from the module into useable power for the application. They include:

- More often than not, the source of problems in fielded systems is either inadequate system design or failure in the power electronics (e.g. charge controller, inverter) or battery system. While many Thin-Film technologies have yet to prove their reliability in industrial applications, most crystalline modules have establish a respectable track record.
- Technological trends in power electronics, data monitoring and energy storage all provide opportunities for more efficient, diverse, cost-effective and “dispatch-able” PV systems.
- Combined with technological developments and standards, trends in higher quality power requirements, cleaner sources of power and distributed generation also provide opportunities for an increased number of PV based applications.
- Indications of a shift from small individual solar home systems in the developing world to larger “mini” or community power plants with the potential for creating mini-grids that in turn can be networked.

Major industrial firms have recently recognised the industrial potential of PV and are vastly increasing usage, integration into their product portfolio and/or construction of major production facilities. This complemented by a high degree of commitment for support of photovoltaic technology by continued commercial and government support. This increase in the global PV demand and production capacity indicates an industry poised for sustained, significant growth and contribution to the global economy. Whether or not this becomes a reality, depends in large part on the industry's ability to sufficiently address key "barriers"(e.g. interconnection, trained workforce) and avoid major pitfalls (e.g system failures, safety issues).

B.4 Ecological environment

The operational impact of PV systems on the natural environment is generally minimal and considered benign. PV is one of the most attractive of the renewable energy sources from the environmental point of view as the PV systems have no moving parts and create no waste effluent or residue for disposal in their daily operation.

The processing of the PV devices and the disposal of storage batteries and some PV devices (such as those containing Cadmium) are the main environmental hazards to be considered in the technology. Recycling processes for current technology batteries, both lead-acid and nickel cadmium are already well established and would appear to require no special consideration. New storage technologies may require special treatment and will be assessed as they are introduced.

The issue of toxicity in the production process and recycling of dangerous products will need to be addressed. In addition, the issues of environmentally acceptable packaging materials, visual pollution, and electromagnetic interference (EMI) are being examined.

ISO standards of environmental management systems will be examined in the future for applicability to PV modules, components and systems. PV standards may be required to comply with the requirements of "Performance evaluation" and/or " Life Cycle Assessment" sections.

C. Work programme

Current work

See Annex A

C.2 Resources/infrastructure needed

Present resources - TC 82 has grown from a small technical committee with 2 working groups (PV Modules and PV Systems) and about 30 experts to the present 7 groups and 146 participants:

Working Group 1 (Glossary) – 9 experts;
Working Group 2 (Modules) – 19 experts;
Working Group 3 (Systems) – 31 experts;

Working Group 6 (Balance-of-system Components) – 24 experts;
Working Group 7 (Concentrators) – 8 experts;
Joint Working Group - Batteries – Joint Working Group - TC 21/TC 82 – 4 TC 82 experts.
Joint Coordinating Working Group - Recommendations for small renewable energy and hybrid systems for rural electrification, JCWG TC82/TC21TC64/TC88 – 24 experts.

Future resources - Additional resources in the form of working group personnel are required to work on EMC (electromagnetic compatibility) and other man-made environmental effects such as pollution, waste disposal, etc. Therefore, a new TC 82 Working Group on man-made environmental effects is being considered. The EMC issue is included in the subject of an IEC parallel committee on safety, ACOS, and of an IEC Technical Committee, TC 77. Any TC 82 work will be co-ordinated with these other committees. Similarly, man-made environmental issues are the subject of another IEC parallel committee, the ACEA. This work, therefore, will fall under their guidelines (see IEC 60947).

All TC 82 working groups plan two meetings per year except for the joint TC21/TC82WG on batteries for PV systems usually meets only once a year. Project teams within the working groups have been created to facilitate timely completion of the documents. Due to the financial restraints and limitations on time for international meetings, it is expected that more homework will be required of the participating experts and that electronic mail communication will play a much larger role in this work of standard preparation. Initial contact is being made currently between some of the experts with this technique and it is forecast to increase significantly in the near future.

D. Future work

Many of the initial IEC PV documents were restricted to crystalline silicon devices for simplicity. These documents will need to be amended to accommodate new thin film devices. Current work anticipates this need and provisions are included to consider improvements or changes in the device technology.

WG 1 will continue to add new terms, symbols, and graphics to the IEC 61836 Guide as future TC 82 standards are approved for publication. In addition, a more world-wide set of definitions of the terms and symbols used in PV technology will be incorporated in this guide.

The highest priority in WG 2 will be the preparation of standards addressing the safety of PV modules, particularly for high voltage grid connected applications of grid-connected systems. WG 2 will also develop an energy rating standard to define performance for standard days of high and low ambient temperature and irradiance rather than relying on a single power rating. WG 2 will also revise and correct the translation equations that are used to compare the I-V curves measured under field operating conditions with factory measurements made under Standard Test Conditions (STC).

WG 3's top priority a standard for defining the performance and test requirements for small, stand-alone PV systems is nearing final publication, as well as the second edition of its standard for connecting to the electric grid.. WG 3 will also address the safety issues for all types of PV systems. Standards for individual systems, guidelines and requirements which are applicable to specific Performance monitoring, efficiency measurements and acceptance testing at the system level are moving into a position to receive higher attention.

Working Group 5 has completed its work in helping to set up a conformity assessment body within the IECEE and has therefore been disbanded.

Working Group 6 will prepare standards for the balance-of-system components. Its highest priority is the standard defining safety of grid-connected inverters. As this standard is completed, similar standards dealing with charge controllers will take precedence. The standards from WG 6 will define the requirements and test procedures for determining the component performance, safety and environmental reliability. Safety guidelines and requirements will also be developed to specify the electrical and mechanical construction characteristics.

Working Group 7 will prepare standards for concentrator PV systems to define the requirements and test procedures for determining the module and system performance, safety and environmental reliability. Safety guidelines and requirements will also be developed to specify the electrical and mechanical construction characteristics for concentrators.

The JCWG TC82/TC21/TC88/TC105/TC64 will continue to prepare a series of recommendations for small renewable energy and hybrid systems for rural electrification systems employing PV, wind, fuel cells and/or batteries. The co-operating TC's in the JCG will be responsible for the specific technical requirements of each technology with the JCG providing a co-ordinating function. The JCWG will also consider topics that apply to all technologies such as project management, project integration, safety and data systems. The group will endeavour to involve other TC's such as TC 4 and TC 64.

To respond to the increasing market and international exchange of PV products, the PV standards being prepared must have a certain flexibility to be able to follow the evolution of the technology. Consideration must also be given to the natural environmental impact issues of manufacturing and disposal of PV products.

Other international organisations such as the International Energy Agency (IEA) have initiated PV programmes to promote the technology and closer liaison (Category A) is deemed necessary to maximise the value of the work done under all the programmes. Surveys done by others of PV system failures for instance could be valuable sources of information to improve qualification and standard requirements.

Future work items will include:

- System commissioning, maintenance and disposal;
- Updates of existing publications;
- New thin film photovoltaic module technologies such as CdTe, CIS, $CuInSe_2$, etc. characterisation and measurement
- New technology storage systems;
- Applications with special site conditions i.e. tropical zone, northern latitudes and marine areas;
- Life cycle and disposal analysis for impact on natural environment.

E. Maintenance cycle

Publication no.	Date of publication	Review date	Maintenance result date	Responsibility (Maintenance Team)
60891	1987	2004	2005	WG 2
60904-1	1987	2004	2005	WG 2
60904-2*	1989	2004	2005	WG 2
60904-3	1989	2003	2005	WG 2
60904-5	1993	2004	2005	WG 2
60904-6*	1994	2004	2005	WG 2
60904-7	1998	2004	2005	WG 2
60904-8	1998	2004	2005	WG 2
60904-9		2004	2005	WG 2
60904-10	1998	2004	2005	WG 2
61173	1992	2005	2006	WG 3
61194	1992	2004	2005	WG 3
61215	1993	2003	2004	WG 2
61277	1995	2002	2003	WG3 (Spooner)
61345	1998	2004	2005	WG2 (Wohlgemuth)
61345	1998	2004	2005	WG 2
61701	1995	2004	2005	WG 2
61721	1995	2004	2005	WG 2
61724	1998	2004	2005	WG3 (Infield)
61725	1997	2004	2005	WG3 (Boulanger)
61727	1995	2003	2004	WG3 (Chalmers)
61829	1995	2002	2003	WG3 (Ossenbrink)
61836	1997	2001	2005	WG 1