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Collaboration on Renewable Energy Standards, Testing, and Certification under the U.S. China Renewable Energy Partnership

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WREF 2012: COLLABORATION ON RENEWABLE ENERGY STANDARDS, TESTING, AND CERTIFICATION UNDER THE U.S. CHINA RENEWABLE ENERGY PARTNERSHIP

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ABSTRACT

During November 2009, the U.S.-China Renewable Energy Partnership agreement was authorized in Beijing by Presidents Obama and Hu from the U.S. and China. One of the principal tasks under this new program is the collaboration of the United States and China on the topic of renewable energy standards, testing, and certification with an initial focus on solar PV and wind topics. Rapid development of renewable energy technologies and markets, particularly for wind and solar applications, has created demands for new and updated standards in both countries, consistency between testing center results, harmonization of standards and certification processes, and potentially mutual acceptance of testing and certification results. This paper will describe and discuss the activities that address these issues, which have taken place under the bilateral collaboration.

1. INTRODUCTION

China's rapid growth in the manufacturing and deployment of renewable energy technologies, particularly wind and solar, is creating internal demands to solve technical issues representing barriers to domestic market expansion, and to more actively integrate with the international community in collectively addressing standards, testing and certification issues. Within the past few years, China has become the leading country for wind power installations, 18 GW in 2011 for a cumulative total capacity of 62.7 GW (1), and is the leading manufacturer of solar PV modules, 14.2 GW in 2010 (2), with a rapidly growing emerging domestic grid-connected market. Cooperation at the international level is becoming increasingly more important to develop solutions for standards, testing and certification issues, and as two of the leading countries for renewable energy development and deployment, China and the United States are important partners in this process.

One of the mechanisms for specific cooperation between the United States and China is the U.S.-China Renewable Energy Partnership (REP), which was established by a Memorandum of Cooperation (MoC) signed in 2009 by the U.S. Department of Energy and the Chinese National Energy Administration (NEA). Five active areas under the agreement include: i) policy, ii) solar research and development, iii) wind research and development, iv) grid integration, and v) standards, testing, and certification. Cooperation in principle for wind and solar standards, testing, and certification is focused on work within the framework of existing international organizations.

2. SOLAR AND WIND STANDARDS

2.1 Cooperation Framework

Under the U.S.-China Renewable Energy Partnership, the U.S. Department of Energy through the National Renewable Energy Laboratory (NREL) is supporting cooperation with China for standards, testing, and certification focusing on solar PV and wind technologies. The China General Certification Center (CGC) in Beijing is the lead organization for this cooperation on behalf of the Chinese NEA. CGC provides the necessary linkages with the national standards organizational structure in China shown in Fig. 1 and Table 1. CGC also provides linkages to a number of international organizations involved in the REP cooperation.

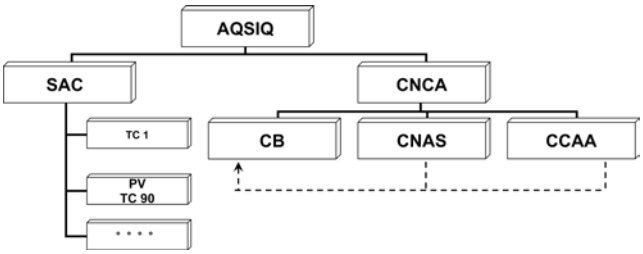

Fig. 1: Relationship of Chinese standards organizations

TABLE 1: STANDARDS ORGANIZATIONS IN CHINA

AQSIQ	General Administration of Quality Supervision, Inspection and Quarantine
SAC	Standardization Administration of China
CACA	Certification and Accreditation Administration
CB	Certification Body
CNAS	China National Accreditation Service for Conformity Assessment
CCAA	China Certification and Accreditation Association

CGC is the key organization in China for solar PV and wind certification. As well as working directly with industry and with testing centers in China, certification organizations can also operate their own testing centers and can be involved in or lead new standards development. For example, the CGC provides PV module certification under its Golden Sun label; it also operates a large-scale wind blade test center in Baoding, China; and it is involved in developing new solar and wind standards.

The development of domestic standards in China is robust and can be classified as national and industry standards. Certification regulations are also developed for product certification. In the Renewable Energy Partnership, the focus of cooperation with China is participation in international standards bodies, e.g., the International Electrotechnical Commission (IEC), and with international standards and testing and advisory organizations, e.g. Underwriters Laboratories (UL) and the International Energy Agency (IEA). Technical committees under the Standardization Administration of China (SAC) perform similar functions as technical committees in international bodies; e.g., SAC's TC 90 parallels the IEC's TC 82 solar committee in overlapping interests.

The membership of the working group under the Renewable Energy Partnership currently consists of NREL, Underwriters Laboratories Inc. (UL), Intertek, CGC, TÜV Rheinland Photovoltaic Testing Laboratory LLC (TÜV PTL), and the China Electric Power Research Institute (CEPRI). The list is expanding. The Renewable Energy Partnership also cooperates with solar and wind standards activities of the Energy Cooperation Program (ECP) in Beijing, which is an organization of U.S. companies with business interests in China (3).

2.2 Solar Standards Cooperation

In China, the solar standards cooperation effort under the Renewable Energy Partnership is led by CGC; and NREL coordinates U.S. efforts. Globally, China leads solar PV module production and is undergoing rapid expansion in its domestic market development, with large grid connected PV power plants and large-scale PV building integrated systems being actively supported by China's Golden Sun program (4). The volume of manufacturing production and acceleration of system deployment have created technical problems that call for urgent attention and near term solutions. Among these issues are needs for quality control in manufacturing and quality assurance standards, improved component and system testing and certification procedures in accordance with international standards, and new system acceptance and grid interconnection standards for solar PV systems.

During the IEC TC 82 meeting in May 2011 in Shanghai, visits of experts from NREL and UL to Chinese companies and standards experts facilitated U.S.-China cooperation on solar standards. Table 2 provides a subset of mutual standards interests identified during these visits. Mutual interests cover a broad range of issues across the value chain for solar PV commercialization, including materials standards and PV module quality assurance standards, rating systems, and test procedures; balance-of-system component standards for inverters; and standards at the system and grid-interconnection levels. As installed PV systems become larger and represent a significant penetration on local and regional grids, utility companies are also becoming more concerned with the operation of intermittent resources on grids. As a result of the increasing interest in China's participation in the IEC, active membership has increased to 28 members in 2012 participating in TC 82 working groups 1, 2, 3, 6 and 7.

TABLE 2: U.S.-CHINA MUTUAL INTERESTS IDENTIFIED IN 2011 DISCUSSIONS ON STANDARDS

Standard Area	**IEC Working Group/Other**	**Description**
New PV Module Rating System and QA Standards	WG-2	NREL and Japan National Institute for Advanced Industrial Science and Technology (AIST) initiative for new rating system for assessing PV module performance for development of QA standards
PV Module Materials Standards	WG-2	New standards for materials in PV modules including encapsulants, backsheets, edge seals and adhesives; and testing methods for TCO and antireflective coatings on glass. China is also interested in i) light induced degradation, ii) curing EVA; and iii) nominal operating cell temperature for BIPV systems.
Inverter Qualification Tests	WG-6	Revision of IEC 62093 standard (inverter standard and qualification test)
Module System Bias Voltage Test Method		Test method for system bias voltage stress effects and module system bias degradation mechanisms and tests as part of the revisions to edition 3 of IEC 61215
PV System and Grid Integration Standards	WG-3	Systems acceptance and grid interconnection
Accelerated Aging Standards	WG-2	Accelerated aging for PV modules; specific interest of CGC
Grid Interconnection Standards	IEEE	Standards for grid connection for experimental testing and verification of all aspects of grid equipment; power quality; relay protection; voltage/active power; security; stability; anti-islanding

2.3 PV Module Quality Assurance Task Force

One specific standards initiative that is being assisted by the Renewable Energy Partnership is the development of a new international PV module rating system and quality assurance standards, initiated by NREL and AIST. The objective of the initiative is to develop a new PV module rating system to assess PV module durability over decades of exposure to regional stresses under variable climatic conditions. This goes beyond the IEC 61215, IEC 61646, and IEC 62108 qualification test standards that set a minimum design criterion. The development of a single set of test procedures to improve the accuracy of quantitative PV lifetime predictions would meet not only the needs of PV manufacturers, but also reduce risks for investors, insurance companies, project developers, and the design of incentive programs. New quality assurance standards will relate to reliability of module design, quality assurance in module manufacturing processes, and test procedures.

International participation in the new initiative is facilitated by the establishment of a PV Quality Assurance (QA) Task Force and interactive website (http://pvqataskforceqarating.pbworks.com). Six task groups address: i) guidelines for manufacturing consistency, ii) testing for thermal and mechanical fatigue, iii) testing for humidity, temperature, and bias, iv) testing for diodes, shading and reverse bias, v) testing for UV, temperature, and humidity, and vi) communication of the

results. Under the Renewable Energy Partnership, an outreach effort was directed at Chinese companies and standards experts throughout late 2010 and 2011, resulting in significant Chinese participation and support of the initiative; including, CGC, Trina Solar, QC Solar, and Yingli Americas.

2.4 Wind Standards Cooperation

Due to the rapid development of wind technology and large scale deployment of wind in China, there is a concurrent rapid development of China's system of national and industry standards to keep pace with changing needs. The Renewable Energy Partnership exchanges information with the China General Certification Center and the Standardization Department of the China Electrical Equipment Industry Association to identify existing standards and monitor the development of new standards in the wind industry. There is a focus on standards associated with large-scale grid connected technologies, but small wind turbine standards are also of interest.

A priority of the Renewable Energy Partnership is participation in international standards bodies, such as the IEC, for direct cooperation in the wind sector. One example of China and United States cooperation is joint participation in the IEC TC88 PT5 for wind turbine blade development. Project Team 5 (PT5) covers a technical scope of blade design, blade manufacturing requirements, test methods, blade handling, and field operation and maintenance, and the chairman and secretary of PT5 are from China and the United States respectively.

3. TESTING COLLABORATION

3.1 U.S. and Chinese PV Test Center Collaboration

Cooperation between PV testing centers in the United States and China under the Renewable Energy Partnership was initiated in 2009 with exchanges between NREL's PV Outdoor Test Facility (OTF) in Golden, Colorado, and the Chinese Academy of Science (CAS) system of PV test centers managed by the Institute for Electrical Engineering in Beijing. The CAS test centers reside in Beijing, Nanjing, Xining, and Lhasa.

Test center research collaboration consists of: i) comparison of cell and module calibration procedures and exchange of calibrated samples, ii) examination of standardized cell/module measurement and test procedures and recommendations for improvements in implementing relevant standards and best practices, iii) checking calibrations of solar simulators for indoor measurements and solar radiation measurements for outdoor tests, and iv) examining challenges for differences in test conditions in north and central China vs. dry, high altitude conditions in western China for outdoor measurements. NREL also has had long term collaboration with the National Institute of Metrology in Beijing for exchange of calibrated cells.

3.2 PV Round Robin Test Activity

During 2011, the China General Certification Center initiated the organization of a PV module and cell round robin test activity, which was formally announced in Dezhou during December 2011. The lead organizations for this activity are the China National Accreditation Service for conformity Assessment (CNAS), the China National Institute of Metrology (NIM), and the China General Certification Center (CGC). NREL will serve as an advisor to the activity and will be one of the participating test centers under the Renewable Energy Partnership. China is conducting the round robin testing as an international activity with prospective participating test centers in China, including Taiwan, Japan, Germany, and the United States.

The objectives of the PV round robin test activity are: i) to compare and assess the level of conformity between Chinese PV test center testing procedures and results, both internally and with international test centers, ii) identify and quantify sources of discrepancies in the test data, and iii) recommend improvements in testing and calibration procedures, test center operations, and system for monitoring testing centers and their accreditation and use of testing results for PV module certification in China. Test centers will follow the IEC 60904-1 measurement of photovoltaic current-voltage characteristics international standard.

3.3 U.S. and Chinese Wind Test Center Collaboration

Mutual interests between Chinese and U.S. wind testing centers accommodate the full range of testing across the value chain for component development, turbine assembly, field testing, deployment and commercialization; including, wind turbine blade testing, dynamometer testing, turbine type testing, and certification. Mutual interests include consulting in setting up new test centers; comparing test procedures and results; cooperation for round robin testing, of actual components or review of test results; and exchange of personnel to share experiences between test centers.

Under the Renewable Energy Partnership, information exchange has occurred between the testing facilities of NREL's National Wind Technology Center in Golden,

Colorado and several test centers in China under the Chinese Academy of Sciences Institute for Electrical Engineering (dynamometer testing) and Institute of Engineering Thermophysics (blade testing), the China Electric Power Research Institute (field testing), the China General Certification Center (blade testing), and others.

For blade testing internationally, there are only a few test centers capable of accommodating the new large blades under development for large capacity and offshore wind turbines. The Massachusetts Clean Energy Center Wind Technology Testing Center (WTTC) is operating a Large Blade Testing Facility, supported by the U.S. Department of Energy, capable of testing blades up to 90 meters. Representatives of this center are discussing collaboration with a new, large-blade testing center in Baoding under the China General Certification Center, including technical staff exchanges and implementation and interpretation of the IEC 61400-23 international blade test standards.

4. CERTIFICATION

Currently for solar and wind technologies, the requirements of multiple testing and certification in different countries represent barriers to the global deployment of renewable energy, adding expense for manufacturers and project developers, and uncertainty for investors, insurers, and other stakeholders. In China the lack of mutual acceptance of test results and certifications between Chinese and other international testing and certification centers is one of the factors that affects both the export and import of renewable energy equipment.

One effort to address lack of transferability of test and certification results is the IEC TC88 committee's effort for harmonizing a number of wind turbine standards and conformity for testing and certification, including a broad range of interested stakeholders. The China General Certification Center is also playing a leading role in China to engage testing and certification centers in Europe and the United States to promote mutual acceptance of solar and wind testing results and certifications. The CGC has signed several agreements for this purpose with Intertek, TÜV Rheinland, and UL.

5. CONCLUSION

Collaboration under the U.S.-China Renewable Energy Partnership is one mechanism that is contributing to the overall framework for cooperation between China and the United States related to renewable energy standards, testing, and certification issues. Active cooperation is being facilitated between solar and wind standards experts and organizations, between test centers, and between certification organizations. The cooperation is also being conducted in principle within the framework of participation in international organizations. Standards, testing, and certification are components of a broader set of issues that impact renewable energy technology development and deployment, financing, and market development. The China General Certification Center is aggressively reaching out to a broad stakeholder group of manufacturers, project developers, banks, financial institutions/investors, insurance companies, and others to encourage communication on standards and certification issues that impact the decision making process of these groups.

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7. REFERENCES

(1) Global Wind Statistics 2011, Global Wind Energy Council, 2012

(2) Shyam Mehta, 27th Annual Data Collection Results, PV News, Greentech Media, 2011, May, Vol. 30 (5)

(3) U.S. China Clean Energy Cooperation, U.S. Department of Energy, January 2011

(4) China's Solar Future: A Recommended China PV Policy Roadmap 2.0, Semi PV Group, April 2011