



rise
Research Institute for
Sustainable Energy



STANDARDS DEVELOPMENT ACTIVITIES 2008

Abstract

This report presents a summary of RISE's involvement during 2008 in the development of standards related to renewable energy systems and components, both in Australia and internationally, via the International Electrotechnical Committee (IEC). It also outlines RISE's planned involvement in standards development work for 2009.

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Table of contents

1. Introduction.....	1
2. Australian Standards	1
3. International Standards.....	4
4. RISE Activities	5
5. Working Documents for TC 82	8
6. Conclusion.....	9

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1. Introduction

New standards are being developed for a range of renewable energy systems and balance of system components as needed, and existing standards are being revised. Ensuring that appropriate standards are in place is of critical importance to the renewable energy industry as it is the means by which the reliability and acceptability of renewable energy systems are improved.

Australia's active participation in the development of international standards ensures that these international standards are suited to the needs of the Australian industry and its climatic conditions. Many individuals in Australia have significant experience in designing, constructing and operating hybrid systems for use in remote areas and have a good understanding of international standards.

The development of standards is very closely linked to the performance testing that is undertaken at RISE and a number of RISE staff members play an active role in this process. RISE participates through its involvement in the following committees:

- [Standards Australia](#)
 - EL-005 - Secondary Batteries
 - EL-042 - Renewable Energy Power Supply Systems & Equipment
 - EL-048 - Wind Turbine Systems
 - Other related committees
EL-001 -- Wiring Rules
- [International Electrotechnical Commission](#)
 - TC 4: Hydraulic turbines
 - TC 82: Solar photovoltaic energy systems
 - TC 88: Wind turbine systems
 - TC 105: Fuel cell technologies
 - Other related committees
 - TC21: Secondary cells and batteries
 - TC64: Electrical installations and protection against electric shock

Solar water heating is another area in which performance, construction and safety requirements are set out in a number of standards. Although RISE is involved in the testing of solar water heaters, it is not involved in the development of standards for them at this stage and so the development of solar water heater standards is not covered in this report.

2. Australian Standards

The development of the standards for renewable energy systems has been progressed through the EL042 committee. The EL042 Committee met twice in 2008; Sydney (27 & 28 March) and Brisbane (23 & 24 July). The work that was progressed or discussed at the meetings is outlined in the following section.

2.1. Documents distributed by the EL042 Committee

2.1.1. Combined Postal Ballot/Draft for Public Comment DR08211 CP

The draft "Inverter – Performance Requirements" specifies performance requirements for single-phase and three-phase inverters intended for use in stand-alone power systems with batteries. RISE was assigned primary responsibility for the development of the draft

standard and the RISE standards team produced several drafts during 2008. These drafts were developed on the basis of results of inverter testing undertaken by RISE together with the feedback from the Committee and other experts. The test procedures specified in the draft standard were further developed and methodologies validated through testing undertaken by RISE.

The most recent draft was released for public comment on 8 of October 2008 with the public comment/voting period closing 19 November 2008. Only minor editorial comments were received and a positive vote for publication. The document is in the final stages of editorial work and is expected to be published during the first semester of 2009.

An example report is available on RISE's website.

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NATA
NATIONAL METROLOGY
ACCREDITATION
Number: 10291

TEST REPORT
Performance of Standalone Inverters to Draft Australian Inverter Performance Standard

Report reference No. REP-R005-T-0006-RevB
Tested by (name + signature) Mehdi Patel
Supervised by (name + signature) Oscar Arzeaga
Approved by (name + signature) Oscar Arzeaga
Date of issue 1-May-2007

Testing laboratory ResLab
Address Research Institute for Sustainable Energy, Murdoch University, Perth WA 6150

Applicant RISE Developmental Test
Address

Test specification
Standard Draft Australian Standard: Inverter - Performance requirements
Test procedure TR-RESL-T-0004 Rev D_ Test procedures for stand alone inverters
Non-standard method N/A

Type of test item
Manufacturer
Model
Serial No
Date of manufacture N/A
Hardware version N/A
Firmware version N/A

Uncertainties
The uncertainties quoted in this test report have been calculated at the 95% confidence level. This means that the chance of the reported value to be in error by more than the stated uncertainty is five in one hundred. All measurements are carried out using equipment that holds calibration traceable to national standards held by the National Measurements Institute.

DC Voltage ±0.2% of reading	Apparent Power ±0.5% of reading
DC Current ±0.3% of reading	Power Factor ±0.01
DC Power ±0.3% of reading	Frequency ±0.03 Hz
AC Voltage ±0.2% of reading	THD (V) ±0.1% of fundamental
AC Current ±0.2% of reading	THD (I) ±0.1% of fundamental
AC Power ±0.3% of reading	Harmonic components ±0.1% of fundamental
Reactive Power ±0.6% of reading	Temperature Rise ± 3 %

rise

Figure 1: Cover page of sample report for SAI test (http://www.rise.org.au/reslab/sample_reports/REP-R005-T-0006-B.pdf)

2.1.2. Committee Draft 4509.1

The AS4509 series of standards relates to the design and installation of stand-alone power systems. These standards, which were originally published in 1999 and 2002, are:

- AS 4509.1-1999 Stand-alone power systems - Safety requirements
- AS 4509.2-2002 Stand-alone power systems - System design guidelines
- AS 4509.3-1999 Stand-alone power systems - Installation and maintenance

At the time that these standards were introduced no other standards were available either nationally or internationally. Industry and various government departments adopted these standards as a basis for growing quality systems. The BCSE (now the Clean Energy Council) uses these standards as the basis for design guidelines and industry accreditation. In 2004-5, 2006, 2007 and 2008, through the PVRP and RRP GP Installation Audit Project, the BCSE inspected multiple installations that had been installed through the PVRP and RRP GP programs. In 2006, the standards committee reviewed the report based on these inspections and became aware of the need to update the standards based on industry experience gained since the initial introduction of the standard.

In May 2008, two public drafts were circulated, as discussed below

DR08125 that combined Parts 1 and 3 into a single Part 1 with a new title [Part 1: Safety and installation].

The main changes were:

- Maintenance has been moved to an informative annex
- Installation of PV arrays refers to AS5033
- Improved guidance on installation of batteries and potentially suitable enclosures
- Updating the standard to align as a companion standard to AS/NZS3000
- It will be a joint AS/NZS standard

The comments received were reviewed and addressed during the EL-042 meeting in Brisbane in July, and a voting draft will be circulated in the first quarter of 2009.

DR08126 is a revised version of part 2. The main comments received relate to the fact that the design procedure is based on d.c. coupled standalone power systems and is not directly applicable to a.c. coupled designs. EL-042-1 is reviewing the design procedure and the progress will be discussed at the next EL-042 meeting in Melbourne in March 2009.

2.1.3. AS/NZS3000

The most important development for the solar PV industry during 2007 was the release of the revised edition of "The Wiring Rules" (AS/NZS 3000:2007). This document is referred to in various state and territory legislation. Section 7 of the revised Wiring Rules now refers (Section 7) to key standards for the installation of PV systems (AS4509.1, AS4777.1 and AS 5033) and photovoltaic arrays (AS5033), elevating adherence to these standards from recommended industry best practice to a regulatory requirement.

Several technical issues relating to the interpretation of the requirements of AS3000 in relation to stand-alone power systems, grid connected power systems and installation of photovoltaic arrays have arisen during 2008. These issues are being addressed by EL-001 in collaboration with EL-042. An amendment to AS/NZS 3000:2007 is already in preparation with input from EL-042. The main areas that require clarification are when a specific standard such as AS/NZS 5033 replace or supplement the requirements of AS/NZS3000.

2.2. AS 61400.2: Wind turbines - Design requirements for small wind turbines

The "AS 61400.2(Int)-2006: Wind turbines - Design requirements for small wind turbines" is an Interim standard prepared by the Standards Australia Committee EL-048, Wind Turbine Systems. This interim standard is identical to the IEC 61400-2, Ed.2 (2006), and can be used by designers, manufacturers, testing laboratories and users. The interim standard provides the requirements for small wind turbines with a swept area up to 200 m². An interim standard is open for comment for 18 months after publication, with the intent of publishing an Australian standard two years after original publication.

2.3. Projects

Ongoing work will continue with the existing projects described in Section 2.1. However the EL042 Committee has also identified the following issues that will need to be addressed in 2009 and the following year. Some of the following standards will also be adopted by NZS as they are revised.

- AS4777 Series: Grid-connected inverters.
 - Part 1 is now referenced by AS/NZS 3000 an editorial review is required to ensure consistency with 3000 phrasing. Appropriate reference and alignment of the standard AS5033 is required and all PV array installation requirements need to be removed.
 - Parts 2 and 3 need to be reviewed to ensure consistency with part 1 requirements. An example of this is that part 1 requires the inverter to be hardwired into the system. However, Parts 2 and 3 make no reference to allowed connection types. Inverters with various plug and sockets systems have been type tested and subsequently approved by various agencies which the installers have then had to remove to comply with Part 1.
- AS5033 PV Array Installation
 - Correct reference to appropriate module standards
 - Issues with installation in some BI situations
 - Issues with arcing and faults detection
- DR08211 CP
 - Draft approved for publication
 - Published standard during first or second quarter of 2009
- AS 4086.2
 - This is the battery installation standard review of this document may be required due to changes in as 4509.1

An ongoing issue is the requirement of signs within the various standards and the potential for conflicting requirements in the standards. These issues will be monitored and reviewed by the committees as the standards are reviewed in the future.

3. International Standards

3.1. TC82 Distributed Documents (last 12 months)

In 2008 the IEC Technical committee 82 distributed 51 documents. The various stages of each standard project typically progress from:

- NP = New Project Proposal
- CD = Committee Draft
- CDV = Committee Draft for International Vote
- FDIS = Final Draft International Standard or,
- DTS = Draft Technical Specification

The last stage is an international standard or a technical specification. The documents distributed in 2008 included 4 FDIS stage, 1 DTS stage, 3 CDV stage, 2 CD stage and 2 NP stage. The documents distributed have been listed in Section 5.

Documents that RISE staff have been involved with, or have actively contributed to, include:

- IEC 62509 Ed. 1.0 Performance and functioning of photovoltaic battery charge controllers
- IEC 62446 Ed. 1.0 Grid connected PV systems - Minimum requirements for system documentation, commissioning tests, and inspection requirements
- IEC 62253 Ed. 1.0 Direct coupled photovoltaic pumping systems - Design qualification and performance measurement
- IEC 62548 Ed. 1.0 Installation and safety requirements for photovoltaic (PV) generators
- IEC 62109-1 Ed. 1.0 Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
- IEC 62109-2 Ed. 1.0 Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters
- IEC 62109-3 Ed. 1.0 Safety of power converters for use in photovoltaic power systems - Part 3: Controllers
- IEC 62257 TS Recommendations for small renewable energy and hybrid systems for rural electrification

RISE (Oscar Arteaga) is project leader of the IEC 62509 project, which relates to the development of test procedures for PV battery charge controllers and is closely aligned to the work being undertaken by RISE. The standard for PV array installation being developed through the IEC 62548 is essentially an international adoption of the AS5033 standard. Interest and acceptance of the need for this standard has increased over time and this was accepted as a new project in 2007. This project is led by Mr Ted Spooner from the University of NSW, with whom RISE works in the standards development area.

4. RISE Activities

4.1. RISE Staff Involvement

RISE is represented (Oscar Arteaga) on Standards Australia EL-042 Renewable Energy Power Supply Systems & Equipment and is actively involved with the following subcommittees:

- EL-042-01 - Solar Photovoltaic Energy Systems
- EL-042-03 - Grid Connected Systems & Equipment
- EL-042-04 - Inverters for Stand-alone Power Systems

In 2007 a RISE representative (Nigel Wilmot) was appointed as the Chair of the EL-042-03 Committee, which is responsible for maintaining the AS4777 series of standards. Nigel has also been nominated as the Standards Australia EL-042 Committee delegate on the IEC Technical Committee 82 (TC 82) Solar photovoltaic energy systems. The main areas of this involvement are in:

- Working Group 3 “Systems”
- Working Group 6 “Balance-of-system components”
- JWG: JCG TC 82/TC 88/TC 21/SC 21A “Guidelines for Decentralized Rural Electrification (DRE) projects”

RISE is also represented (Dr Hari Sharma) on Standards Australia sub-committee EL-042-03 “Grid Connected Systems & Equipment” and RISE’s expertise on grid-connected inverter testing and on grid connected systems design and certification has played a key

role in revising the AS4777 series of standards. RISE is also involved in revising and testing to support the development of IEC TC82 documents, particularly those relating to grid-connected systems.

RISE is also represented (Oscar Arteaga) on Standards Australia sub-committee EL-042-01 "Solar Photovoltaic Energy Systems" and EL-042-04 "Inverters for Stand-alone Power Systems". RISE has played a key role in the development of the standard "Inverter – Performance Requirements" and has also had a key role in the development of the international draft standard IEC 62509 Ed. 1.0 "Performance and functioning of photovoltaic battery charge controllers". Other involvements include document revision, the development of test methodologies and testing to the standards being developed

RISE is involved (Andrew Ruscoe) in document revision, the development of test methodologies and testing to the standards being developed. The main involvement has been with standards related to grid connected systems and equipment and PV array I-V curve measurements, both in the Australian and international arenas.

4.2. Testing Activities – Current issues and investigations

4.2.1. SAI

RISE tested several battery supplied inverters for use in stand-alone power systems, using both Australian and overseas manufactured systems, in order to develop meaningful test procedures and to establish performance criteria to be used as a benchmark in the Australian standard "Inverter – Performance Requirements".

4.2.2. BCC

Several photovoltaic battery charge controllers have been tested by RISE in order to develop meaningful test procedures and to establish performance criteria to be used as a benchmark in the draft international standard IEC 62509 Ed. 1.0 "Performance and functioning of photovoltaic battery charge controllers".

4.2.3. Arcing and circuit breakers

RISE investigated the rating and suitability of DC circuit breakers and fuses for use within photovoltaic arrays. This investigation is ongoing and stems from work in Australian standards committee on the AS5033. At the ATRAA 2008 conference held in Melbourne, Victoria, RISE gave a presentation on some of the work that it had undertaken on DC arcs from photovoltaic arrays and what happens to incorrectly specified circuit breakers and fuses in DC circuits.

A "Photovoltaic (PV) Safety, Arcing and Fusing" workshop was held at the University of New South Wales on 26 March 2008 with presenters from UNSW, Clean Energy Council, Standards Australia and RISE. The presentation on "Fusing of PV arrays" highlighted the recent investigation conducted at the RISE test centre into the performance of fuses in relation to PV module characteristics. In a typical PV array, short circuit and earth faults create limited currents which may prevent the fuse from operating and breaking the current. So the correct specification and matching of fuses to the PV array installation is an important issue.

Two papers relating to PV array installation safety were authored and co-authored by RISE staff:

Spooner, E., Wilmot, N., 2008. "Safety Issues, Arcing and Fusing in PV Arrays", Paper presented at the 3rd International Solar Energy Society Conference - Asia-Pacific Region (ISES-AP-08), 25-28 November 2008, Sydney, New South Wales.

Calais, M., Wilmot, N., Ruscoe, A., Arteaga, O., Sharma, H., 2008. "Over-Current Protection in PV Array Installation", Paper presented at the 3rd International Solar Energy Society Conference - Asia-Pacific Region (ISES-AP-08), 25-28 November 2008, Sydney, New South Wales.

These presentations and short videos are available on RISE's website (<http://www.rise.org.au/standards/index.html>) and are being used in a variety of TAFE and training courses within Australia. The papers are also available on RISE's website (<http://www.rise.org.au/pubs/index.html>)

4.3. 2009 planned activities

The standards development that RISE will be working on in 2009 are:

- Installation of PV Arrays
 - Fusing
 - Arcing
 - Module requirements
- Photovoltaic battery charge controllers
 - Testing and development of methodologies in response to international comments
 - Development of document to next IEC document stage i.e. FDIS
- Commenting and participation in the development of Australian and international standards as they are distributed.
- Testing of the new tests and procedures contained in international and Australian standards that are being developed.
- Presentation of industry relevant information at workshops and conferences where applicable.

The main meeting of the IEC TC 82 committee in 2009 will be held in September in France and RISE will send a representative to this meeting. A combined working group 3 and 6 meeting will be held in the second quarter of 2009.

It is expected that two Australian Standards meetings will also be held to progress the development of the various standards projects (first quarter and third quarter 2009).

RISE will continue to provide information and advice to members of the Australian industry and to government agencies on the development of Australian and international standards for renewable energy systems.

5. Working documents for TC 82

5.1. Since: 11 January 2008

Distributed Document	Previous Document	IEC Standard	Information
507 RVC	492/DTS	62257-7	New std: <i>Rural electrification Pt 7: Generators.</i>
508 RVC	493/DTS	62257-7-3	New std: <i>Rural electrification Pt 7-3: Generating sets - selection.</i>
509 CC	489/CD	62257-9-6	Proposed Pt 9-6: <i>Selection of Photovoltaic Individual Electrification Systems (PV-IES)</i>
510 DTS	489/CD & 509/CC 532/RVC	62257-9-6	Proposed Pt 9-6: <i>Selection of Photovoltaic Individual Electrification Systems (PV-IES)</i>
511 FDIS	454/CDV & 502/RVC 519/RVD	60904-3	Revision: Measurement principles for PV solar devices
512 FDIS	438/CDV & 499/RVC 528/RVD	61646	2 nd ed: Thin-film modules: Type approval
513 MCR	Sec	TS 62257-7-1	2 ^{no} ed (maintenance revision to simplify): PV arrays
514 CD	481/NP & 497/RVN	62548	New std: Instal'n of PV generators
515 CD	445/NP & 473/RVN 550/CC	62509	New Std: <i>Performance & functioning of PV battery charge controllers</i>
516 DA	503/AC 530/MTG & 548/RM	TC 82	Draft agenda for meetings of TC 82 in San Francisco, 22 & 23 May 08 [Revised agenda + exe file ~8 MB]
517 AC	503/AC	TC 82 & WGs	Information re meetings of TC 82 & WGs, in San Francisco, 19-23 May 08
518 RVC	447/CDV 531/FDIS	62116	New std: <i>Testing procedure of islanding prevention measures for utility interactive photovoltaic inverters</i>
519 RVD	511/FDIS	60904-3	Revision: Measurement principles for PV solar devices
520 INF	506/DC	WG 3	Appointment of Ted Spooner & Martin Cotrell as joint convenors of WG 3
521 INF	Sec	TC 23	Review of the TC 82 Strategic Policy Statement (SPS)
522 NP	WG 2 544/RVN	61853-1	New std: re <i>PV modules Part 1: Performance measurements and rating</i>
523 RVN	482/NP	New	New std: Portable solar lanterns - REJECTED
524 MCR	Sec	61173	Std: <i>Overvoltage protection for photovoltaic (PV) power generating systems – Guide</i> - WITHDRAWN
525 MCR	Sec	61277	Std: <i>Terrestrial photovoltaic (PV) power generating systems - General and guide</i> - WITHDRAWN
526 RVC	501/DTS	62257-9-1	New std re micropower systems
527 PW	CO	TC 82	Programme of Work
528 RVD	512/FDIS	61646	2 ^{no} ed: Thin-film modules: Type approval - APPROVED
529 RVC	458/CDV 540/FDIS	60904-7	Revision: Re Computation of spectral mismatch error in testing PV devices
530 MTG 530A MTG		TC 82	Presentations made at meeting of TC 82 in San Francisco, 22 & 23 May 08 [zip file ~ 10 Mbytes]
531 FDIS	447/CDV & 518/RVC 542/RVD	62116	New std: <i>Testing procedure of islanding prevention measures for utility interactive photovoltaic inverters</i>
532 RVC	510/DTS	62257-9-6	Proposed Pt 9-6: <i>Selection of Photovoltaic Individual Electrification Systems (PV-IES)</i>
533 CDV	479/NP & 496/RVN	60904-4	Revision: re traceability of reference solar devices
534 MCR	Sec	61215	Re Crystalline silicon modules - REVISE
535 MCR	Sec	60904-8	Re spectral response of PV device - REVISE
536 MCR	Sec	61730-1	Re PV modules, requirements - REVISE
537 MCR	Sec	61730-2	Re PV modules, tests - REVISE

538 MCR	Sec	61836	Re terms, definitions & symbols - REVISE
539 CDV	432/MCR	60904-10	Revision: Re linearity measurements
540 FDIS	458/CDV & 529/RVC	60904-7	Revision: Re Computation of spectral mismatch error in testing PV devices
541 MCR	547/RVD	61683	Revision: re power conditioner efficiency - REVISE
542 RVD	Sec	62116	New std: <i>Testing procedure of islanding prevention measures for utility interactive photovoltaic inverters</i> - APPROVED
543 MCR	531/FDIS	60891	Revision: re temp & irradiance corrections for PV devices
544 RVN	551/CDV	61853-1	New std: re <i>PV modules Part 1: Performance measurements and rating</i>
545 MCR	522/NP	60904-5	Revision: re determination of cell temp of PV devices
546 NP	Sec	61853-2	New std: re PV modules Pt 2: Spectral response etc
547 RVD	Sec	60904-7	Revision: Re Computation of spectral mismatch error in testing PV devices – APPROVED
548 RM	540/FDIS	TC 82	Minutes from TC 82 meeting in San Francisco, California USA, from 21 st to 23 rd May 08.
549 DC	516/DA	JCWG 1	Call for Convenor
550 CC	Sec (548/RM issue)	62509	New Std: <i>Performance & functioning of PV battery charge controllers</i>
551 CDV	515/CD	60891	Revision: re temp & irradiance corrections for PV devices
552 RVC	543/MCR	62446	New std: <i>Minimum system documentation requirements for grid connected photovoltaic systems.</i>
553 MCR	486/CDV	62257-4	Reconfirmation: <i>Recommendations for small renewable energy and hybrid systems for rural electrification - Part 4: System selection and design</i>
554 MCR	Sec	62257-5	Reconfirmation: <i>Recommendations for small renewable energy and hybrid systems for rural electrification - Part 5: Protection against electrical hazards</i>
555 AC	CO	TC 82	Invitation to next meeting in Aix-les-Bains, France 28 Sept to 2 Oct 09
556 MCR	Sec	61724	Reconfirmation: <i>Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis</i>
557 MCR	Sec	61701	Revision: <i>Salt mist corrosion testing of photovoltaic (PV) modules</i>
558 FDIS	82/486/CDV 82/552/RVC	62446	New standard: <i>Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection</i>
559 CDV	82/515/CD 82/550/CC	62509	New standard: <i>Performance and functioning of photovoltaic battery charge controllers</i>
560 CD	82/472/NP 82/495/RVN	62253	New standard: <i>Photovoltaic pumping systems - Design qualification and performance measurements</i>

6. Conclusion

Growth in the global uptake of renewable energy technologies such as wind and solar PV systems has been rapid and this is likely to continue or accelerate. In order for this rate of growth to be sustainable, however, safety, quality and reliability standards for these technologies will need to be in place. Australia has considerable knowledge and expertise in the design and installation of these technologies and for this reason Australia has been actively involved in the development of standards for many renewable energy technologies. Australia's participation in the development of standards will need to be increased over the coming years in order to ensure that appropriate standards are developed to support the growth of the Australian industry and to ensure that the needs of the Australian industry and technologies continue to be considered in the development of international standards.