AREP

ASSOCIATION FOR RENEWABLE ENERGY PRACTITIONERS

SOLAR PV RISK INSIGHTS

INSIGHTS ON RISKS ASSOCIATED WITH SOLAR PV AND POSSIBLE MITIGATION STRATEGIES

Prepared by

THE ASSOCIATION FOR RENEWABLE ENERGY PRACTITIONERS

Registered Non-Profit Organisation Nr: 224-033 NPO

ABOUT THE REPORT

The solar and renewable energy industry has grown exponentially over the last 10 years. The rapid rate of growth has outpaced the development and implementation of standards both locally and internationally.

Though there are numerous risks associated with Solar PV in South Africa, the industry has found various effective mitigation strategies.

The Association for Renewable Energy Practitioners (AREP) along with key industry stakeholders have compiled this guide in an effort to assist parties in mitigating risks involved with financing and insuring Solar PV projects.

Project Partners

- Association for Renewable Energy Practitioners AREP
- Energy Industry Ombudsman - South Africa EIOSA
- Aarden Solar
- ARB Electrical Wholesalers
- ElecTech
- Herholdts
- Iseli Energy
- Kathea
- Magneto Renewable Energy
- MSPD Africa
- Rubicon
- Solar Imports

ABOUT

AREP
ASSOCIATION FOR RENEWABLE ENERGY PRACTITIONERS

Home of the P4

The Association for Renewable Energy Practitioners (A.R.E.P) is a non-profit quality assurance organisation reg. nr. 224-033 NPO, created to promote the adoption of Renewable Energy.

As the fastest-growing renewable energy industry body in South Africa with more than 4000 members to date, AREP is in a unique position to positively influence this rapidly growing industry through its focus on quality assurance. AREP primarily serves the industry by offering affordable Solar PV accreditation in the form of the P4 quality assurance program, and sharing relevant industry information.

P4 Program	AREP NPO	Members
Since 2013	Since 2018	4085

EXECUTIVE SUMMARY

The Association for Renewable Energy has found, through analysing the results of its recent *South African Solar PV Repair-and-Fire-Callouts Survey*, that Solar PV holds identifiable risks which could be mitigated through appropriate strategies. This document reports the survey results and gives insights into each risk and its appropriate mitigation strategy.

The two most prominent risk factors highlighted by practitioner respondents relate to the installation phase (refer to page 10) and are *Poor Installation Practices* and *Inexperienced or Unaccredited Installers*.

Though fire is arguably the most publicised risk associated with Solar PV, the survey results did not identify fire as a stand-alone risk and it could potentially rather be viewed as a by-product of other prominent risks.

Though there are numerous risks associated with Solar PV, the industry has developed - and is actively implementing - various effective mitigation strategies. Wide adoption of these strategies is necessary to reduce the overall risk associated with Solar PV.

RESEARCH AND RESULTS

As part of its ongoing research efforts, AREP recently completed a brief *South African Solar PV Repair-and-Fire-Callouts Survey* to shed some light on the post-installation reality of solar systems in South Africa.

About the research methodology and parameters:

1. The survey was conducted amongst 281 individual Solar PV practitioners who are P4 Level 2 Accredited.
2. All candidates received a minimum of 3 prompts to participate.
3. Of the 281 candidates, 144 responded with viable information - 51%
4. All information was gathered within 4 months starting from November 2023 to March 2024.
5. 14% of the candidates responded via email, and 86% via telephonic engagement.
6. All blank or unclear answers were excluded from the report.
7. Where candidates responded with multiple answers to a single question, all responses were reflected in the report.
8. Practitioners were asked to answer based on the length of their entire industry experience.
9. Error margins due to interpretation are considered to be 10% up or down. Error margins are not specifically indicated on the resulting graphs.

About the respondents

All respondents are:

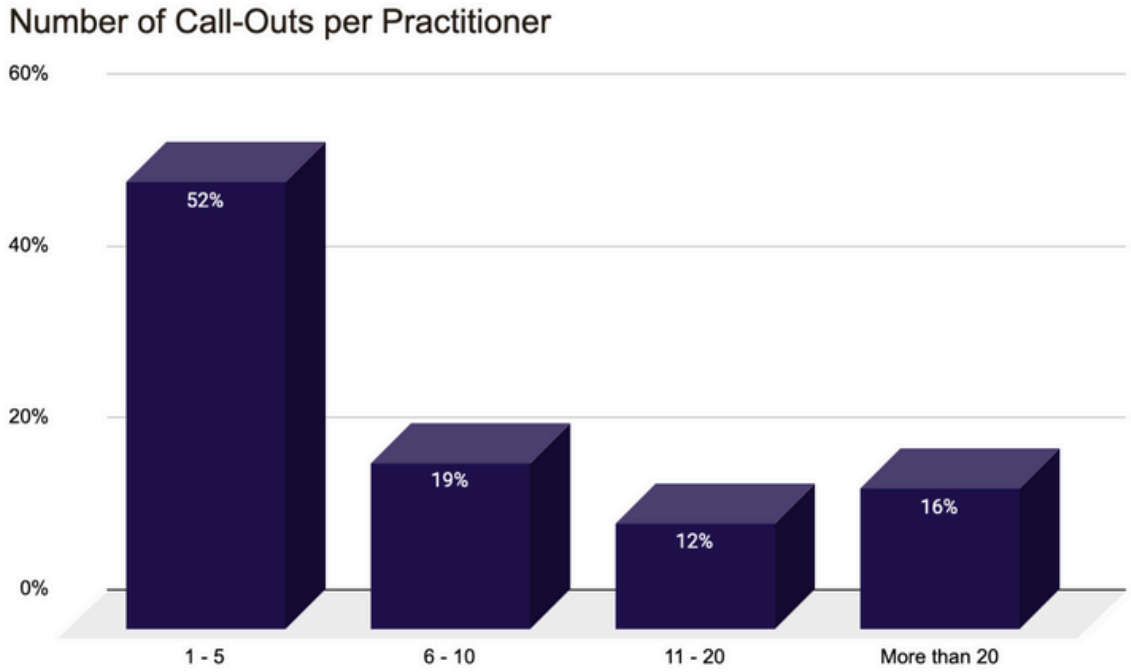
- Actively working in the industry as of the survey date.
- Personally involved in Solar PV installations, maintenance and repairs regularly.
- AREP Registered P4 Level 2 Accredited Practitioners.

With P4 Level 2 Accreditation, practitioners have shown competency in 12 different small-scale residential and commercial Solar PV design and installation principles including Electrical Theory, Module Technology, Irradiation, Surge Protection and Earthing, etc.

Visit P4 Program

About the results

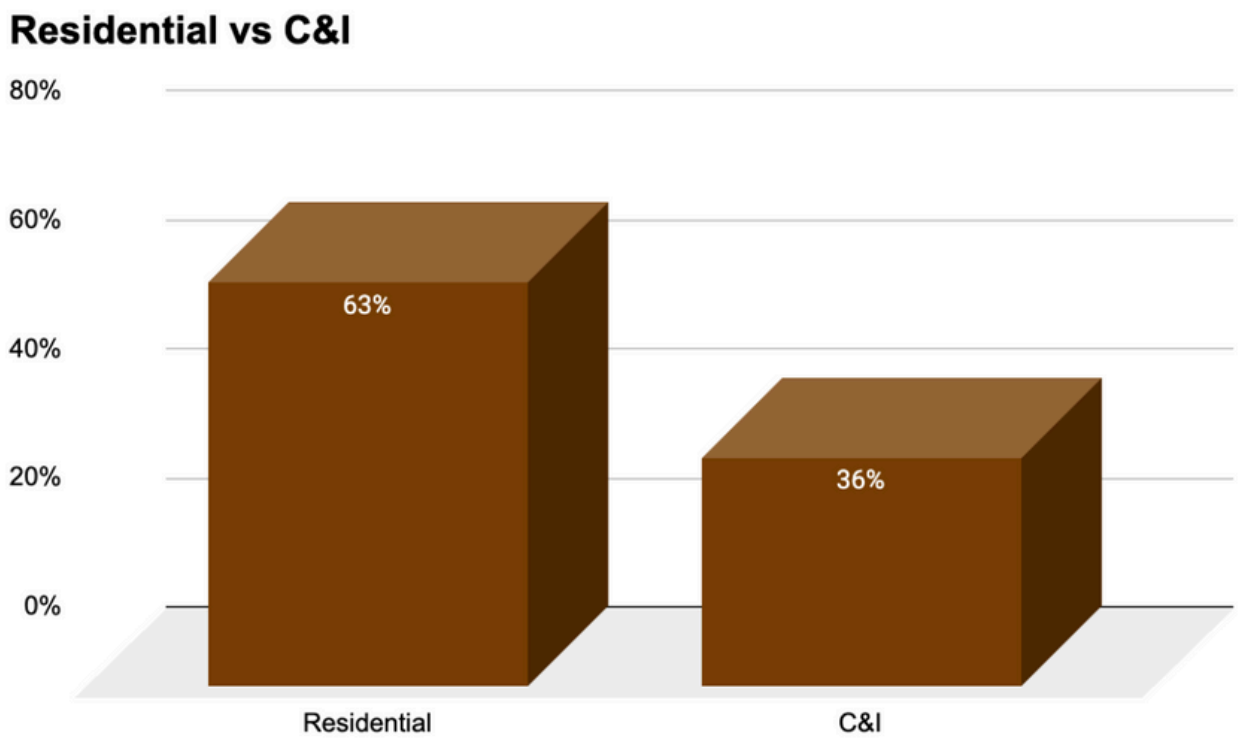
68% of practitioner respondents indicated that they have been called out to inspect or repair faulty or incorrectly installed Solar PV systems during their careers; either their own installations or that of third parties. The majority of practitioners were called out between 1 and 5 times.



Installation Type

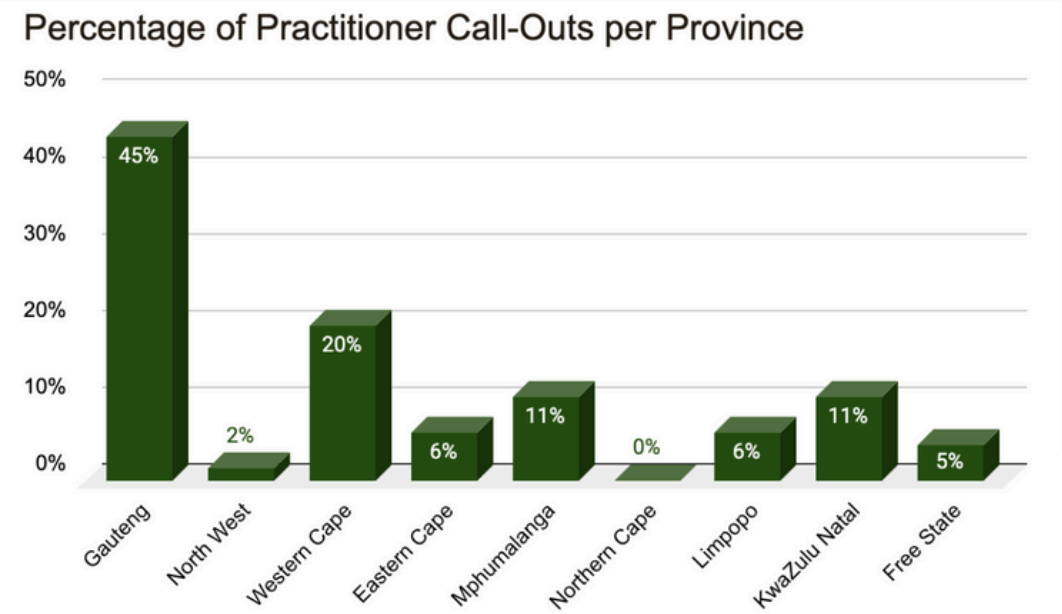
The majority of callouts were in response to residential installations (63%).

A still significant 36% of practitioner respondents reported callouts to Commercial and or Industrial installations.

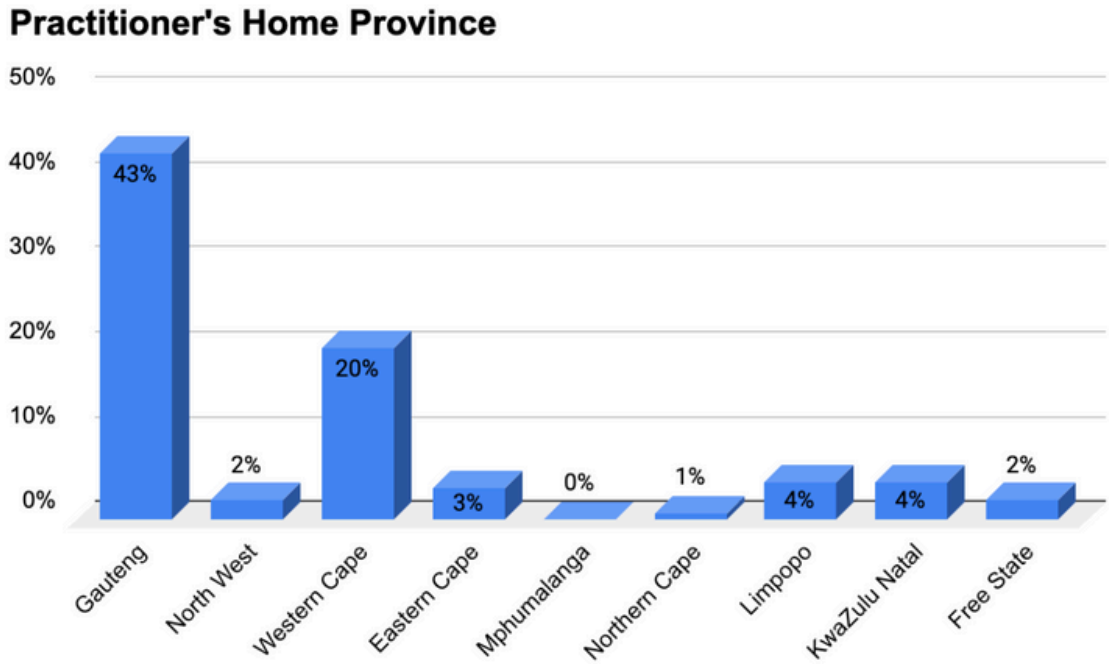


Geographic Locations

The bulk of Solar PV repair callouts occurred in Gauteng (45%), and the Western Cape (20%).

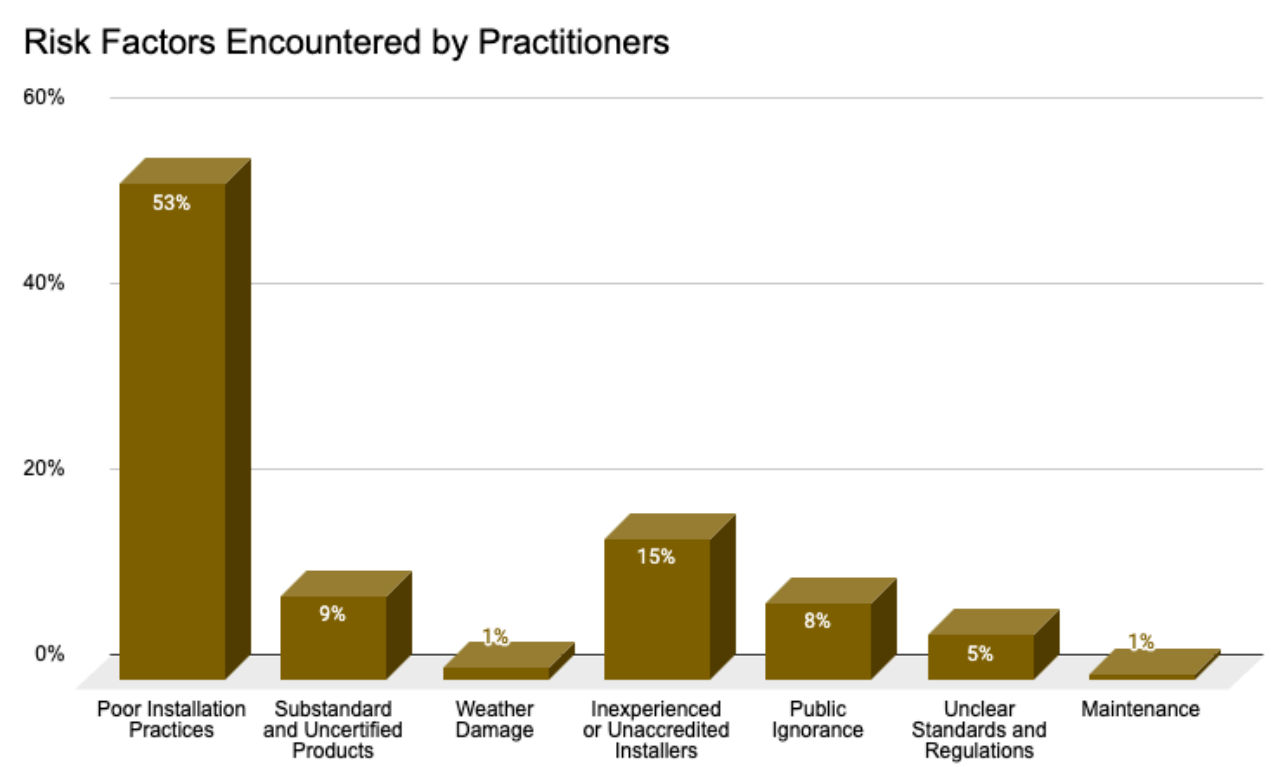


The location of practitioner callouts coincides with respondents' home provinces, with slight anomalies in Mpumalanga and Kwa-Zulu Natal.



Risk Factors

Practitioner respondents highlighted various challenges which were then categorised into identifiable risk factors:

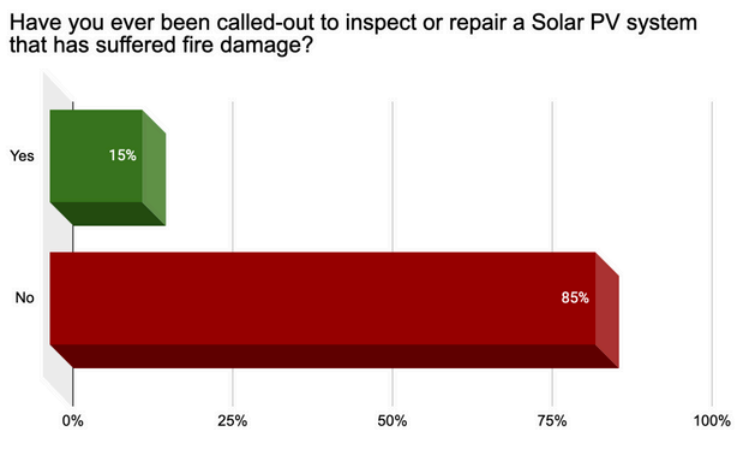


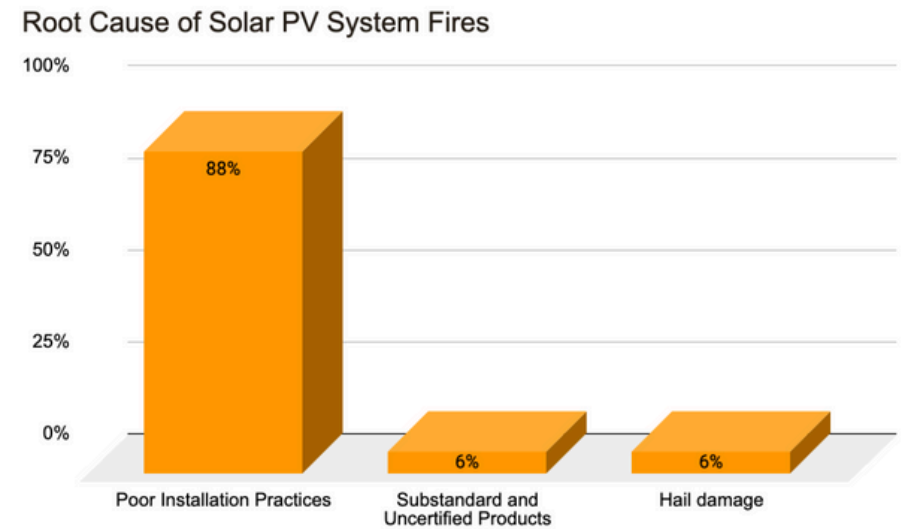
The two most prominent risk factors highlighted by practitioner respondents were *Poor Installation Practices* and *Inexperienced or Unaccredited Installers*.

- *Poor Installation Practices* encompass various issues highlighted by respondents including bad or inappropriate design, loose connections, faulty wiring, incorrect installation of products, general poor workmanship, etc.

Substandard and Uncertified Products came in as the third most prominent risk, followed by Public Ignorance.

- *Public Ignorance* describes where practitioner respondents encountered client/ end-user resistance to good practices, insistence on a specific design or installation not deemed safe or appropriate by the practitioner, incorporation of unsafe homemade additions, unrealistic price expectations, etc.





A note on Solar PV Fires

The survey results did not identify fire as an independent risk factor. 85% of practitioner respondents reported that they had never been called out due to fire damage and of the 15% who were, 88% indicated that the root cause of the fire damage was due to *poor installation practices*. Therefore, fire could rather be viewed as a by-product of other risk factors.

One respondent reported that one *fire started inside the DB box. There were bad connections, loose connections, the AC side had no protection, there were wiring faults*, and *the wrong size wires were used.*

A Note on Lithium Battery Fires

There is a vital difference between instances where a battery's cells burned (in other words, the Lithium cells had caught fire and created thermal runaway), and where battery components other than the cells burned.

Only one practitioner respondent encountered a Lithium battery fire. When asked about the root cause of the fire, the recorded response was: "*Battery burned because of faulty wiring*". No instances of burning Lithium cells were reported.

INSIGHTS

Solar PV Risk Factors in three phases:

Installation

Maintenance

Operation

AREP has identified three phases related to Solar PV projects:

- The Installation phase,
- The Maintenance phase, and
- The Operation phase.

Each prominent risk identified by AREP's *South African Solar PV Repair-and-Fire-Callouts Survey*, has been grouped in a suitable phase.

Additionally, possible mitigation strategies have been researched and compiled for stakeholder consideration.

Risk

Mitigation

INSTALLATION PHASE

Poor Installation Practices

Poor installation practices have emerged as the most prominent risks to Solar PV: In AREP's recent *South African Solar PV Repair-and-Fire-Callouts Survey*, 53% of practitioner respondents encountered Poor Installation Practices in person. Where practitioners have encountered Solar PV fires, the root cause of 88% thereof was reported as due to poor installation practices.

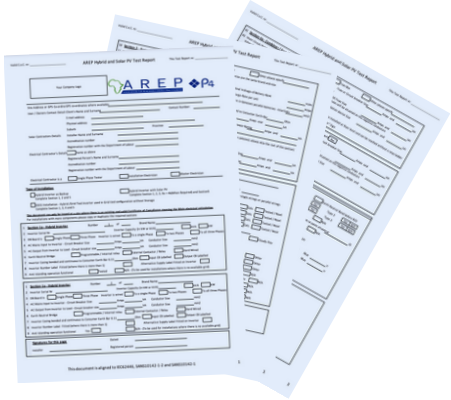
One respondent reported that the "*fuse holder burned*... due to *surge protection incorrectly installed*". Another reported '*Inverter melted*...due to *poor workmanship* and *incorrect specs*".

Hybrid Test Report

AREP's Hybrid Test Report checks approximately 50 different solar PV installation parameters which could improve or highlight technical accuracy, safety, design and certain performance criteria of an installed Solar PV system. AREP encourages all Solar PV practitioners to check their systems using the Hybrid Test Report prior to issuing a C.o.C on the installation. The report template is freely accessible and can be downloaded by any AREP member from www.arep.online.

The Hybrid Test Report is aligned with all required standards including:

- South African National Standards (SANS) as hosted by the South African Bureau of Standards (SABS)
- International Electrotechnical Commission (IEC) standards
- NRS guidelines as produced by NRS Association under guidance of Eskom



Download the HTR

INSTALLATION PHASE

Inexperienced or Unaccredited Installers

Until the 3rd quarter of 2023, there were no formal qualifications for solar PV practitioners in South Africa. The QCTO finalised the formal qualification at the end of 2023 and the first installers will likely only officially receive their qualifications in 2025. Despite the positive development of a formal Solar PV qualification, the lack of skilled labour in the industry is an ongoing risk.

Solar PV Accreditation

There are only two Solar PV accreditation platforms in South Africa: AREP's P4 program, and SAPVIA's PV GreenCard. AREP's P4 Quality Assurance Program holds the most members and is growing at the fastest rate. Additionally, the P4 program is widely accepted by key industry stakeholders including the AMEU (Association of Municipal Electricity Utilities), SALGA (South African Local Government Association), local municipalities, financiers, insurers, distributors, installers, and end-users, to name a few.

The P4 program is aligned with all required standards including:

- South African National Standards (SANS) as hosted by the South African Bureau of Standards (SABS)
- International Electrotechnical Commission (IEC) standards
- NRS guidelines as produced by NRS Association under guidance of Eskom

A recent review by the Energy Industry Ombudsman found that through gaining accreditation, "the solar project and finance risk is reduced based on the assumption that candidates gained valuable information in the process, enabling them to understand solar as a technology."

Read the Review

Verification

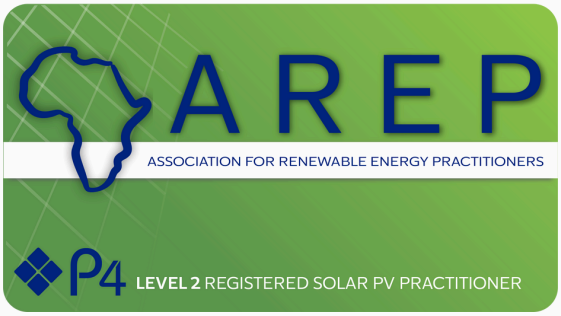
Verifying a practitioner's Solar PV accreditation is quick and easy.

AREP provides an easily accessible directory containing the details of AREP P4 Level 2 accredited practitioners on its website: www.arep.online/directory.

Simply search the directory to find or verify an accredited practitioner. Alternatively, contact the association directly for more information.

Visit the AREP P4 Level 2 Accredited Solar PV Practitioners' Directory

AREP recommends practitioners gain a minimum of P4 Level 2 accreditation for quality assurance purposes.
The association only grants directory exposure to P4 Level 2 accredited practitioners.



INSTALLATION PHASE

Substandard and Uncertified Products

There are several critical components in solar PV systems. Substandard products may pose a significant risk and malfunctions can lead to overheating and potential fire hazards. The use of substandard and uncertified products in solar PV systems has proven to be a significant risk: Based on AREP's recent *South African Solar PV Repair-and-Fire-Callouts Survey*, substandard and uncertified products have emerged as the third most prominent risk encountered by Solar PV practitioners in the field.

Standards and Regulations

From a standards and regulatory point of view, South Africa already has policies in place to ensure good quality work. The SABS standards cover most Solar PV aspects:

- SANS10142-1 covers all AC and DC installations up to 1500VDC
- SANS60364-7-712 covers design principles for solar PV systems
- The Electrical Installation Regulations cover the responsibility

Product Performance Risks	NRS 097
	IEC Suppliers declaration of conformity
Product Safety Risk	NRCS LOAs and SABS standards

INSTALLATION PHASE

Public Ignorance

The use of renewable energy systems in private homes and businesses may have become commonplace, but the public's understanding of these technologies has not kept pace with their adoption thereof. The lack of general comprehension among property owners and industry stakeholders alike regarding solar PV technologies, standards, regulations, and safety practices can increase risk.

AREP's recent *South African Solar PV Repair-and-Fire-Callouts Survey* has highlighted this reality. One respondent is recorded as saying that they regularly encounter problems due to: *"Customer lack of knowledge. {A client} wants installs to be placed where he wants it, not where it will be best suited."*

Public Education

Key industry stakeholders should have a vested interest in conducting regular safety awareness campaigns promoting the use of accredited installers and certified products. AREP hosts a directory of AREP P4 Level 2 Registered Solar PV Practitioners on www.arep.online, that is freely accessible to the public. The association encourages the use of this directory to find or research a registered, accredited practitioner in your area before choosing a contractor to install your Solar PV system.

Additionally, it is important to note that Solar PV practitioners (installers) are ideally positioned to provide basic educational material and training to solar PV system owners on maintenance and emergency procedures as part of their services. It would be greatly beneficial for end-users and the industry itself, should such practices become commonplace in future.

View Directory

MAINTENANCE PHASE

Electrical Faults and Overloading

A prominent concern during the maintenance phase is the possibility of electrical faults and overloading. South Africa experiences frequent power outages and voltage fluctuations, which can strain Solar PV systems and lead to electrical malfunctions.

Regular Professional Inspections

Regular professional inspections to identify and rectify electrical faults could mitigate the risk of electrical faults and overloading.

Installation of surge protectors and overcurrent devices to prevent overloading is advisable, as well as other safety technologies including isolation switches, Anti-Arcing Equipment and Rapid Shutdown Technologies.

Vegetation, Debris and Weather Damage

The dry and hot climate in many parts of South Africa increases the risk of fires caused by vegetation or debris accumulating around rooftop Solar PV panels.

Regular Inspections and Cleaning

Regular cleaning and maintenance to remove vegetation and debris, and creating a clear safety perimeter around solar installations, are two easy and affordable ways to maintain the safety of Solar PV systems.

Damaged rooftop solar PV panels and other system components should be replaced immediately.

OPERATIONAL PHASE

Safety and Early Warning Technologies

A number of safety and early warning technologies have been developed to combat various safety concerns. They include

- Isolation Switches and Anti-Arcing Equipment
- Various Rapid Shutdown Technologies
- Lithium Battery Fire Gel Extinguishers in case of battery fires
- Solar PV panel Light Blocking Solutions to neutralise the DC Danger Zone
- Early heat detection technologies including thermal imaging
- Smoke detectors
- CCTV cameras

Emergency Evacuation and Response Planning

In the event of a fire or other emergency scenario, having a well-thought-out emergency response plan is crucial to minimise damage and ensure the safety of a structure and its occupants. As a starting point, Solar PV installations should be placed with due consideration to an efficient evacuation plan and should not obstruct evacuation routes.

The risks associated with e.g. lithium-ion batteries, such as thermal runaway, need to be considered, as well as the DC danger zone. The DC Danger Zone is created by damaged rooftop solar PV panels which continue to push a live current through a damaged solar PV system - often leaving emergency responders with no way of shutting down the current other than waiting for nightfall. Mitigation measures in case of emergencies include:

- Updating existing, or developing new emergency response procedures to include Solar PV considerations.
- Installing fire detection and early warning systems as additional safety measures (see “Safety and Early Warning Technologies” above).
- Installing fire suppression systems on site: Examples include Lithium-Ion fire gel extinguishers in case of battery fires, and securing a viable solution to de-energize solar PV systems at the source of power production, e.g blocking light to solar PV panels to neutralise the DC danger zone.

FAQ

What are the most important standards and regulations applicable to Solar PV practitioners and installations?

- South African National Standards (SANS) as hosted by the South African Bureau of Standards (SABS)
- International Electrotechnical Commission (IEC) standards
- NRS guidelines as produced by NRS Association under guidance of Eskom

What is the difference between SAPVIA, the PV GreenCard, AREP, and the P4?

AREP and SAPVIA are both non-profit industry bodies created for the benefit of the renewable energy industry. Both organisations fulfil various roles in the industry, and both offer a Solar PV quality assurance program.

The P4 and the PV GreenCard are both Solar PV quality assurance programs created to address the need to improve the standard of Solar PV installations. These programs offer a form of training and accreditation specifically focused on Solar PV practitioners.

What does P4 accreditation guarantee?

Candidates who want to achieve P4 accreditation undergo evaluation as per the requirements of each tier of P4 accreditation. When a candidate has successfully passed these evaluations, the assumption is that candidates gained valuable information in the process, enabling them to understand solar as a technology.

What is the recommended level of P4 accreditation?

AREP recommends installers/ Solar PV practitioners have a minimum of P4 Level 2 accreditation.

How can I find out more about P4 Accreditation?

- Visit www.arep.online and click on P4

or

- Contact AREP directly
  - Anne Nel | Accounts Manager | anne@areprac.org

FAQ

For how long is P4 Solar PV Accreditation valid?

The P4 Sales Certificate is valid for 12 months
The P4 Level 1 Certificate is valid for 12 months.
The P4 Level 2 Certificate is valid for 36 months.
The P4 Level 2 Registered Solar PV Practitioner's Card is valid for 36 months.
The P4 Level 3 Certificate is valid for 36 months.
The P4 Trainer Certificate is valid for 36 months.

Does the P4 program comply with all necessary standards and regulations?

Yes. The P4 program and AREP's accompanying Hybrid Test Report are aligned with all required standards including:

- South African National Standards (SANS) as hosted by the South African Bureau of Standards (SABS)
- International Electrotechnical Commission (IEC) standards
- NRS guidelines as produced by NRS Association under guidance of Eskom

Is the P4 program formally recognised?

AREP's P4 is a form of informal Solar PV accreditation. The P4 quality assurance program is widely accepted by key industry stakeholders including the AMEU (Association of Municipal Electricity Utilities), SALGA (South African Local Government Association), local municipalities, financiers, insurers, distributors, installers, and end-users, to name a few.

Are all P4 accreditations the same?

No. P4 accreditation has 5 tiers:

- P4 Sales Accreditation A basic understanding of Solar PV principles to assist sales and support personnel in the Solar PV industry.
- P4 Level 1 Basic solar design and installation principles
- P4 Level 2 Small-scale residential and commercial Solar PV design and installation principles.
- P4 Level 3 Level 2 Accreditation plus a practical assessment of one of the practitioner's installations.
- P4 Trainer Accreditation A person is fully accredited to train others on the content and requirements of the P4 quality assurance program.

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www.arep.online