

★ SLIDE 1 — Introduction

Good morning ladies and gentlemen, and thank you for attending this **technical session on Solar Compliance Testing**.

My name is **Grant Seeman**, and I am the **National Technical Advisor for the Electrical Contractors' Association of South Africa**.

It is a privilege to be presenting at the **Solar and Storage Expo**, where we have the opportunity to discuss practical technical matters affecting the electrical industry.

This session focuses on **solar compliance testing**, and in particular on the proposed **Generating Plant Test Report** that forms part of the draft **SANS 10142-1 Edition 3.3**.

The report is contained in **Annex S** and is intended to provide structured guidance for the verification of **photovoltaic and battery generating systems**.

This presentation is not product-driven.

The emphasis is on **legal compliance, electrical safety, correct verification methodology**, and the **professional responsibility of the registered person** issuing certification for installations incorporating generating plant.

South Africa has experienced very rapid growth in **embedded photovoltaic generation** and **energy storage systems** in recent years. As a result, verification of these installations has become an increasingly important and routine aspect of **electrical installation practice**, requiring a clear understanding of both **technical requirements** and **regulatory obligations**.

During this approximately **45-minute technical session**, we will look at the context for the proposed changes, the structure and intent of the new test report, the required **inspection and testing procedures**, and some of the **common compliance failures** currently being observed in the field.

★ SLIDE 2 — Session Agenda

This session has been structured to move in a logical sequence from **context** through to **practical technical application**, so that we can build a clear understanding of the proposed verification requirements.

We will begin by examining **the compliance landscape**, including the rapid growth in photovoltaic installations, increasing **Certificate of Compliance liability**, and the safety risks that make structured **inspection and testing more important than ever**.

We will then review what is proposed in **SANS 10142-1 Edition 3.3**, focusing on the key changes such as the introduction of the **Generating Plant test report**, and how this new report is intended to replace the previous **embedded generation reporting approach**.

Following that, we will conduct a structured **walk-through of the new Generating Plant test report**, working through all **five sections of Annex S** and discussing the intent behind each field based on the current **draft standard**.

The largest technical portion of the session will focus on **conducting all seventeen required tests**, including the appropriate **test methods**, relevant **standard references**, required **compliance criteria**, and the typical **test instruments** used during verification.

We will then consider **common failures observed in the field**, and discuss practical ways to avoid these issues when performing inspection, testing, and certification of generating plant installations.

Finally, time has been allocated for **questions and open discussion**, allowing participants to raise real-world technical challenges and share their practical experience.

This overall structure is intended to ensure that by the end of the session you have a clearer and more practical understanding of how the proposed requirements may influence your **daily installation, testing, and compliance responsibilities**.

★ SLIDE 3 — Compliance Landscape

🕒 5 min

South Africa has experienced a very significant increase in **embedded generation installations** over the past few years, with installed photovoltaic capacity now estimated at approximately **five gigawatts and continuing to grow rapidly**.

This rapid expansion has fundamentally changed the **risk profile of electrical installations**, increasing the importance of proper **verification of protection systems**, effective **earthing and bonding arrangements**, and overall **installation performance**.

Where generating systems are incorrectly installed or inadequately tested, there is an increased potential for **fire hazards, electric shock risk**, and operational problems affecting the interaction between the installation and the **public electricity supply network**.

In addition to safety considerations, installations operating in parallel with the grid must comply with applicable **municipal and utility interface requirements**, such as those contained in **NRS 097-2-1**.

Non-compliant grid connections can result in **supply disconnection**, legal disputes, and additional financial risk for both contractors and customers.

From a regulatory perspective, the **Electrical Installation Regulations** place clear responsibility on the **registered person** issuing the **Certificate of Compliance**, which must be supported by appropriate **inspection and test documentation** in the prescribed format.

The draft **Edition 3.3 of SANS 10142-1**, for which public comment has recently closed and publication is anticipated, proposes the inclusion of **Annex S**, introducing a structured **Generating Plant Test Report** within the main wiring code.

These proposed changes are intended to respond to the evolving compliance environment by improving **verification consistency**, strengthening **technical accountability**, and ultimately enhancing **electrical safety outcomes** in installations incorporating photovoltaic and battery systems.

★ SLIDE 4 — What Changed in ED3.3

🕒 8 min

Edition 3.3 of SANS 10142-1 is currently a **draft amendment** that was circulated for **public enquiry**, with the enquiry period having recently closed and publication anticipated in the near future.

It is therefore important to understand that the content discussed here reflects the **proposed technical direction of the standard**, rather than requirements that are already formally enforceable.

All new photovoltaic and battery-related content in this draft has been introduced under **Amendment 3**, and one of the most significant developments is the proposal to include a structured **Generating Plant test report** directly within the main **wiring**

code as Annex S. This represents a shift away from the previous approach, where **embedded generation verification documentation** was handled through separate guidance material and legacy reporting formats.

The draft amendment also introduces updated **terminology**, using the term **Generating Plant**, or **GP**, to describe photovoltaic systems, battery storage systems, and hybrid energy installations. This terminology reflects the recognition that these systems function as **active electrical sources** within the installation rather than simply as connected loads.

As part of this evolution, **installation information requirements** have been expanded. For example, additional data must now be recorded relating to **battery chemistry, photovoltaic module wattage**, and the **structural impact of installed equipment**, where applicable, together with consideration of relevant **fire safety requirements**.

New technical provisions have also been proposed relating to the assessment of **prospective short-circuit current** where **parallel sources** are present, including installations incorporating **battery management systems**. These considerations influence the **selection and coordination of protective devices**, as well as the overall **fault performance of the installation**.

Existing clauses addressing installations with **alternative supplies**, including generating systems, remain applicable and continue to provide the framework for safe **integration of distributed energy resources** into electrical installations.

The overall intent of these proposed changes is to improve **clarity**, strengthen **verification practice**, and align the national wiring code with the evolving technical realities of modern **distributed generation systems**.

★ SLIDE 5 — Annex S Generating Plant Test Report Overview

🕒 Suggested time: ≈ 6–7 minutes

Annex S, as proposed in **Amendment 3 of SANS 10142-1 Edition 3.3**, introduces a structured **test report specifically for generating plant installations**, including systems incorporating **photovoltaic generation and battery storage**.

The proposed report is divided into **five logical sections**, intended to guide the **verification process** in a consistent and systematic manner.

Section 1 records the **location of the installation**, ensuring that all inspection and testing results are clearly linked to a specific **site and electrical installation**. This is important for traceability, future inspection, and regulatory compliance.

Section 2 records detailed **installation information**, including identification of the installed **inverters or power converters, energy storage systems, and photovoltaic modules**. This section establishes the technical basis for understanding the configuration and operating characteristics of the generating plant.

Section 3 provides a **description of the installation configuration**, including the **number of photovoltaic modules, the series and parallel string arrangement, the battery storage configuration, and the number of inverters installed**. This information assists in verifying correct system design and evaluating expected **voltage and fault current behaviour**.

Section 4 contains the **inspection checklist** together with the recorded **electrical test results** required to demonstrate compliance with the applicable **verification requirements**. This section forms the core technical evidence supporting the issuing of certification.

Section 5 records the **responsibility for completion and certification** of the report, reinforcing the accountability of the **registered person** performing the verification. The overall intent of this structured format is to align **generating plant verification** with the broader **verification principles already established in the wiring code**, thereby promoting consistency, improved documentation quality, and enhanced **electrical safety outcomes**.

★ SLIDE 6 — Installation Fields

🕒 5 min

Section 2 of the proposed report introduces several **expanded installation information requirements**, many of which are **new compared to the previous embedded generation reporting format**.

The intention is to ensure that the **registered person** has a clear understanding of the **generating plant configuration** before inspection and testing are performed.

Separate identification must now be recorded for each **power converter or inverter**, each **energy storage system**, and the installed **photovoltaic modules**. Where multiple units are installed in parallel, appropriate **supporting lists or schedules** may be required to fully document the installation.

The **battery chemistry type** must also be specified. This is an important safety consideration, as different storage technologies exhibit different **charging characteristics, thermal behaviour, protection requirements, and prospective fault current capabilities**.

The report further requires recording of the **DC voltage rating of the photovoltaic array** together with the **total installed photovoltaic wattage**. This information assists in verifying correct **system design**, assessing **maximum voltage conditions**, and evaluating potential **fault energy levels**.

In addition, confirmation must be provided that the **structural impact of the installation** has been considered by a **competent person**, where applicable. This recognises that photovoltaic modules, battery systems, and associated equipment can introduce **additional mechanical loading** or alter the **structural performance** of the building.

Similarly, the report requires confirmation that relevant **national and local fire safety requirements** have been taken into account. This may include compliance with applicable **fire regulations**, appropriate **equipment placement**, and suitable **emergency isolation provisions**.

Information relating to **anti-islanding protection** must also be recorded. The updated format recognises that this function may be provided either **internally within the inverter** or through an **external protection relay**, and this distinction must be clearly documented.

Other existing requirements, such as **lightning risk assessment, surge protection**, provision of a **single-line diagram**, and the availability of an **accessible disconnect**, remain applicable and continue to form part of the overall verification framework.

The overall purpose of these expanded fields is to improve the **quality of installation documentation**, support more effective **verification procedures**, and strengthen **technical accountability** in installations incorporating generating plant.

★ SLIDE 7— Inspection Checklist

🕒 Suggested time: **4 minutes**

Before any **electrical measurements** are carried out, a thorough **visual inspection** of the generating plant installation must be completed.

This inspection stage is intended to confirm that the installation appears to be **safe, correctly configured, and suitable for energisation** prior to proceeding with formal testing.

Firstly, it must be verified that all **equipment has been correctly sized and installed** in accordance with the relevant **manufacturer's instructions**. This includes consideration of appropriate **current ratings, environmental conditions, mounting arrangements,** and **ventilation requirements**, particularly where power converters or energy storage systems are installed.

Secondly, confirmation must be obtained that applicable **supplier, municipal, or utility requirements** have been adhered to. This is especially important for installations operating in parallel with the **public electricity supply**, where specific **grid-connection conditions** may apply.

The inspection must also confirm that suitable **disconnecting devices** are provided for both **operational control** and **safety isolation**. These devices must be correctly located, accessible where required, and capable of safely interrupting the intended **load current**.

In addition, correct **labelling of equipment and circuits** must be verified in accordance with the relevant **standard requirements**. Clear identification assists with safe operation, maintenance, and emergency response.

The overall outcome of this **inspection checklist** determines whether the installation is considered **safe to energise** and whether it is appropriate to proceed to the subsequent **electrical testing and functional verification stages**.

This structured approach reinforces the principle that **inspection precedes testing** in the verification process.

★ SLIDE 8 — Tests 1–5 (Introduction to Testing Section)

🕒 Suggested time: **2 minutes**

The **verification process** for a **generating plant installation** proceeds to an initial series of **electrical tests** intended to confirm the effectiveness of the installation's **fault protection arrangements**.

The first requirement is verification of the **continuity of equipotential bonding conductors**. All **exposed conductive parts** associated with the generating plant installation, including **photovoltaic module frames, mounting structures, and metallic enclosures**, must be bonded so that they are maintained at substantially the same **electrical potential**. This reduces the risk of **dangerous touch voltages** under **fault conditions**.

The next step is confirmation of the effectiveness of the **protective earthing path** associated with the generating plant equipment. This involves verifying that exposed conductive parts are connected to the **main earthing terminal** via a **low-impedance protective earthing conductor** capable of carrying **fault current** and enabling correct operation of **protective devices**.

A **neutral loop impedance test** must then be carried out at the point where the generating plant connects to the electrical installation, typically at the **main switch** or a **local isolator**. Measurement of **loop impedance** assists in confirming that sufficient **fault current** will flow to achieve **automatic disconnection of supply** within the prescribed **disconnection time**.

The **prospective short-circuit current** at the same point of connection must also be determined. This confirms that the **interrupting capacity** and **short-circuit withstand rating** of installed **switchgear** and **protective devices** are suitable for the expected **fault level**, particularly where multiple **sources of supply** may operate in **parallel**.

Finally, verification may include assessment of any **abnormal voltage** between the **incoming neutral conductor** and **external earth**. Such conditions may indicate **supply or earthing system irregularities** that should be investigated before the installation is **energised**.

These tests collectively confirm both the effectiveness of **equipotential bonding** and the adequacy of the **protective earthing and fault current return path**, forming the basis for subsequent verification of **insulation integrity, operating voltage performance, and functional system behaviour**.

★ SLIDE 9 — Section 4 Tests 6–12

🕒 Suggested time: 6 minutes

Following completion of the initial **fault-path verification**, the testing process proceeds to confirmation of **insulation performance, operating voltage behaviour, photovoltaic string characteristics, and battery fault current contribution**.

The first requirement is measurement of the **insulation resistance of the AC installation**. This test is carried out using a minimum **500-volt DC insulation tester**, with all connected **loads disconnected**, and is applied between **live conductors and earth**. The purpose of this test is to confirm the integrity of the **fixed wiring system**, associated **distribution equipment**, and connected **circuits**, ensuring that no insulation defects exist that could lead to **leakage current, tracking, or electrical failure**.

Verification must then be performed on the **insulation resistance of the DC conductors** associated with the **photovoltaic array**. This test is also conducted at **500 volts DC**, applied between each **live DC conductor and earth**, with the **inverter DC input isolated** to protect sensitive **electronic components**. This confirms the integrity of **DC cable runs, array connections, and wiring exposed to environmental conditions**.

The next step is verification of the **voltage at the output terminals of the generating plant under no-load conditions**. With the inverter operating and all **output loads disconnected**, the **phase-to-neutral voltage** is measured for each phase. Measured values within the acceptable operating range confirm correct **inverter operation** and appropriate **system configuration**.

Voltage performance must then be confirmed under **load conditions**, or by comparison with the **calculated full-load voltage**. This assessment verifies adequate **voltage regulation**, appropriate **conductor sizing**, and stable **operating performance** of the generating plant.

Each **photovoltaic string open-circuit voltage** must then be measured individually after isolation at the **DC isolator or combiner**. The measured value must not exceed the **calculated maximum open-circuit voltage**, taking into account **module ratings** and expected **low-temperature conditions**. This confirms correct **series string configuration** and the absence of **wiring or module defects**.

Verification of the **on-load voltage of photovoltaic strings** must also be performed while the system operates near the **maximum power point**. Measured values should be compared with the expected **MPP voltage range** derived from **manufacturer data** and the configured **number of modules in series**, confirming correct **array performance** and effective **inverter tracking**.

Where an **energy storage system** is installed, the **prospective short-circuit current of the battery bank** must be determined. Modern **battery technologies**, particularly **lithium-ion systems**, are capable of delivering **significant fault current**, which influences the **selection, rating, and coordination of protective devices, switchgear, and disconnectors**.

Assessment of **battery fault current contribution** may be carried out by **calculation**, reference to **manufacturer data**, or **measurement**, depending on the installation design.

In systems incorporating a **Battery Management System**, the effect of **electronic current limiting** and internal **protection functions** must also be considered.

These tests collectively confirm that the generating plant installation is electrically **sound**, correctly **configured**, and capable of safe and reliable **voltage performance** before proceeding to verification of **storage system functionality** and overall **operational behaviour**.

★ **SLIDE 10 — Tests 13–17** Storage System, Polarity, Switching and Grid Interface Verification

🕒 Suggested time: **6 minutes**

The final group of verification tests focuses on confirmation of **energy storage system performance**, correct **DC polarity**, proper **operation of switching devices**, and safe **grid interface behaviour**.

The first requirement is measurement of the **open-circuit voltage of the storage system**. This test is performed at the **battery DC terminals**, with the **inverter DC input disconnected**, and the measured value must be compared with the relevant **manufacturer's specification**. This confirms correct **battery configuration**, appropriate **series connection**, and the expected **state of electrical connection**.

Verification must then be carried out on the **charging voltage of the storage system** while the inverter is actively **charging the battery bank**. The measured voltage

should correspond with the manufacturer's specified **bulk or absorption charging voltage**, confirming correct **charging control**, proper **system settings**, and compatibility between the **battery technology** and the **power conversion equipment**.

The **polarity of DC cables** must also be verified using a suitable **DC voltmeter** at the inverter input terminals. It must be confirmed that the **positive conductor** is connected to the **positive terminal** and the **negative conductor** to the **negative terminal**, with no reversal at any point in the installation. Incorrect polarity can result in **equipment damage**, malfunction of **protective devices**, or serious **electrical hazards**.

All installed **switching devices**, including **circuit-breakers**, **isolators**, and **disconnectors**, must then be physically operated to confirm correct **mechanical function** and reliable **electrical interruption capability**. Each device must be capable of safely **interrupting load current**, must not be **mechanically defective**, and must return to its intended **operating position** after operation.

The final verification step confirms that **grid connection and disconnection requirements** are correctly complied with. While the generating system is producing power, the **utility supply is intentionally disconnected** to simulate a **loss-of-grid condition**. The generating plant must then automatically **trip and disconnect within the prescribed time**, confirming correct **anti-islanding protection** and safe interaction with the **public electricity supply network**.

Successful completion of these tests confirms that the generating plant installation operates safely under **normal operating conditions**, responds appropriately during **supply disturbances**, and satisfies the intended **protection and control philosophy** of the installation.

★ SLIDE 11 — Old vs New Report

🕒 Suggested time: **3 minutes**

The proposed **Generating Plant Test Report** represents a significant evolution from previous **embedded generation documentation formats** used in practice.

One of the most important changes is that the report is now **incorporated directly into the main wiring code**, rather than existing as a separate or supporting document. This reinforces that **generating plant verification** forms an integral part of normal **electrical**

installation certification and must be addressed with the same level of **technical diligence** as any other installation work.

The required **installation information** has been expanded considerably. The new report requires clearer identification of **power conversion equipment, energy storage systems, and photovoltaic modules**, together with additional data relating to **battery chemistry, array voltage rating, total installed capacity**, and potential **structural impact considerations**. These additions improve both **traceability** and the overall quality of **technical assessment**.

There is also an important shift in **terminology**. The draft standard now consistently uses the term **Generating Plant**, recognising that photovoltaic and battery systems operate as **electrical sources** within the installation. This has direct implications for **fault current contribution, protection coordination**, and the required **verification methodology**.

Changes are also evident in the **sequence and scope of electrical testing**. Tests are now arranged to better reflect the logical progression from **earthing and fault-path verification**, through **insulation performance, operating voltage assessment, photovoltaic string evaluation**, and finally **storage system and grid interface testing**. This structured approach supports improved **consistency of testing practice**.

The revised report further clarifies the framework for **responsibility and certification**. Completion of the generating plant test report is explicitly linked to the duties of the **registered person**, reinforcing professional **accountability** for both the accuracy of recorded results and the overall **compliance declaration**.

Overall, these changes are intended to improve **technical clarity**, strengthen **documentation consistency**, and raise the standard of **compliance verification** for generating plant installations within the national wiring code framework.

★ SLIDE 12 — Common Failures

🕒 Suggested time: **4 minutes**

Field experience with **embedded generation installations** highlights several recurring **compliance risks** that the proposed report structure aims to address.

One important risk relates to **incomplete documentation**. The proposed report requires clear **numerical results**, and omission of these values would weaken the overall **verification process**.

Another potential issue is that the new **installation information fields** may be overlooked. Details such as **battery chemistry, PV array rating, structural considerations, and fire requirements** are intended to improve **technical transparency** and must be properly completed.

From a testing perspective, there is also a risk that the **DC insulation resistance test** could be omitted if installers apply only traditional **AC verification routines**. Photovoltaic **DC circuits** require separate confirmation of **insulation integrity**, particularly where cabling is exposed to **environmental conditions**.

Errors in assessing **photovoltaic string voltage** may occur if appropriate **temperature correction factors** are not considered during **design verification**. This can result in actual operating voltages exceeding expected limits under **low-temperature conditions**.

Verification of **anti-islanding protection** must also be treated as a **functional test**, not an assumption based on **factory settings**. Correct procedure requires confirmation of **automatic disconnection** following loss of the **utility supply**.

Finally, the absence of a clear **single-line diagram** remains a common weakness in installation records. This document is essential for understanding **system configuration**, identifying **points of isolation**, and supporting future **maintenance and fault investigation**.

These considerations emphasise the need for a **structured, disciplined approach** to inspection, testing and documentation in generating plant installations.

★ SLIDE 13 — Key Takeaways

🕒 Suggested time: **2 minutes**

The proposed **Generating Plant Test Report** represents an important development in the verification of **photovoltaic and battery installations**.

The report is now incorporated directly into the main **wiring code**, confirming that **generating plant verification** forms part of normal **electrical installation certification**.

Updated terminology recognises these systems as **electrical sources**, which requires careful consideration of **fault current contribution**, **protection coordination**, and overall **system performance**.

Additional **installation information requirements** have been introduced, particularly relating to **battery chemistry**, **photovoltaic capacity and voltage rating**, and relevant **structural and fire considerations**.

Although the total number of required **electrical tests** remains the same, the **sequence and wording** have been refined to better reflect practical **verification procedures**, including clearer reference to the **output terminals of the generating plant**.

Greater emphasis is also placed on **functional verification of grid disconnection**, requiring confirmation that the **point of source isolation** operates correctly.

Overall, these proposed changes aim to improve **electrical safety**, support **regulatory compliance**, and promote more **consistent technical standards** in generating plant installation verification.

★ SLIDE 14 — Questions

🕒 Suggested time: **2 minutes**

This brings us to the end of the overview of **solar compliance testing** and the proposed **Generating Plant Test Report** within the draft **Edition 3.3 of SANS 10142-1**.

The key message is that generating plant verification is becoming a more **structured, disciplined**, and **technically accountable** part of normal **electrical installation certification**.

Thank you for your time and attention.

If you do have any **questions**, or would like to discuss specific **technical or practical matters** in more detail, you are very welcome to come and speak to us at the **ECA stand in Hall 2** after the session.

We will be available there for further discussion.