

 Eskom National Transmission Company South Africa™	Process	NTCSA/System Operator/ Grid Code Management
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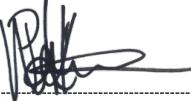
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1. Introduction

The Grid Connection Code for Renewable Power Plants (RPP) and Grid Connection Code for Battery Energy Storage Facilities (BESF) connected to or seeking connection to the Electricity Transmission System (TS) or the Distribution System (DS) in South Africa, as amended, (hereinafter referred to as RPP Grid Connection Code and BESF Grid Connection Code, respectively) provides the minimum technical requirements and connection conditions for RPPs and BESF. Compliance to the RPP and BESF Grid Connection Code is a generation license or registration condition as per schedule 2 for all RPPs and BESF connected to the DS or TS in South Africa.

The RPP and BESF Grid Connection Code further requires the Plant Owner to demonstrate compliance to all applicable requirements specified in the Codes to the National Energy Regulator of South Africa (NERSA), System Operator (SO) and the local Network Service Provide (NSP), to connect to the TS or DS and operate commercially.

The Ancillary Services (AS) capability test is only applicable if the RPP, BESF or Hybrid power plants are contracted to provide primary frequency response as per figure 7 of the RPP Code and figure 7 of the BESF Code. Automatic Generation Control (AGC) is done through the SCADA functionality test process.

All thermal RPPs and hydro units of category C shall also comply with the design requirements specified in the SA Grid Code specifically section 3.1. of the Network Code – Grid Code Requirement GCR 3.

2. Supporting Clauses

2.1 Scope

The scope of this document covers roles and responsibilities of parties involved in the Grid Code Compliance assessments. The document further focuses on the process activities performed by RETEC and the Plant Owner at various stages of the project to assess compliance to the RPP and BESF Grid Connection Code.

2.1.1 Purpose

The purpose of this document is to describe how *RETEC* and *Plant Owner* perform Grid Code compliance assessment.

2.1.2 Applicability

This document shall be applicable to the SO, *RETEC* and the *Plant Owner* connected or seeking connection to the *TS* or *DS* as defined in the *RPP and BESF Grid Connection Code*.

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2.1.3 Effective date

01 December 2024

2.2 Normative/Informative References

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

- [1] Applicable version of the SAGC Requirements for Renewable Power Plants, available from www.nersa.org.za
- [2] Applicable version of the SAGC Requirements for Battery Energy Storage Facilities, available from www.nersa.org.za
- [3] Applicable version of the RSA Distribution Code, available from www.nersa.org.za
- [4] Applicable version of the RSA Grid Code, available from www.nersa.org.za

2.2.2 Informative

- [1] None.

2.3 Definitions

All terms used in the document are defined hereunder, in the *RPP Grid Connection Code*, *in the BESF Grid Connection or the Preamble Grid Code*.

Battery Energy Storage Facility

As defined in the Code

Codes

All electricity codes as approved and published by the NERSA. These shall include *RPP Grid Connection Code*, *BESF Grid Connection Code*, *The Transmission Grid Code* and the *Distribution Code*.

Grid Code Compliance Notification Letter

A letter issued by the Grid Code Secretariat to the *Plant Owner* confirming that the Generator has demonstrated compliance with the *Codes*, subject to any approved exemptions, derogations or any other allowable post-commercial operation unresolved issues.

Distribution System (DS)

As defined in the Codes

Grid Connection Date

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The date the RPP, BESF or Hybrid Power Plant is energized into the TS or DS.

Hybrid Power Plant

A Facility that has a combination of two or more of the following technologies connected to the same POC and operate as a single entity:

- PV
- Wind
- Energy Storage
- Alternator

Network Service Provider (NSP)

As defined in the Codes

Operating Scenario

Operation of a Hybrid Power Plant such that one or more technologies (e.g., PV, Wind, BESF and/or Alternator) are in operation at the same time (refer to Appendix A).

Point of Connection (POC)

As defined in the Codes.

Plant Owner

A legal entity licensed or registered by NERSA to own and operate an RPP, BESF or Hybrid Power Plant

Renewable Energy Technical Committee (RETEC)

RETEC is a technical team within the *System Operator* established to validate or verify compliance to the *Codes* as demonstrated by the *Plant Owner*.

Renewable Power Plant (RPP)

As defined in the Codes

System Operator (SO)

As defined in the Codes

Transmission System (TS)

As defined in the Codes

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2.4 Abbreviations

Abbreviation	Description
AS	Ancillary Service
BESF	Battery Energy Storage Facility
DCUOSA	Distribution Connection and Use of System Agreement
DS	Distribution System
DSL	Digsilent Simulation Language
GAU	Grid Access Unit
GC	Grid Code
GCC	Grid Code Compliance
GCM	Grid Code Management
GCR	Grid Code Requirement
GM	General Manager
IPP	Independent Power Producer
MD	Metering and Data Services
NCSS	National Control System Support
NERSA	National Energy Regulator of South Africa
NSP	Network Service Provider
OEM	Original Equipment Manufacturer
OP	Operations Planning
PPC	Power Park Controller
RPP	Renewable Power Plant
REIPP	Renewable Energy Independent Power Producers
RETEC	Renewable Energy Technical Evaluation Committee
SCADA	Supervisory, Control and Data Acquisition
SLD	Single Line Diagram
SO	System Operator
STATCOM	Static Synchronous Compensator
TS	Transmission System

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VRT	Voltage Ride Through
WTG	Wind Turbine Generator

2.5 Roles and Responsibilities

2.5.1 Plant Owner Responsibilities

It is the responsibility of the *Plant Owner* to ensure that their *RPP, BESF or Hybrid Power Plant* complies with all applicable requirements of the Codes (including, but not limited to, those set out in this document) by submitting the required information (data, equipment specifications, tests data and/or reports) to *RETEC* for GC compliance assessment according to the timelines specified in this document.

2.5.2 RETEC Responsibilities

It is the responsibility of *RETEC* to assess and confirm information (data, equipment specifications, tests data or reports) submitted by the *Plant Owner* in order to confirm GC compliance status of the *RPP, BESF or Hybrid Power Plant*, and to provide feedback to the *Plant Owners* on the GC compliance status. *RETEC* shall inform the SO on the outcome of the grid code compliance assessment for the issuing of the Grid Code Compliance Notification Letter.

2.6 Process for Monitoring

This will be monitored by *RETEC* via document and feedback checklist.

2.7 Related/Supporting Documents

- [1] Applicable version of the RSA Grid Code, available from www.nersa.org.za.
- [2] Applicable version of the RSA Distribution Code, available from www.nersa.org.za.
- [3] Applicable version of the SAGC Requirements for Renewable Power Plants, available from www.nersa.org.za.
- [4] 240-180000842 RPP, BESF and Hybrid Plant Grid Code Compliance Test Guideline.
- [5] 240-180000896 Guidance note – Grid Code Requirements for Hybrid Power Plants.

3. Process

3.1 Process Triggers/Inputs

This process is mainly triggered by the following:

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- Granting of the generation license or registration by NERSA to a *Plant Owner*.
- RPP, BESF or Hybrid Power Plant Modification (which warrants re-assessment in line with *RPP and BESF Grid Connection Code* requirements).

3.2 Grid Code Compliance Assessment Process Flow Chart

Figure 3.1 and Figure 3.2 illustrate a recommended process for GC compliance assessment of *RPP, BESF and Hybrid Power Plants* by *RETEC* and *Plant Owners* for a single operating scenario, each addition of an operating scenario will add an extra week to the respective tasks in the process. The processes cover GC Asset Integration Process for pre-commissioning and post-commissioning.

The rest of this document describes the roles and responsibilities from *RETEC* and *the Plant Owner* during each task of the main process. Appendix A outlines the RACI for this process.

3.2.1 RPP, BESF or Hybrid Power Plant Project Kick off Meeting

RETEC leader shall be responsible to organize the project kick off meeting with the relevant *System Operator (SO)* stakeholders and RPP, BESF or Hybrid Power Plant Owner. The main purpose of this meeting is to introduce the *SO team* to the RPP, BESF or Hybrid Power Plant Owner and to facilitate seamless communication between stakeholders. It is the responsibility of each SO manager to appoint a resource per project based on technology and services that would be provided by the RPP, BESF or Hybrid Power Plant.

3.2.2 Plant Owner Pre-commissioning: Grid Code Compliance Submissions

When undertaking a project in a form of a New Built, Refurbishment, Replacement, Expansion or Modification, the *Plant Owner* shall ensure that the work is carried out in a manner that does not adversely affect compliance with RPP or BESF Grid Connection Code. The *Plant Owner* has the obligation to demonstrate compliance with all applicable requirements of the Codes as approved by NERSA

The Plant Owner shall submit all supporting documentation necessary to prove compliance to RETEC@ntcsa.co.za, unless otherwise agreed with RETEC. The Grid Code Compliance report shall be submitted at least 8 months before the Grid Connection date, in the case of a new built RPP, BESF or Hybrid Power plant. In the case of modified RPP, BESF or Hybrid Power plants, this report shall be submitted as soon as reasonably possible or unless agreed with RETEC. The Grid Code Compliance Package shall consist of the following:

- (a) Grid Code Compliance Report, as required in terms of the *RPP and BESF Grid Connection Code* shall consist of the following studies:
- Transformer and cable losses to the Point of Connection (POC),
 - 20-degree sudden phase jump capability,
 - Voltage Ride Through (VRT) capability,
 - Reactive Current Injection and absorption during VRT conditions,
 - Inverter/WTG temperature and altitude de-rating methodology

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- Reactive Power Capability,
- Tolerance to Frequency Deviations

- (b) Type testing and GCC supporting documents, as specified in the Table 1 or as agreed with RETEC.
- (c) Simulation Models

Documents	Requirements	*Parameters	*Document name	*Page number	Status (Submitted /Not Submitted)	Comments
DCUOSA (Signed)	Fault Levels					
Inverter/WTG/BESS Specifications	Voltage & Frequency Ranges					
Inverter/WTG/BESS Transformer Specifications	Rating					
Power Transformer Specifications	Rating					
Tap-Changer Specifications	Tapping					
STATCOM/Capacitor Bank Specs (If Applicable)	Rating					
STATCOM/Capacitor Bank Switching Logic	Logic					
SLD (Including Lengths and Type)	Impedance/Length					
VRT Prototype Testing	Inverter Capability					
Phase Jump Prototype Testing	Inverter Capability					
Reactive Power Capability Prototype Testing	Inverter Capability					
DSL Model Parameter Description	Parameter Description					

Table 1: Supporting Document Requirements

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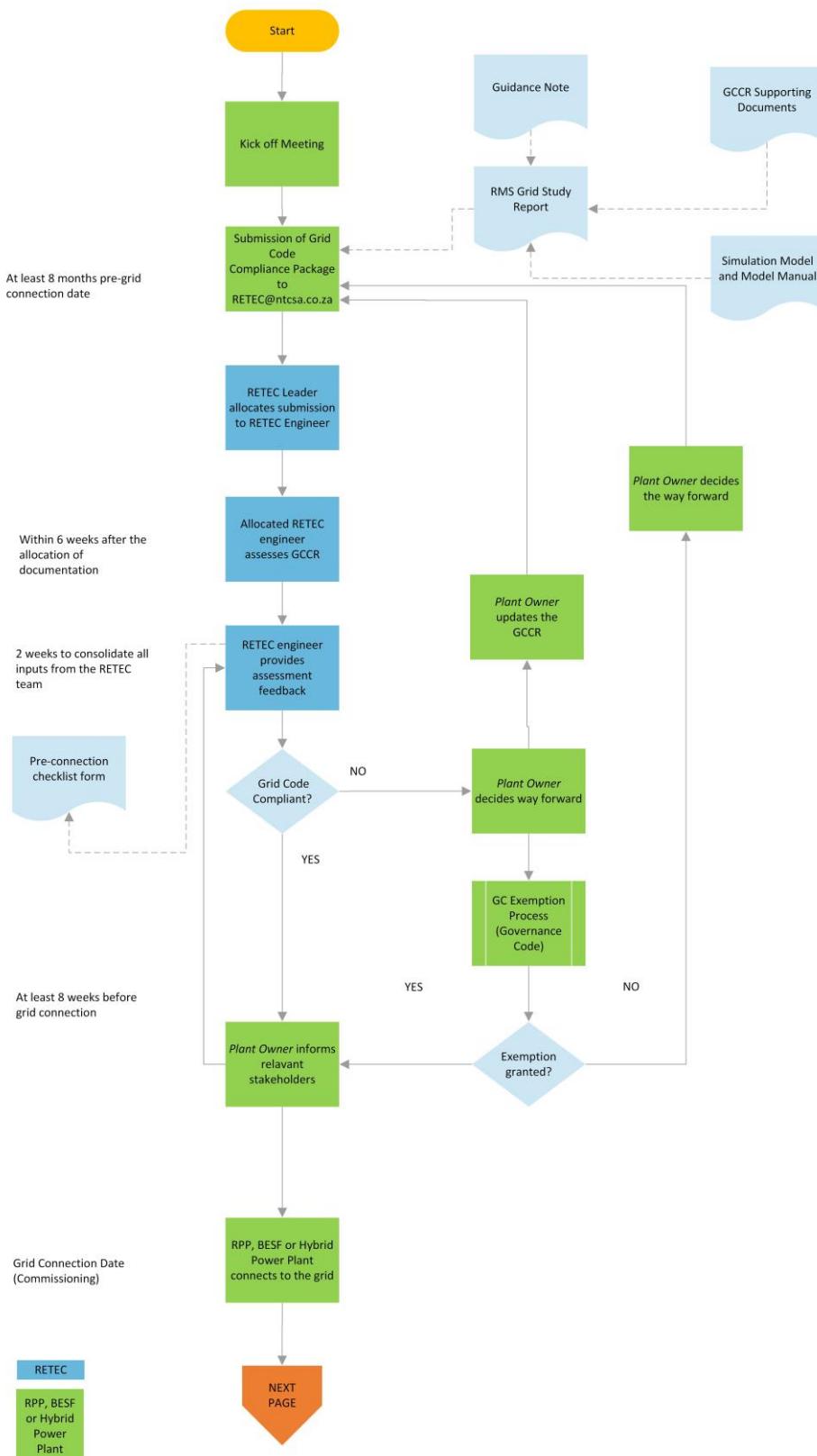


Figure 1: GC Compliance Process (Pre-Commissioning)

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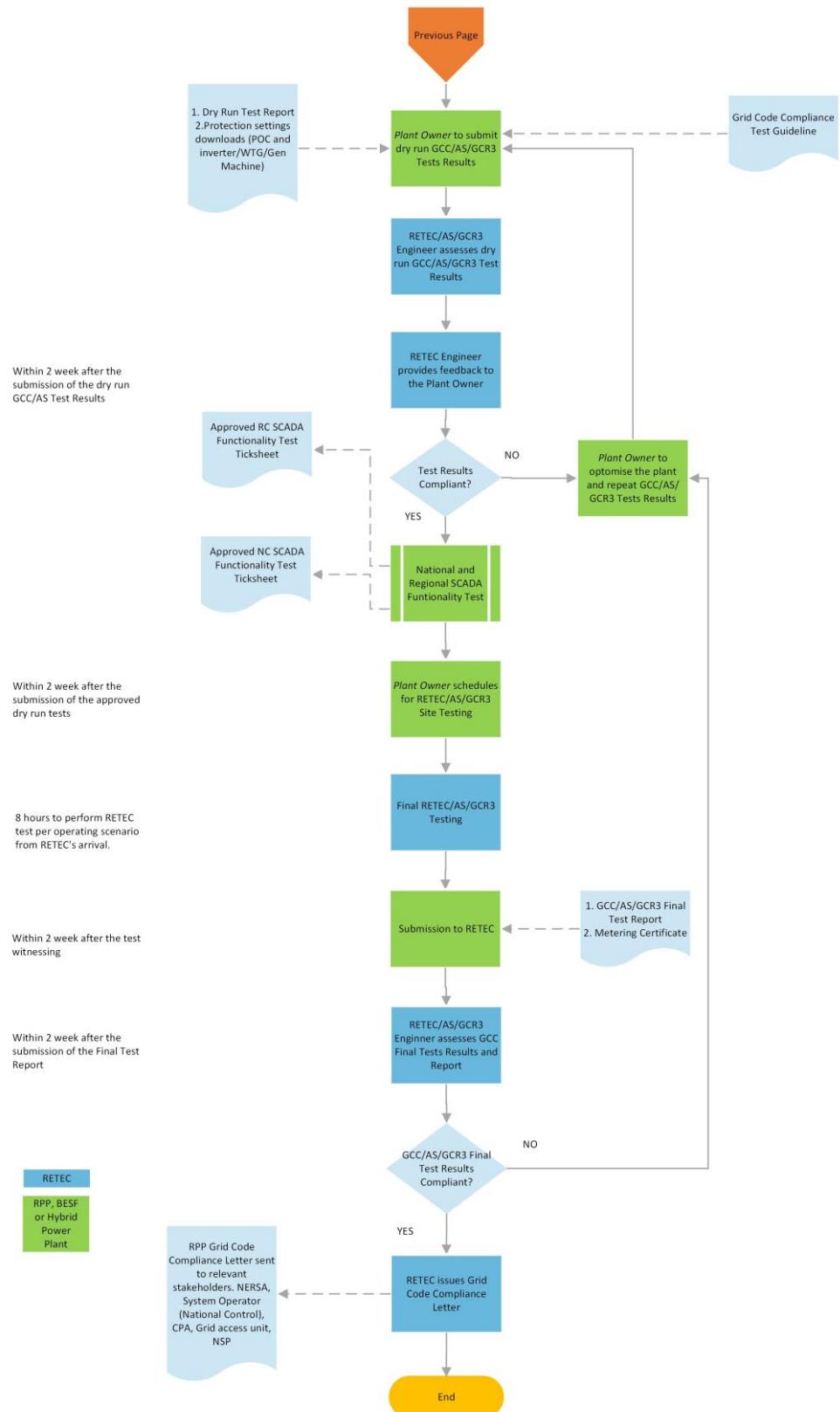


Figure 2: GC Compliance Process (Post-Commissioning)

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3.2.3 Allocation of a project to RETEC Engineer

The *RETEC Leader* has the responsibility of appointing a *RETEC Engineer* per project, within one week after receiving the *Grid Code Compliance* submission package from the *Plant Owner*. The *RETEC Leader* shall forward all documentation submitted by the *Plant Owner* to the appointed *RETEC Engineer*.

3.2.4 Grid Code Compliance Report Submission Package Review

The *RETEC Engineer* shall review the *Grid Code Compliance Report* and supporting documents using requirements as stipulated on the applicable version of the *Codes*. This task shall be concluded within six weeks after receiving all *GCCR supporting documentation* from the *RETEC Leader*

3.2.5 Grid Code Compliance assessment feedback

The *RETEC Engineer* shall provide feedback to the *RETEC Leader* with respect to the outcome of compliance assessment process.

The *RETEC Leader*, in collaboration with the *RETEC Engineer*, shall liaise with the *Plant Owner* to discuss the findings of *RETEC team's assessment*. The *RETEC Leader* shall provide the *Grid Code compliance assessment feedback* to the *Plant Owner* within nine weeks from the *Grid Code compliance report submission date*.

3.2.6 Grid Code Exemption Process

In the event that the *RPP, BESF or Hybrid Power Plant* does not comply with any of the requirements of the *Codes*, the *Plant Owner* has an option to apply to NERSA for an exemption or derogation as provided in the *Governance Code*. RETEC takes no responsibility for the application process, the delays thereof and the NERSA's decision with regards to any exemption application

3.2.7 Grid Connection Date (GCD)

The local NSP is responsible for sanctioning the energization of the RPP, BESF or Hybrid Power Plant during *Grid Connection Date* to start the commissioning process.

3.2.8 Submission of the RETEC/GCR 3/AS Dry Run Test Results

The *Plant Owner* shall submit a fully analyzed and successful RETEC/GCR 3/AS Dry-run Grid Code Compliance Tests Results Report to the *RETEC Leader*. The *Plant Owner* has an option of using the *RETEC Grid Code Compliance Test Procedure* for performing the Dry-run tests or the *Plant Owner* may derive their own *Grid Code Compliance Test Procedure* that has to be approved by *RETEC* before implementation.

The *Plant Owner* shall submit the following:

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- POC protection settings document and downloads.
- Inverter/WTG and PPC parameter download.
- Relay injection (Commissioning) test report.
- RETEC/GCR 3/AS Dry Run capability Test Reports

3.2.9 Dry-run Grid Code Compliance Assessment

The RETEC Engineer shall assess the *Plant Owner's* Dry-run Grid Code Compliance Test Results. This task shall be concluded and communicated to the Plant Owner within two weeks after receiving the Dry-run Grid Code Compliance Tests Results Report.

If the Dry-run tests were unsuccessful, the *Plant Owner* shall optimize the RPP, BESF or Hybrid Power Plant and conduct another Dry-run test and submit the Dry-run Grid Code Compliance Tests Results Report to the RETEC Leader.

3.2.10 Submission of the National and Regional SCADA functionality Test

The Plant Owner shall submit an approved National and Regional SCADA Functionality Test Report to RETEC before the arrangement of site testing can be agreed upon.

3.2.11 RETEC Test Scheduling

The process for Grid Code Compliance site testing is triggered through an invitation by the *Plant Owner*.

In order to schedule the site testing, the *Plant Owner* must:

- (a) Ensure approval of items 3.2.7 and 3.2.8 and 3.2.9
- (b) Dry run test raw data shall be within 6 months of the proposed RETEC testing.
- (c) Submit production in MW forecast in graph format of not less than 50% of full rated power and propose a suitable day for RETEC testing.
- (d) Ensure that all major components that make up the full *rated power* of the *Plant* capacity required to be validated by RETEC are fully commissioned and operational on the day of the test. The whole plant should be fully operational and in service.
- (e) The RPP, BESF or Hybrid Power Plant has to ensure that they have the following resources on site as a minimum:
 - SCADA specialist – Ability to understand and resolve any issues to do with SCADA
 - Inverter or WTG OEM technical personnel – Ability to access and read the PPC and Inverter or WTG settings/parameters.

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3.2.12 Final RETEC/GCR 3/AS Grid Code Compliance Tests

Once both parties agreed on the date of the final Grid Code compliance tests, the *Plant Owner* shall perform the final Grid Code Compliance demonstration witnessed by the *RETEC* team. The RPP, BESF or Hybrid Power Plant shall not be optimized during the Grid Code compliance demonstration. If the *Plant* has to be optimized at any stage during the performance of the Grid Code Compliance Tests, all the tests will have to be repeated. RETEC shall be given a maximum time of 8 hours to complete each operating scenario from the time of arrival on site or as agreed with RETEC.

Before the departure of the *RETEC* team from the *RPP, BESF or Hybrid Power Plant*, the *Plant Owner* must provide the test raw data to the *RETEC* team within 1 hour after the completion of testing.

The *Plant Owner* shall submit the Final Grid Code Compliance Tests Results Report and the associated raw data within two weeks after the tests were performed.

All thermal RPPs and hydro units of category C as specified in the RPP Code, shall also comply with the design requirements specified in the SA Grid Code (specifically section 3.1. of the Network Code – GCR 3). The RETEC test shall be conducted first then followed by the GCR 3 test. If the RETEC test or GCR 3 test fails, both the RETEC test and GCR 3 test will need to be repeated.

3.2.13 Assessment of Grid Code Compliance Tests Results Report

The *RETEC* team shall independently perform the Grid Code Compliance Assessment of the *RPP, BESF or Hybrid Power Plant* using the raw data collected during the site testing. This task shall be concluded and results communicated to the *Plant Owner* within two weeks after the receipt of the Final Grid Code Compliance Test Results Report and the associated raw data from the *Plant Owner*.

If the *RPP, BESF or Hybrid Power Plant* is unsuccessful on the Grid Code Compliance Tests, the *Plant Owner* will have to optimize the *RPP, BESF or Hybrid Power Plant* and redo the Dry-run Grid Code Compliance Tests and submit the results to the *RETEC* Leader.

3.2.14 Grid Connection Code Compliance Notification Letter

If the RPP, BESF or Hybrid Power Plant has successfully demonstrated compliance to the Codes. RETEC shall issue the Grid Connection Code Compliance Notification Letter.

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4. Acceptance

This document has been seen and accepted by:

Name	Designation
Isabel Fick	General Manager – System Operator
Phokoane Moshodi	Senior Manager – Grid Code Management
Themba Khoza	Chief Engineer - Grid Code Management

5. Revisions

Date	Rev.	Compiler	Remarks
01 September 2021	2		
25 November 2024	3	Sureshan Naidoo	Inclusion of BESF and Hybrid Power Plants

6. Development Team

The following people were involved in the development of this document:

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7. Appendix A – RACI

<u>Process</u>		<u>Key Function</u>	<u>R</u>	<u>A</u>	<u>C</u>	<u>I</u>
RPP, BESF or Hybrid Power Plant Grid Code Compliance Assessment Process	Pre-Connection Study	a) Submission of Pre-Connection study package	IPP	IPP	IPP	GCM
		b) Assessment of Pre-Connection study Package	GCM	GCM		
		c) Feedback on the outcome of Pre-connection study	GCM	GCM		IPP
	Dry Run Test Report and protection setting downloads	e) Submission of RETEC/GCR 3/AS Dry Run Test package	IPP	IPP		GCM
		f) Assessment of RETEC/GCR 3/AS Dry Run Test package	GCM OP*	GCM OP*		
		g) Feedback on the outcome of RETEC/GCR 3/AS Dry Run Test package	GCM OP*	GCM OP*		IPP AS*
	SCADA Functionality	h) Assessment of SCADA functionality test	NCSS	NCSS	IPP	IPP
		i) Feedback of SCADA functionality test results	NCSS	NCSS	IPP	IPP GCM
	Final RETEC Testing	j) Scheduling of the RETEC/GCR3/AS test	IPP	IPP	GCM	GCM NSP OP
		k) Conducting of the RETEC/GCR 3/AS Test	GCM OP	IPP		NSP
		l) Assessment of the raw data and test report	GCM IPP OP	GCM IPP OP		
		m) Feedback on the outcome of RETEC/GCR 3/AS test	GCM OP	GCM OP		AS IPP
	CO Letter	n) Issuing of the commercial operation letter	GM	GCM		IPP/OP NC/GAU NSP/MD NERSA

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