

LEADING THE ELECTRICITY DISTRIBUTION INDUSTRY



GRID CONNECTION CODE FOR RENEWABLE POWER PLANTS (RPPs) CONNECTED TO THE ELECTRICITY TRANSMISSION SYSTEM (TS) OR THE DISTRIBUTION SYSTEM (DS) IN SOUTH AFRICA

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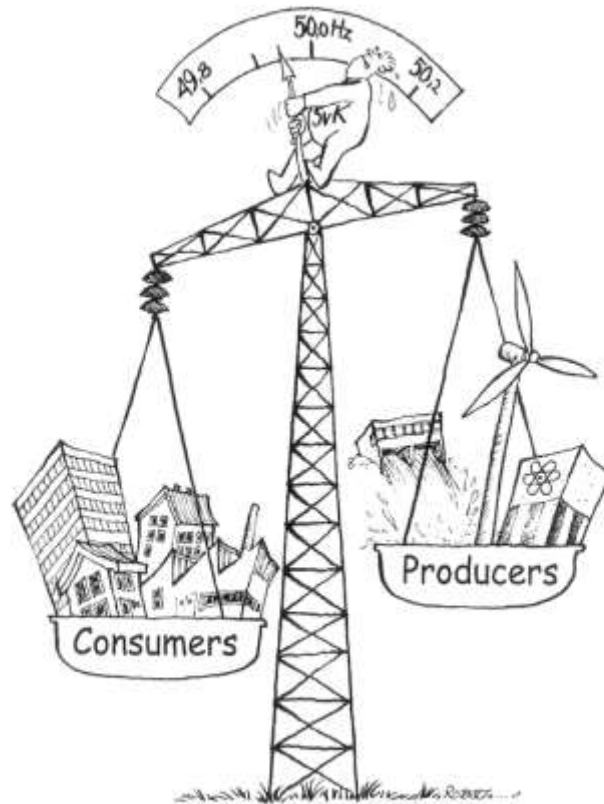
Powering your world



- 1. Need for Grid Code Requirements**
- 2. Grid Code Objectives**
- 3. Technical aspects regulated by the RE grid code**
- 4. Monitoring and control**
- 5. Conclusion**

Why Grid Code Requirements?

Example, the challenge of frequency control



1. **Main issue: going from one way to two way power flow**
2. **Similar type of standards –different aims:**
 - **Maintain local stability –Voltage as main issue**
 - **Ensure power is provided (when needed) in a stable, reliable manner –Reactive and active power**

- Electricity Regulations Act calls for NERSA to:
 - Issue licenses to:
 - operate any generation, transmission or distribution facility;
 - import or export of electricity;
 - trading of electricity.
 - Develop and enforce as license conditions:
 - Guidelines,
 - Regulations and
 - **Codes.**

- **The Grid Code establishes reciprocal obligations of Electricity Supply Industry participants regarding:**
 - Connection and use of the distribution and transmission power systems
 - Development of the network
 - Operation of the Interconnected Power System (IPS)
- **It defines minimum technical requirements (i.e. design capabilities) for:**
 - Network service providers
 - Generator proponents
 - Load customers
- **It ensures:**
 - Non-discriminatory access to the IPS by both generators and loads customers
 - Adherence to **minimum** technical requirements
 - System integrity & adequate service delivery
 - Defined accountabilities
 - Information availability where it's needed

Scope: what is regulated by the codes?

- **Connection process**, for example:
 - Issuing of connection quotes by service providers
 - Minimum connection network redundancy and related charges
 - Agreements to be put in place between network service providers and generators (e.g. connection, operating, Use of System, Ancillary Services etc.)]
- **Design requirements (for both generators and network service providers)**
 - Codes specify mandatory minimum requirements (e.g. unit islanding, protection, voltage control, frequency control, fault ride through, metering installations etc.)
 - There are also negotiable requirements, these are contracted on a need basis
- **Operations and maintenance coordination by the *System Operator***
 - Participants are required to cooperate with SO in this process
- **Dispatch** of generation and demand side resources in line with the rules
- **Information exchange** between participants
- **Tariffs** of the network service providers (Transmission and Distribution)

RE Technologies Regulated by the Code

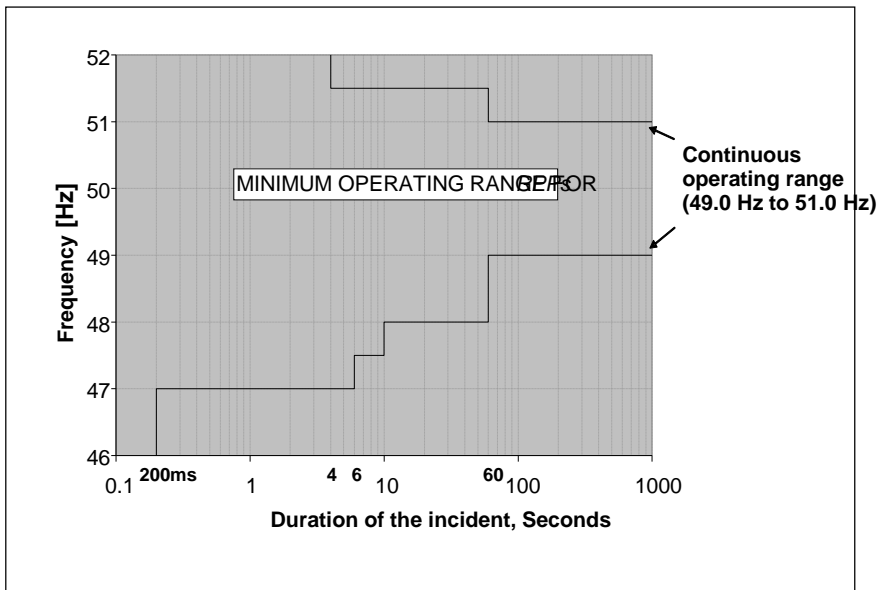


Categories of RE Facilities

Applicability of Grid Code requirements depends on these categories (i.e. size of the facility and connection voltage)

Sub-Categories	Power Range	V Connection
A1	$0 < x \leq 13.8\text{kVA}$	LV
A2	$13.8\text{kVA} < x < 100\text{kVA}$	LV
A3	$100\text{kVA} \leq x < 1\text{MVA}$	LV
B	$1\text{MVA} \leq x < 20\text{MVA}$	MV & HV
C	$\geq 20\text{MVA}$	HV

- Stay within these limits

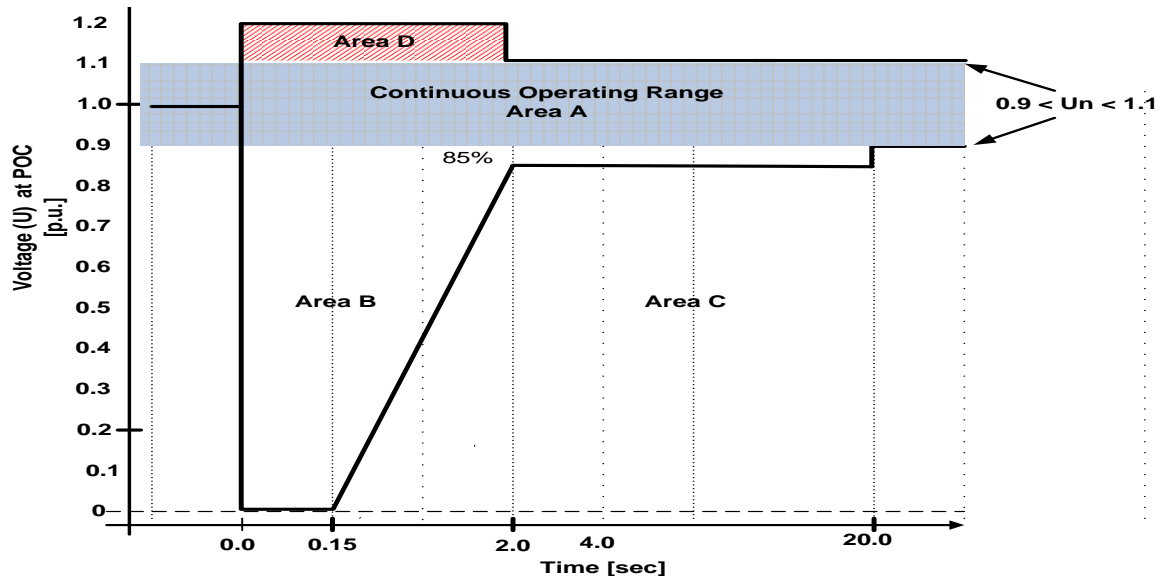


Minimum frequency operating range of a RPP (during a system frequency disturbance)

Sub-Categories	Voltage Limits
A1	-15% to +10%
A2	
A3	
B	±10%
C	±10%

Maximum and minimum operating voltages at POC

HV/ MV grid code fault ride through

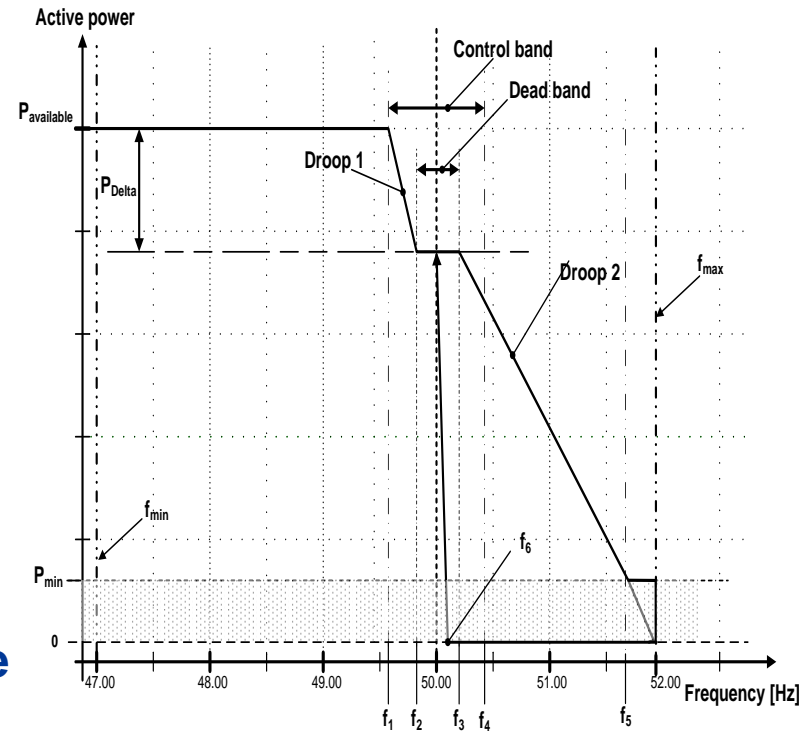


- Not to disconnect from network in the event of network faults
- Support with reactive current
- After fault clearance not to extract more inductive reactive power than prior to fault
- restore active power production to at least 90% upon clearance of fault

Active power control / frequency support

- Network operator will temporarily limit or disconnect the RPP if there is risk of;

- Unsafe system operation
- Bottlenecks or congestion
- Unintentional islanding
- Static or dynamic grid instability
- Instability due to frequency increase



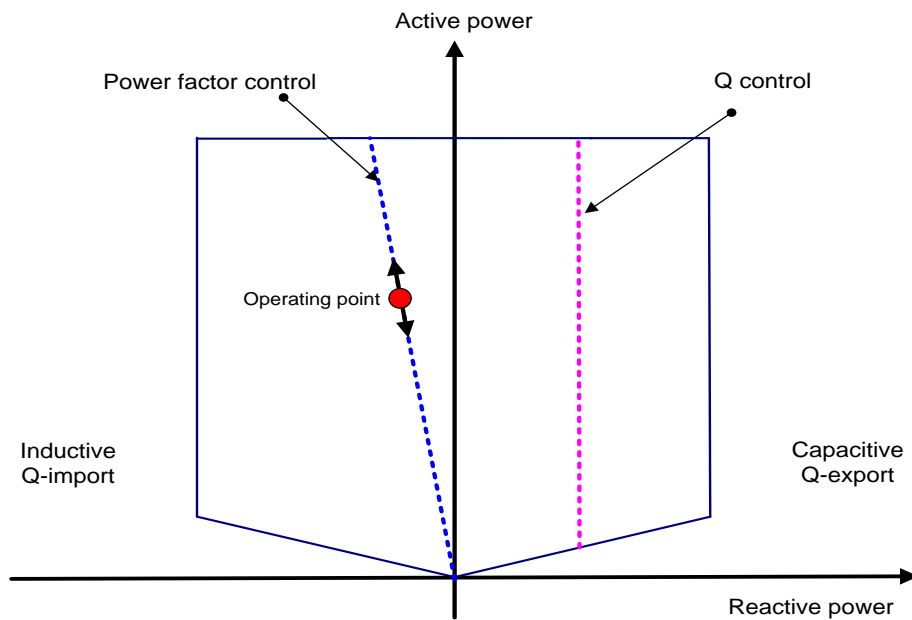
RPP Code provides: Frequency control for primary and secondary frequency control, plus over frequency control

Reactive Power and Voltage Control Functions

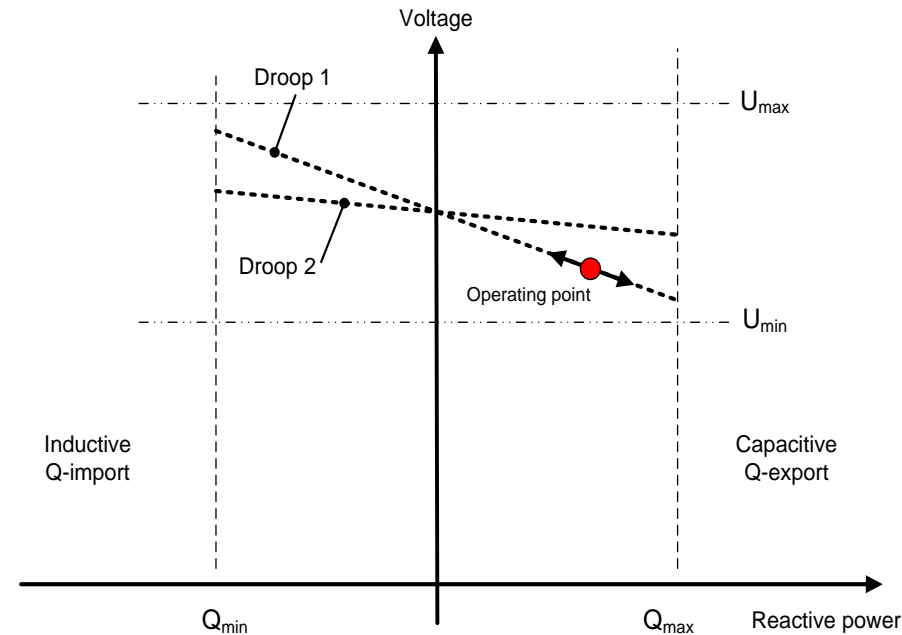
- System generating plants to provide static grid support, i.e. voltage stability, through reactive power

–Cos (φ) = 0.975 underexcited to 0.975 overexcited (Cat B)

–Cos (φ) = 0.95 underexcited to 0.95 overexcited (Cat C)



MVar and Pf control



Voltage control

Monitoring and control

- **Communication is key to smart grid**
 - SO/ DSO communication
 - DSO/ customer
- **As a minimum RPP Code often ask for:**
 - Power production at point of connection
 - P and Q
 - Voltage
 - Frequency
 - Transformer tap position
 - Plant Status
 - Out for maintenance
 - Out for high wind/fault etc.
 - Meteorological Information
 - Current, past and (possibly) future (forecasts)



- **Participants are ultimately responsible to ensure that their RE facilities comply with all applicable codes**
- **“black box” principle applies whereby compliance is tested at the connection point**
- **Enforcement :**
 - Enforced by NERSA through licenses
 - Alternatively through agreements between parties
 - Parties must demonstrate compliance to applicable code requirements prior to connection or commercial operation
 - Submission of information required as per Information Exchange Code
- **Compliance monitoring:**
 - This is mainly NERSA’s responsibility. However, there is an implied compliance monitoring role by other participants especially the System Operator

- **RE code sets out technical framework for integrating renewable energy into the electricity grid**
 - This ensures industry standardisation, network integrity and non-discriminatory access to the grid (transmission or distribution)
- **Intermittence nature of renewables brings about a different challenge to the power system.**
- **RE code is limited to technical aspects and does not regulate power purchase agreements (PPAs)**
- **Areas currently under development:**
 - RE Forecasting, RE aggregation, Compliance testing and monitoring, energy banking etc.
- **Approved versions of the grid codes are available from www.nersa.org.za**

A decorative graphic on the left side of the slide. It features a large, light blue curved shape that frames two overlapping circular images. The top circle shows a silhouette of a tree against a sunset sky. The bottom circle shows a high-voltage power line tower. The circles are outlined with multiple thin, concentric lines.

Thank you