NOJA Power®

Renewable Energy Connections

To the Distribution Grid – Protection, Switchgear and Controls

Brisbane, Australia

www.nojapower.com.au

Acknowledgment of Country

NOJA Power acknowledges the Traditional Owners and their custodianship of the lands on which we meet.

We pay our respects to their Ancestors and their descendants, who continue cultural and spiritual connections to Country.

We recognise their valuable contributions to Australian global society.

Presentation Overview

1. Our Background
2. The Application – An empirical overview
3. Switchgear
4. Protection Schemes
5. Protecting the Assets
6. Anti-islanding and Grid Connection requirements
7. Power Quality Monitoring and Compliance
8. Metering
9. Putting it all together

OSM Recloser Installation – Narrabri Solar New South Wales, Australia


NOJA Power®
NOJA Power®
OUR BACKGROUND AND EXPERTISE
© 2002-2024 NOJA Power Switchgear Pty Ltd

OUR MISSION

To be the world leader in medium voltage outdoor switchgear.

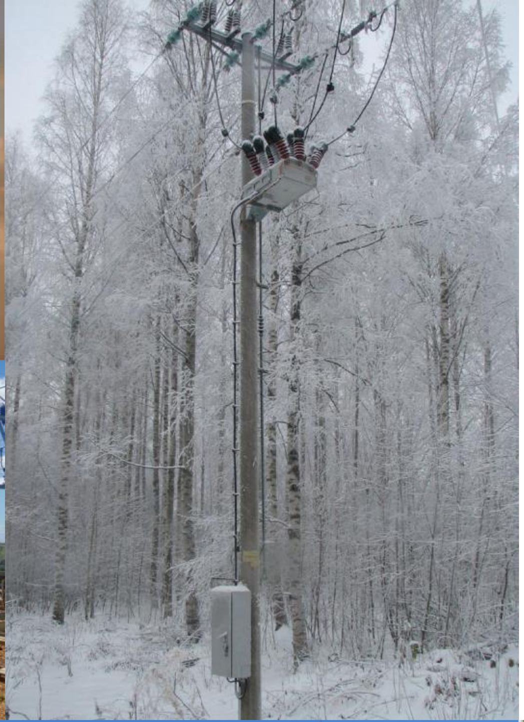
We offer our customers integrated solutions using innovative products combined with unrivalled service and reliability worldwide.

NOJA Power®

OUR PURPOSE

“My work here today, and every day, is keeping the lights on all over the world”

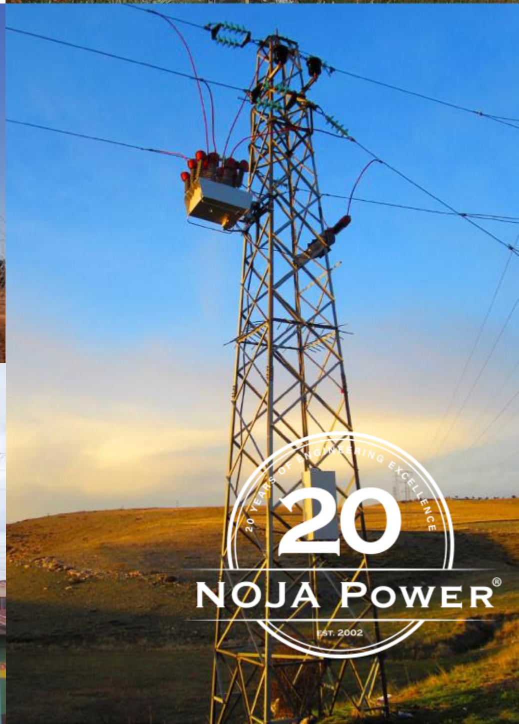
20 YEARS OF ENGINEERING EXCELLENCE
20
NOJA Power®
EST. 2002



GLOBAL INSTALL BASE

Empowering the World.

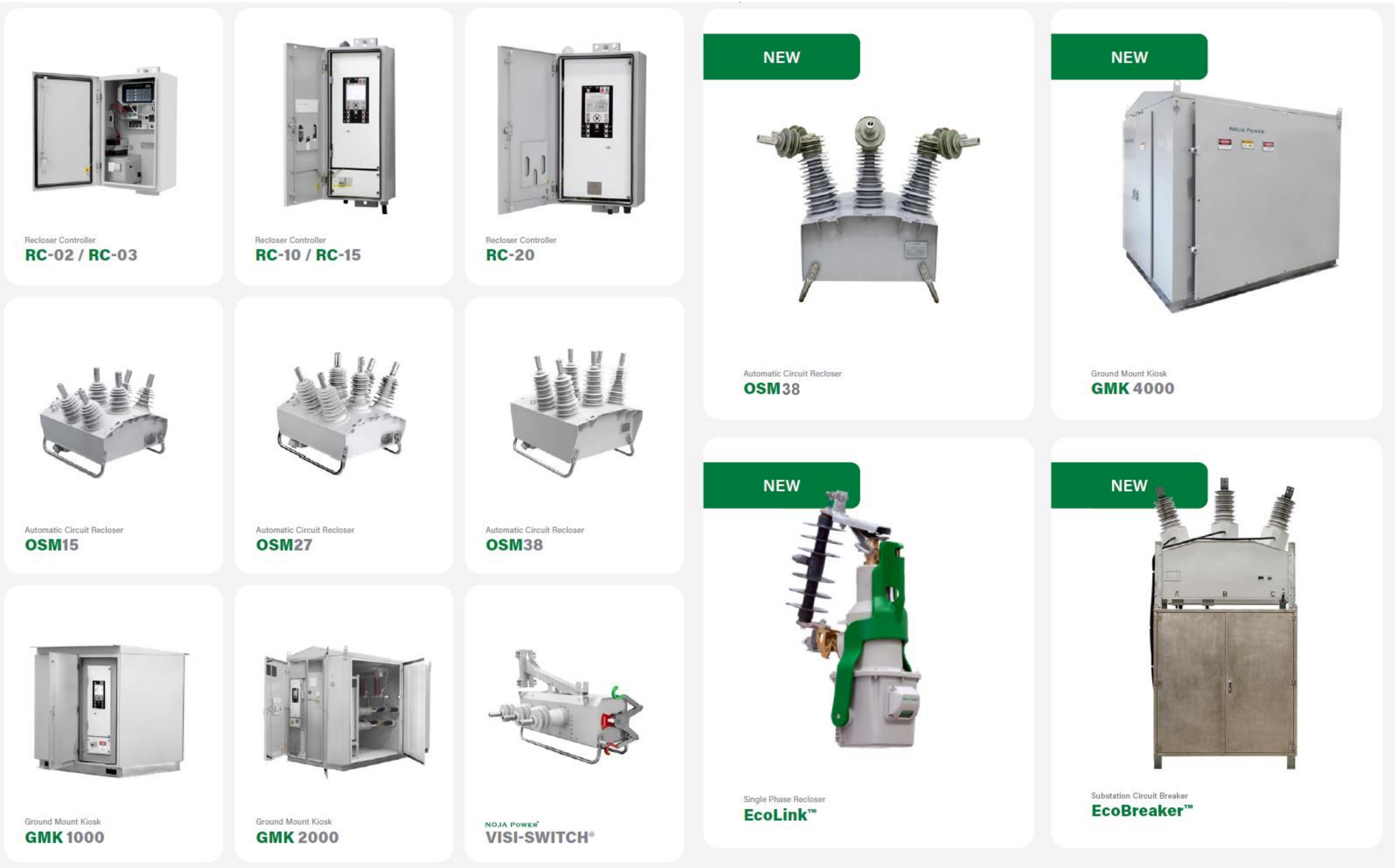
The company has installations of more than 100,000 NOJA Power OSM Series automatic circuit reclosers in over 106 countries worldwide.



Headquarters and Manufacturing Campus

Based in Murarrie, Brisbane.

Our Product Range



NOJA Power®

The Opportunities in our Industry

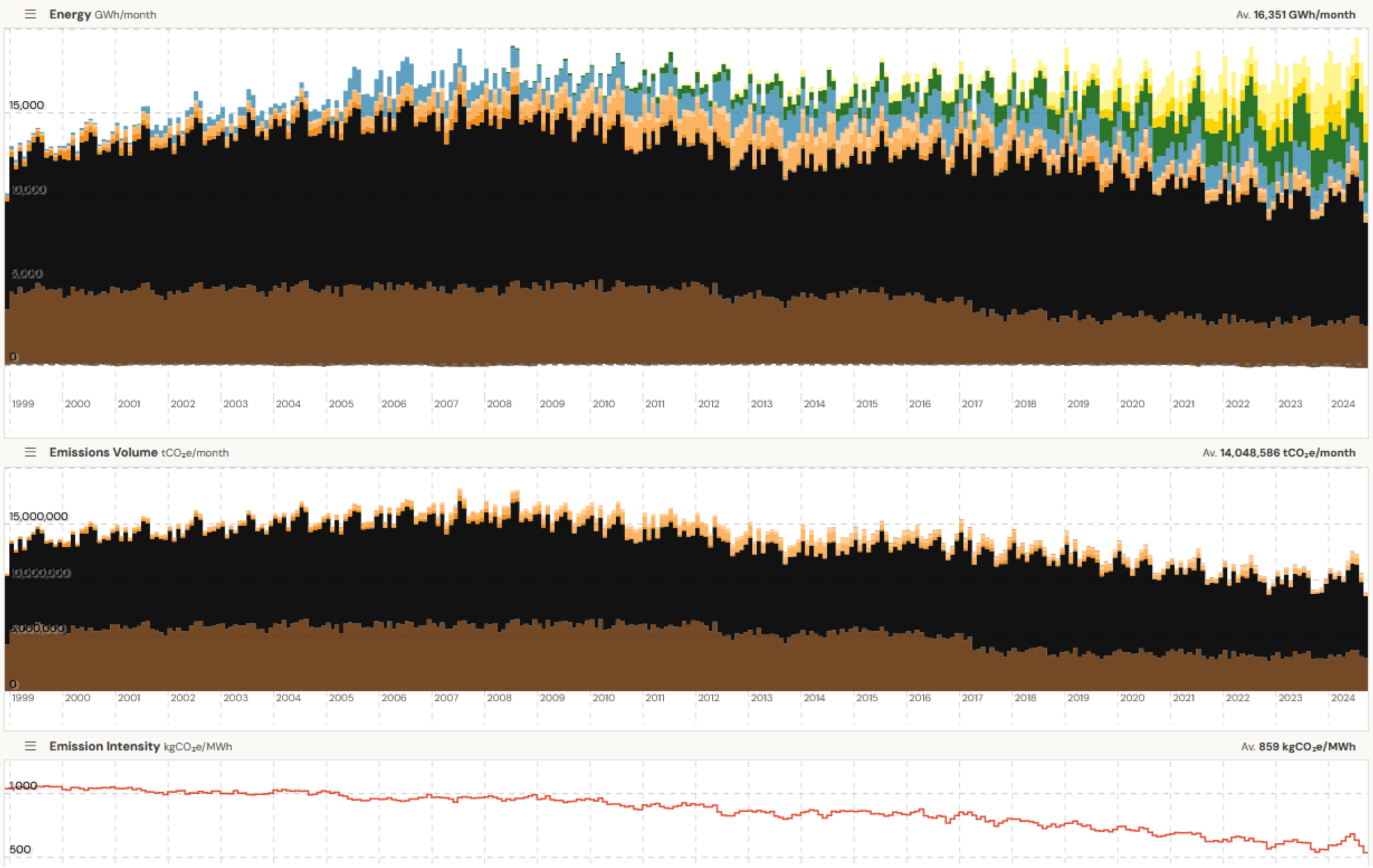
- The Power Industry is entering a super cycle for the next decade that will see unprecedented growth
- The Biden $1.2 trillion infrastructure bill with funding for EVs, transmission, distribution and renewables
- United Nations target to achieve Net Carbon Zero by 2050
- The elimination of SF6 gas from Distribution Networks
- Large scale renewable energy connections to the Distribution Grid
- Security and Automation of the grid
- Electric Vehicles and the change in Energy use that will create
- Our R&D Team has been very busy for the last 3 years to develop solutions to take advantage of the super cycle

Changing Generation Mix

Open~Electricity

Tracker | Facilities | Scenarios | Analysis | About

Energy ⌄ NEM ⌄ | 1D | 3D | 7D | 30D | 1Y | ALL ⌄ | Month ⌄ | All ⌄ | Consumption | Generation

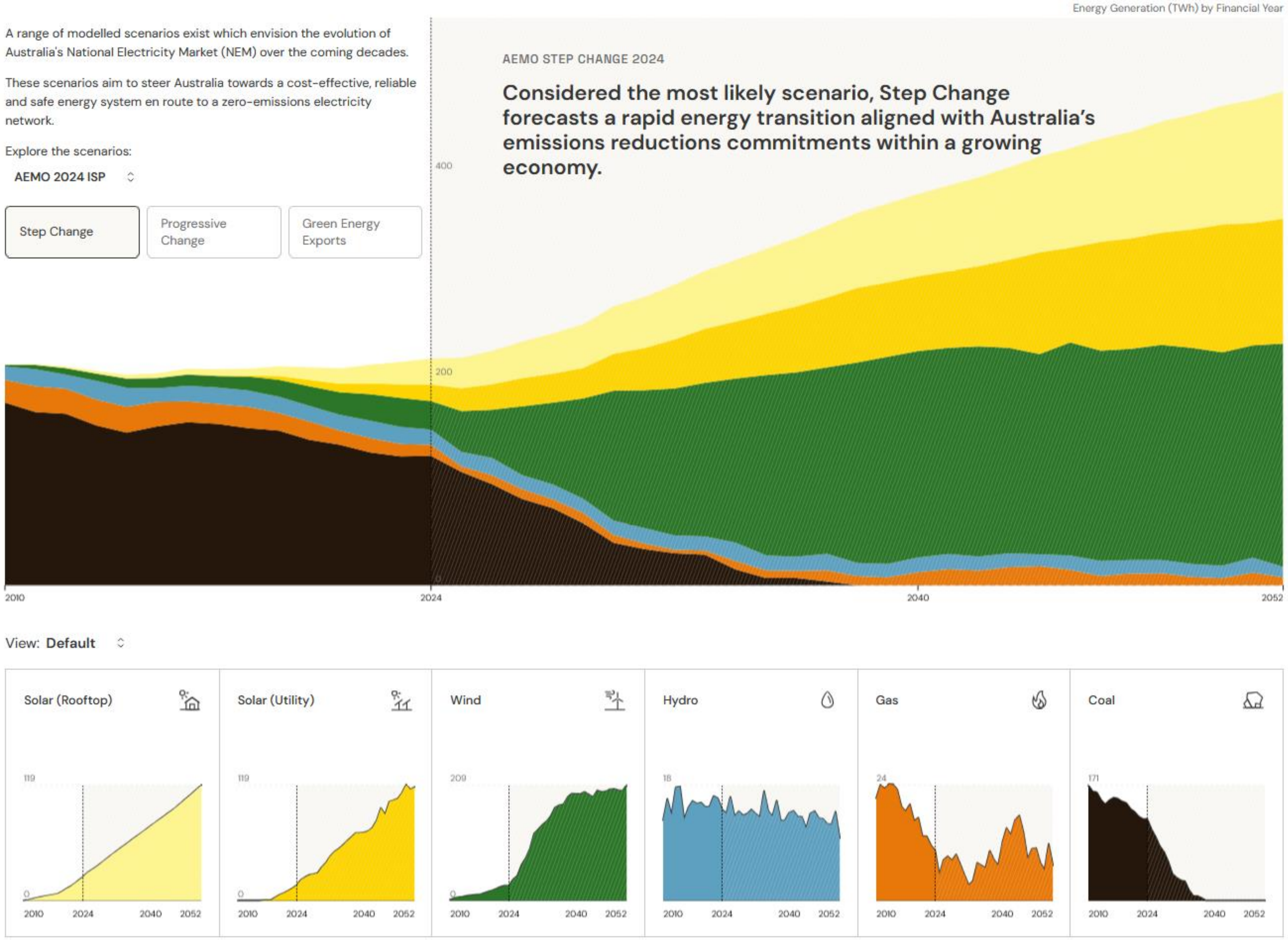


Dec 1998 – Sep 2024

Detailed	Energy GWh	Contribution to demand	Av.Value $/MWh
Sources			
Solar (Rooftop)	134,318	2.6%	$51.94
Solar (Utility)	60,814	1.2%	$61.00
Wind	213,977	4.2%	$66.11
Hydro	309,494	6.1%	$74.85
Battery (Discharging)	1,376	0.03%	$212.21
Gas (Waste Coal Mine)	6,698	0.1%	$82.19
Gas (Reciprocating)	1,579	0.03%	$196.19
Gas (OCGT)	78,059	1.5%	$119.48
Gas (CCGT)	236,029	4.6%	$69.34
Gas (Steam)	79,690	1.6%	$76.73
Distillate	1,351	0.03%	$354.26
Bioenergy (Biomass)	3,764	0.07%	$63.69
Bioenergy (Biogas)	223	0.004%	$114.24
Coal (Black)	2,737,675	53.8%	$57.80
Coal (Brown)	1,222,966	24.0%	$47.90
Loads	-19,101		
Pumps	-17,347	-0.3%	$53.78
Battery (Charging)	-1,754	-0.03%	$51.00
Net	5,068,912		
Renewables	722,589	14.2%	

Future AEMO Forecast

1. All scenarios suggest high levels of distributed generation
2. The most likely scenario is a Step Change to renewables.



NOJA Power®

The Application

AN EMPIRICAL OVERVIEW

NOJA POWER

Renewable Connections

- Medium Voltage Connections Proliferating
- Many applications below 5MW
- Requirements for Protection, Control, Power Quality Monitoring, Anti Islanding and Revenue Metering


NOJA POWER®
QLD
McIntyre River
NSW


PQM
OSM
GMK
GMK


OSM
MV Switchgear
Protection, Control and Automation
Metering

Requirements

- Circuit Breaker
- Protection System – Protecting the asset, and meeting the anti-islanding requirements
- Power Quality Monitoring
- Revenue Metering
- Maintenance provisions

Goondiwindi Solar Farm – Overhead Connection with separate metering installation

Switchgear

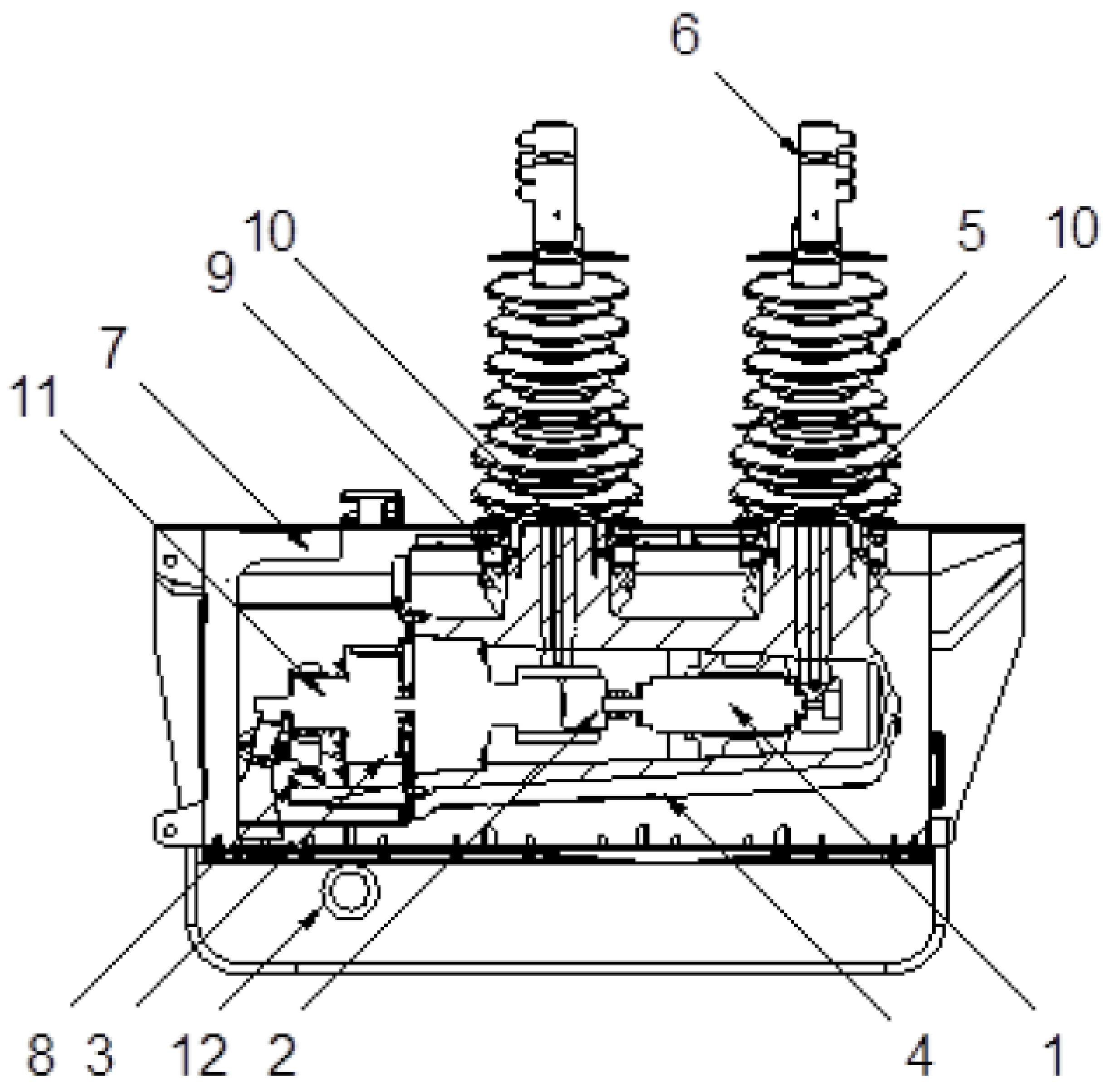
Switchgear Requirements

- Protection for the assets
- Switch for anti-islanding and grid connection
- Many renewable sites have relatively low peak fault currents – non-synchronous generation
- Lower peak interruption capacity enables use of other switchgear asset classes
- If it's below 16 kA RMS interruption, engineers can use devices such as reclosers to fulfil the circuit breaker role
- These other asset classes reduce need for additional protection control assets if the protection relays/sensors meet the connection requirements.

Rated maximum voltage	15.5 kV	15.5 kV	27 kV	38 kV	38 kV	40.5 kV
Rated continuous current	630 A	800 A	800 A	800 A	800 A	800 A
Fault make capacity RMS	12.5 kA	16 kA	12.5 kA	12.5 kA	16 kA	16 kA
Fault make capacity Peak (50Hz)	31.5 kA	40 kA	31.5 kA	31.5 kA	40 kA	40 kA
Fault make capacity Peak (60Hz)	32.5 kA	42 kA	32.5 kA	32.5 kA	42 kA	42 kA
Fault break capacity	12.5 kA	16 kA	12.5 kA	12.5 kA	16 kA	16 kA
Asymmetrical Breaking Current	13 kA	17 kA	13 kA	13 kA	17 kA	17 kA
DC component Interruption capacity	20%	20%	20%	20%	20%	20%
Mechanical operations	10000	30000	30000	30000	30000	30000
Full Load Operations	10000	30000	30000	30000	30000	30000
Fault break capacity operations	70	70	140	100	140	140
Short time current withstand 3 seconds	12.5 kA	16 kA	16 kA	12.5 kA	16 kA	16 kA
Mainly active breaking capacity	630 A	800 A	800 A	800 A	800 A	800 A
Cable charging current	10 A	25 A	25 A	40 A	40 A	40 A
Line charging current	2 A	5 A	5 A	5 A	5 A	5 A
Impulse withstand across the interrupter	110 kV	110 kV	150 kV	170 kV	170 kV	190 kV
Impulse withstand phase to earth and phase to phase	110 kV	110 kV	150 kV	195 kV	200 kV	200 kV
Power frequency withstand phase to earth ~~(dry)~~ and across the interrupter	50 kV	50 kV	60 kV	70 kV	70 kV	80 kV
Arc Fault Current Duration	16 kA/0.2 s[(2)]	16 kA/0.2 s[(2)]	16 kA/0.2 s[(2)]	12.5 kA/1 s	12.5 kA/1 s	12.5 kA/1 s
Closing Time	<60 ms	<60 ms	<60 ms	<70 ms	<70 ms	<70 ms
Opening Time	<30 ms	<30 ms	<30 ms	<30 ms	<30 ms	<30 ms
Interrupting Time	<50 ms	<50 ms	<50 ms	<50 ms	<50 ms	<50 ms
Arcing Time	<20 ms	<20 ms	<20 ms	<20 ms	<20 ms	<20 ms

Why can a Recloser be used as a Circuit Breaker?

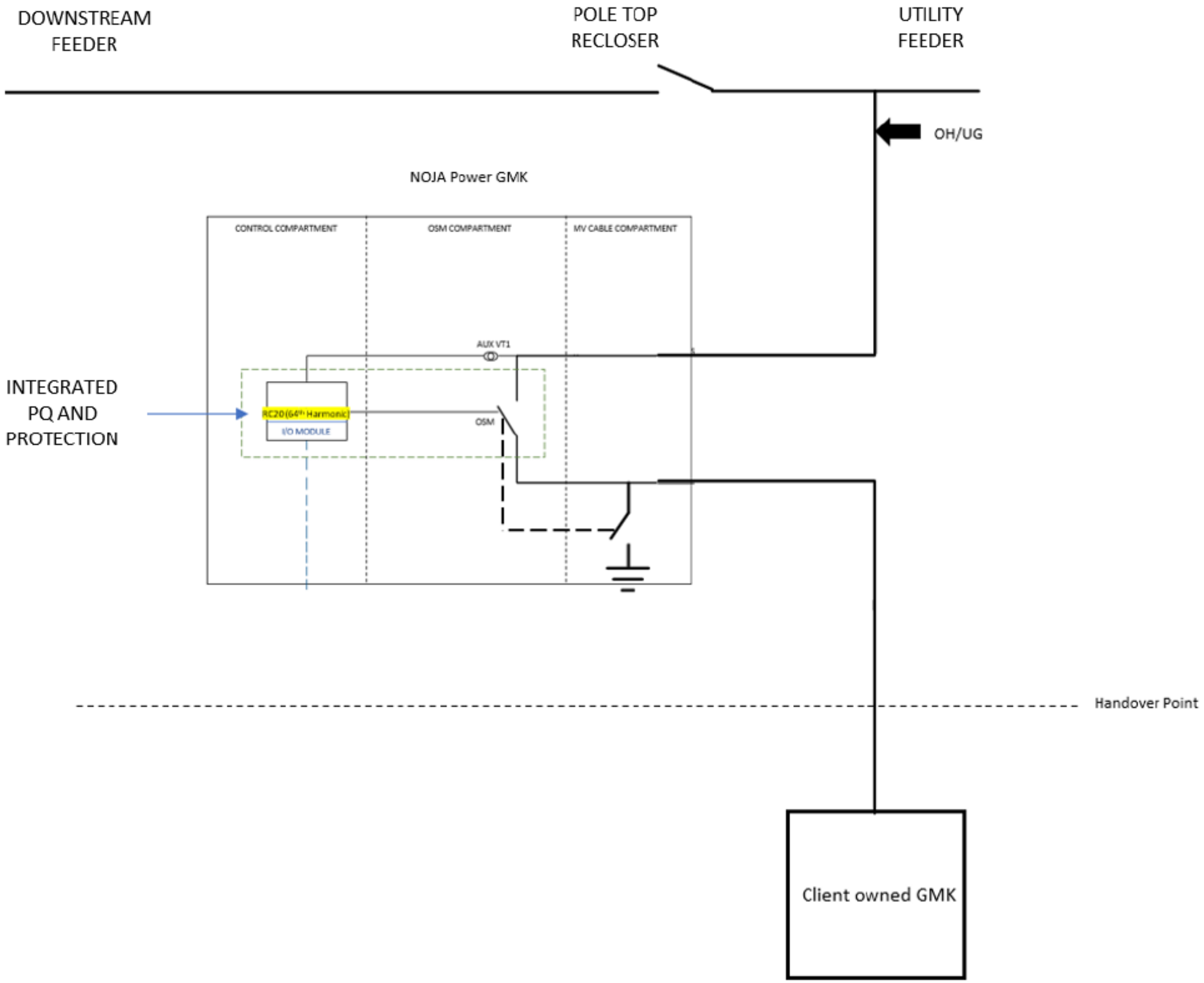
- Compliant to IEC 62271-1 and -111.
- Recloser standard shortens the duty cycle – more arduous than CB standard
- Reclosers generally have lower peak interrupt current, 16 kA typical peak while Circuit Breakers up to 40 kA.
- All reclosers are CBs, not all CBs are reclosers.
- Provided recloser can address peak fault current, either CB or Recloser can be used.
- Reclosers often supplied complete with sensors and protection – reduces cost in design, control system
- Recloser generally used in "Circuit Breaker Mode" in Renewable connections – that is, single shot to lockout.



1. Vacuum Interrupter
2. Insulated Drive Rod
3. Magnetic Actuator
4. Aromatic Epoxy Resin Housing
5. Silicone Rubber Bushing Boot
6. Cable Connector
7. Stainless Steel Tank
8. Auxiliary Switches
9. Current Transformer (position varies with model)
10. Capacitively Coupled Voltage Sensor
11. Opening spring
12. Mechanical Trip Ring

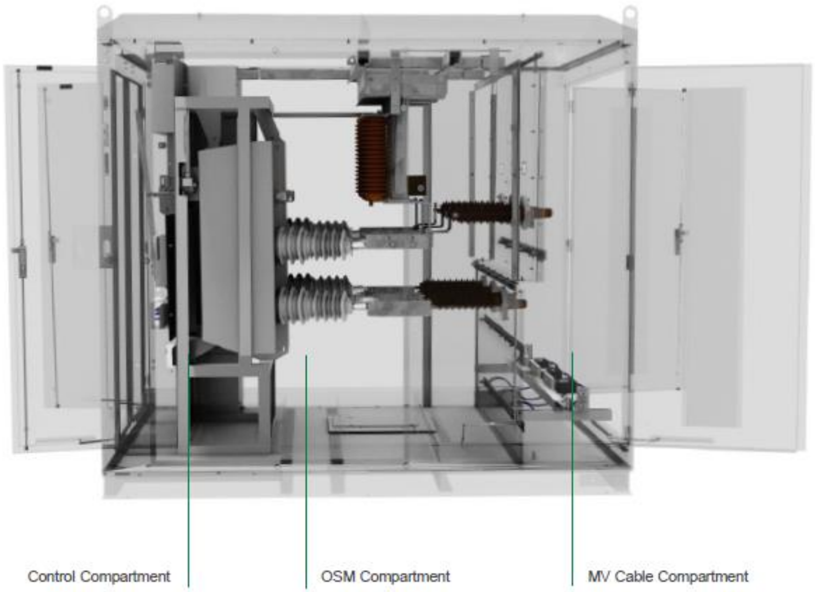
Single Line Diagram of Switchgear Assembly

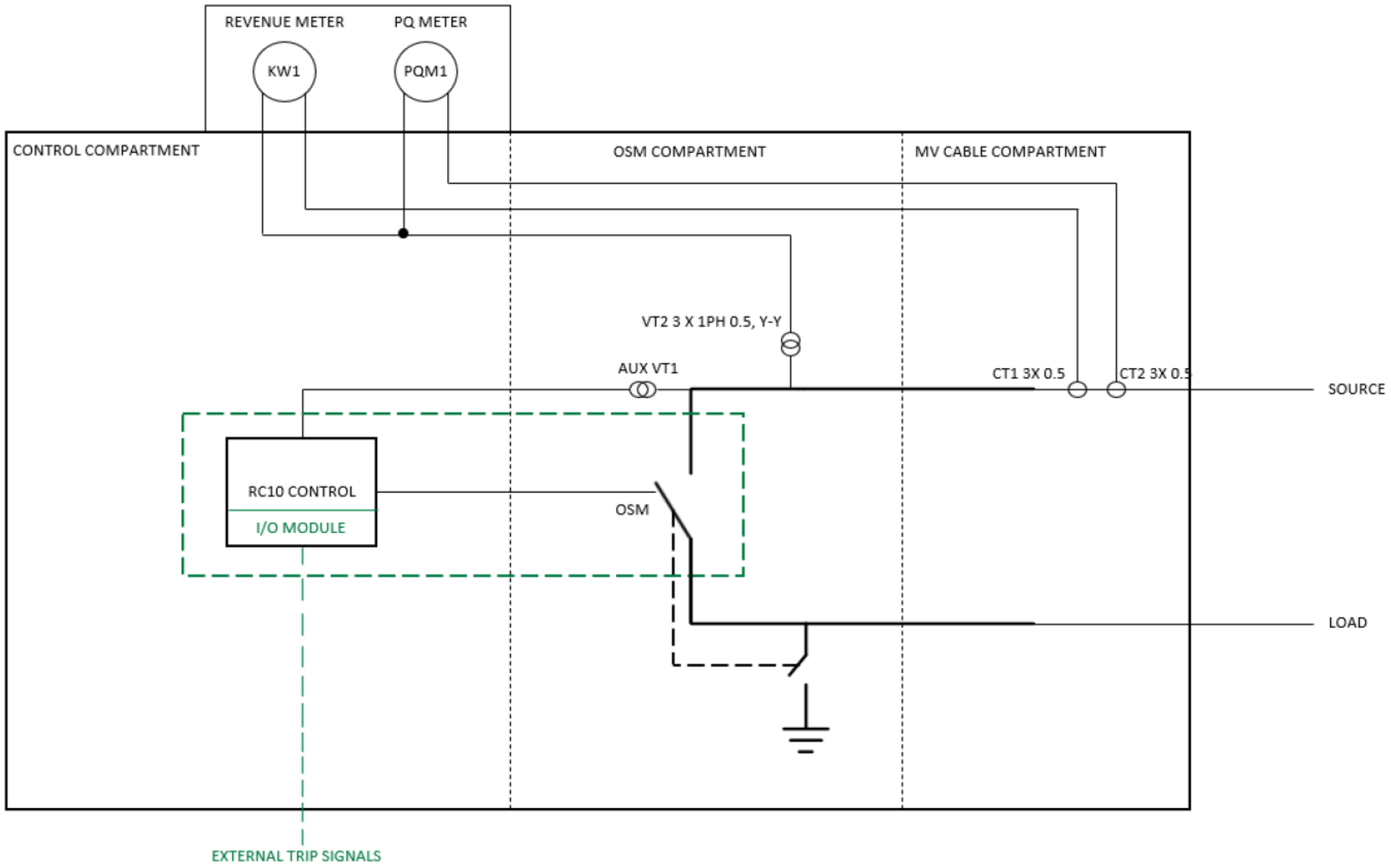
- Example layout – from first case study showing GMK interface
- GMK has a Recloser in switchgear compartment, with interlocked earth switch on the generator side.
- Load current is below 630 A, fault interrupt is below 16 kA
- Engineers using the ACR's integrated sensors for PQ Monitoring and protection
- Control compartment is a Low Voltage access area, can be operated locally onsite while asset is live if within works practices, or controlled remotely via SCADA.



Alternative Case Example

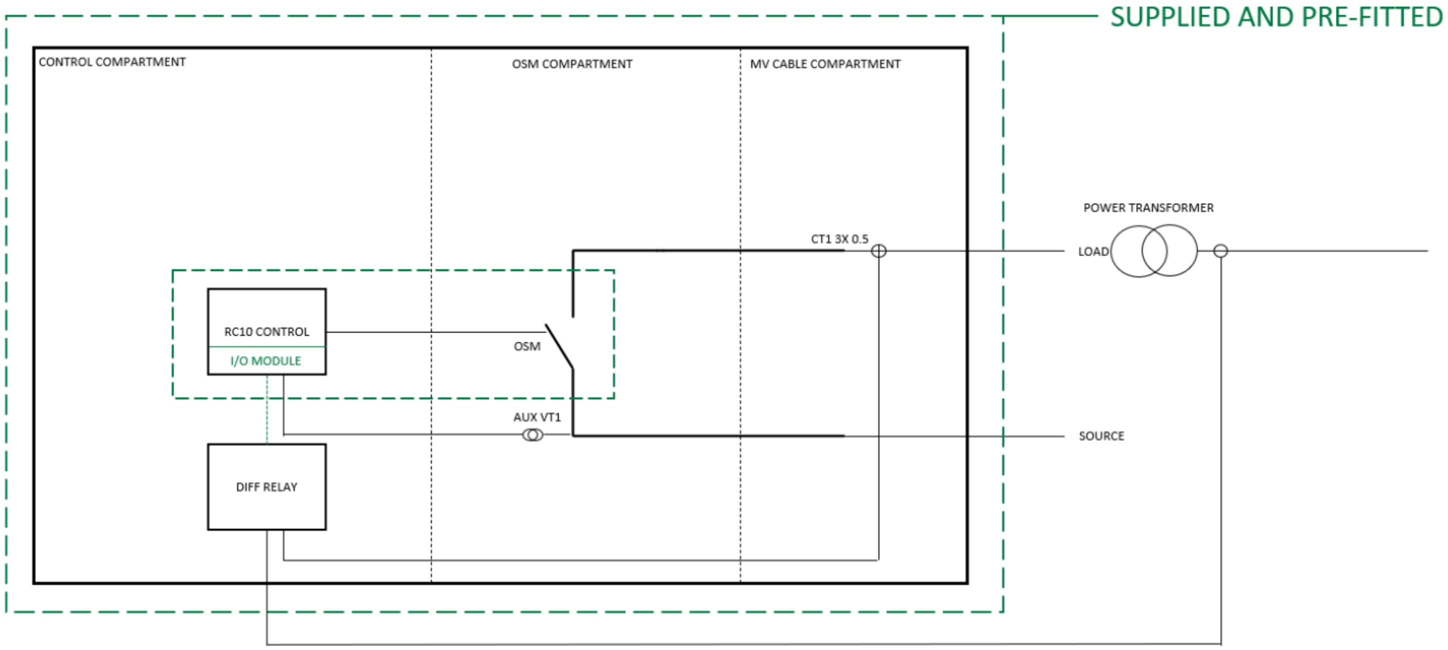
- Adding more features to the asset.
- Revenue metering and PQ Meter
- Copper controls for switchgear





Adding Differential Protection with the Switchgear

- Cable bay has CTs
- CT outputs wired to Differential Relay in control compartment
- Additional CTs wired on transformer secondaries
- Differential relay interfaces with switchgear through copper Input Output module.



Protection Schemes

Approved Grid Protection Relays

Table 1 - High Priority Functions - Level 1

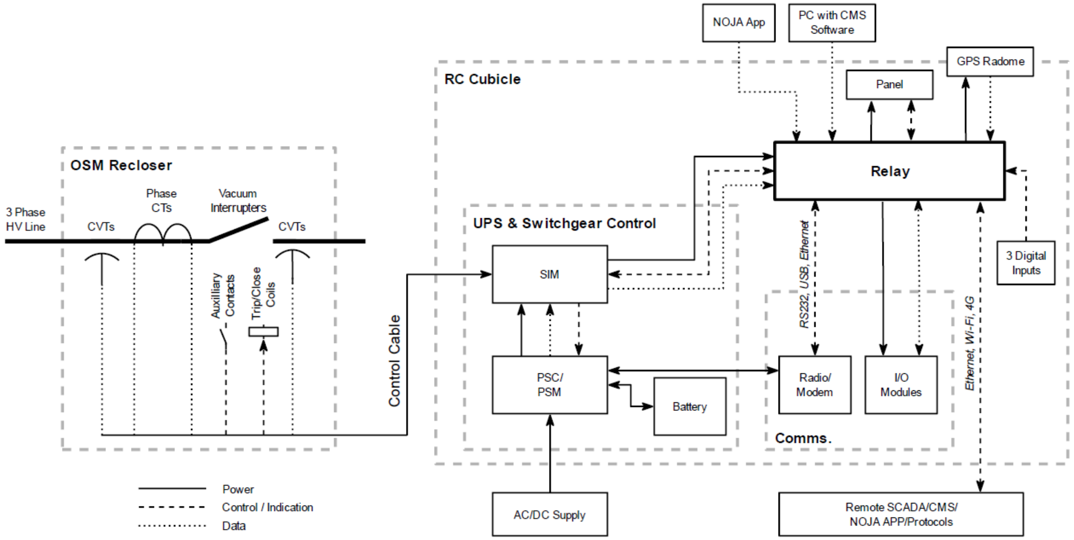
Item	Protection Functional Description	ANSI/IEEE Standard C37.2 Code
1	Under voltage (UV)	27P
2	Over voltage (OV)	59P
3	Under frequency (UF)	81U
4	Over frequency (OF)	81O
5	Rate of change of frequency (ROCOF) #	81R
6	Directional power (for export limiting)	32 (can be a separate device)

ROCOF is mandatory for IES and rotating machine systems.

The list provided is based on the GPR certified compliance to the following:

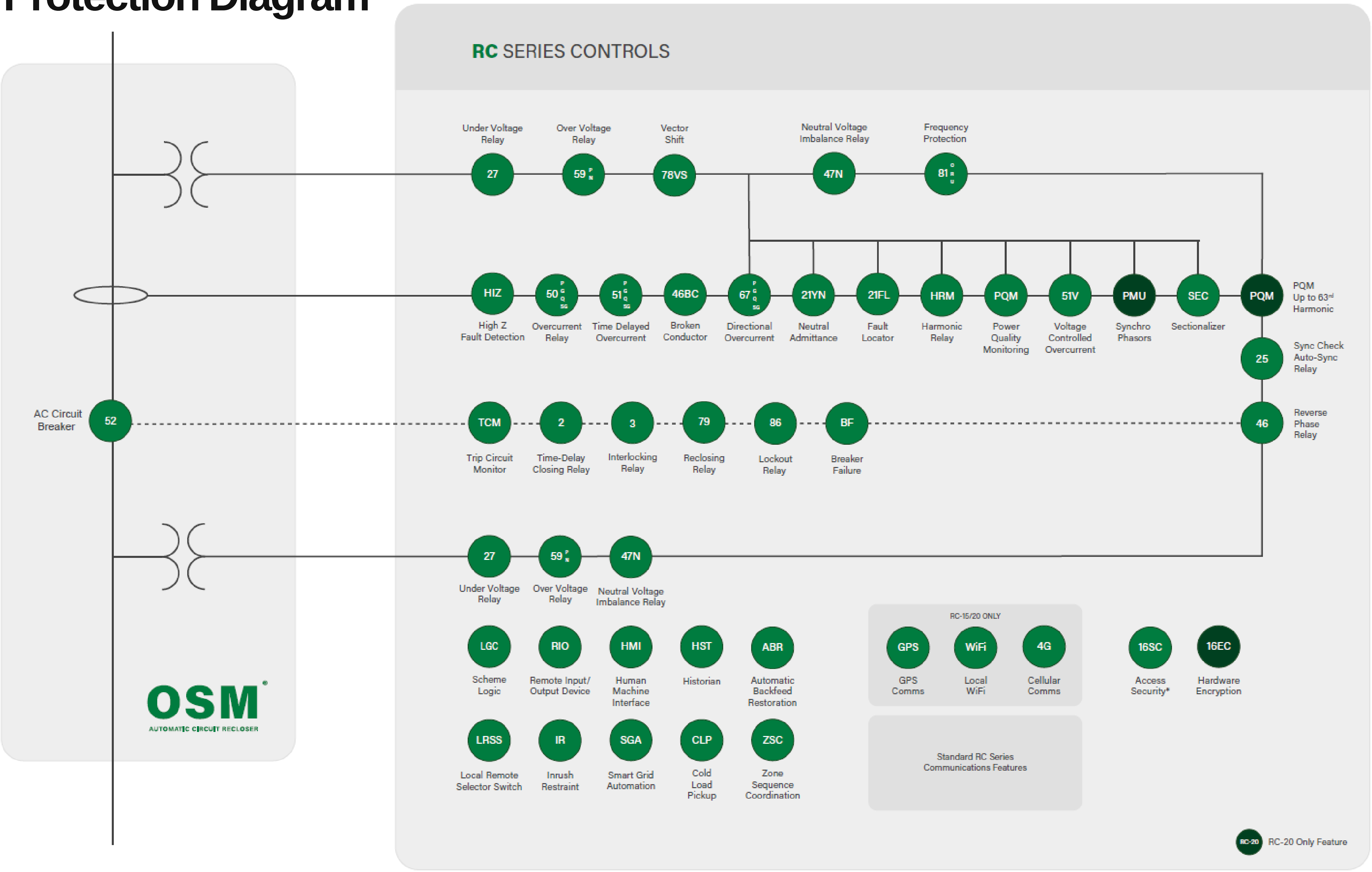
- IEC 60255-1 Common requirements;
- IEC 60255-26 EMC requirements;
- IEC 60255-27 Product safety requirements;
- IEC 60255-127 Functions requirements for over/under voltage protection; and
- IEC 60255-181 Functional requirements for frequency protection.

Manufacturer	Model	Approval		Endorsed Date
		Level 1	Level 2	
Noja Power	RC20 Controller (REL-20-4G)	Yes	No	24/01/2024



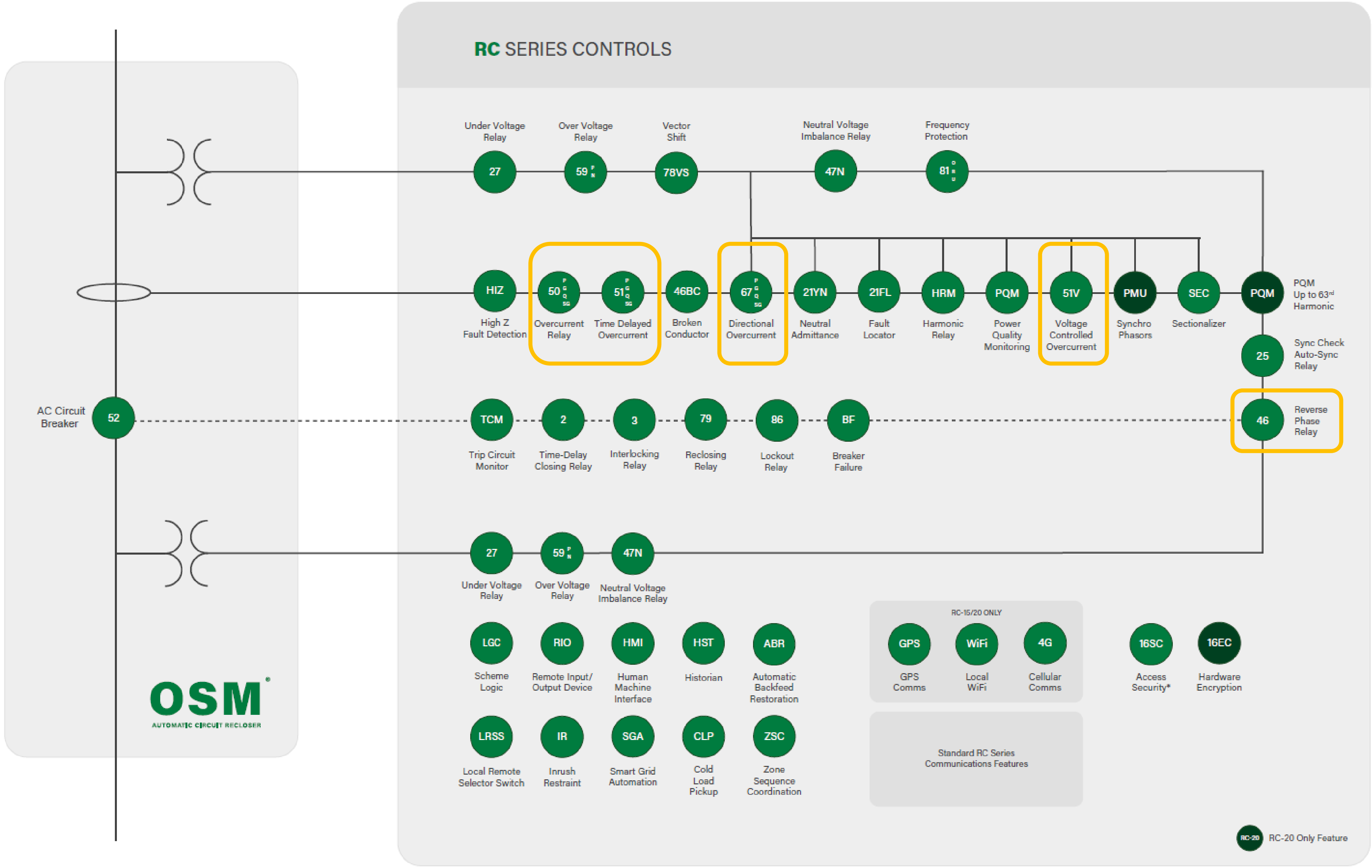
Protection Diagram

NOJA POWER®



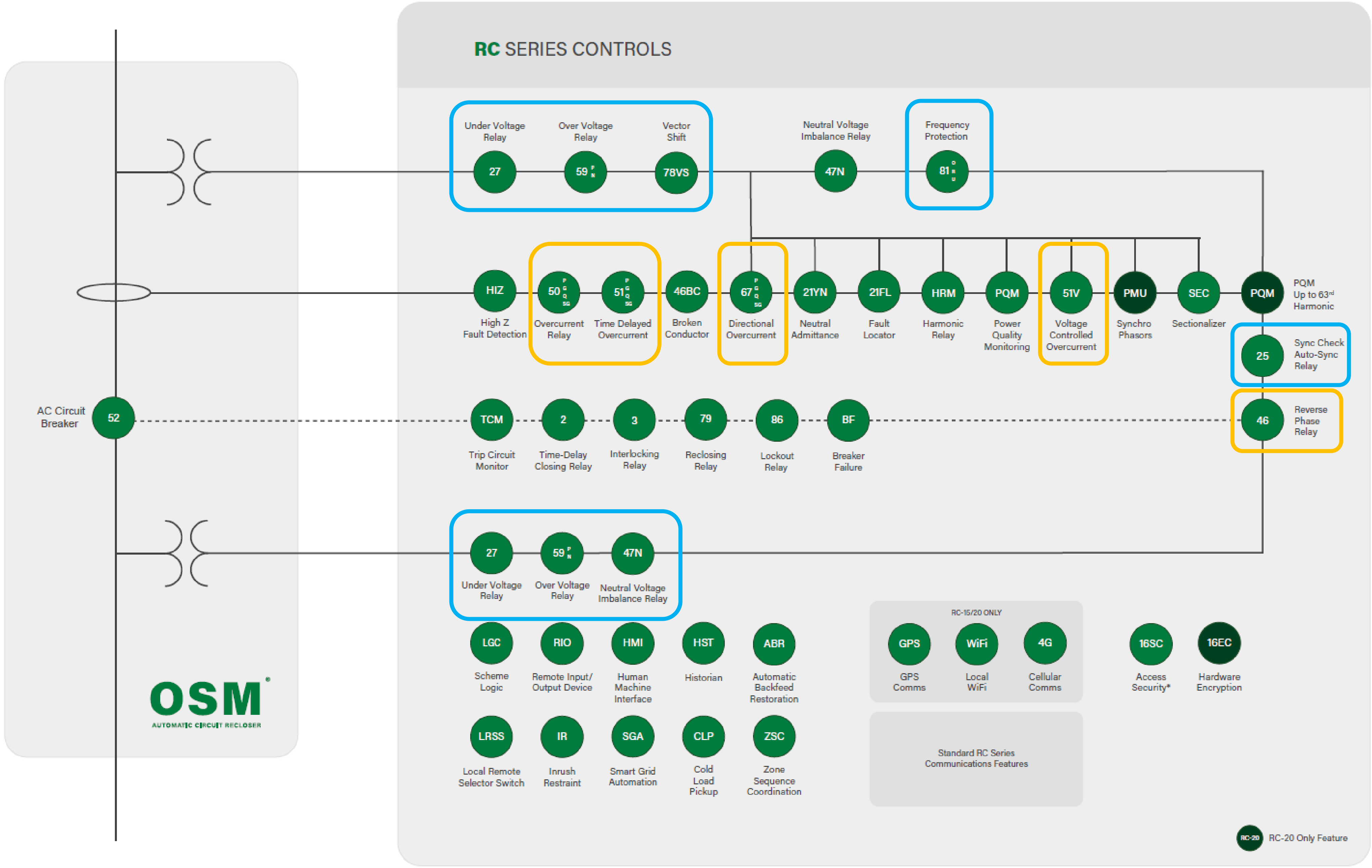
Protection Diagram – Protecting the Assets

NOJA POWER®



Protection Diagram – Anti Islanding

NOJA Power



NOJA POWER

Protecting the Assets

Protecting Assets – Typical Features

Time Delayed (51*) and Instantanteous (50*) Overcurrent:

- Phase Overcurrent
- Negative Phase Sequence Overcurrent
- Earth Fault
- Sensitive Earth Fault

Directional Overcurrent (67*)

- Phase Overcurrent
- Earth Fault

Voltage Controlled Overcurrent (51V)

Reverse Phase Relay

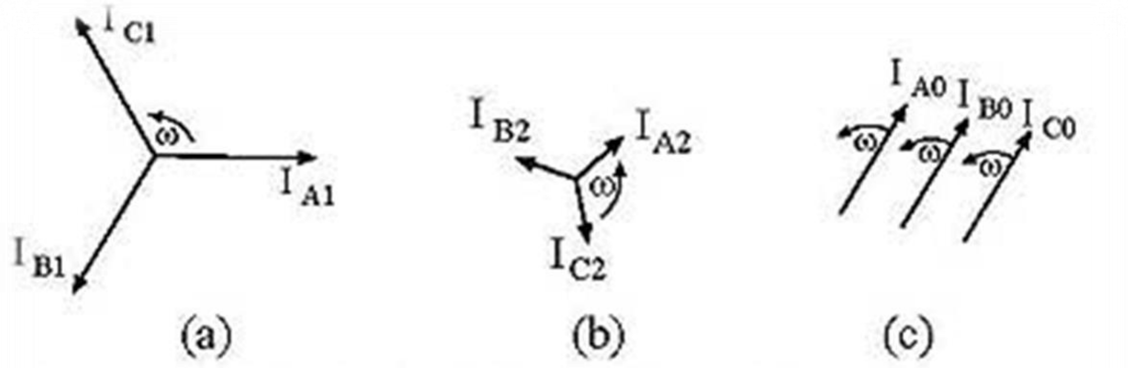
Asymmetric Faults

- Most faults are unbalanced
- 80% of overhead line faults are Line to Ground
- We use symmetrical components to transform all the phasor data into something meaningful, then make protection decisions based on that information.

Recloser installation, NSW Australia

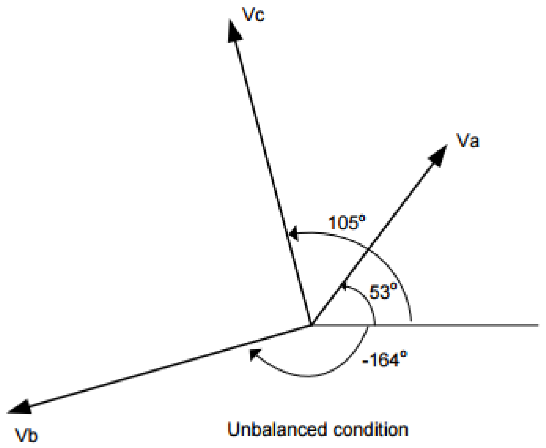
Symmetrical Components

- Mathematical transformation of phasor data
- Takes the unbalanced set of phasor data, gives a result of 3 balanced components.
- By doing this, we:
- Get the balance back AND
- Extract new information about the relationship between the phasors AND
- Can detect specific fault types



(a) Positive, (b) Negative, and (c) Zero Sequence Components

Example – Phasor to Symmetrical Components



- Given:
- Va = 5∠53 ,
- Vb = 7∠−164
- Vc = 7∠105

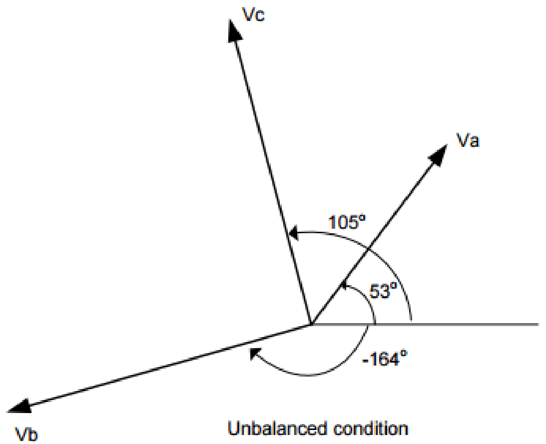
Formulae – Sequence Components from Phasors

$$V_0 = \frac{1}{3}(V_a + V_b + V_c)$$

$$V_1 = \frac{1}{3}(V_a + aV_b + a^2V_c)$$

$$V_2 = \frac{1}{3}(V_a + a^2V_b + aV_c)$$

Example – Phasor to Symmetrical Components



- Given:
- Va = 5∠53 ,
- Vb = 7∠−164
- Vc = 7∠105

Formulae – Sequence Components from Phasors

$$V_0 = \frac{1}{3}(V_a + V_b + V_c)$$

$$V_1 = \frac{1}{3}(V_a + aV_b + a^2V_c)$$

$$V_2 = \frac{1}{3}(V_a + a^2V_b + aV_c)$$

Solve for the positive-sequence component:

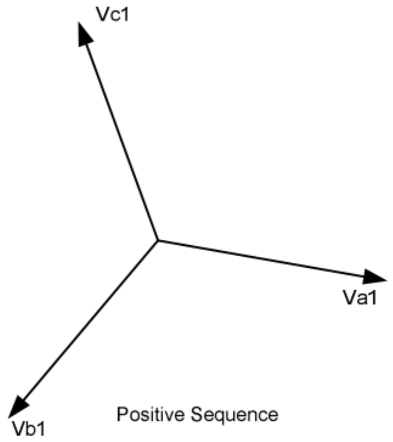
$$V_{a1} = \frac{1}{3}(V_a + aV_b + a^2V_c)$$
$$= \frac{1}{3}(5\angle 53^o + (1\angle 120^o \cdot 7\angle -164^o) + (1\angle 240^o \cdot 7\angle 105^o))$$
$$= 5.0\angle -10^o$$

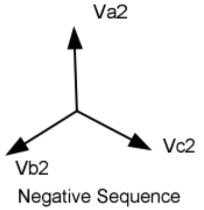
Solve for the negative-sequence component:

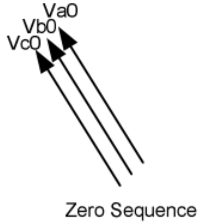
$$V_{a2} = \frac{1}{3}(V_a + a^2V_b + aV_c)$$
$$= \frac{1}{3}(5\angle 53^o + (1\angle 240^o \cdot 7\angle -164^o) + (1\angle 120^o \cdot 7\angle 105^o))$$
$$= 1.9\angle 92^o$$

Solve for the zero-sequence component:

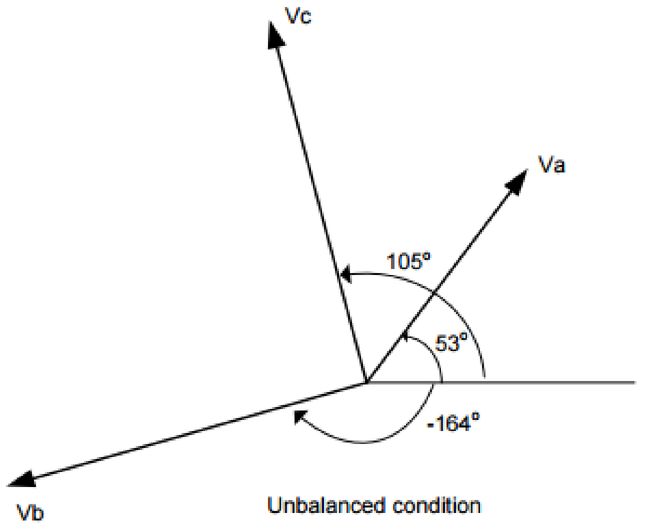
$$V_{a0} = \frac{1}{3}(V_a + V_b + V_c)$$
$$= \frac{1}{3}(5\angle 53^o + 7\angle -164^o + 7\angle 105^o)$$
$$= 3.5\angle 122^o$$

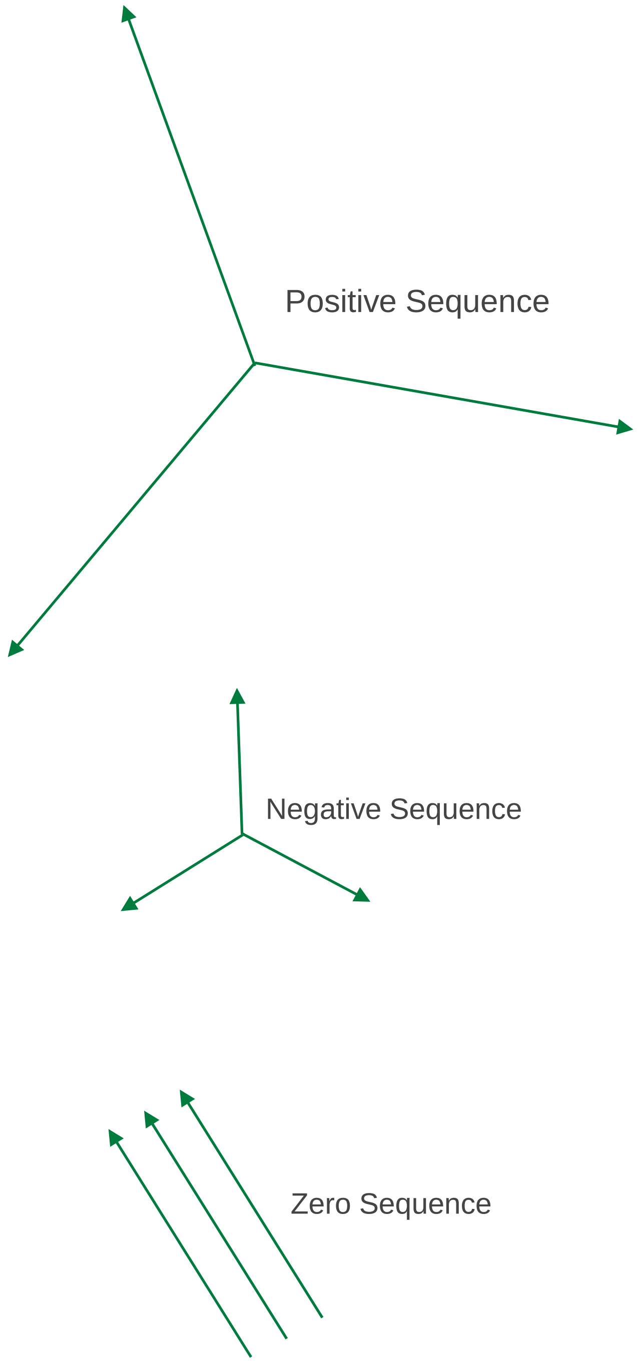


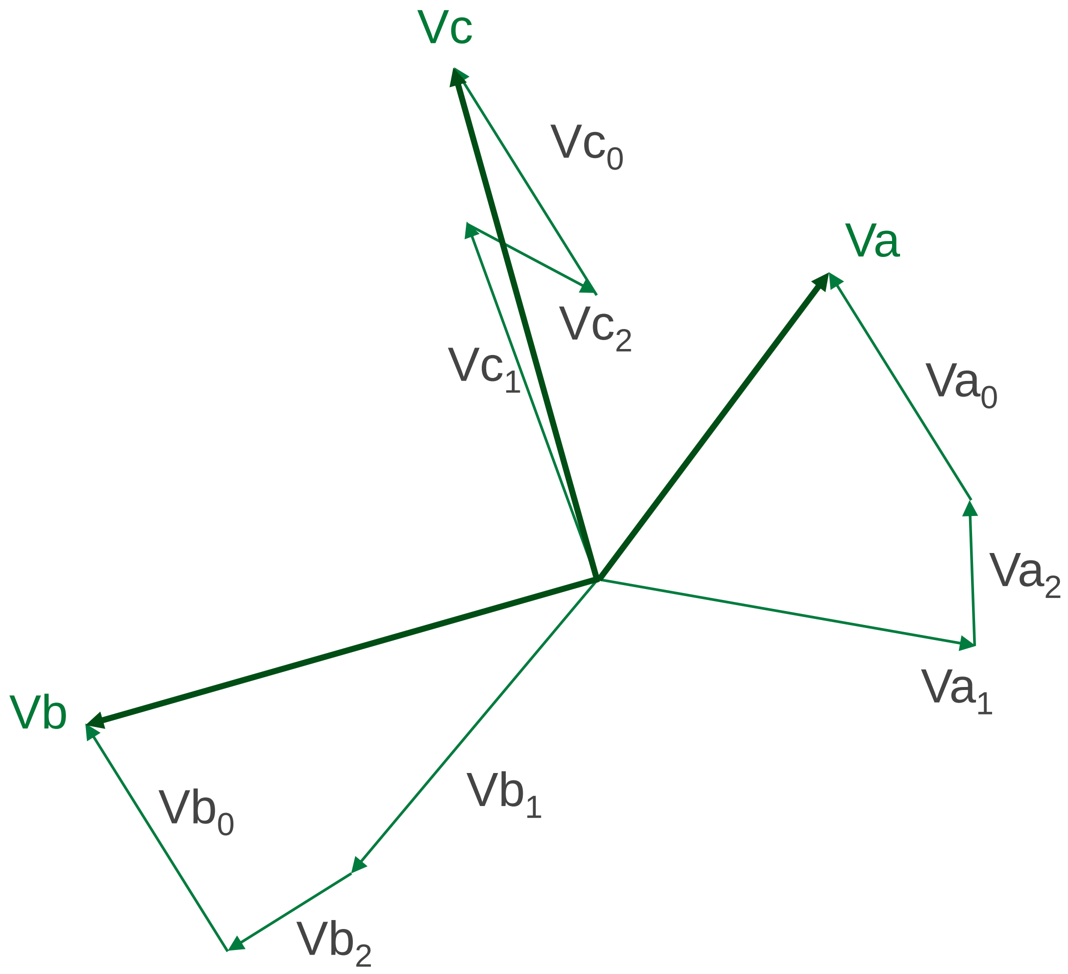




Vector Proof

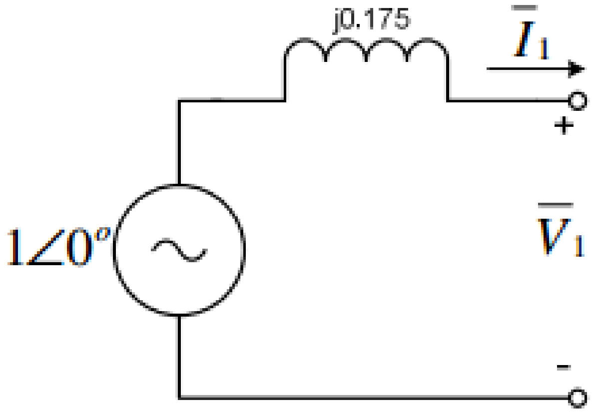




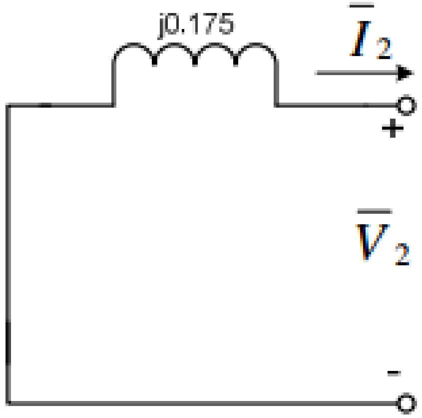


Symmetrical Components in Practice

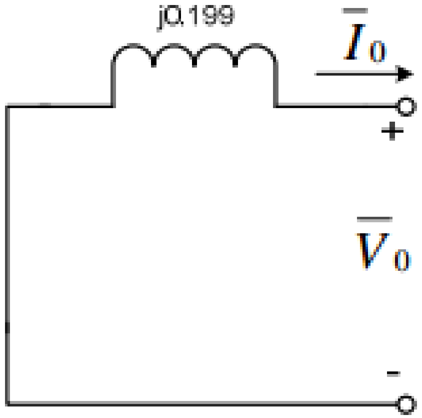
- Thevenin Equivalent Circuits
- Just as we have Positive, Negative and Zero Sequence Currents and Voltages, we can also calculate symmetrical impedances too.
- We can rely on V = IZ to calculate our fault magnitudes.



Positive Sequence Thevenin Equivalent



Negative Sequence Thevenin Equivalent



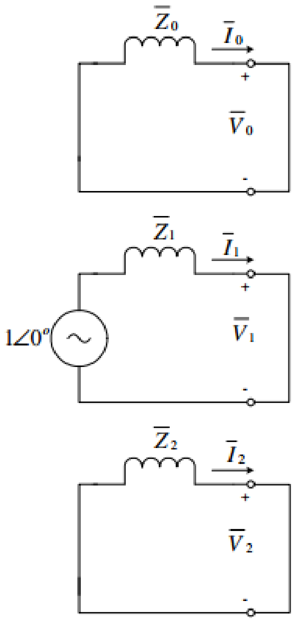
Zero Sequence Thevenin Equivalent

**Arbitrary Values*

Connecting Sequences per Fault Type for Calculations

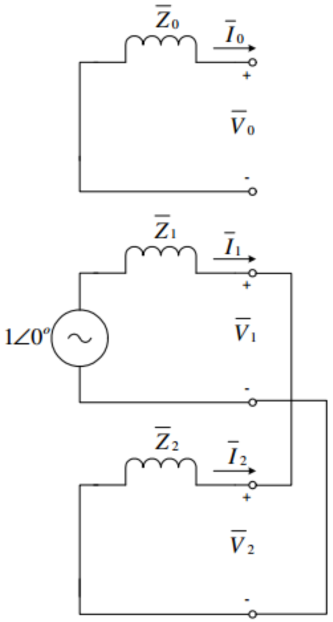
Single Line to Earth Fault	• All sequence equivalents are connected in series
Line to Line Fault	• Positive and Negative Sequence equivalent networks are connected in parallel
Double Line to Ground Fault	• All Three equivalent networks are connected in Parallel
Three Phase Fault	• The Positive Sequence equivalent network is only used in Three Phase Faults. No other networks connected
Open Phase Fault (Broken Conductor)	• Depends on Network Topology

Three Phase Fault



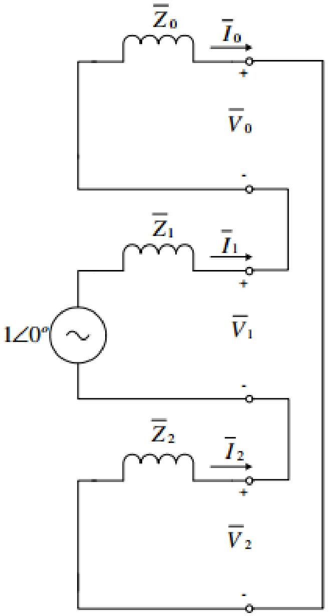
Balanced, big, mostly Positive Sequence

Line to Line Fault



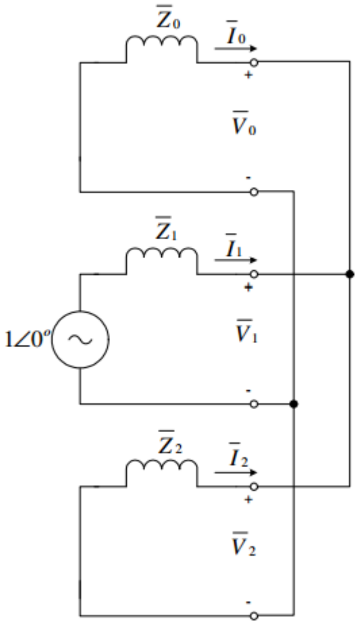
Large Fault – Only impedance is the conductor and generator/transformer windings. Positive and Negative sequence current is equal. Limited Zero Sequence Current

Single Line to Ground



Unbalanced, generally smallest magnitude of overcurrent fault types. Zero sequence impedance varies on earthing type. Positive, negative and zero sequence equal.

Double Line to Ground



Can be very large, impedances connected in parallel. Highly unbalanced.

Basic Overcurrent Protection Summary

- Overcurrent (51P), NPS (51Q), Earth Fault (51G) and Sensitive Earth Fault (51SG) cover most fault scenarios for overload and insulation failure.

- All these features provided by modern recloser assets.

- Using a Recloser as a point of connection for renewables works, because it meets the peak interruption capacity, and the integrated protection feature set covers all scenarios necessary.

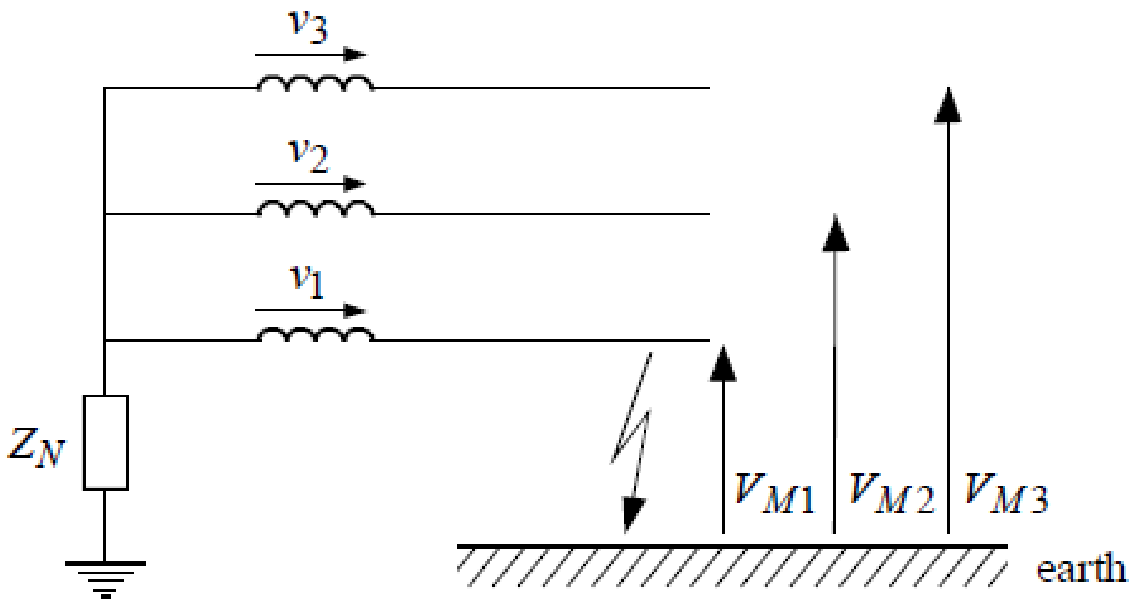
NOJA POWER

Adding Directional Earth Fault

- Renewable installations may have underground cables.
- Underground cables have a higher capacitance to earth than overhead lines.
- Capacitive currents can cause nuisance tripping on Earth Fault.
- Here's how it works

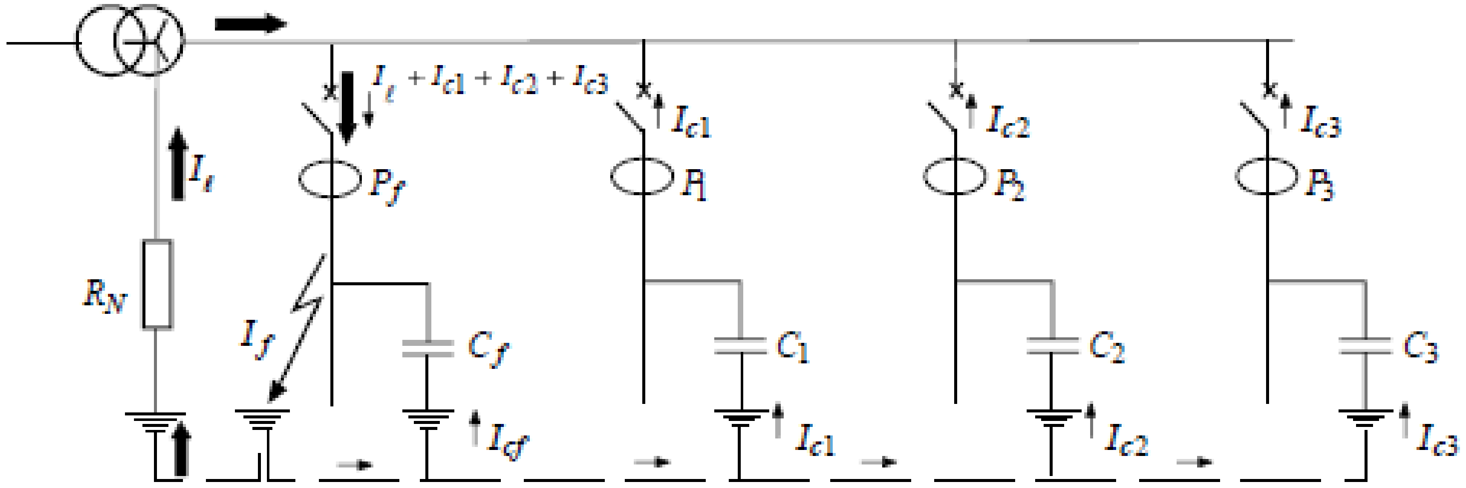
$$V_{rsd} = V_{M1} + V_{M2} + V_{M3} = 0 + V_2 - V_1 + V_3 - V_1$$
$$= V_1 + V_2 + V_3 - 3V_1$$
$$= -3V_1$$

$$V_{rsd} = -3V_q$$



V_{M1}, V_{M2}, V_{M3} : phase-to-earth voltages measured in phases 1, 2 and 3

A Faulted Sample Network with a Neutral Earthing Resistor (NER)



resistive current $I_\ell = \frac{V_n}{R_N}$ capacitive current

Fault current $I_f = I_\ell + I_{Cf} + I_{C1} + I_{C2} + I_{C3}$

- More capacitance, more capacitive current
- This can creep over the SEF level, and in worst case exceed EF
- Use directional EF to select forward faults only

thus:

$$I_{rsdi} = -3\, j\, C_i\, \omega V_n$$

$$I_{rsdi} = j\, C_i\, \omega V_{rsd}$$

where $V_{rsd} = -3\, V_n$ for a solid fault.

Non faulted phase current

$$I_{rsdi} = -I_{Ci}$$

Faulted Phase Current

where $I_\ell = \frac{V_n}{R_N}$

and

$$I_{Ci} = 3\, j\, C_i\, \omega V_n$$

thus:

$$I_{rsdf} = \frac{V_n}{R_N} + 3\, j\, (C_1 + C_2 + C_3)\, \omega V_n$$

$$I_{rsdf} = -\frac{V_{rsd}}{3\, R_N} - j\, (C_1 + C_2 + C_3)\, \omega V_{rsd}$$

where:

$V_{rsd} = -3\, V_n$ for a solid fault

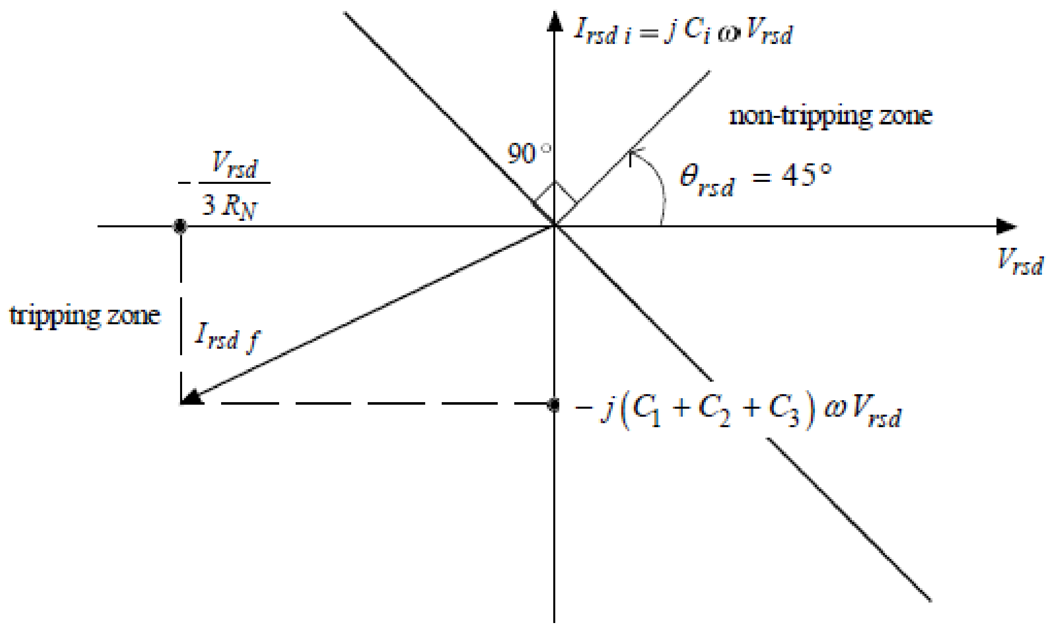
C_i : feeder i capacitance

V_n : nominal single-phase voltage

R_N : limiting resistance

Mapping Vectors to Polar Coordinates

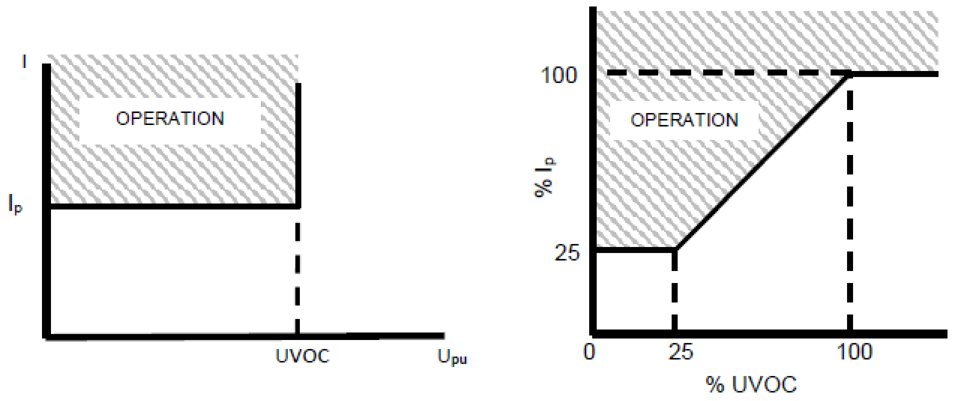
- Note the direction of Earth Fault. Some relays shift the Residual 180 degrees (as calculation always gives 180.) Read the manual
- The greater the capacitive effects, the more the zero sequence angle approaches the 90/270 plane.



Protecting Generation Assets – 51V

Protection features such as Directional Power and Voltage Controlled OC are used.

51V Voltage Controlled Overcurrent uses a voltage gate to enable protection. The pickup is either completely blocked if voltage remains, or the pickup is scaled according to the voltage movement.



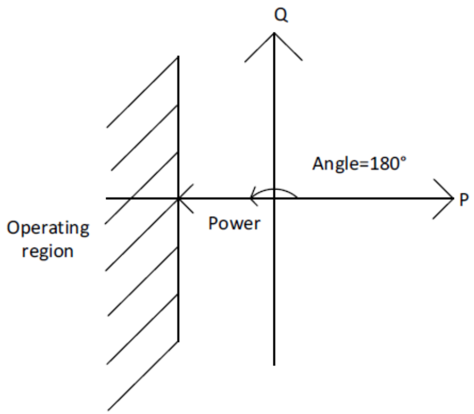
Directional Power Protection

Reverse power protection is used when connecting rotating generators to the grid.

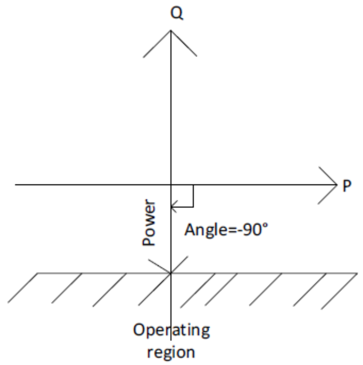
Failure of the prime mover can cause motoring, protected against by Reverse Power

Underpower protection is used to protect against overspeed when large loads are

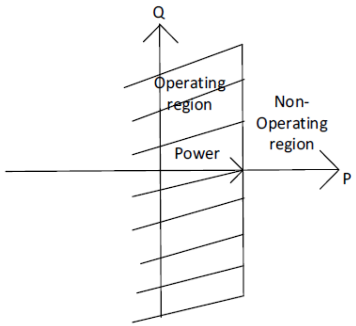
disconnected from the generator.



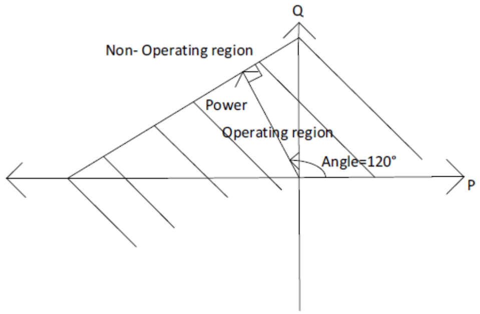
Reverse active power protection



Reverse reactive power protection



Power angle at 0°



Power angle at 120°

NOJA Power®

Anti Islanding Protection

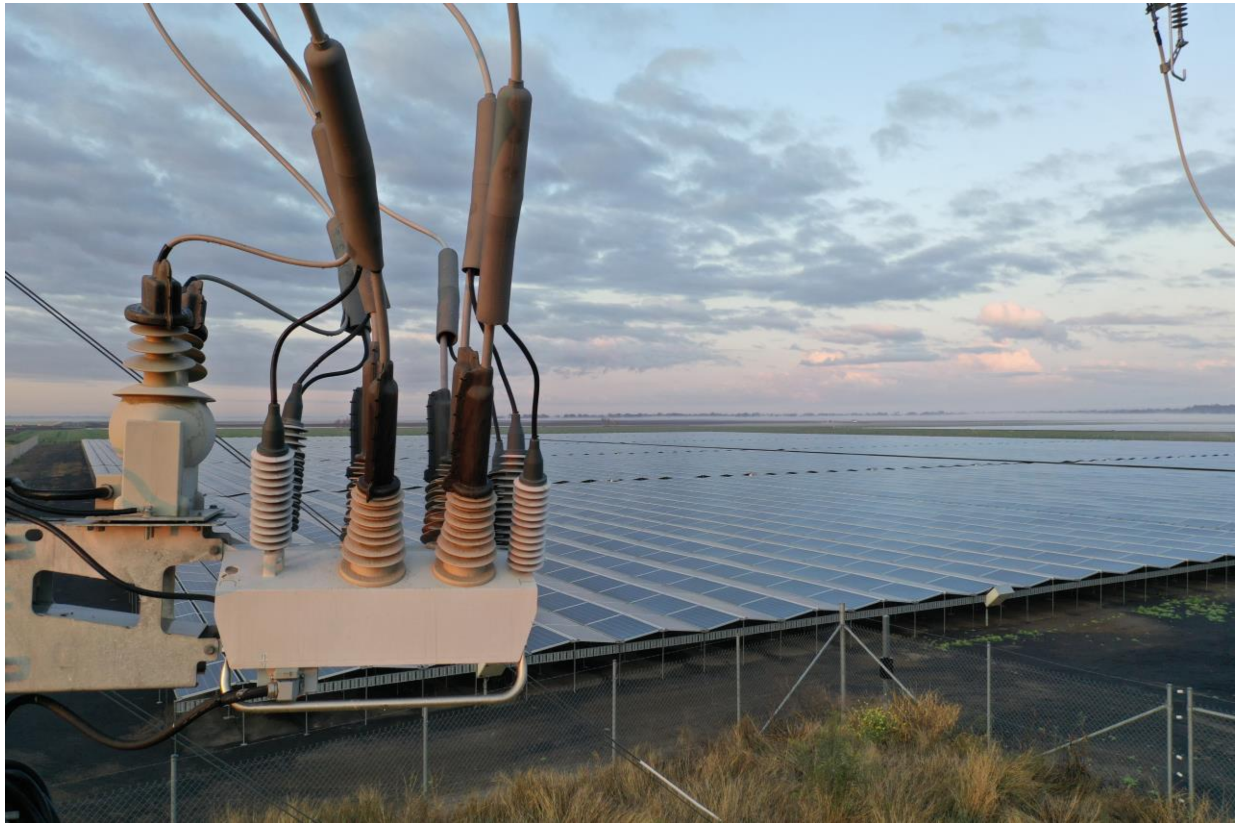
Anti Islanding Protection Techniques

Grid connected inverters often have “Active” techniques.

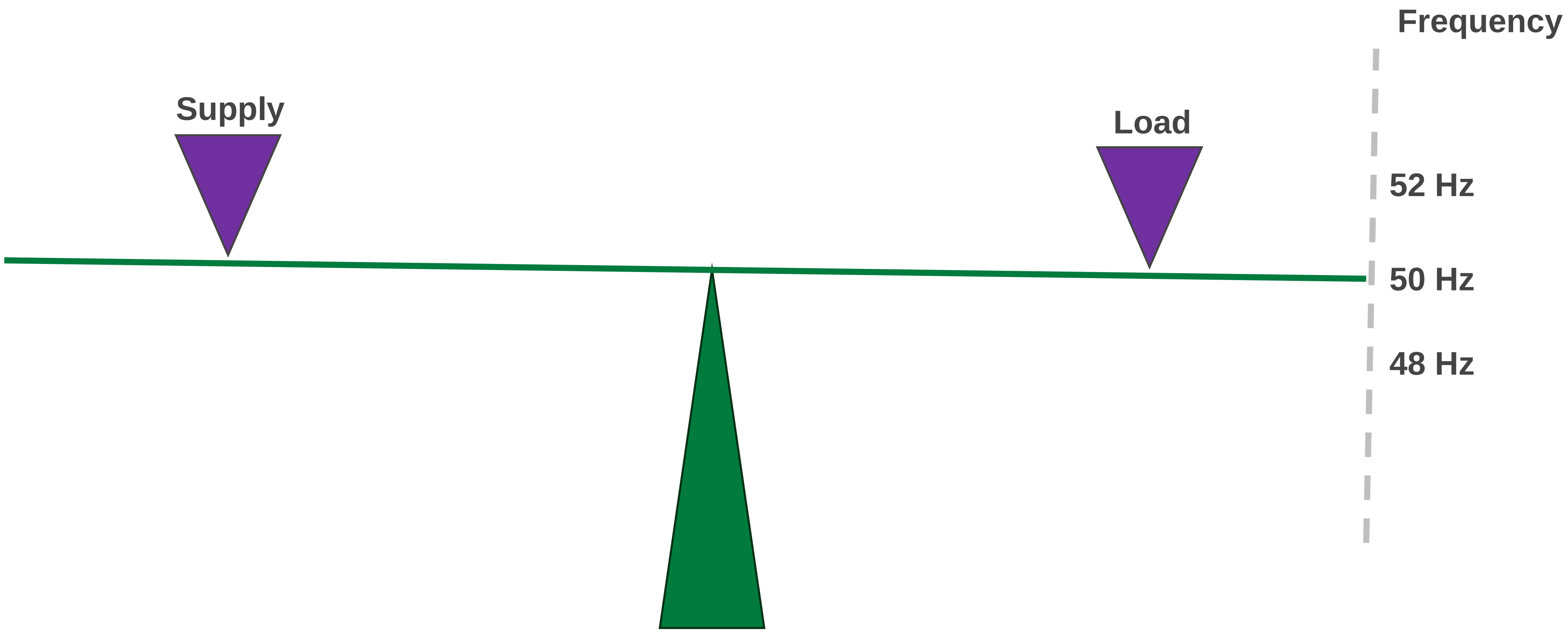
Connection Switchgear uses Passive Protection techniques, outlined in Renewable connections standards and local network compliance codes.

Features typically used:

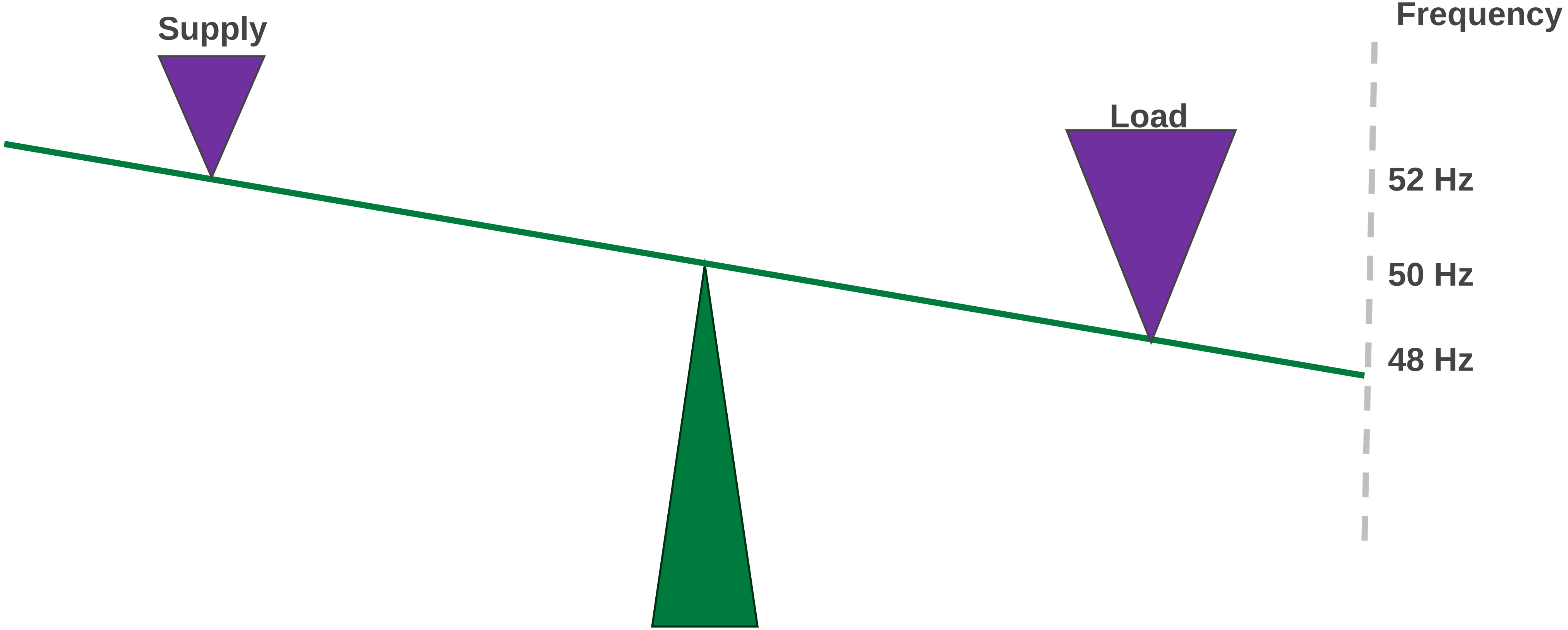
- Frequency, Over (81O), Under (81U), Rate of Change (81R),
- Multistage Frequency
- Undervoltage
- Overvoltage
- Voltage Vector Shift



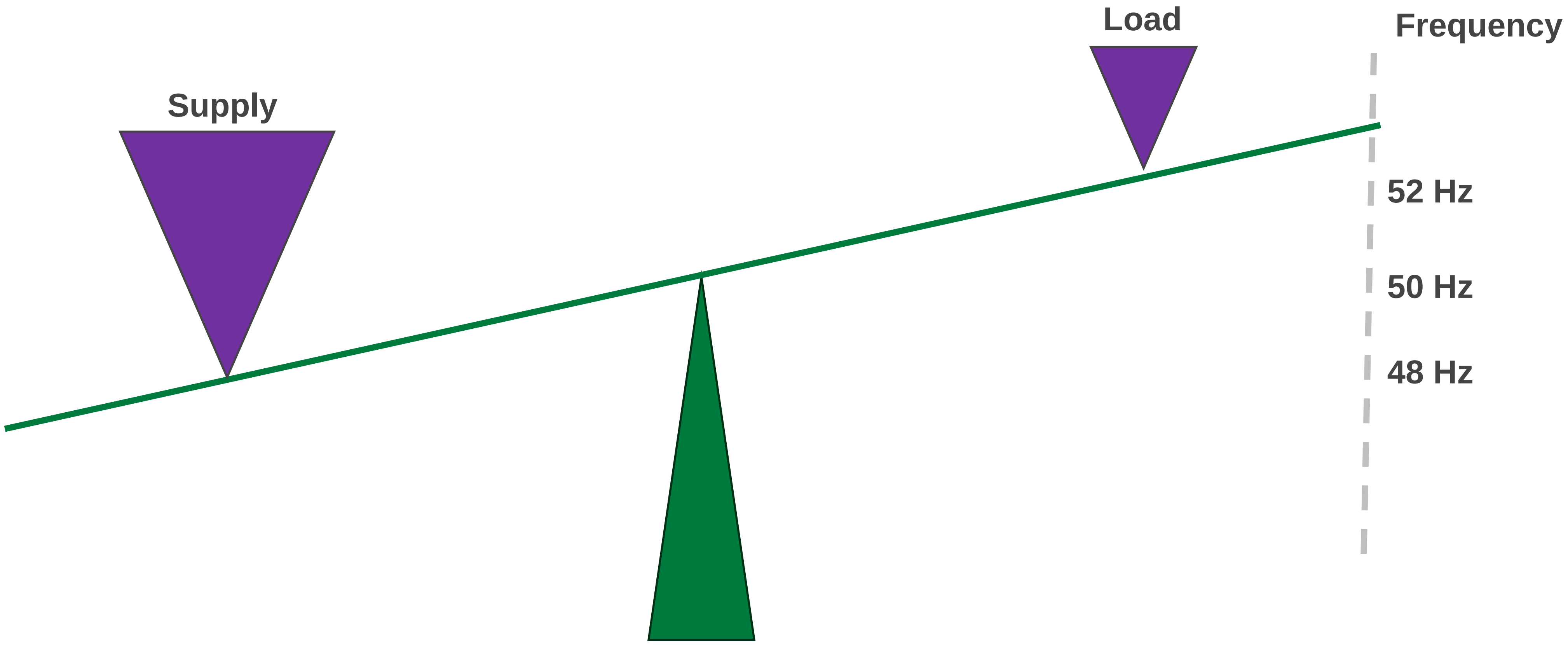
Frequency Protection



Frequency Protection



Frequency Protection

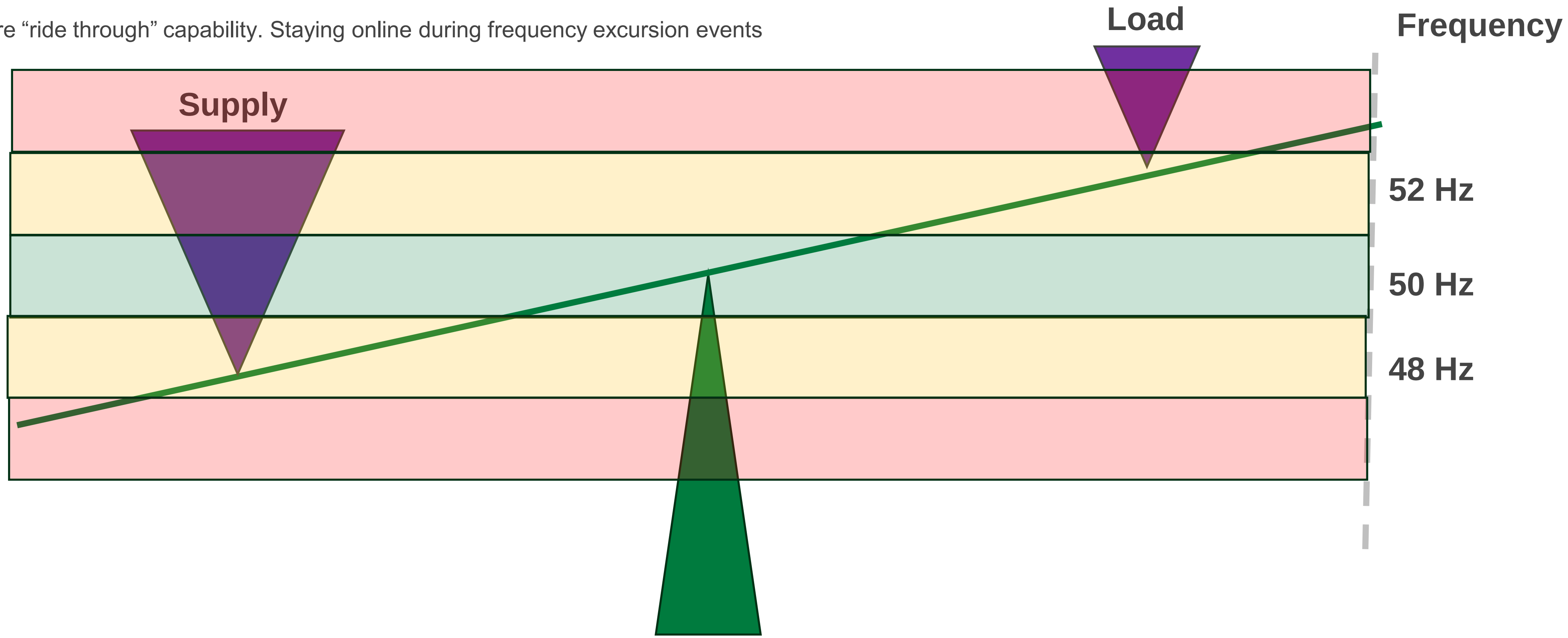


Frequency Protection

Sets the range of imbalance tolerance.

Frequency protection requirements set by grid code.

Most codes require “ride through” capability. Staying online during frequency excursion events



ROCOF Protection

$$\frac{df}{dt} = \frac{\Delta P \cdot f}{2 \cdot G \cdot H}$$

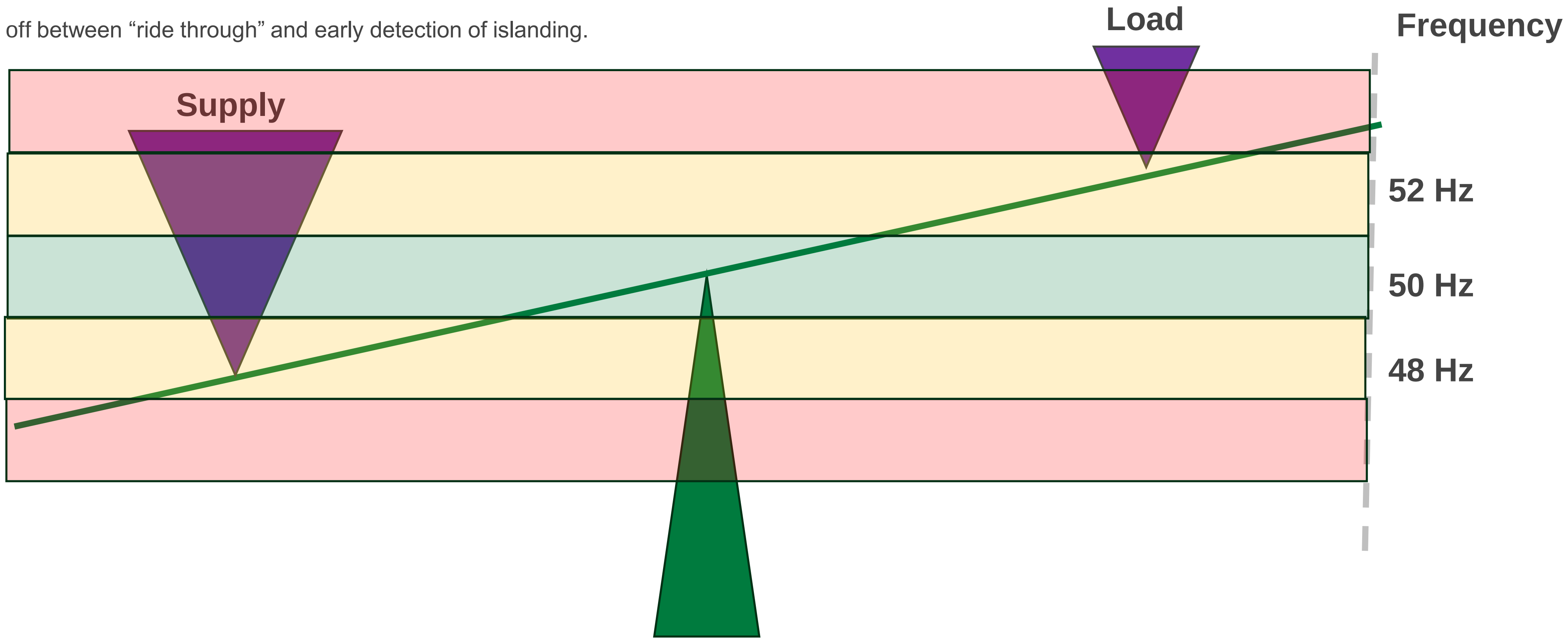
Where:

- ΔP – Change in power output between synchronised and islanded operation;
- f – Rated frequency;
- G – Machine rating in MVA;
- H – Inertia constant.

Derivative of Frequency over Time – i.e. how fast Frequency is moving.

Instead of waiting to reach a limit, protection acts on how fast the frequency is getting there

Engineering trade off between “ride through” and early detection of islanding.



Class Question – What scenarios wouldn’t this work?

NOJA Power®

Power Quality Monitoring

Power Quality

The degree to which the voltage, frequency and waveform of a power supply conform to established specifications

Important for a generator – connection compliance requirements.

Specifications vary based on local grid code.

However, they look at the same metrics:

- Harmonics
- Voltage (sags and swells)
- Interruptions
- Frequency

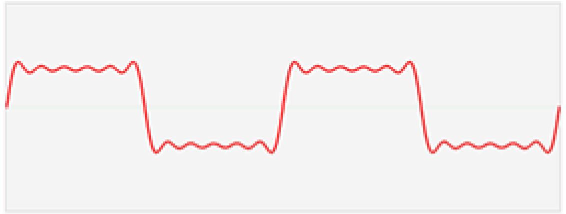
Harmonics

- Calculate the Fourier Transform of the measured wave

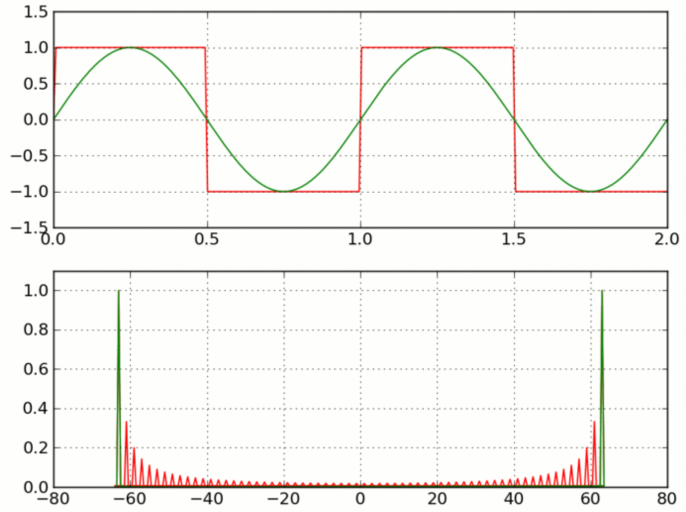
- Harmonics are constituent waves with a frequency multiple of the fundamental.

- In Australia, 3rd harmonic = 3 x 50 Hz = 150 Hz
- RC-10/15 can measure up to the 15th Harmonic
- RC-20 can measure up to 63rd Harmonic

- RC-20 has been approved as a power quality monitor in some networks, removing need for additional PQ assets on renewable connection sites



$$\hat{f}(\xi) = \int_{-\infty}^{\infty} f(x)\, e^{-2\pi i x \xi}\, dx$$

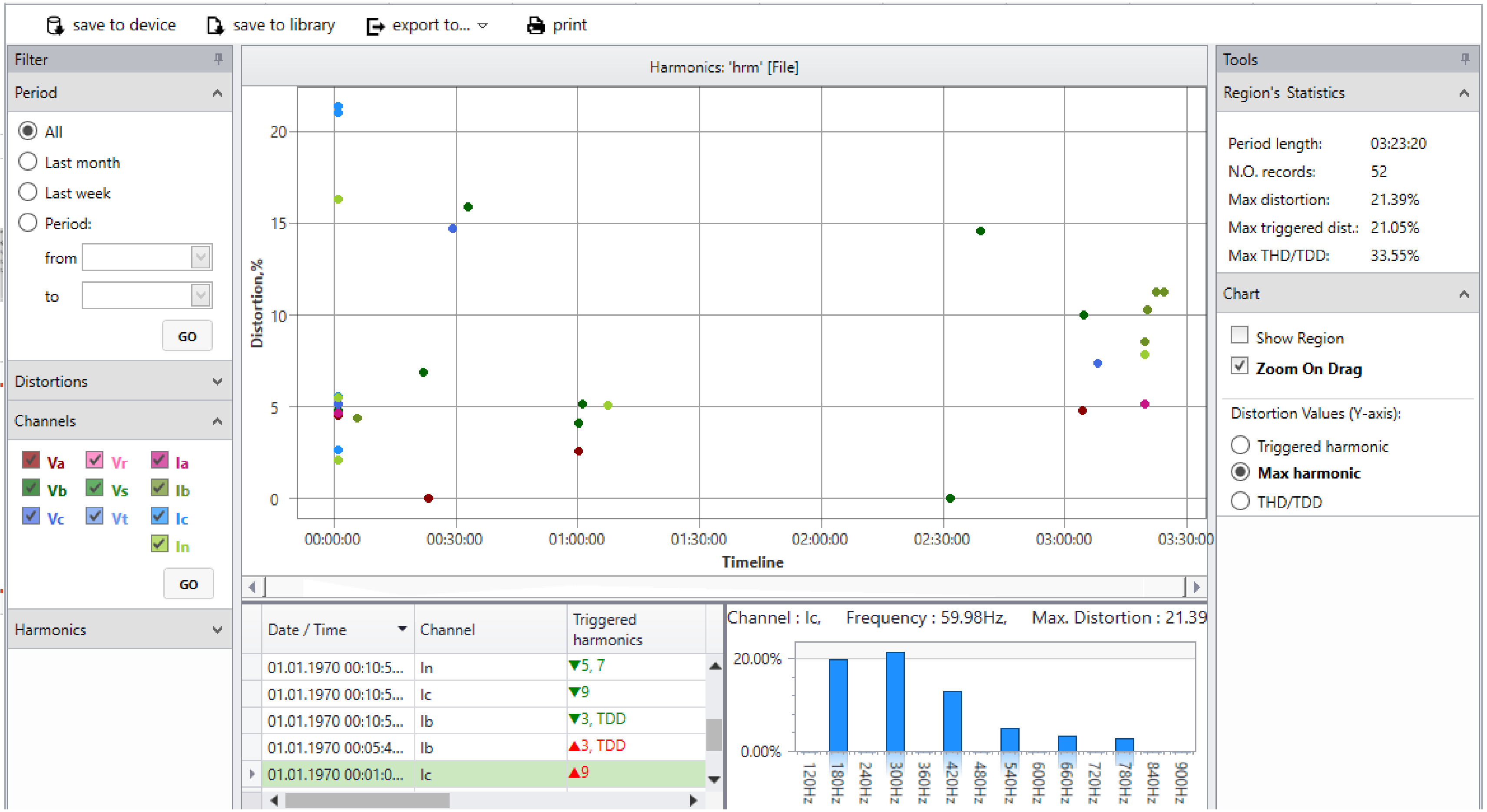


Harmonics in PQS

Captures triggered by dead-band transitions

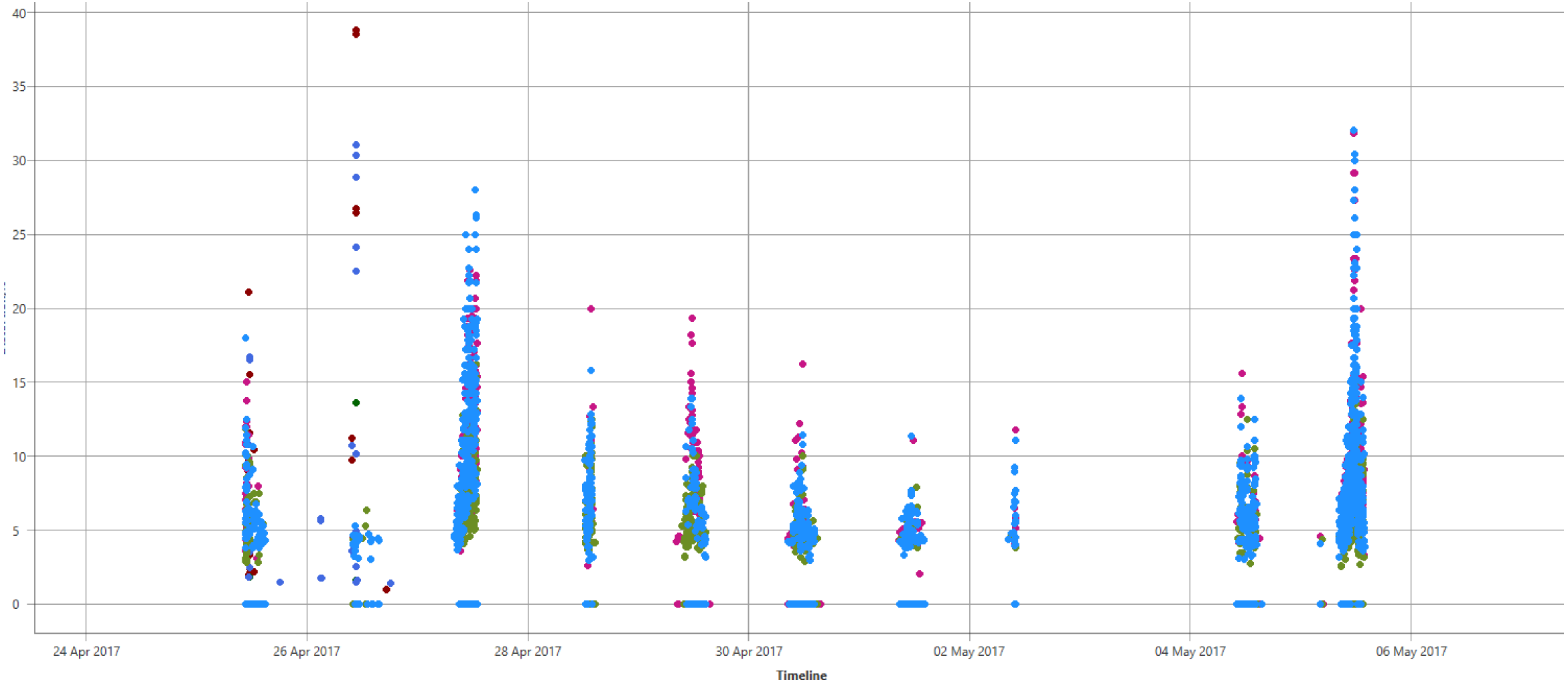
Takes a Fourier analysis at the transition

Defines triggered harmonics

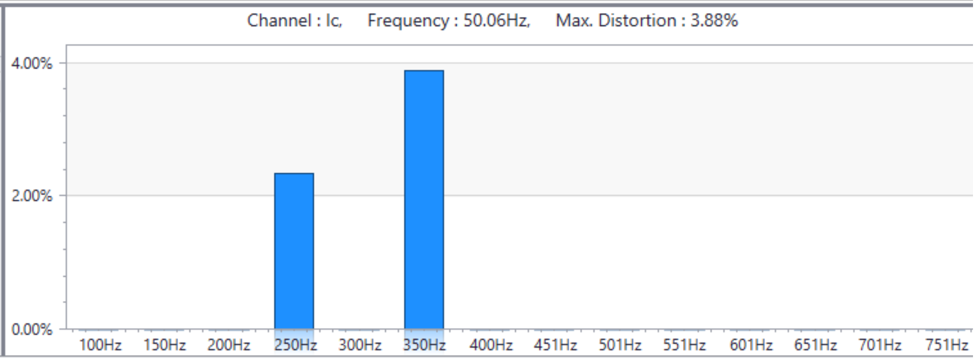


Example – Australian Data of LV Solar inverter Distortion

NOJA POWER®

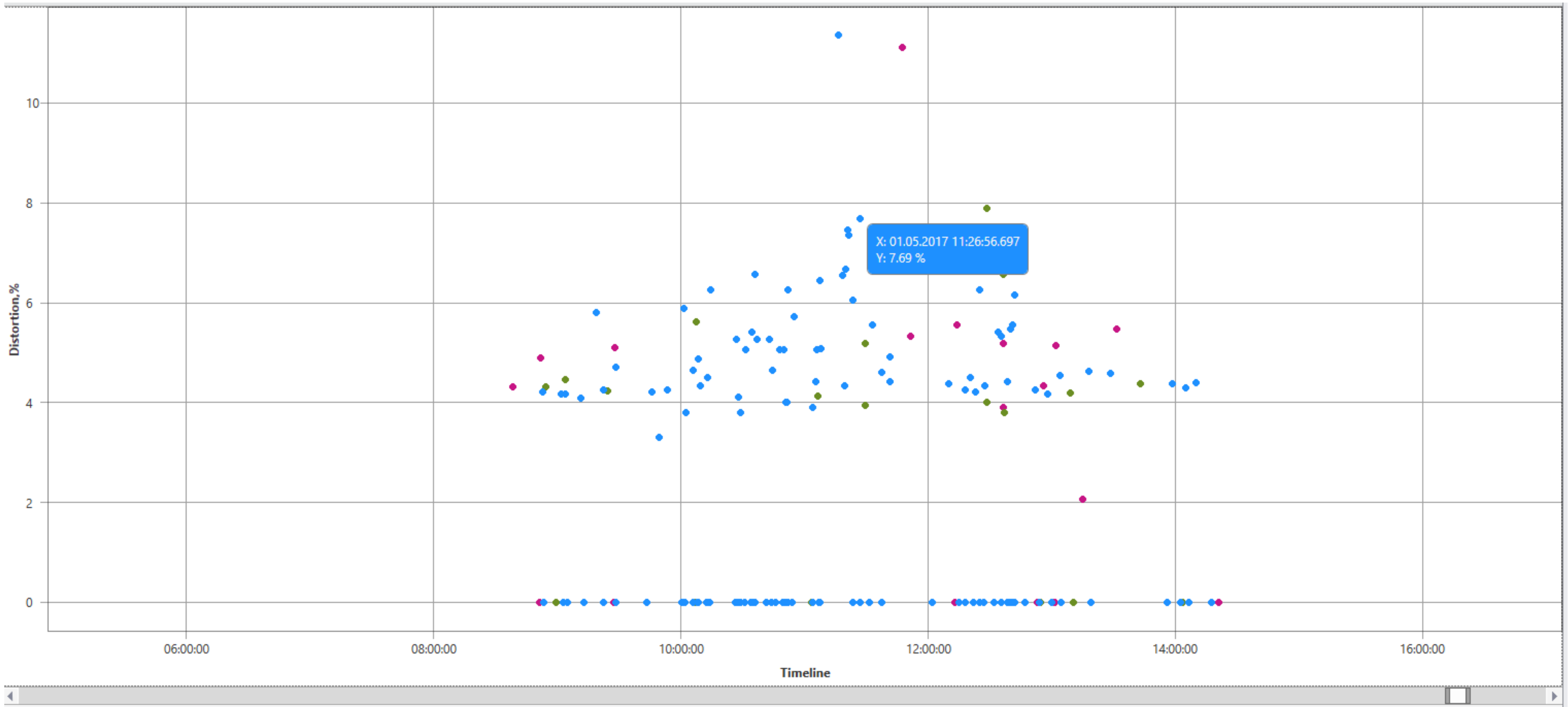


Date / Time	Channel	Triggered Harmonics	Triggered Hrm., %	Max Hrm., %	THD/TDD, %	Freq., Hz	Log ID
05.05.2017 14:01:10.113	Ic	▼5	2.3	3.9	2.6	50.1	
05.05.2017 13:50:24.812	Ic	▼7	0.0	4.3	2.1	49.9	
05.05.2017 13:49:12.966	Ic	▲7	4.9	4.9	2.8	49.9	
05.05.2017 13:45:12.221	Ic	▼7	0.0	4.3	1.8	50.0	
05.05.2017 13:44:28.713	Ic	▲7	5.1	5.1	2.3	50.0	
05.05.2017 13:44:13.985	Ia	▼5	3.3	3.3	1.4	50.0	
05.05.2017 13:43:08.718	Ic	▼7	0.0	4.2	1.4	50.0	
05.05.2017 13:42:50.174	Ic	▲7	4.1	5.5	2.3	50.0	
05.05.2017 13:42:46.337	Ib	▼5	3.2	3.2	1.5	50.0	
05.05.2017 13:42:32.901	Ia	▼7	0.0	3.9	1.4	50.0	
05.05.2017 13:40:40.944	Ic	▼7	0.0	10.2	2.5	50.1	

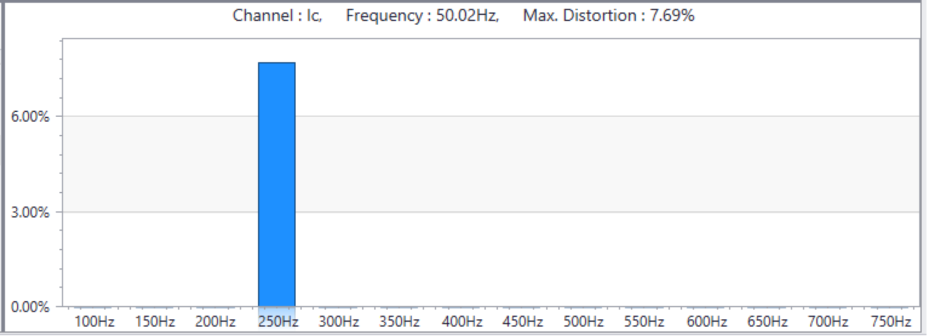


Example – Australian Data of LV Solar inverter Distortion

NOJA Power®



Date / Time	Channel	Triggered Harmonics	Triggered Hrm., %	Max Hrm., %	THD/TDD, %	Freq., Hz	Log ID
01.05.2017 11:29:21.333	Ib	▲3	5.2	5.2	2.5	50.0	
01.05.2017 11:26:56.697	Ic	▲5	7.7	7.7	2.2	50.0	
01.05.2017 11:26:45.182	Ic	▼5	0.0	0.0	0.0	50.0	
01.05.2017 11:23:41.463	Ic	▲5	6.1	6.1	1.9	50.0	
01.05.2017 11:23:26.747	Ic	▼5	0.0	0.0	0.0	50.0	
01.05.2017 11:21:23.312	Ic	▼3	0.0	7.4	2.2	50.1	
01.05.2017 11:20:57.750	Ic	▲3	4.5	7.5	2.7	50.1	
01.05.2017 11:19:43.617	Ic	▼3	0.0	6.7	1.9	50.1	
01.05.2017 11:19:27.639	Ic	▲3	4.3	4.3	2.1	50.1	
01.05.2017 11:18:40.327	Ic	▼5	6.6	6.6	1.9	50.0	
01.05.2017 11:16:13.037	Ic	▲5	11.4	11.4	2.2	50.0	



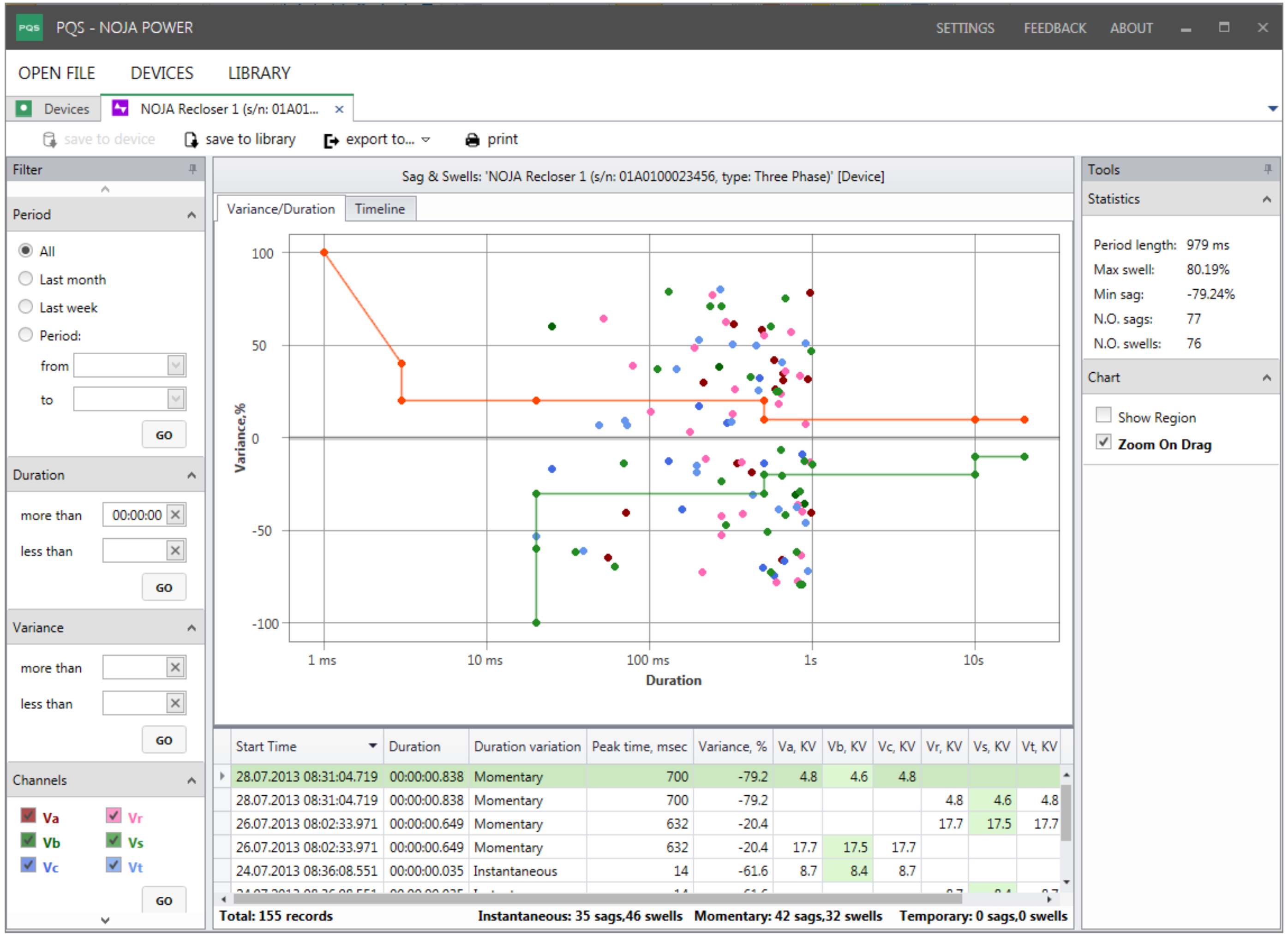
Voltage Sags and Swells

- Measured deviations of Voltage from system specifications

Power Quality Settings

Osc   Hrm   Interruptions   ►Sags/Swells◄

Sag Monitoring	Disable
Sag Normal Threshold	0.90
Sag Min Threshold	0.10
Sag Time (ms)	20
Swell Monitoring	Disable
Swell Normal Threshold	1.10
Swell Time (ms)	20
Reset Time (ms)	50

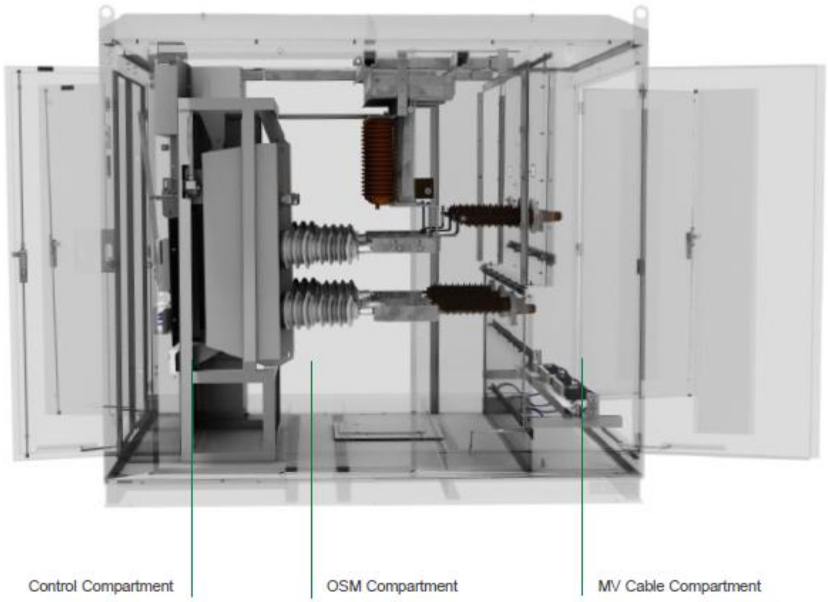


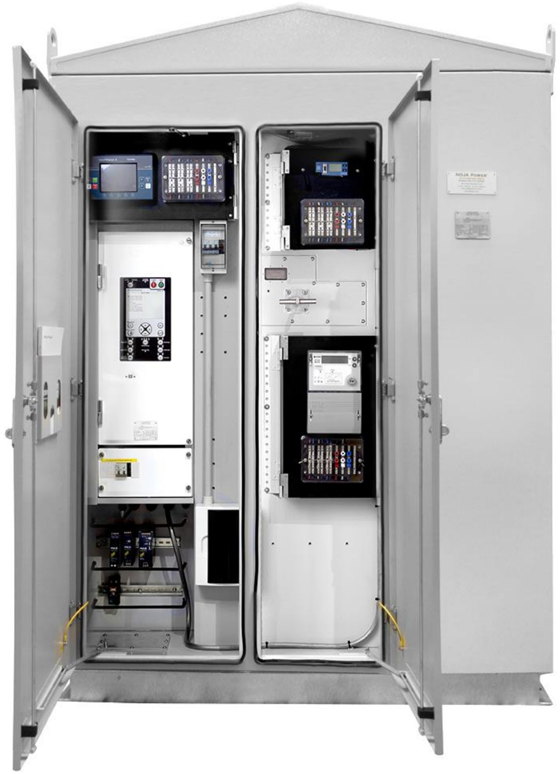
NOJA Power®

Revenue Metering

Revenue Metering

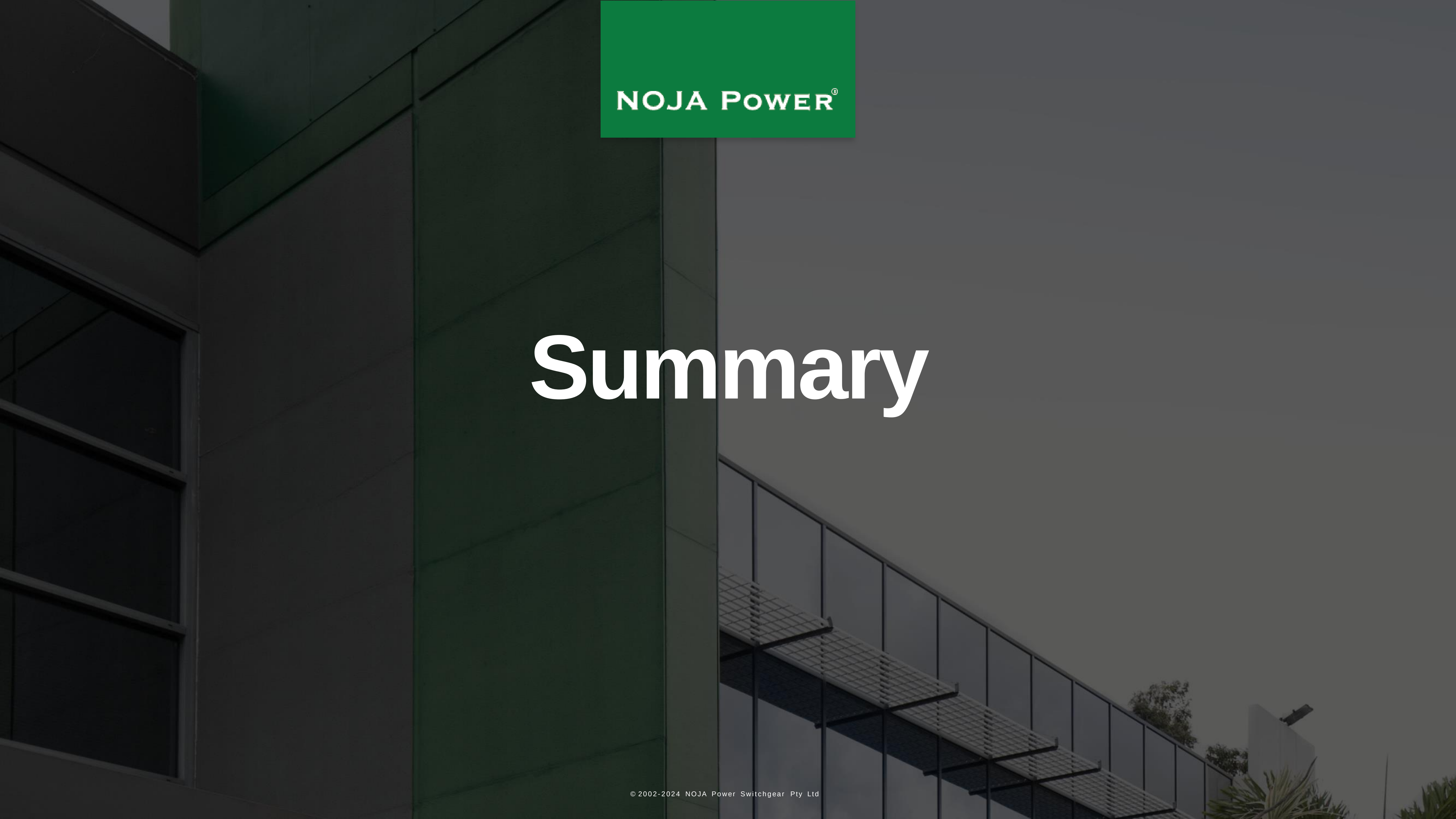
- Requires local certification, utility code compliance.
- In Australia, NATA Certification needed





- LV Compartment Method

- Example Bolt-on method



NOJA POWER®

Summary

Summary

- Circuit Breaker
- Protection System – Protecting the asset, and meeting the anti-islanding requirements
- Power Quality Monitoring
- Revenue Metering
- Maintenance provisions

Goondiwindi Solar Farm – Overhead Connection with separate metering installation

Summary

- Protection, Control, Power Quality, Metering, Earth Switch, all integrated to connect renewable energy
- Protection features for assets and anti-islanding
- Power Quality capabilities
- Works practices (earthing and voltage sensing)

Thank you!

Questions?