

Living with the Solar Energy Transformation Program (SETuP)

Isolated Power Systems
Connect
26 – 29 July 2022

Power and Water Corporation

Gas supply | Electricity distribution | Water and sewerage services

\$700

**MILLION
REVENUE**

\$4B

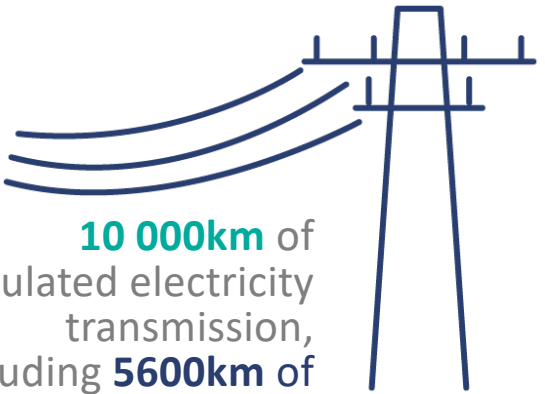
**GAS SUPPLIES
MANAGED**

\$2.8B

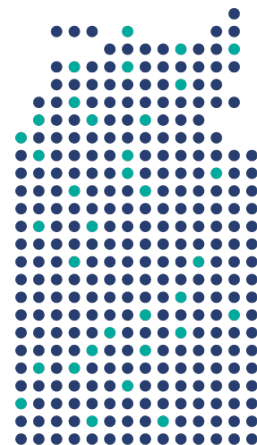
**TOTAL
ASSETS**

\$153M

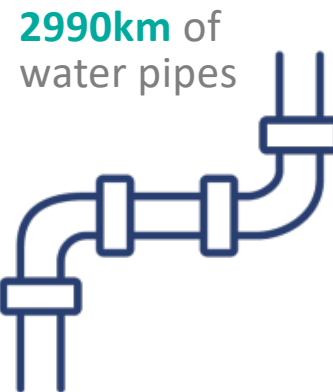
**PROJECTS
2019/20**



10 000km of regulated electricity transmission, including **5600km** of overhead powerlines



We provide essential services to 244,300 People. Servicing **72 remote communities**, 79 Outstations, 5 Major Centres & 13 minor centres across **1.3 million square kilometres**



28 billion litres of wastewater treated annually



65 billion litres of drinking water sourced.

Indigenous Essential Services Program

- NTG subsidised service delivery
- Not for profit subsidiary
- End-to-end electricity services
- 72 remote Aboriginal communities
- 79 outstations (homeland settlements)
- Across 1.3 million square kilometres
- Approx 36,000 residents
- Majority public housing, NTG services
- 52 isolated diesel grids, ~\$29M p.a. diesel budget

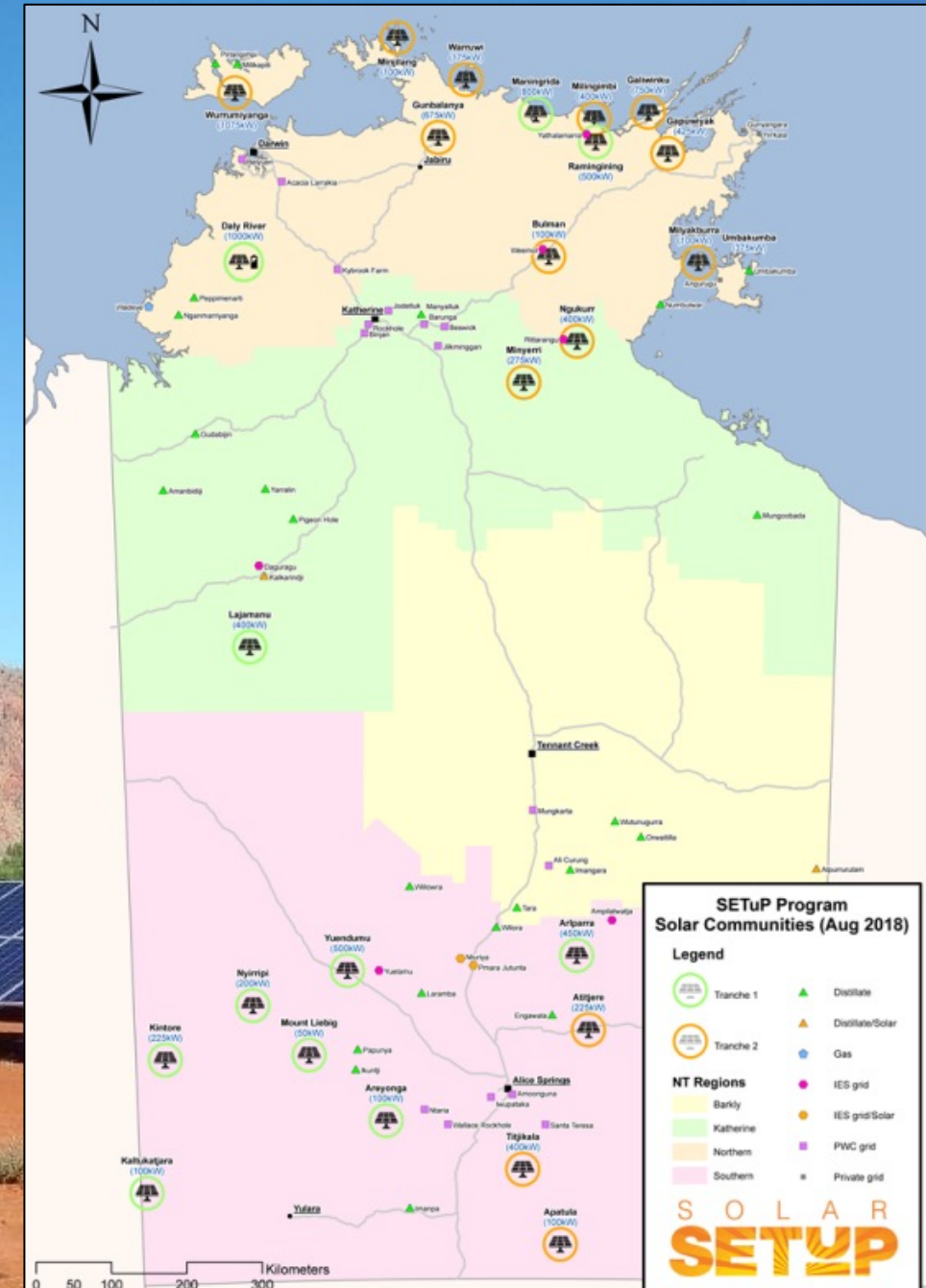


Solar Energy Transformation Program (SETuP)

- Building on 20 years of experience with solar PV
- 10MW of utility solar PV, 25 IES communities
- ARENA funding and NTG loans \$59M
- Transformative scale
- Mass rollout to achieve 15% diesel saving
- Pilot of solar plus storage for 50% savings
- Cloud forecasting trial
- Evaluation and knowledge sharing

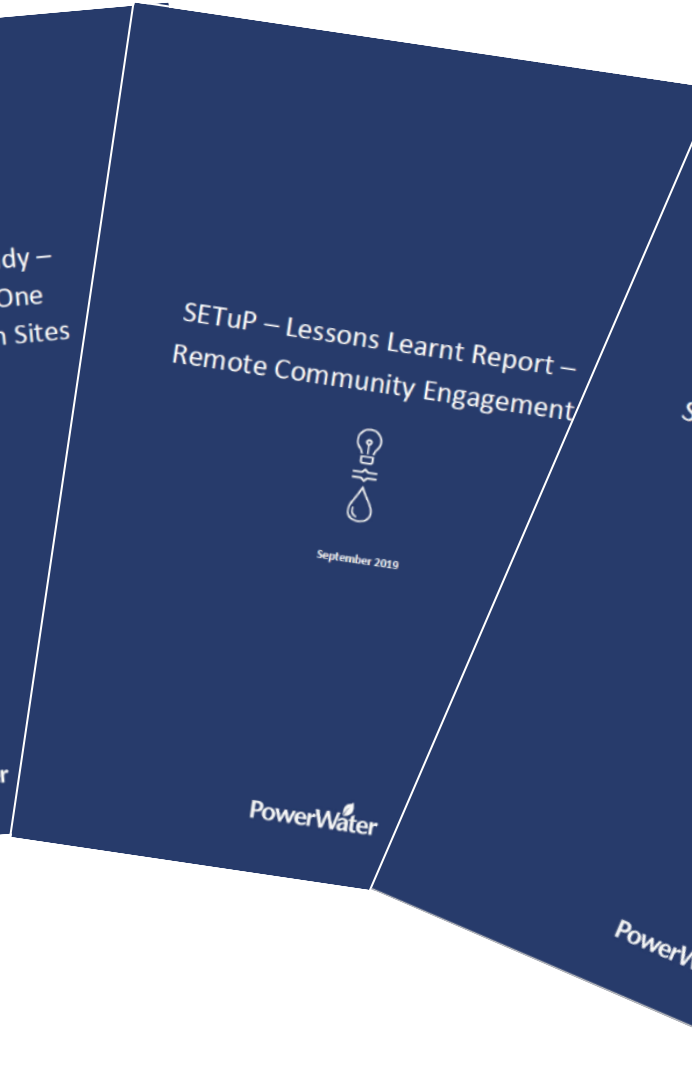
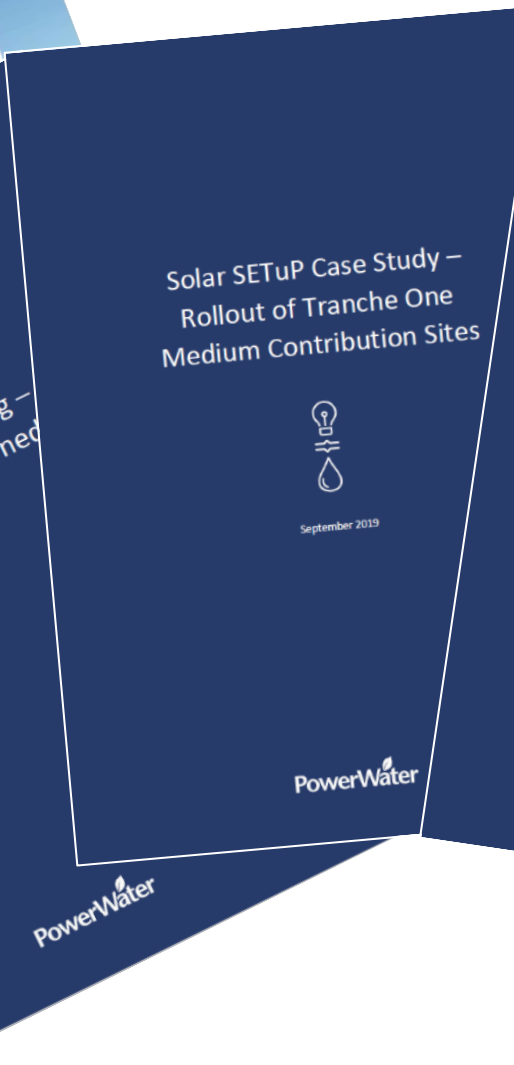


Docker River



Publications available online

[Solar energy transformation program | Power and Water Corporation \(powerwater.com.au\)](http://powerwater.com.au)



Region: South

Site: Titjikala

Station Overview

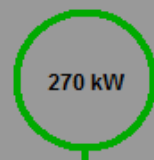
Current User: SAGE

11/05/2021 10:21 AM

GENERATOR 1

AUTO

STOPPED

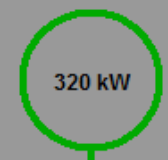


STATION VOLTAGE
426 V

GENERATOR 2

AUTO

STOPPED

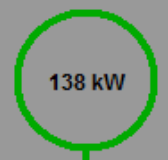


GENERATOR LOAD
0 kW

GENERATOR 3

AUTO

STOPPED



SYSTEM LOAD
115 kW

STATION PF
Lg 0.97

STATION FREQUENCY
50.00 Hz

PV SPILLAGE
141 kW

PV PENETRATION
100 %



AUTO

FEEDER 1



AUTO

FEEDER 2

DIESEL ON

ON

24:00:00

DIESEL OFF

OFF

AUTO

ISOCRONOUS MODE

-11 kW (SETPOINT:)

98% SOC

ESS



AUTO

UNLOCKED

125 (SETPOINT: 123 kW)

OK

PV



52 stations
27 Hybrid Sites

Same hardware

- Common Code
- kW Call Up
- PV control

STATION CONFIGURATION

STATION POWER INFO

STATION DETAILS

STATION LOGS

STATION PARAMETERS

BULK FUEL PARAMETERS

1	2	3	PV U	0 kW
1	2	3	PV A	115 kW
1	2	3	PV D	0 kW

SWITCH DOWN TIME
REMAINING
1800 sec

STATION WEEKLY MAXIMUM DEMAND 167 kW
STATION MAXIMUM DEMAND 494 kW

Back

Overview

Menu

Alarms

Reset

Sgl PA

Dbl PA

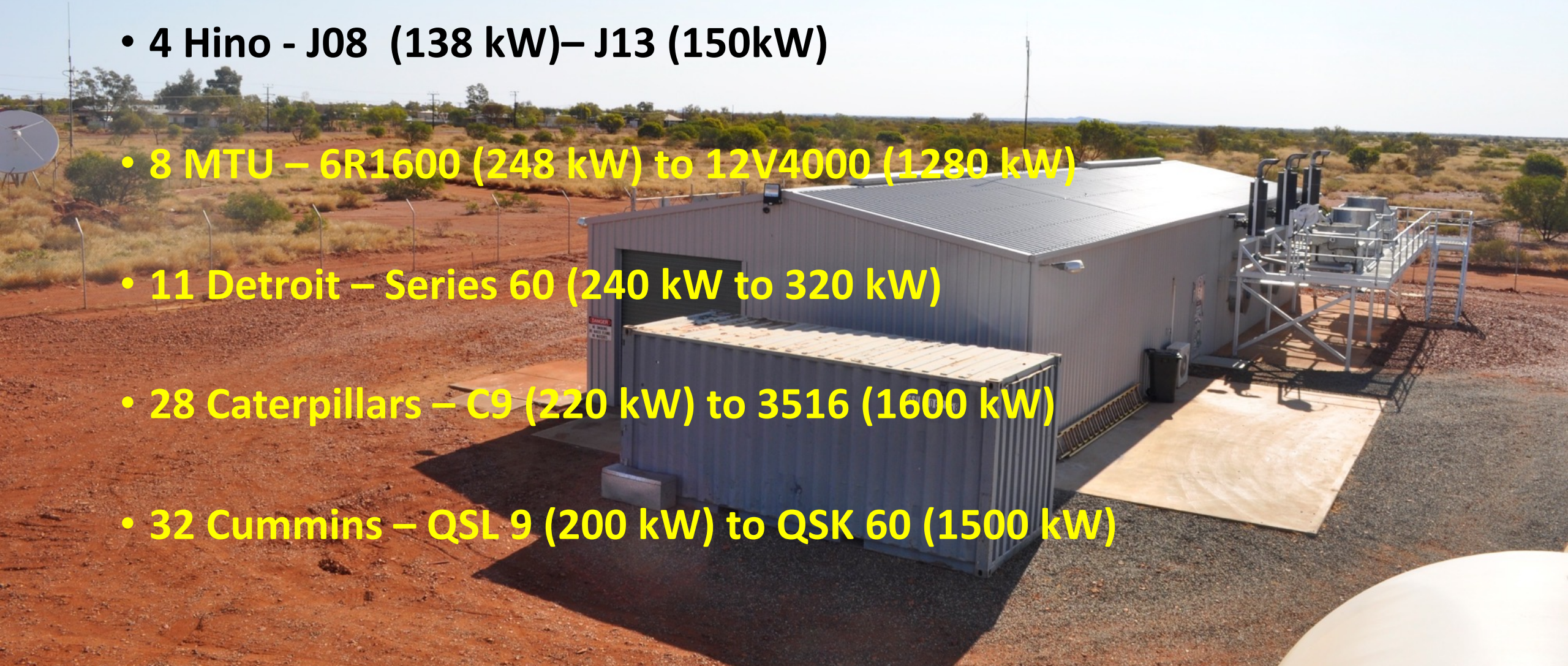
Tool Box

Logout

Login

OUR FLEET 83 ENGINES

- 4 Hino - J08 (138 kW)– J13 (150kW)
- 8 MTU – 6R1600 (248 kW) to 12V4000 (1280 kW)
- 11 Detroit – Series 60 (240 kW to 320 kW)
- 28 Caterpillars – C9 (220 kW) to 3516 (1600 kW)
- 32 Cummins – QSL 9 (200 kW) to QSK 60 (1500 kW)



Minimum Load settings

DETROIT

- Series 60 – 30% or 40%
with BESS installed

HINO

- J08 – 20%
- J13 – 20%

• MTU

- 6R1600 – 10%
- 10V1600 – 10%
- 12V1600 – 10%
- 12V2000 – 30% - New HPCR 10%
- 12V4000 – 28%

Minimum Load settings

CUMMINS

QSL 9 – 10%
NTA855 – 40%
QSX15 – 40%
KTA19 – 40%
QSX 23 – 10 and 30%
QST30 – 40%
KTA50 – 40%
QSK50 – 10%
QSK 60 – 40%

CATEPILLAR

- C9 – 50%
- C15 – 30%
- C18 – 40%
- C32 – 30%
- 3412 – 40%
- 3508 – 50%
- 3512 – 40% at 1500 rpm and 50% at 1000 rpm
- 3516 – 40% at 1500 rpm and 50% at 1000 rpm

WHOLE OF LIFE REF

Community	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	YTD % PV
Maningrida	22.2%	21.6%	20.1%	17.3%	17.0%	13.7%	12.2%	14.7%	16.1%	17.0%	18.8%	17.6%	17.4%
Ramingining	23.5%	23.8%	20.9%	18.4%	15.4%	14.3%	14.9%	14.1%	14.5%	16.3%	17.4%	18.5%	17.7%
Yuendumu	13.2%	12.2%	10.9%	15.1%	15.5%	13.7%	12.5%	14.2%	11.9%	14.1%	13.0%	12.2%	13.2%
Lajamanu	17.1%	18.2%	17.2%	19.5%	17.2%	16.6%	17.2%	15.4%	15.7%	20.2%	18.8%	16.7%	17.5%
Docker River	9.2%	12.2%	14.0%	13.5%	12.8%	11.9%	11.3%	12.4%	11.7%	10.6%	10.2%	9.5%	11.6%
Kintore	25.2%	27.5%	27.3%	20.2%	19.5%	16.8%	13.6%	16.1%	16.5%	21.8%	17.5%	17.7%	20.0%
Arlparra	12.4%	20.0%	21.5%	17.8%	15.9%	12.5%	14.4%	16.8%	15.7%	21.3%	19.0%	11.2%	16.5%
Areyonga	12.1%	16.7%	19.3%	19.0%	11.8%	7.1%	8.0%	11.1%	12.5%	14.5%	12.8%	8.7%	12.8%
Mt Liebig	11.9%	14.1%	14.0%	11.8%	10.6%	7.1%	8.0%	9.9%	9.2%	11.1%	11.0%	8.3%	10.6%
Nyirripi	28.7%	30.3%	33.1%	7.5%	29.3%	26.4%	25.3%	25.8%	26.4%	31.1%	28.8%	26.1%	26.6%
Daly River	62.0%	58.6%	50.0%	45.1%	43.9%	46.4%	49.0%	45.8%	35.1%	37.1%	46.2%	53.3%	47.7%
Apatula	11.4%	12.3%	13.9%	16.1%	16.8%	13.2%	14.2%	17.7%	17.1%	13.9%	11.8%	12.2%	14.2%
Milyakburra	20.4%	20.2%	23.4%	20.8%	17.7%	14.4%	15.6%	14.8%	15.4%	16.7%	17.4%	19.2%	18.0%
Minyerri	18.6%	19.0%	15.2%	10.2%	10.4%	9.4%	7.7%	9.7%	8.4%	12.0%	14.2%	12.9%	12.3%
Atitjere	16.7%	24.3%	31.6%	33.0%	27.2%	30.2%	30.2%	32.8%	30.8%	29.5%	19.1%	13.8%	26.6%
Titjikala	31.6%	30.0%	39.7%	39.8%	20.8%	19.8%	21.0%	32.6%	46.3%	54.0%	48.4%	34.1%	34.8%
Milingimbi	17.9%	20.0%	19.5%	18.2%	16.1%	13.2%	13.3%	13.4%	14.3%	13.6%	15.5%	16.4%	15.9%
Minjilang	14.0%	14.7%	14.8%	13.2%	11.2%	8.5%	8.5%	8.9%	7.5%	10.9%	11.1%	11.9%	11.3%
Galiwinku	15.1%	16.2%	16.9%	14.4%	14.0%	11.6%	10.9%	12.6%	12.6%	13.3%	13.7%	15.1%	13.9%
Warruwi	18.3%	18.9%	18.6%	16.1%	13.7%	11.3%	11.4%	12.4%	13.3%	14.9%	16.4%	15.9%	15.1%
Ngukurr	12.5%	13.8%	12.3%	10.9%	11.2%	10.7%	11.3%	11.1%	11.4%	12.7%	13.4%	12.7%	12.0%
Wurrumiyanga	23.8%	23.8%	20.9%	17.2%	18.2%	15.9%	13.7%	14.2%	14.5%	17.8%	19.5%	19.7%	18.3%
Gapuwiyak	20.4%	20.9%	22.4%	19.6%	15.8%	14.3%	12.9%	9.1%	12.8%	14.8%	12.2%	17.6%	16.1%
Bulman	11.3%	11.5%	9.7%	9.2%	9.6%	8.2%	8.6%	7.5%	9.5%	9.8%	9.3%	7.6%	9.3%
Gunbalanya	7.7%	13.0%	16.7%	16.6%	14.7%	13.9%	15.0%	15.6%	16.2%	16.5%	15.4%	14.7%	14.7%

Power and Water Corporation

PV Total MWh 40866

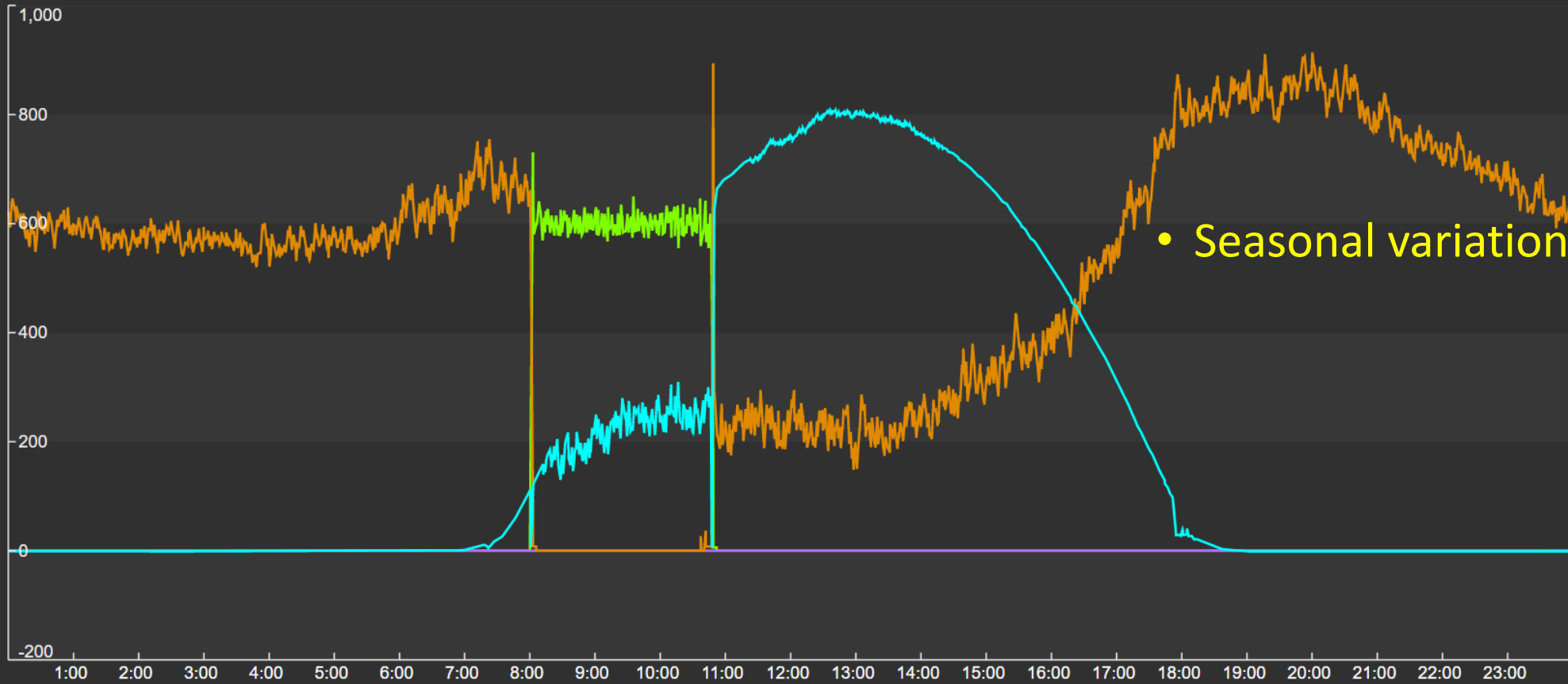
Total Litres Saved 10.789 ML

17.8%

SOLAR PRODUCTION DRIVERS



Popup Trend



Solar|3P Real Power
-1 kW
Generator 1|3P Real Power
637 kW
Generator 2|3P Real Power
0 kW
Generator 3|3P Real Power
0 kW
Generator 4|3P Real Power
0 kW

11/08/2020 00:00:00



1d

Now

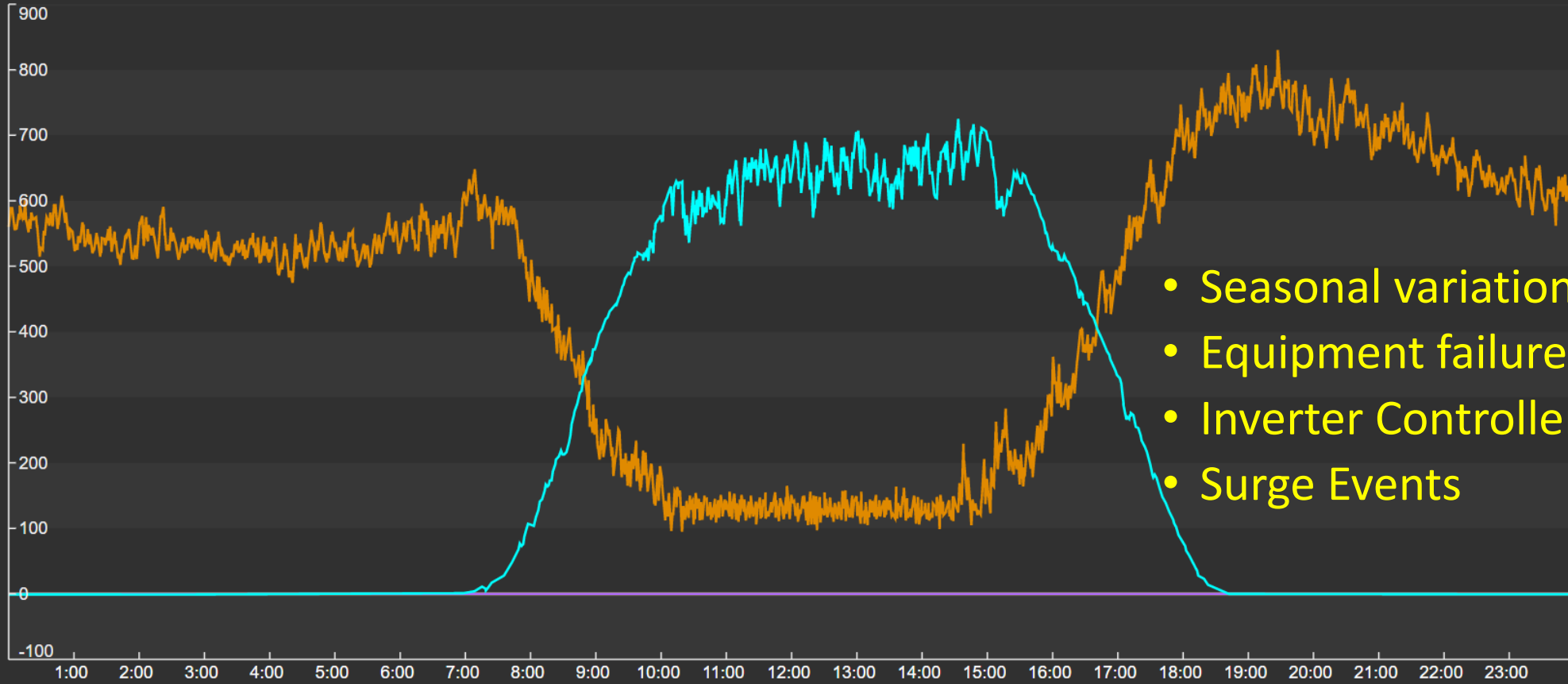
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Wet Season and REF

Community	Jul-21	Aug-21	Sep-21	Oct-21	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	Jun-22 YTD % PV	
Maningrida	17.7%	18.0%	17.7%	15.3%	15.3%	11.9%	9.0%	14.1%	15.2%	14.8%	17.1%	15.6%	15.1%
Ramingining	21.5%	19.0%	17.7%	15.7%	14.0%	13.6%	13.6%	14.0%	14.8%	14.9%	15.6%	17.0%	15.9%
Daly River	53.0%	53.9%	48.7%	41.8%	45.7%	47.7%	48.2%	48.5%	43.8%	40.0%	44.8%	49.1%	47.1%
Milyakburra	22.8%	23.5%	22.9%	18.2%	16.1%	12.4%	15.3%	15.2%	16.1%	16.4%	18.4%	18.3%	18.0%
Milingimbi	18.7%	20.0%	19.0%	15.7%	15.1%	12.0%	13.1%	14.3%	15.7%	10.5%	14.4%	15.0%	15.3%
Minjilang	12.4%	15.0%	14.4%	12.2%	10.1%	8.0%	8.4%	9.5%	8.9%	11.1%	11.0%	11.2%	11.0%
Galiwinku	11.8%	17.1%	16.0%	13.0%	13.0%	10.4%	10.4%	12.2%	12.5%	11.5%	11.5%	13.5%	12.8%
Waruwi	15.5%	16.9%	15.6%	11.6%	12.4%	10.6%	11.0%	12.6%	13.5%	14.1%	15.2%	14.5%	13.6%
Wurrumiyanga	24.9%	28.2%	23.7%	16.3%	16.6%	15.1%	14.7%	14.5%	16.9%	19.5%	19.5%	19.5%	19.1%
Gapuwiyak	20.7%	18.9%	20.8%	17.0%	11.8%	12.8%	10.1%	3.7%	11.4%	14.5%	16.6%	16.3%	14.6%
Gunbalanya	15.1%	18.0%	17.6%	16.6%	15.9%	14.5%	15.7%	16.5%	17.9%	16.0%	14.2%	16.0%	16.2%

SOLAR PRODUCTION DRIVERS

Popup Trend



- Seasonal variation
- Equipment failure
- Inverter Controller
- Surge Events

Solar|3P Real Power
-1 kW
Generator 1|3P Real Power
610 kW
Generator 2|3P Real Power
0 kW
Generator 3|3P Real Power
0 kW
Generator 4|3P Real Power
0 kW

08/08/2020 00:00:00



1d

Now

09/08/2020 00:00:00

LOW LOAD and ENGINES

Damaged Engines

- 1 – Caterpillar C9
- 1 – Cummins QSK23

- 1 – Caterpillar 3508

- Exercise period needed after low load
- Delay low load at start of life
- Targeted sizing, good for production, limits operation

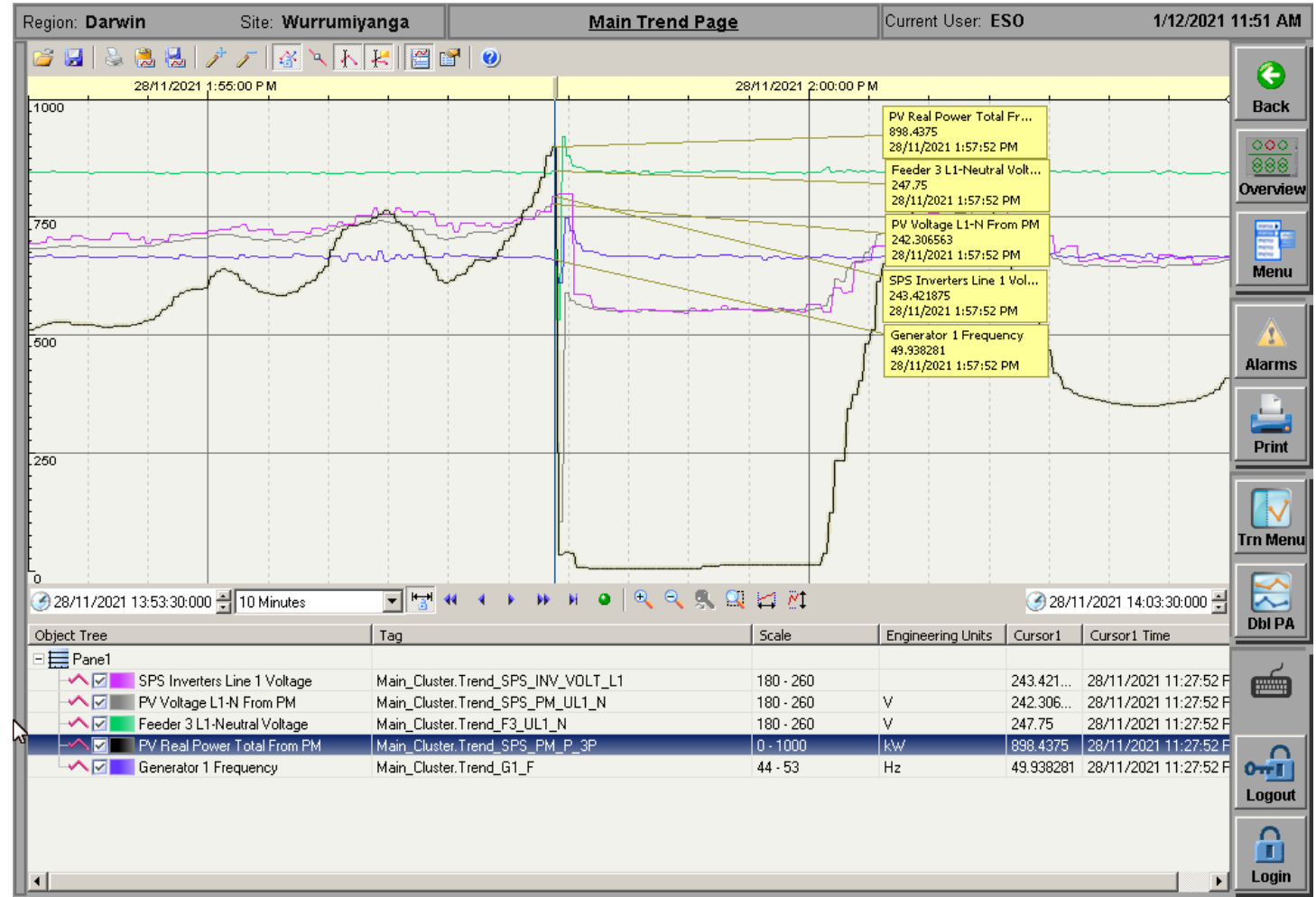
Wurrumiyanga

- Earth leakage
- Circuit breaker failure
- Temperature
- Undersized cables

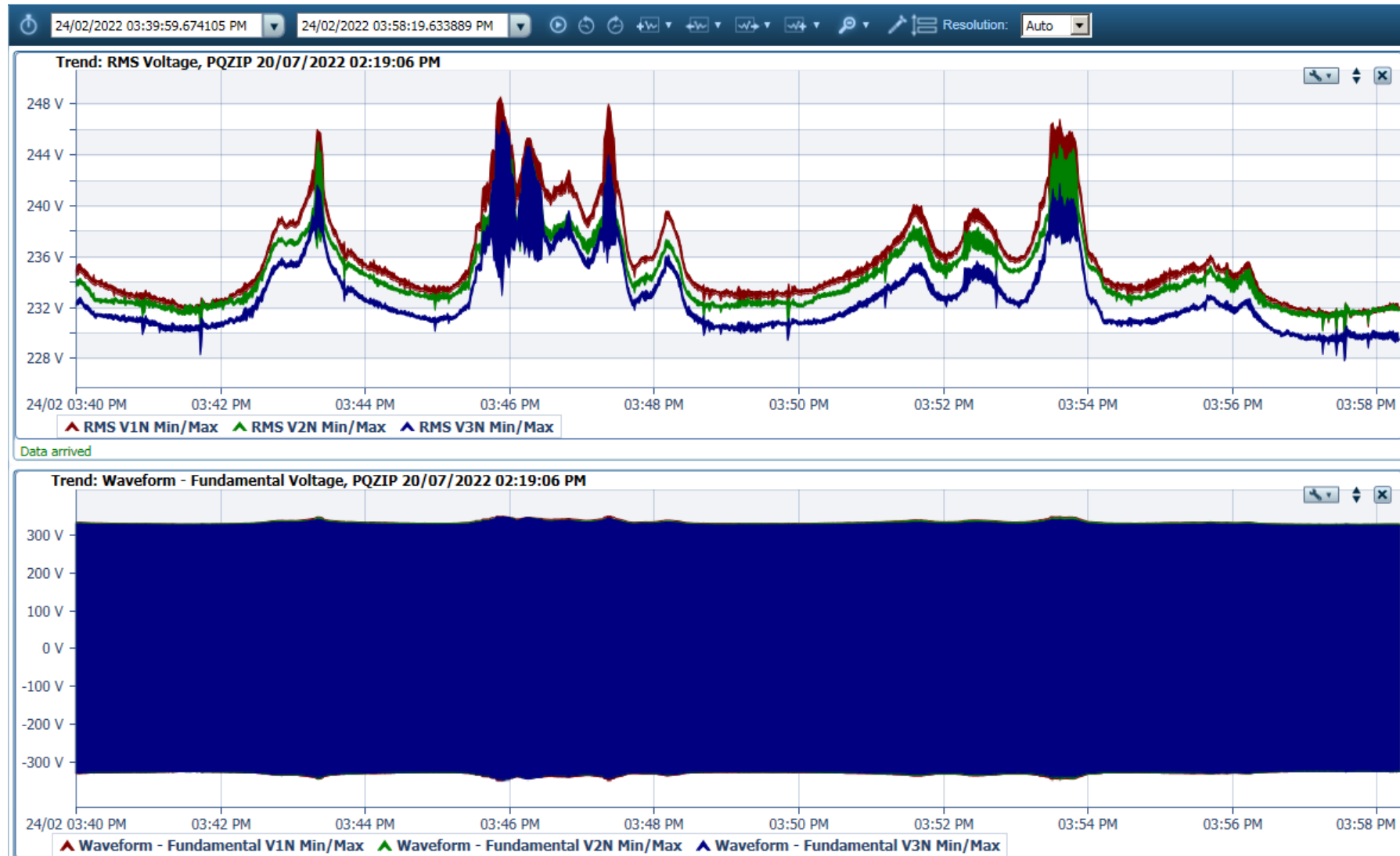


Wurrumiyanga

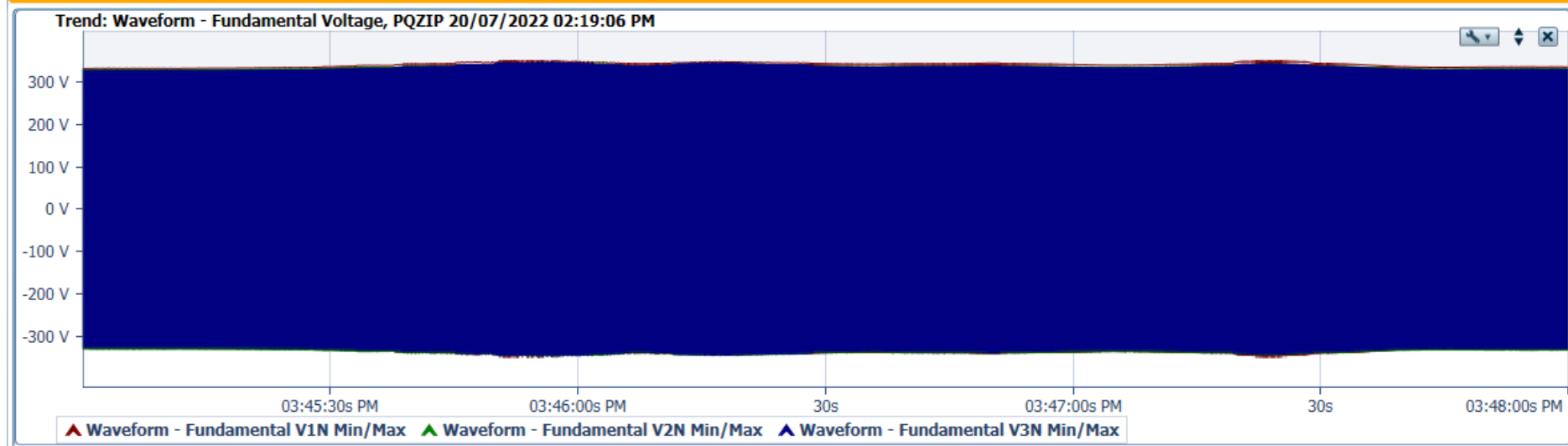
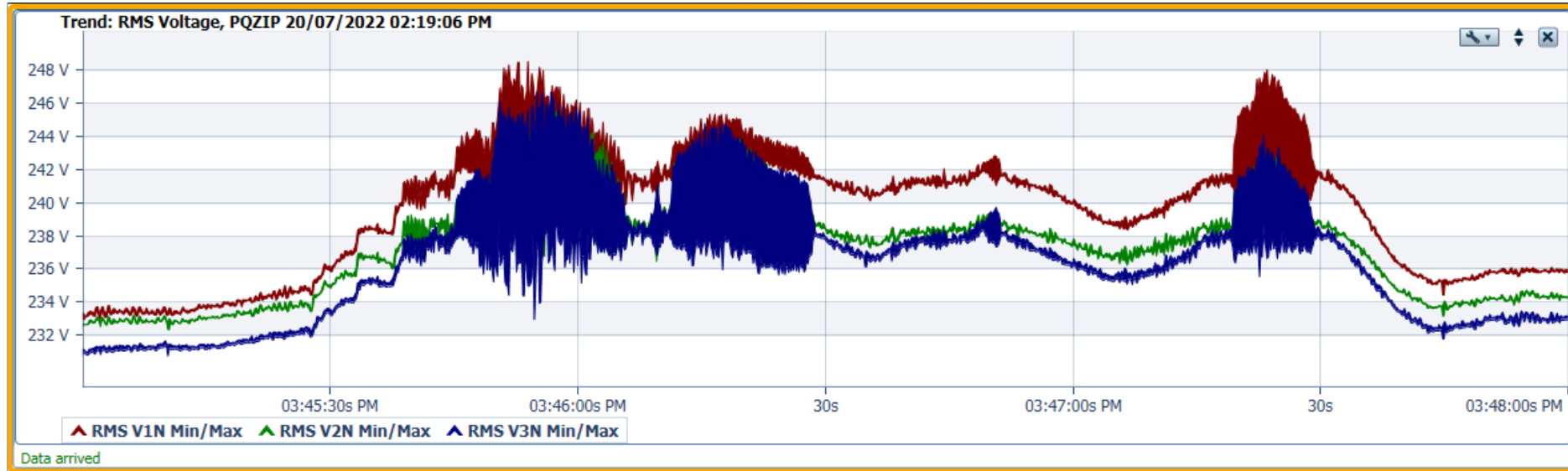
- Overvoltage shutdown



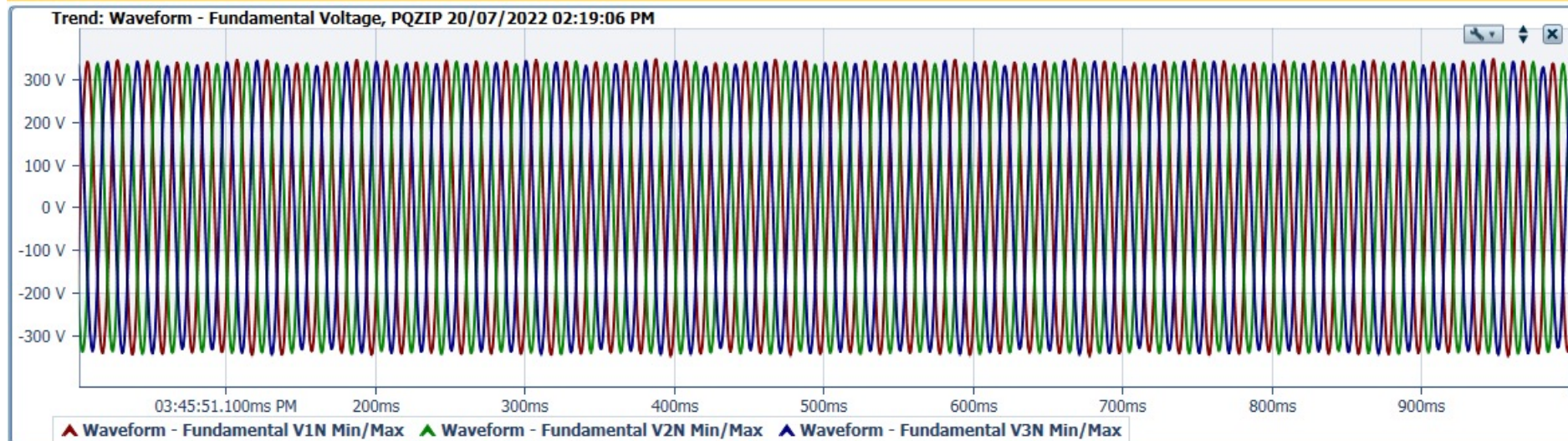
Espec DFR 15 minute sample



Elspec DFR 3 minute sample



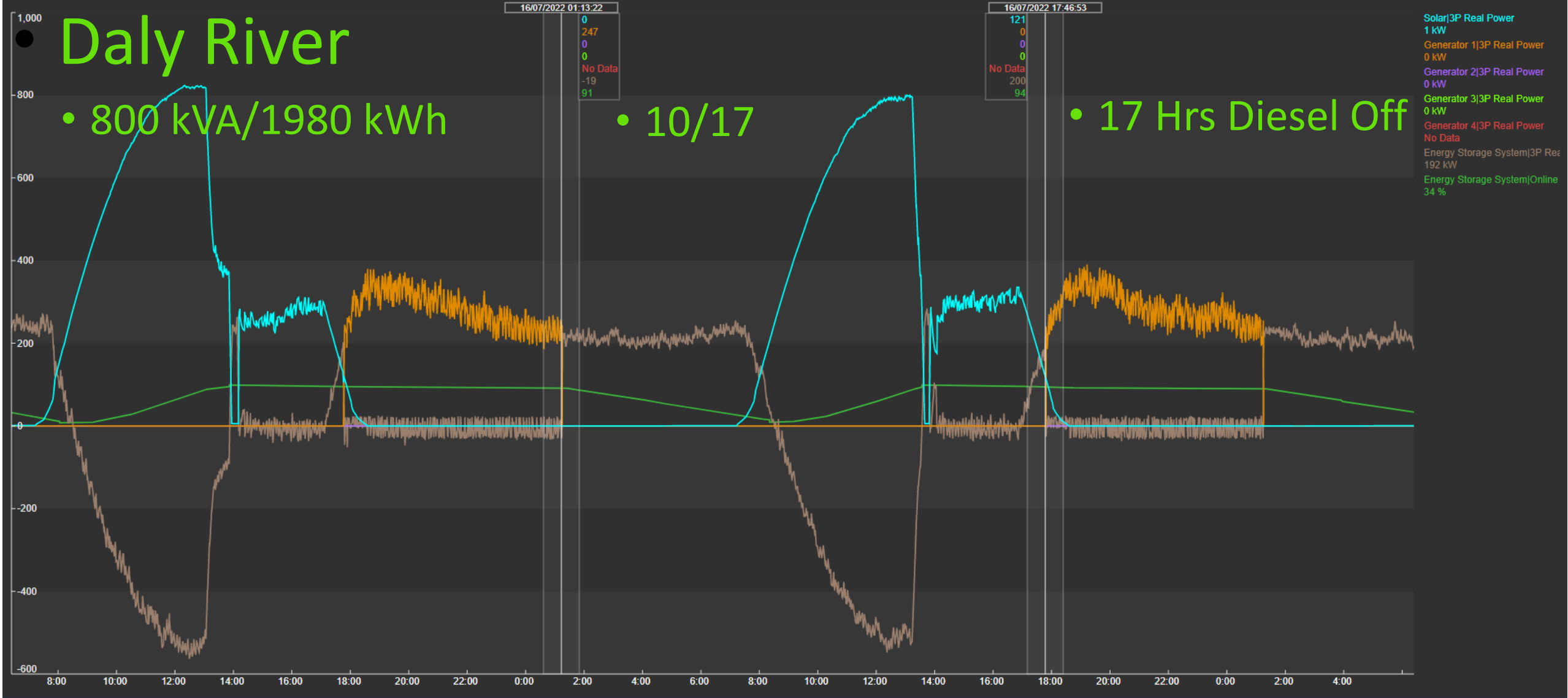
Espec DFR 1 second sample

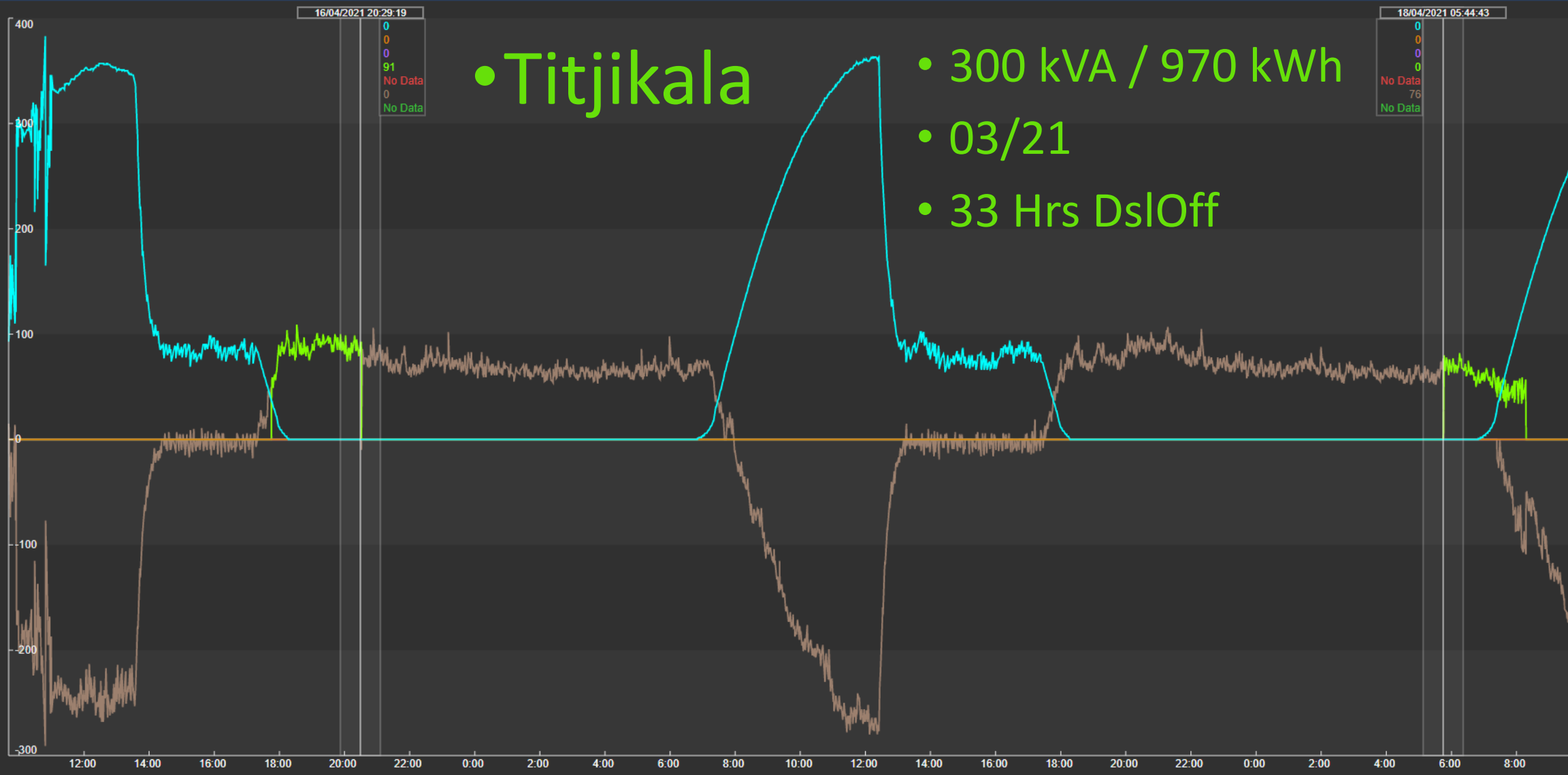


BESS

- Daly River
- Titjikala







• Titjikala

- 300 kVA / 970 kWh
- 03/21
- 33 Hrs DsIOff

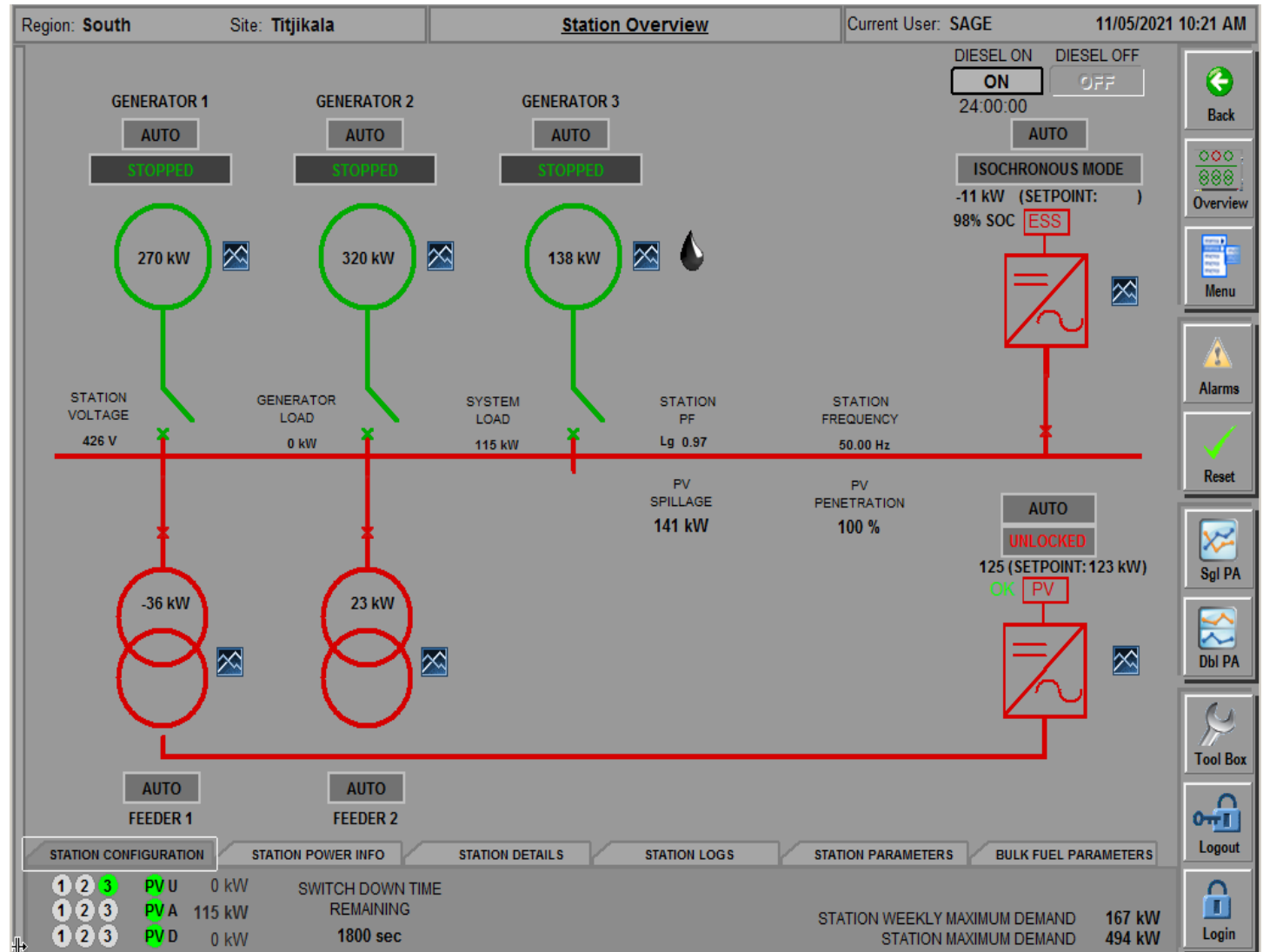
16/04/2021 20:29:19	18/04/2021 05:44:43
0	0
0	0
0	0
91	0
No Data	No Data
0	76
No Data	No Data

Solar 3P Real Power	260 kW
Generator 1 3P Real Power	0 kW
Generator 2 3P Real Power	0 kW
Generator 3 3P Real Power	0 kW
Generator 4 3P Real Power	No Data
Energy Storage System 3P Real Power	-168 kW
Energy Storage System Online %	No Data %

Operation

- Diesel On – Grid Following
- Droop – Transitions
- Isochronous – Diesel Off

- Delayed Discharge
- Standby mode
- Switching losses



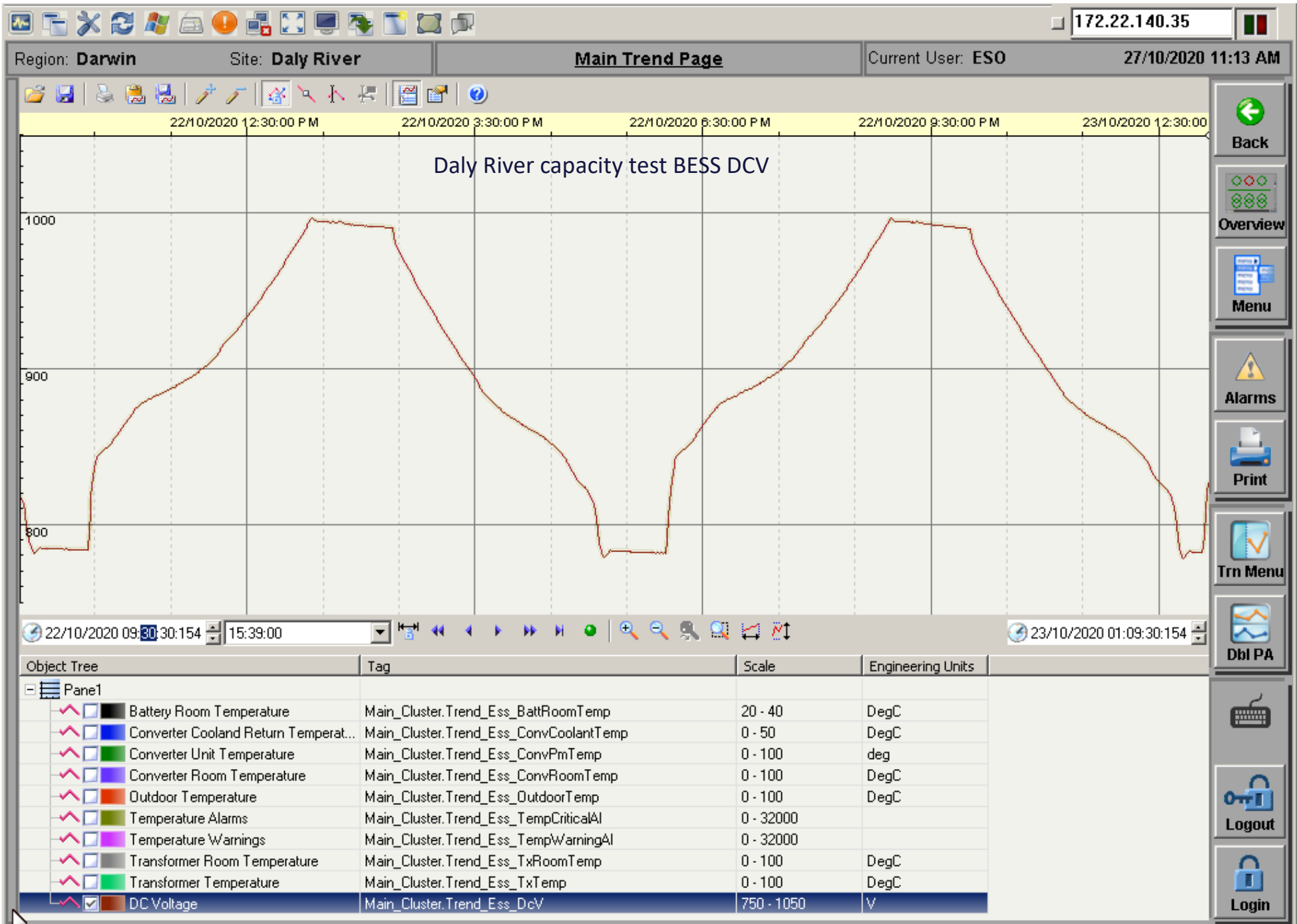
Single points of failure

- Pre Charge Rack
- Cooling System

BESS maintenance

- Filters
- Cooling system
- Capacity test





Round Trip Efficiency

Daly River

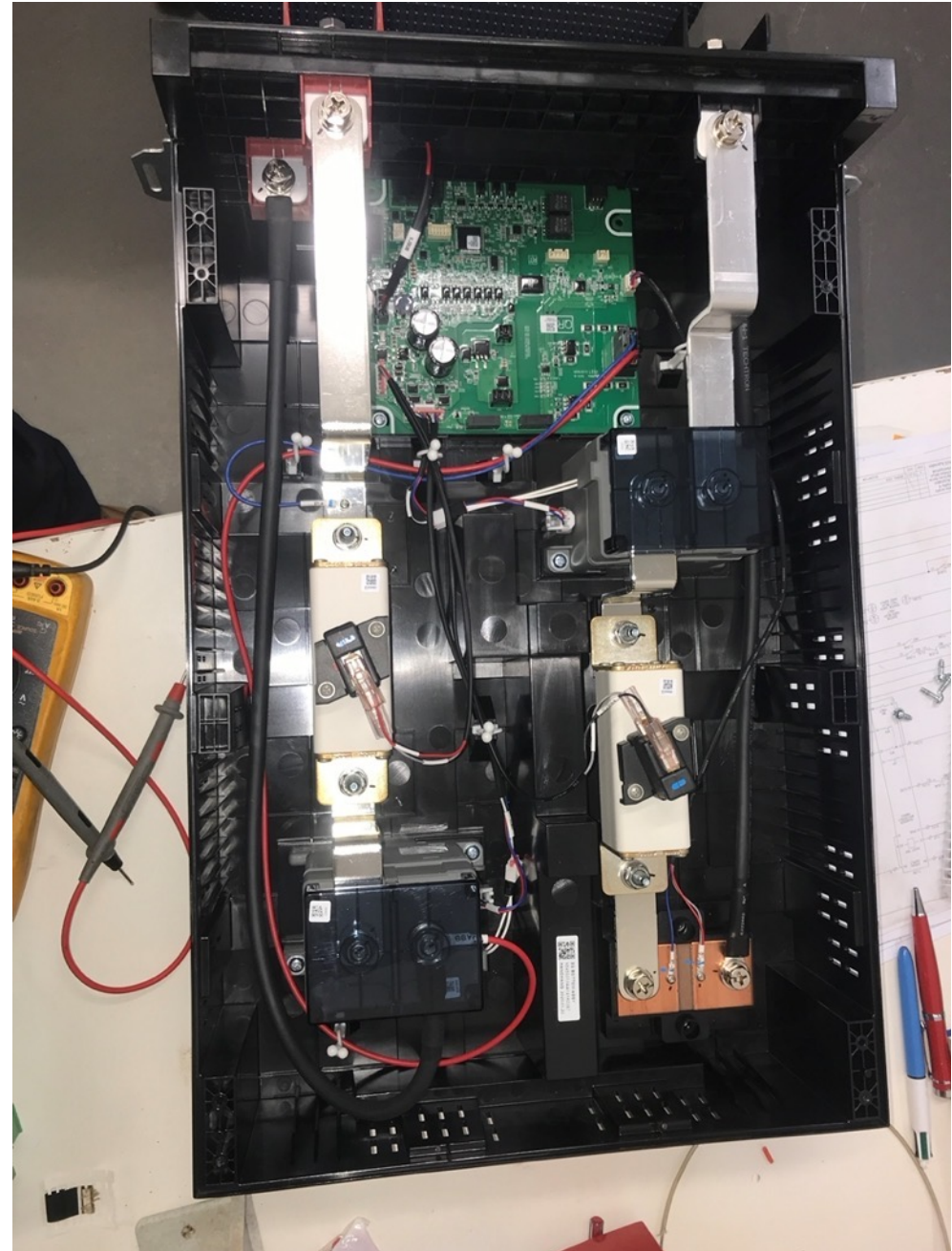
- 90.9 Excluding ancillaries
- 89.8 Including ancillaries

Titjikala

- 92.1 Excluding ancillaries
- 88.7 Including ancillaries

Titjikala

- Remote Commissioning
- Base Load
- CanBus latency



PowerWater

Thank you

Questions

Jeff Adams

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