EMPOWER YOUR ANALYTICS WITH OPERATIONAL DATA

# PI Vision in the Network Operations Control Centre

*Rudy Bake, Network Operations Development Manager, Western Power*

*10 September 2019*

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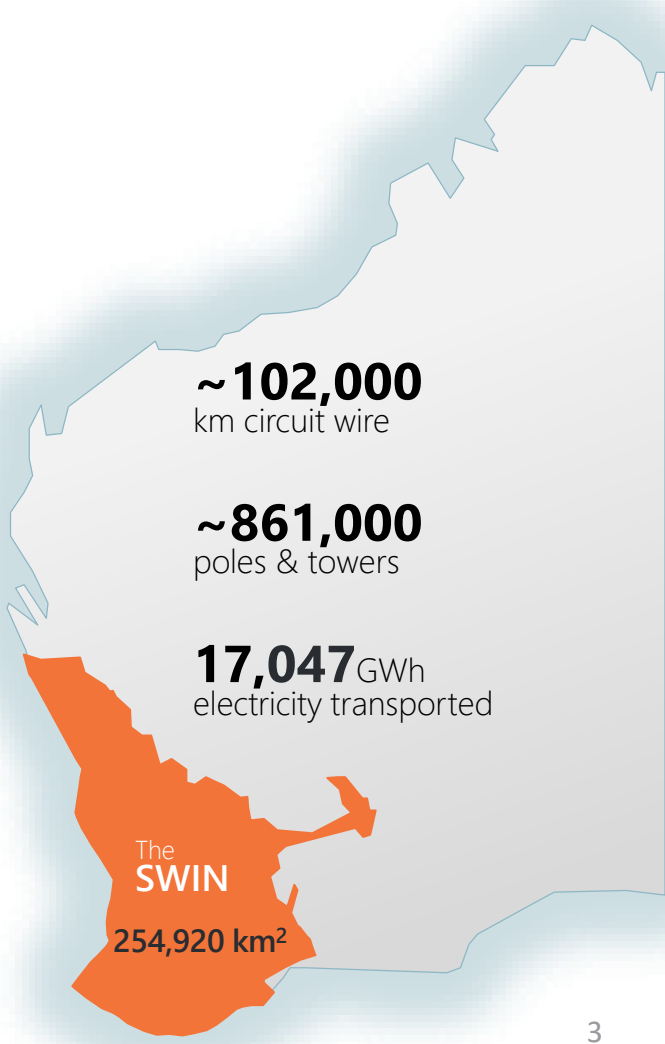
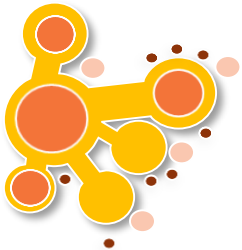
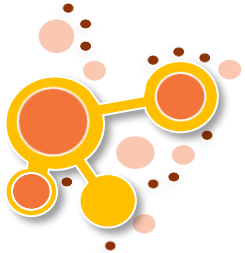
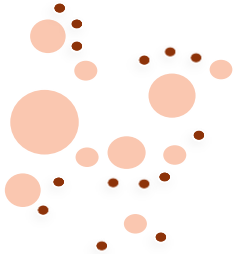
# About Western Power

- Build, maintain & operate transmission and distribution assets: South West Interconnected Network (SWIN)
- 1.1+ million customers
- ~264,000 street lights
- ~237,800 solar PV installations*
- ~570 battery systems*




* As at 31/5/18

# Network evolution is reliant on community behaviour, technology advancement rates, regulation and policy

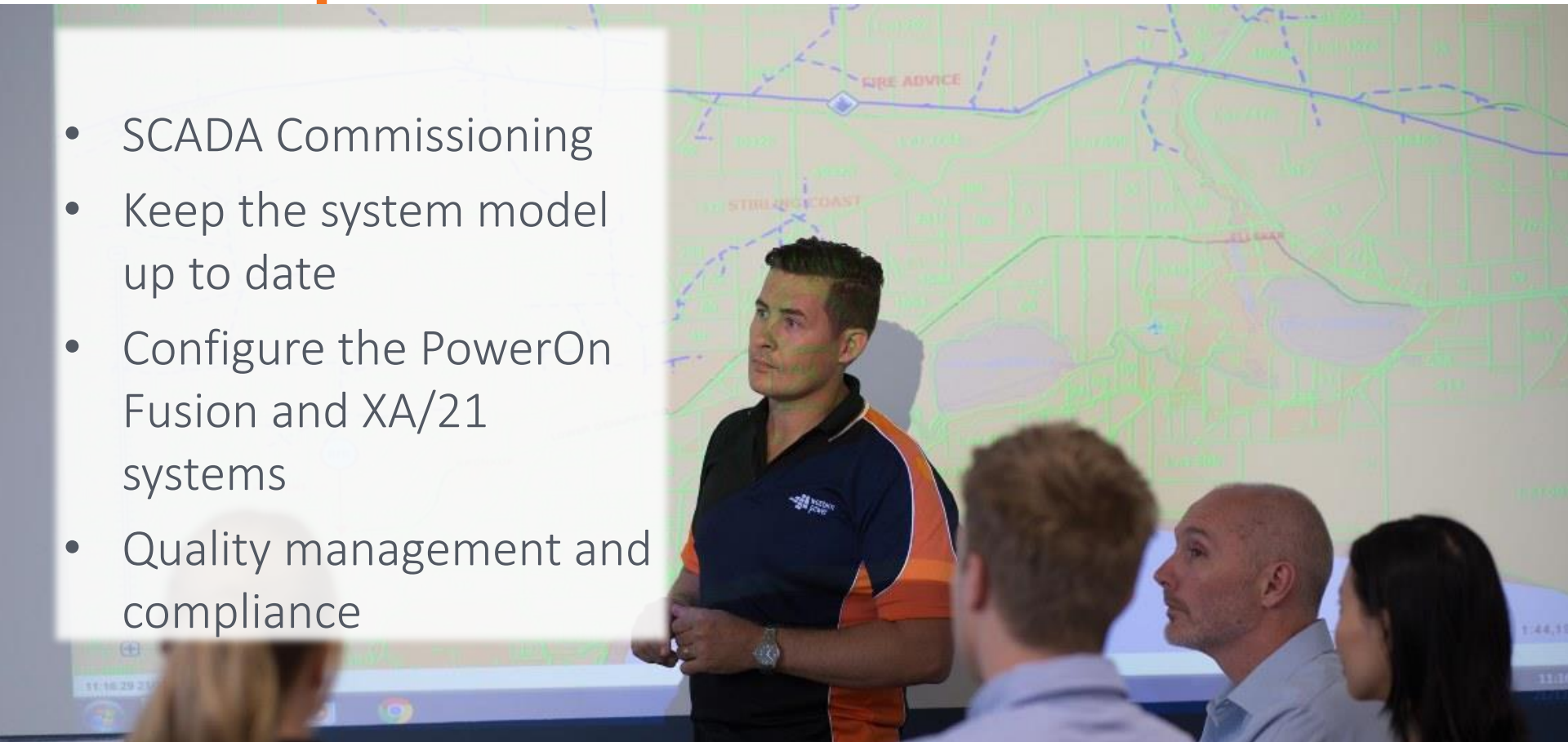
| Integrated Network | Fringe Disconnection | Modular Network | Fully Decentralised |
|---|---|---|---|
|  |  |  |  |
| **Current SWIS model** | **Future model with small number of islanded systems** | **Future model with variable network types** | **Extreme model without centralised network** |

# Network Operations

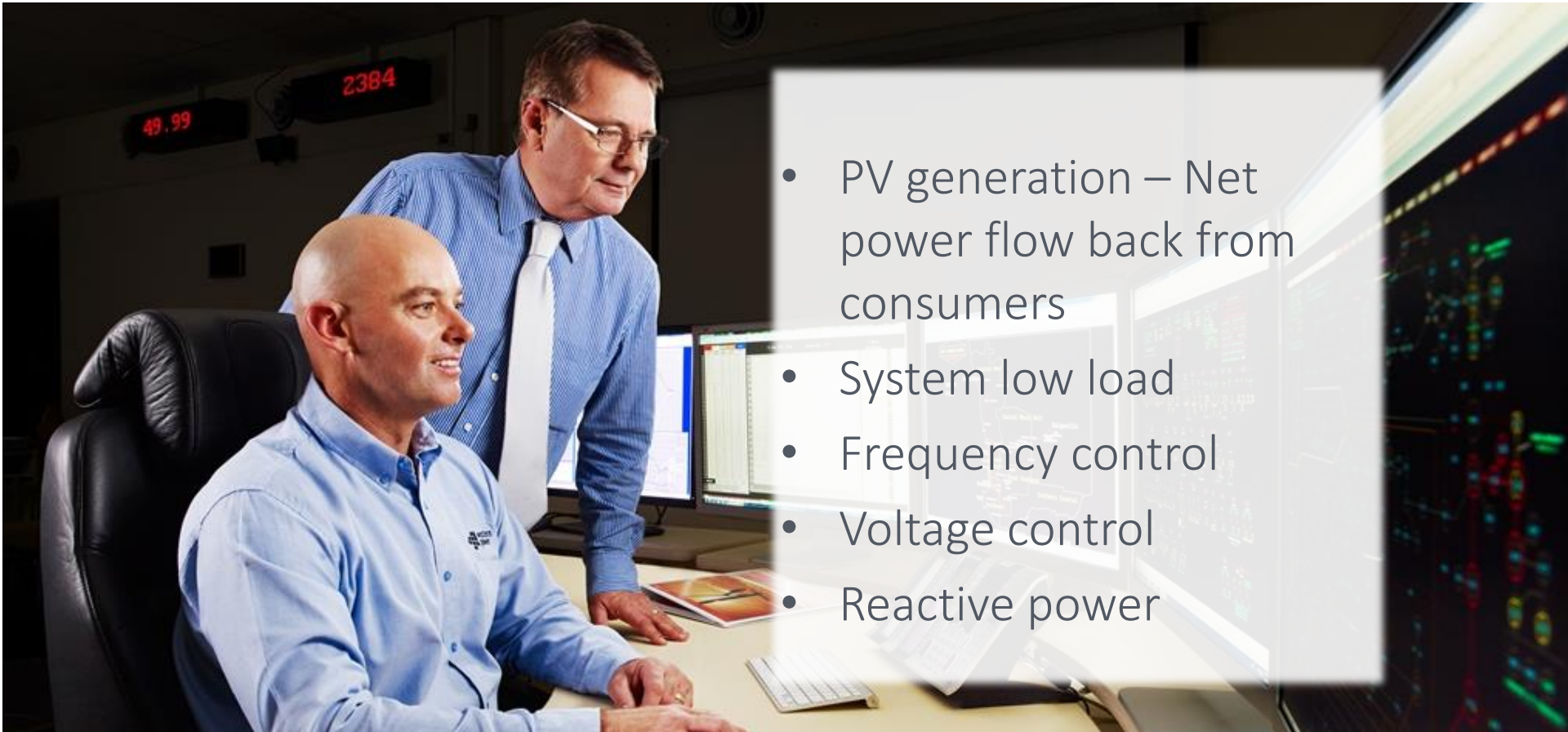

- We keep the lights on!
- Manage the Transmission and Distribution networks in real time
- Dispatch faults
- Run planned work
- Control voltage

# Development Area

- SCADA Commissioning
- Keep the system model up to date
- Configure the PowerOn Fusion and XA/21 systems
- Quality management and compliance

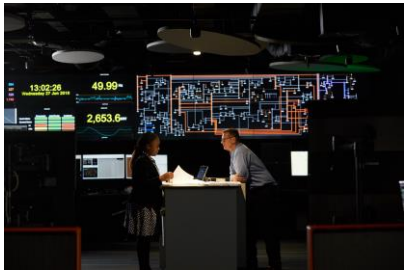


# Current Challenges




- PV generation – Net power flow back from consumers
- System low load
- Frequency control
- Voltage control
- Reactive power

# C-S-R Customer Use Case



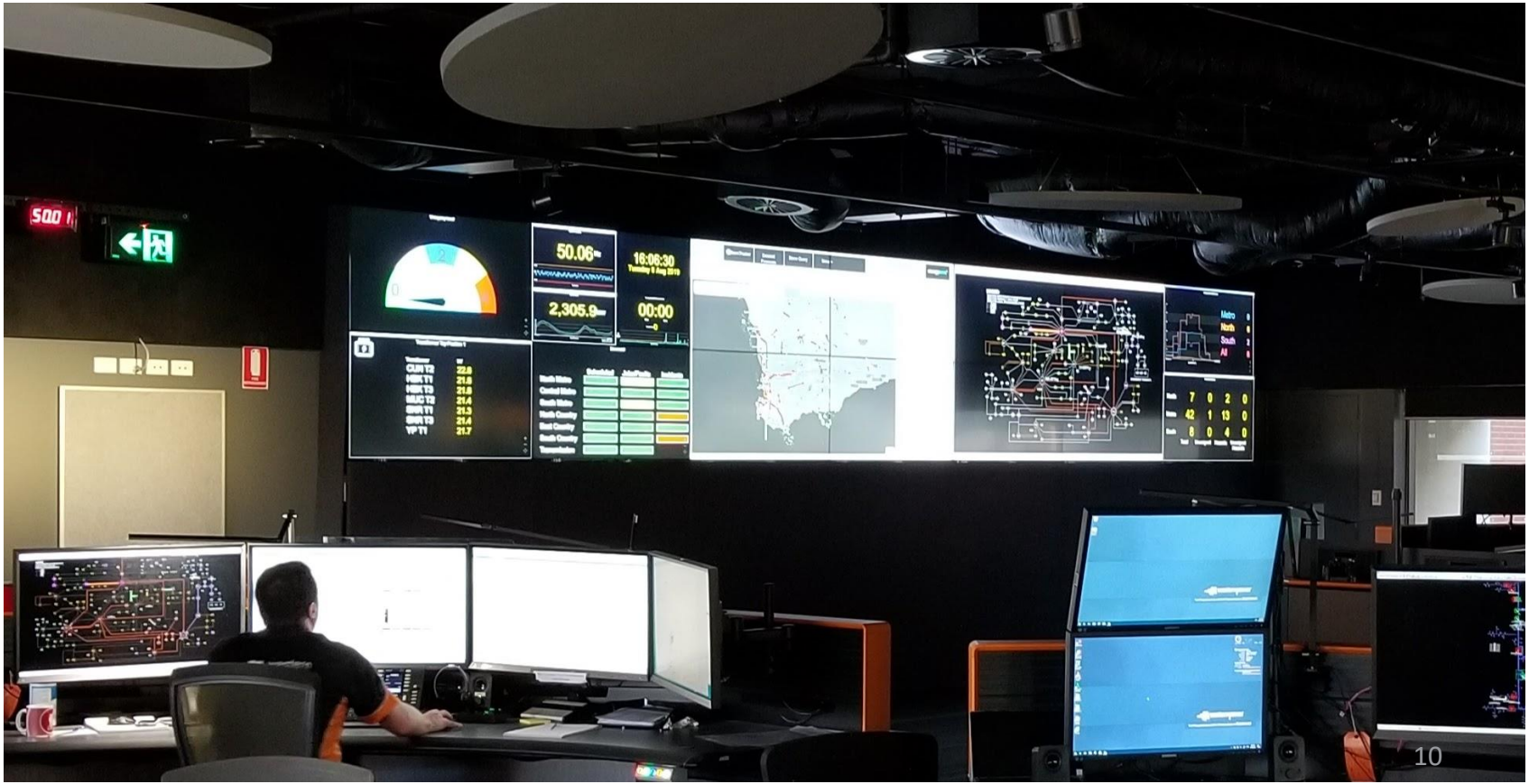
Leveraging the information in PI System using PI Vision to develop displays for the video walls in the Network Operations control centre has provided a significant improvement in situational awareness.

| CHALLENGES | SOLUTION | RESULTS |
| --- | --- | --- |
| Provide situational awareness of the network and factors impacting on its performance and our responses in real-time. | Build a video wall in the control centre and a set of PI Vision displays to clearly present a wide range of information. | A significant improvement in situational awareness across Network Operations and, in the future, the whole of Western Power. |

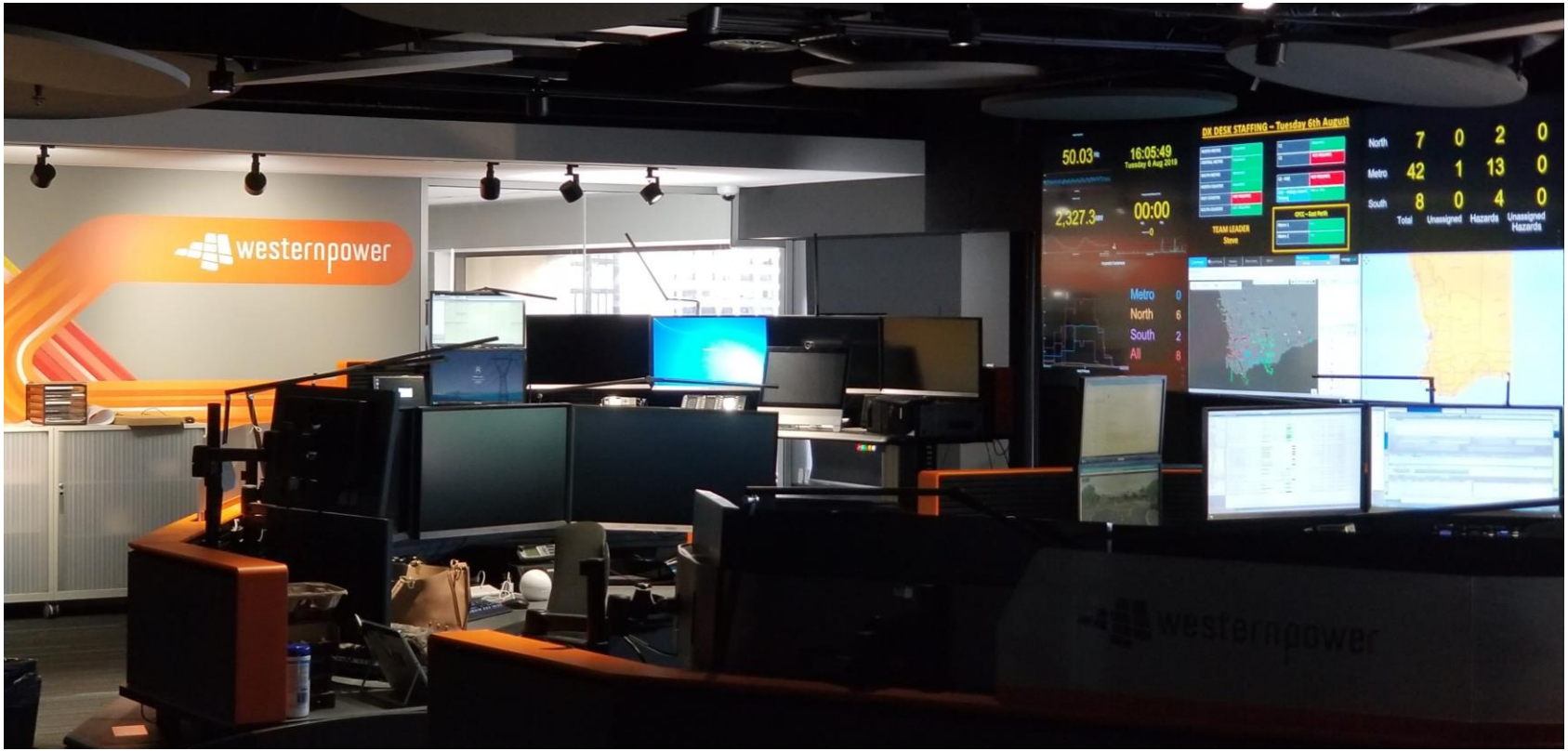
# Where it started

- In 2017 Network Operations moved from the end-of-life control centre in East Perth to Head Office
- Built a new control room
- Included a range of video walls in the requirements
- Selected PI Vision as the main technology to develop displays

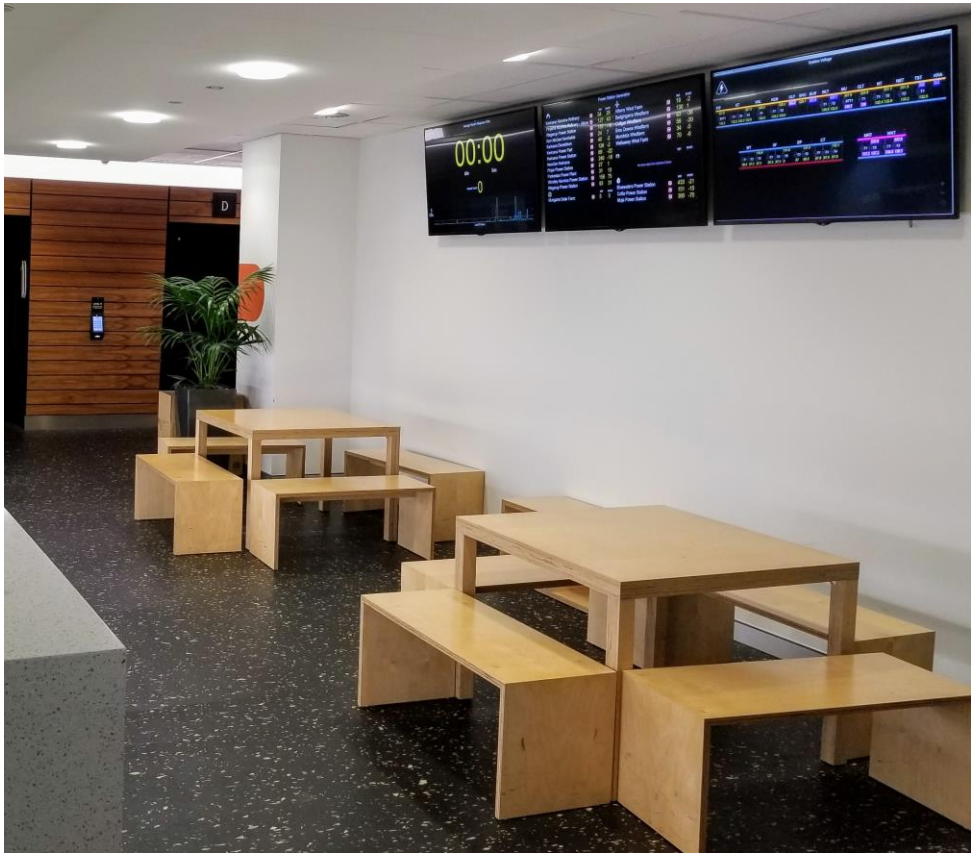
# Main video wall – 7 x 2 array



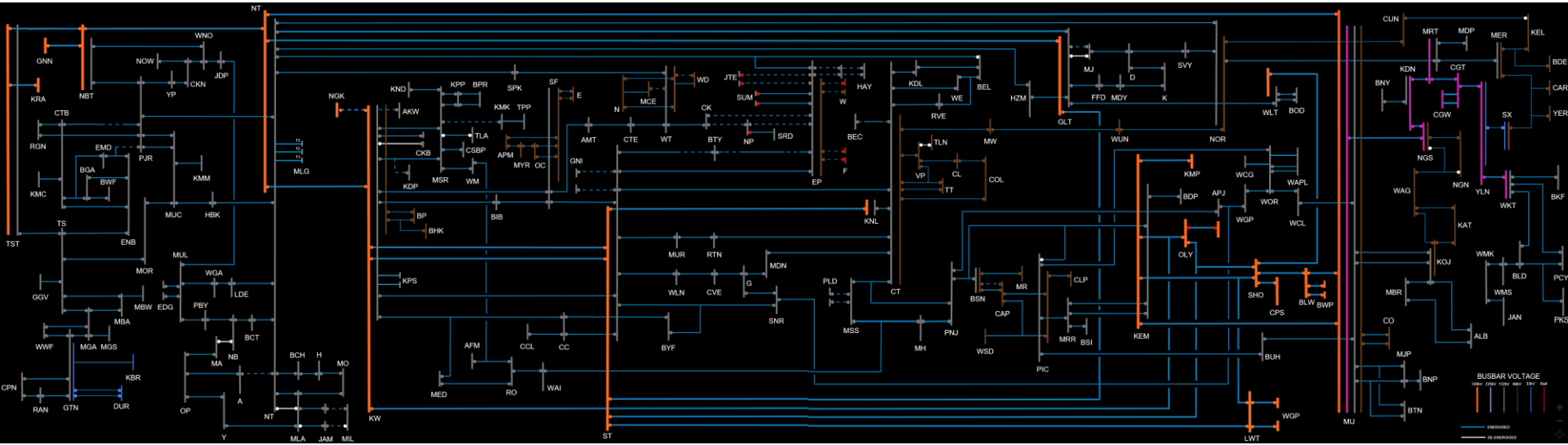
# Secondary video wall – 3 x 2 array

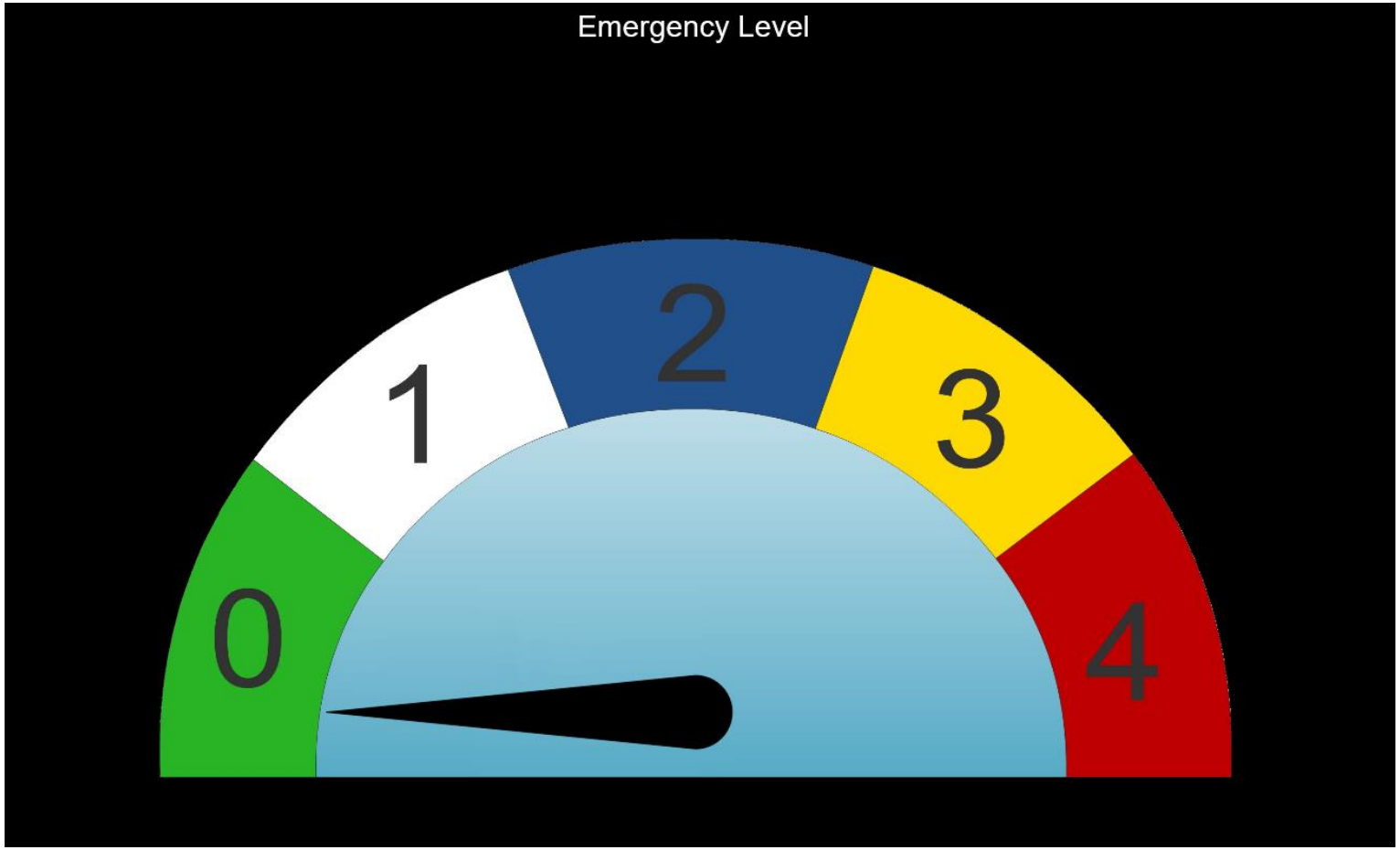


# Breakout area - 3 screens

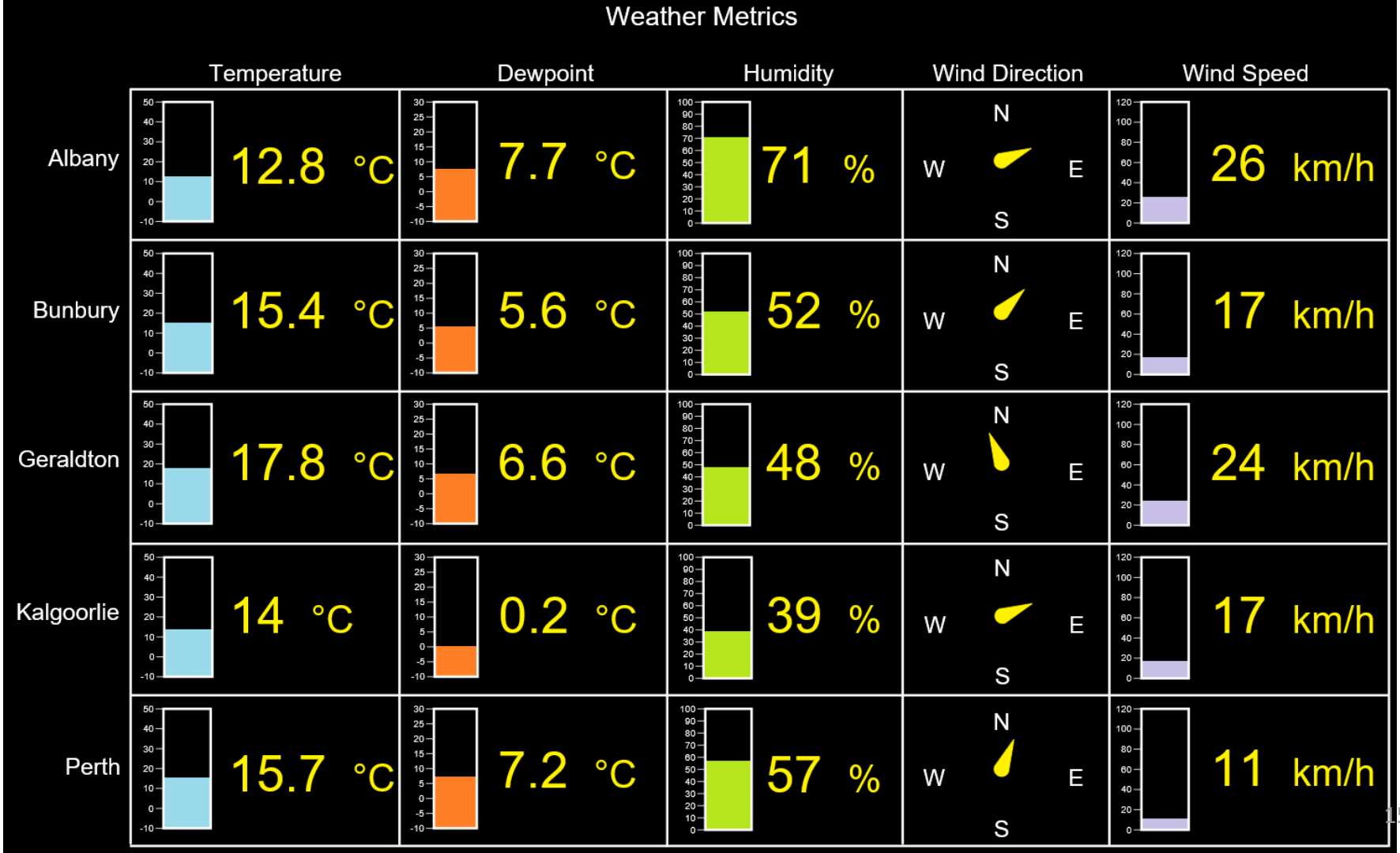


# Transmission Network Overview




Emergency Level
0
1
2
3
4

# Weather Metrics

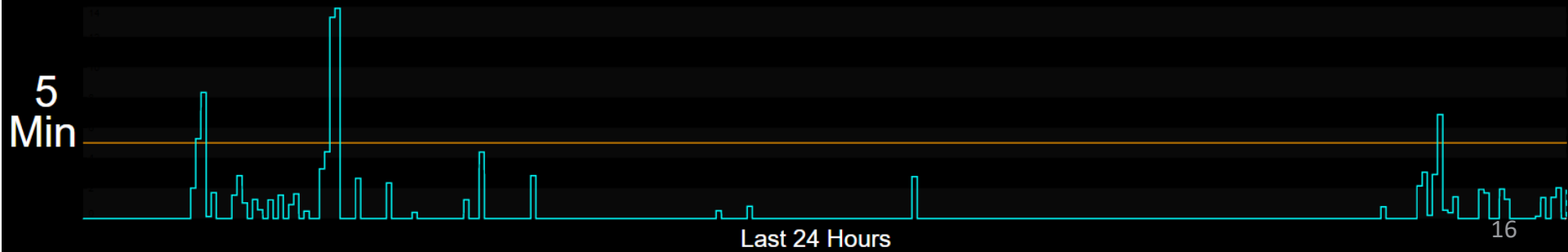


Average Hazard Response Time

# 01:52

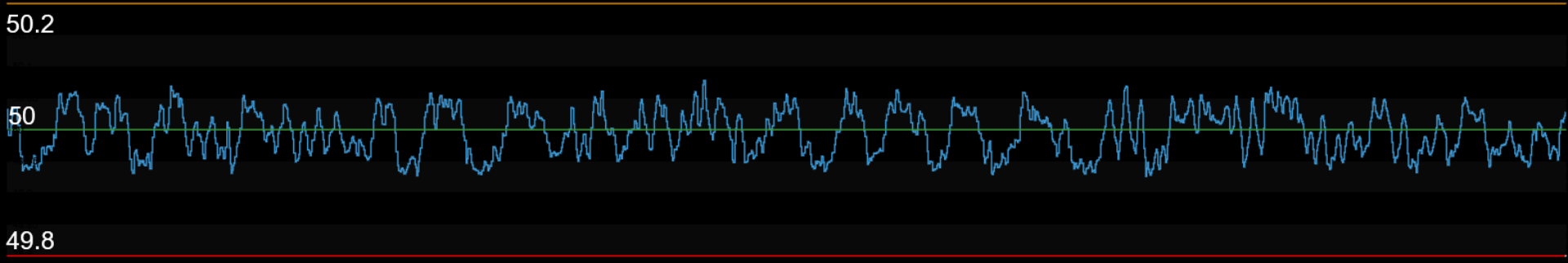
Min Sec

Hazard Count: 2



System Frequency

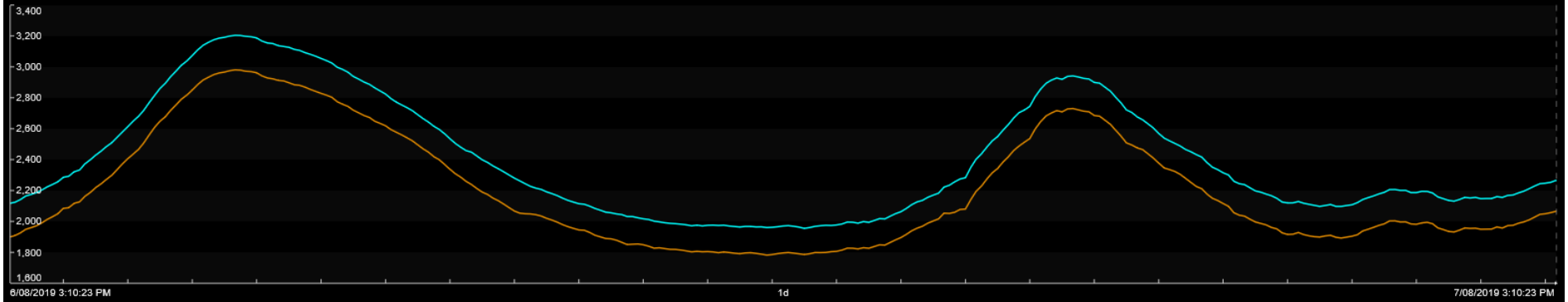
# 50.01 Hz




Last Hour

System Load

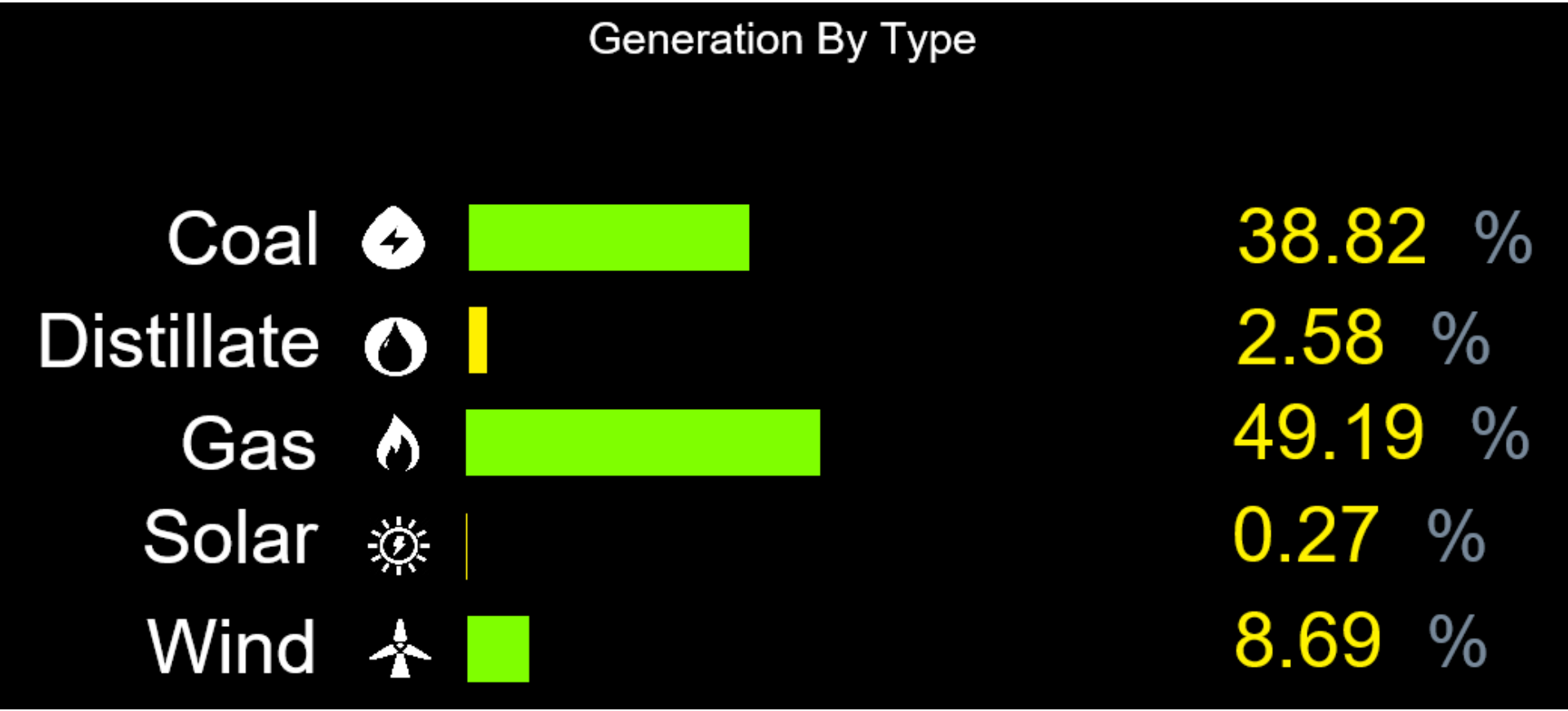
# 2,275.1 MW



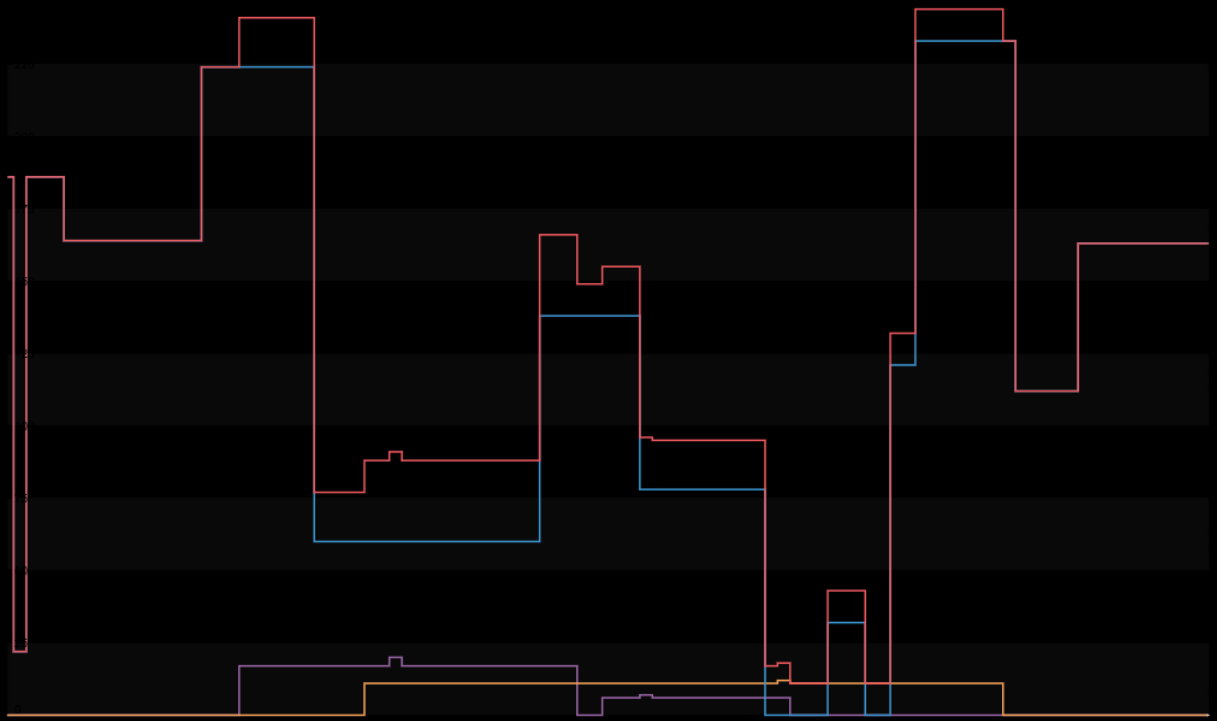

Last 24 Hours

System Total Load

Market Total Load


Generation By Type
Coal
38.82 %
Distillate
2.58 %
Gas
49.19 %
Solar
0.27 %
Wind
8.69 %

# Impacted Customers

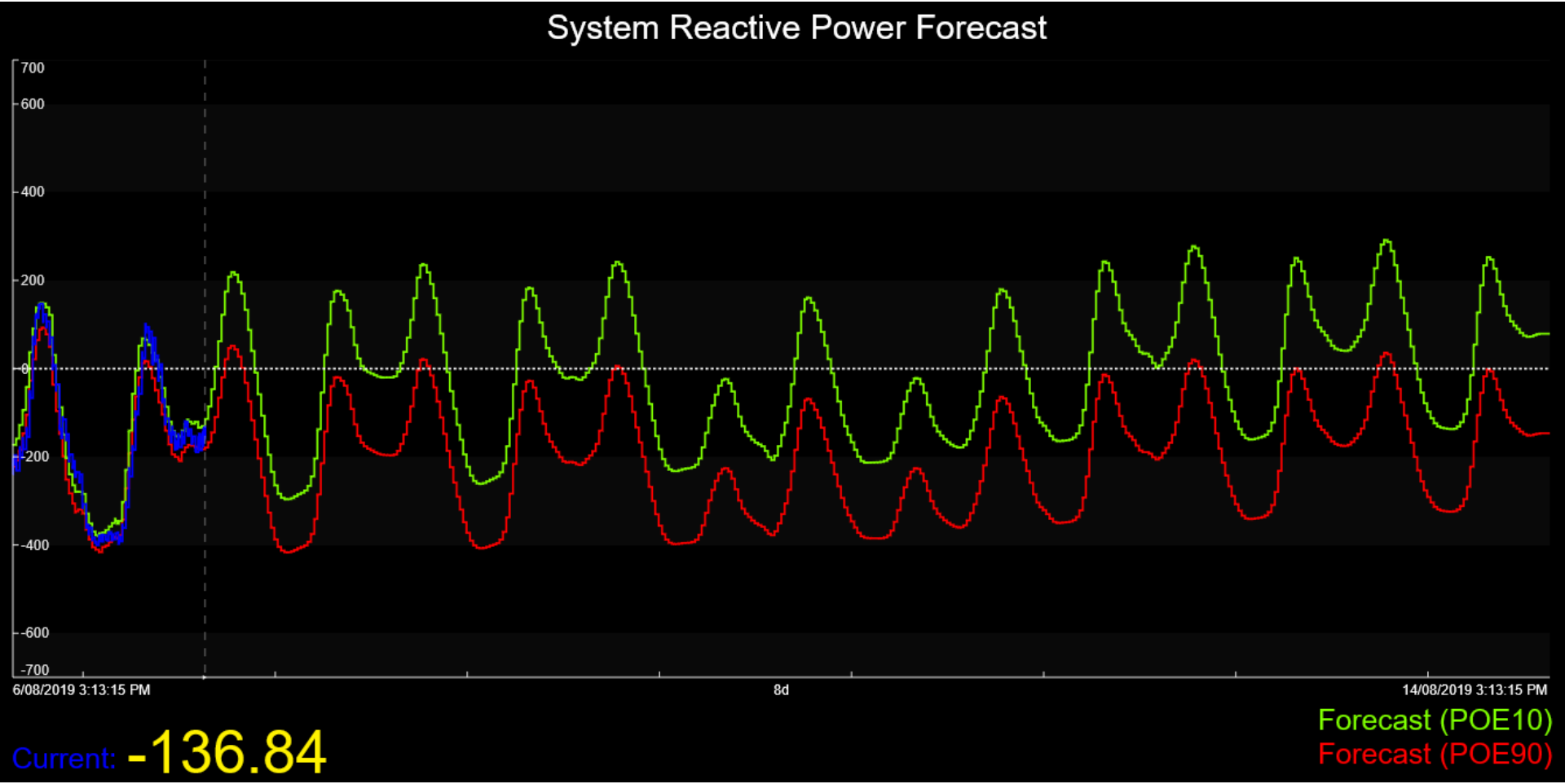


Last 8 Hours

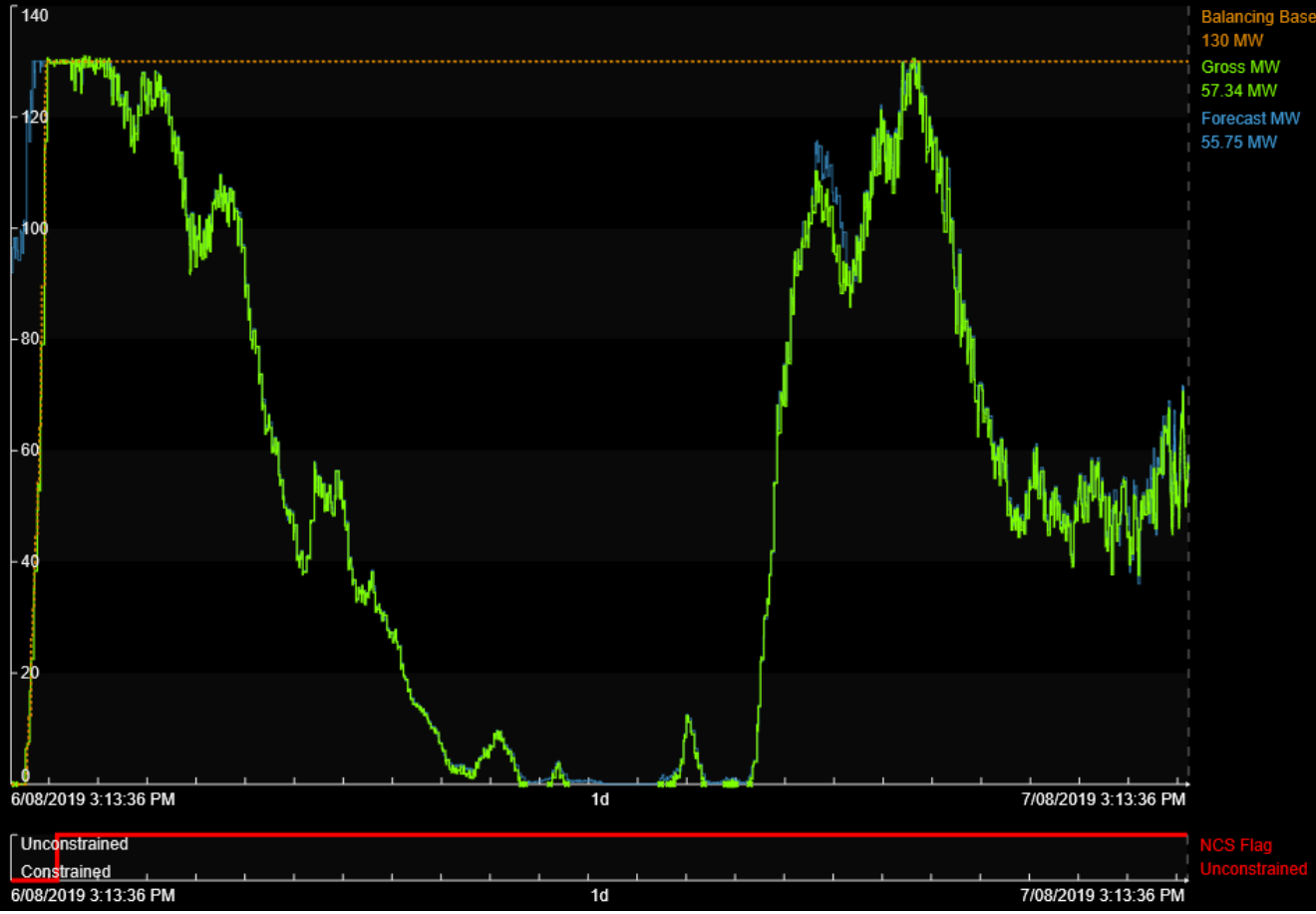
| | |
|---|---|
| Metro | 163 |
| North | 0 |
| South | 0 |
| All | 163 |

# Incident Status

| | Total | Unassigned | Hazards | Unassigned Hazards |
|---|---|---|---|---|
| North | 5 | 0 | 2 | 0 |
| Metro | 64 | 5 | 21 | 0 |
| South | 4 | 0 | 3 | 0 |


System Reactive Power Forecast
700
600
400
200
0
-200
-400
-600
-700
6/08/2019 3:13:15 PM
8d
14/08/2019 3:13:15 PM
Current: -136.84
Forecast (POE10)
Forecast (POE90)

# Badgingarra Wind Farm



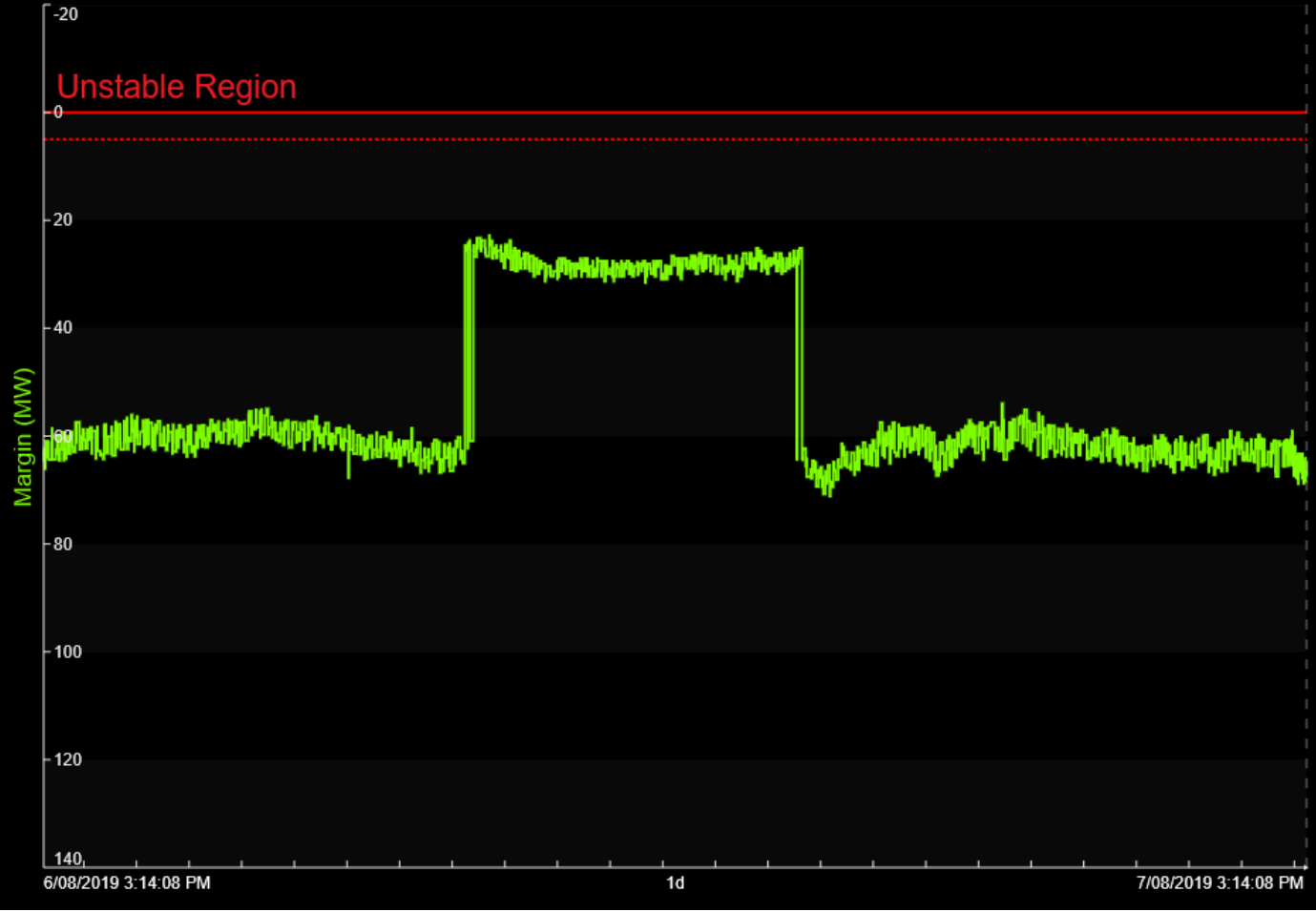

57.34 MW

Constraint Exposure (30 days): 2.6 %

Critical Offline Circuits

No items match the Collection Criteria.

# West Kalgoorlie Terminal 220kV Power Transfer Margin




(MW)

Margin 67

IPP +Export/-Import 12

WKT Import 60

*Note: Positive values - IPP Export, negative values - IPP Import

## Power Station Generation

| | MW | MVAR |
|---|---|---|
| Kwinana Alumina Refinery | 54 | 26 |
| Pinjarra Alumina Refinery - Alcoa | 121 | 40 |
| Wagerup Power Station | 170 | -26 |
| Cockburn Power Station | 87 | 20 |
| Kerr McGee Kambalda | 21 | 3 |
| Kwinana Power Part | 126 | -8 |
| Kwinana Power Station | 25 | -2 |
| NewGen Kwinana | 251 | 4 |
| Pinjar Power Station | 51 | -7 |
| Parkeston Power Plant | 33 | 14 |
| Worsley Alumina Power Station | 156 | 76 |
| Wagerup Power Station | 99 | 31 |

| | MW | MVAR |
|---|---|---|
| Mungarra Solar Farm | 7 | -1 |

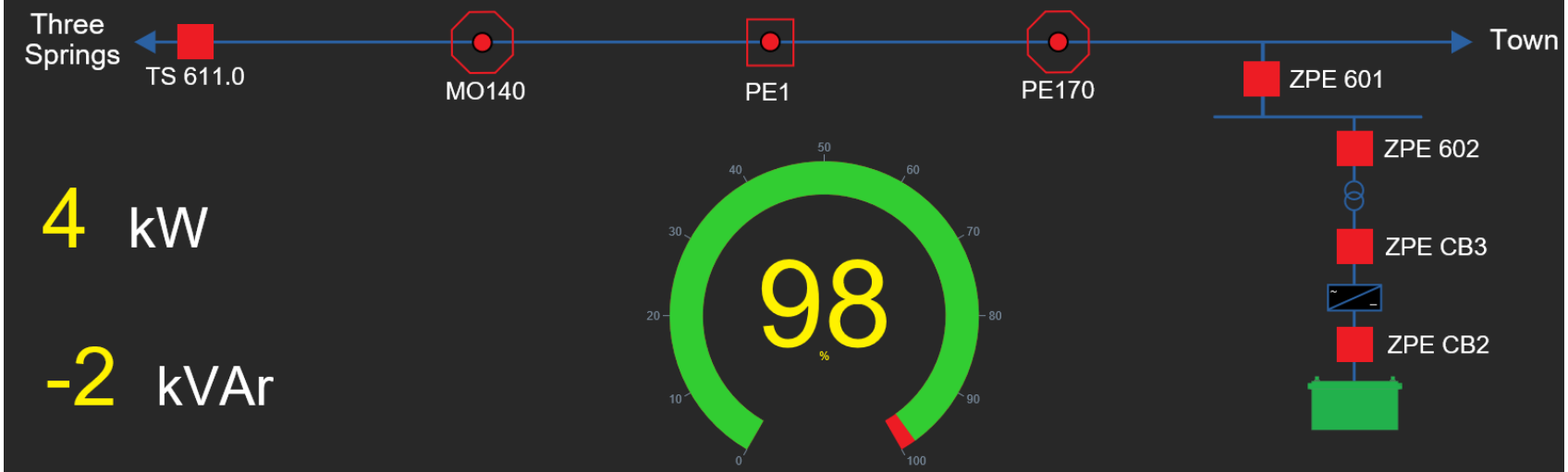
| | MW | MVAR |
|---|---|---|
| Albany Wind Farm | 25 | -3 |
| Badgingarra Windfarm | 54 | -15 |
| Collgar Windfarm | 61 | -35 |
| Emu Downs Windfarm | 28 | -10 |
| Mumbida Windfarm | 21 | -4 |
| Walkaway Wind Farm | 42 | -9 |

| | MW | MVAR |
|---|---|---|

No items match the Collection Criteria.

| | MW | MVAR |
|---|---|---|
| Bluewaters Power Station | 433 | -36 |
| Collie Power Station | 148 | -25 |
| Muja Power Station | 466 | -27 |

# Perenjori BESS




4 kW

-2 kVAr

| | |
|---|---|
| SWIN Frequency | 49.99 Hz |
| SWIN Voltage | 32.1 kV |
| SWIN Reactive Power | -41 KVAR |
| SWIN Real Power | 79 kW |

| | |
|---|---|
| BESS Frequency | 50.04 Hz |
| Town Voltage | 32.11 kV |
| Town Reactive Power | -26 KVAR |
| Town Real Power | 77 kW |
| Town Current Phase A | 1 A |
| Town Current Phase B | 1 A |
| Town Current Phase C | 1 A |

## Transformer Tap Position 1

| Transformer | kV |
|---|---|
| BYF T2 | 21.6 |
| CUN T2 | 21.9 |
| MUC T2 | 21.3 |
| YP T1 | 21.4 |

# Generator Reactive Absorption Availability

## Load Area 9

| Generator | MW | MVar | MVar Available | SUT Tap Position | Busbar Kv |
|---|---|---|---|---|---|
| APJ-GT2 | 144 | 5 | 44 | 15 | 329.3 |
| AWG-GT1 | 171 | 10 | 87 | 12 | 326.8 |
| AWG-GT2 | 172 | 6 | 83 | 13 | 326.8 |
| BW1-G2 | 216 | 5 | 124 | 15 | 322.1 |
| BW2-G1 | 216 | 0 | 119 | 15 | 322.1 |
| CPS G1 | 153 | 3 | 145 | 13 | 325.5 |
| GNN-GT11 | 0 | 0 | 82 | 9 | 326 |
| GNN-GT12 | 0 | 0 | 0 | 9 | 326 |
| KMP-GT11 | 0 | 0 | 0 | 15 | 324.9 |
| KMP-GT12 | 70 | 3 | 85 | 16 | 324.9 |
| MU-G5 | 0 | 0 | 0 | 18 | 325.2 |
| MU-G6 | 200 | -10 | 61 | 14 | 325.2 |
| MU-G7 | 217 | -1 | 66 | 18 | 325.2 |
| MU-G8 | 216 | -9 | 58 | 18 | 325.2 |
| NGK-GT | 160 | 9 | 79 | 15 | 324.3 |
| NGK-ST | 89 | -7 | 77 | 15 | 324.3 |

## Load Area NN8

| Generator | MW | MVar | MVar Available | SUT Tap Position | Busbar Kv |
|---|---|---|---|---|---|
| MGA-GT1 | 1 | 0 | 19 | 8 | 133.7 |
| MGA-GT2 | 0 | 0 | 18 | 9 | 133.7 |
| MGA-GT3 | 0 | 0 | 0 | 11 | 133.7 |
| PJR-GT1 | 0 | 0 | 0 | 1 | 133.1 |
| PJR-GT10 | 25 | 12 | 64 | 12 | 133.1 |
| PJR-GT11 | 75 | 2 | 69 | 12 | 133.1 |
| PJR-GT2 | 0 | 0 | 0 | 1 | 133.1 |
| PJR-GT3 | 0 | 0 | 0 | 15 | 133.1 |
| PJR-GT4 | 0 | 0 | 0 | 15 | 133.1 |
| PJR-GT5 | 0 | 0 | 0 | 12 | 133.1 |
| PJR-GT7 | 0 | 0 | 0 | 12 | 133.1 |
| PJR-GT9 | 77 | 9 | 55 | 12 | 133.1 |

## Load Area SWC8

| Generator | MW | MVar | MVar Available | SUT Tap Position | Busbar Kv |
|---|---|---|---|---|---|
| APJ-GT1 | 0 | 0 | 0 | | 131.5 |

## Load Area KW8/7

| Generator | MW | MVar | MVar Available | SUT Tap Position | Busbar Kv |
|---|---|---|---|---|---|
| CKB-GT | 0 | 0 | 0 | 10 | 131.5 |
| CKB-ST | 0 | 1 | 1 | 9 | 131.5 |
| KMK-GT1 | 41 | 10 | 26 | 14 | |
| KND-GT1 | 55 | 1 | 30 | 13 | 129.8 |
| KND-GT2 | 55 | 0 | 29 | 13 | 129.8 |
| KPP-CT1a | 42 | -3 | 2 | 13 | 133.1 |
| KPP-CT1b | 43 | 5 | 9 | 13 | 131.6 |
| KPP-ST1 | 40 | 4 | 9 | 14 | 133.1 |
| KPS-GT2 | 93 | 11 | 62 | 13 | 130.7 |
| KPS-GT3 | 0 | 0 | 0 | 12 | 130 |

## Load Area EGF8

| Generator | MW | MVar | MVar Available | SUT Tap Position | Busbar Kv |
|---|---|---|---|---|---|
| PKS-GT1 | 33 | 14 | 33 | 7 | 137.9 |
| PKS-GT2 | 0 | 0 | 0 | 7 | 137.9 |
| PKS-GT3 | 34 | 14 | 33 | 7 | 137.9 |
| WKT-GT2 | 0 | 0 | 15 | 6 | 137.9 |
| WKT-GT3 | 0 | 0 | 0 | 8 | 137.9 |
| WMK | 35 | 10 | 32 | | 137.9 |
| WMS | 36 | 8 | 30 | | 137.9 |

# Questions?

## Contact Information

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