ESCRI-SA KNOWLEDGE SHARING

Second Workshop

8 May 2018

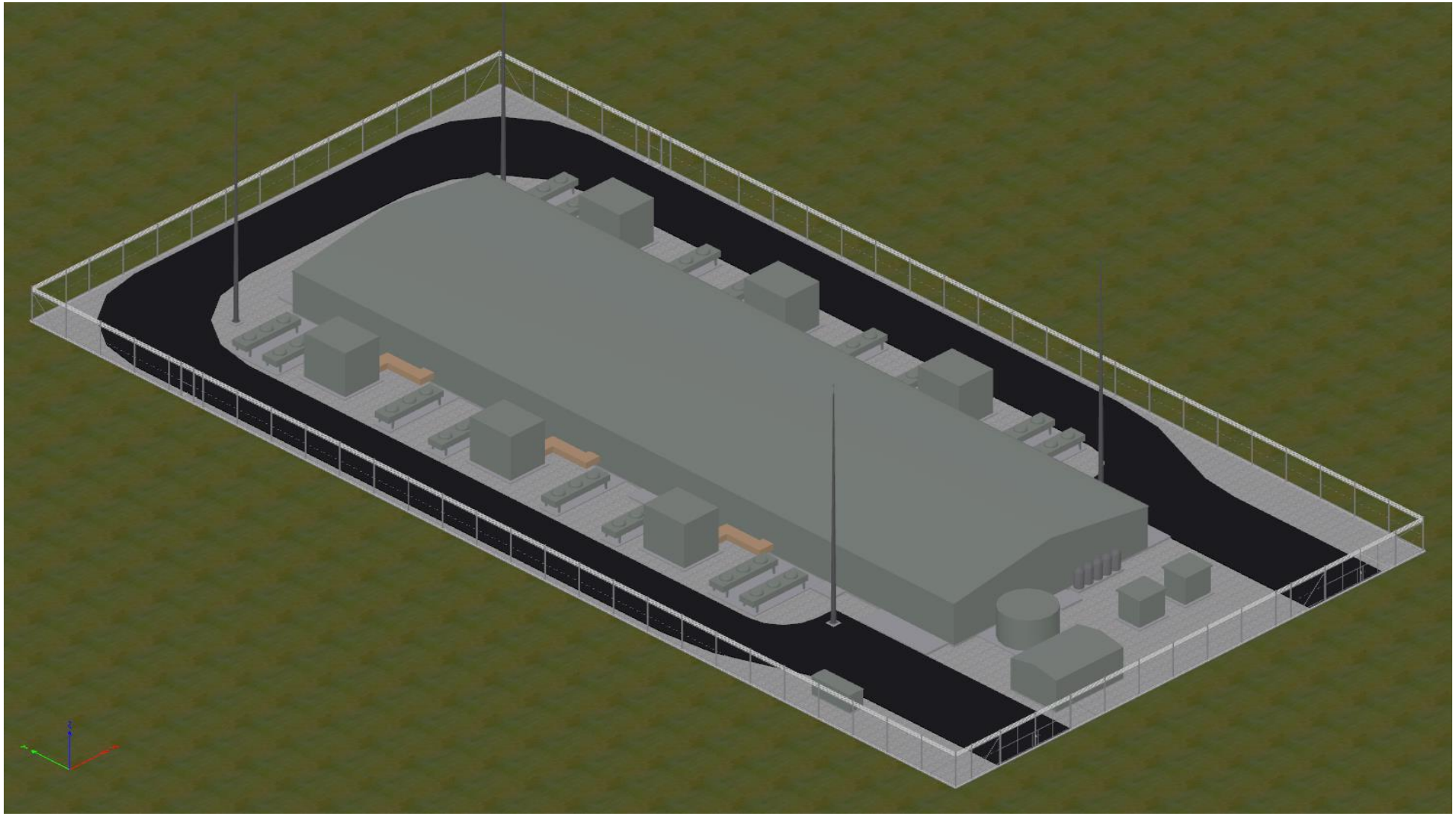
HIGH VOLTAGE SOLUTIONS…

Agenda

- Welcome – Introduce CPP and ABB
- Construction Video
- Knowledge Sharing – CPP and ABB
- CPP: Key Achievements
- CPP: Installation Testing and Commissioning Challenges
- ABB: Modelling
- ABB: Testing
- ABB: Knowledge Sharing Portal
- ABB: Custom Training Packages

Design Installation and Commissioning Challenges - Video

Dalrymple North Site – As Designed



Dalrymple North Substation – As Constructed

Key Installation and Commissioning Challenges

- Tight Timeframe
- Manage large number of interfaces on site
- Different understanding of design boundaries between work packages
- Difficult to reach key suppliers
- Language barriers
- No access to the Network to complete all on load tests
- Management of key stakeholders
- Underestimate the project complexity

Design Installation and Commissioning Challenges

Tight Timeframe

- *Compressed program, only one weekend off taken by site personnel*
- *Significant delays in deliveries from overseas impacted on site program*
- *Intense installation work for ABB and Samsung equipment*
- *Design additions after the IFC*

Design Installation and Commissioning Challenges

Difficult to manage multi disciplinary interfaces on site at the same time

- *SCADA,*
- *Telco,*
- *IDS Scheme,*
- *Fire Suppression,*
- *Security,*
- *ABB Equipment,*
- *Equipment Delivery and Installation*
- *Equipment HV testing*
- *Protection Commissioning*
- *Control Schemes*
- *RTU Panel Commissioning*
- *Air Con Installation*

Design Installation and Commissioning Challenges

Different understanding of design boundaries between work packages

- *Additional design required*
- *Additional procurement of panels and equipment required*
- *Additional installation work*
- *Re-work required*
- *Additional testing required*
- *Documentation review and re-issued required*

Design Installation and Commissioning Challenges

Difficult to reach key suppliers

- *All equipment required intense cooperation with the supplier*
- *Most of the suppliers located overseas*
- *Slow responses to key information*

Design Installation and Commissioning Challenges

Language barriers

- *Use of incorrect information due to the formulation of responses*
- *Delivery of plant incomplete*
- *Unable to validate some of the design inputs*

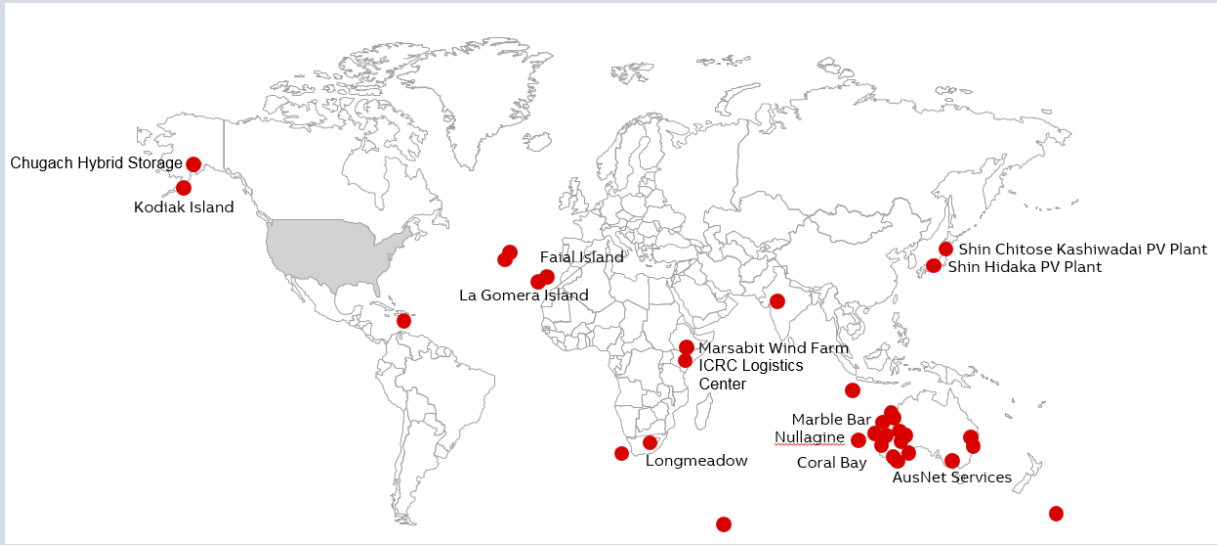
Key Topics

- Modelling
- Factory Testing of Complex Control System
- Inverter/Control System Pre-Commissioning Challenges
- Custom Training Packages

Modelling

- Modelling – Background
  - Systems focussed historically on islanded / offgrid networks – with varying technology
  - More recently fringe of grid applications appearing
  - ESCRI represents first large grid NEM connected Microgrids
  - Draws requirements for extended functions to be developed and embedded in product

    i.e. FFR, FCAS, Network Support



Global overview of ABB installed base

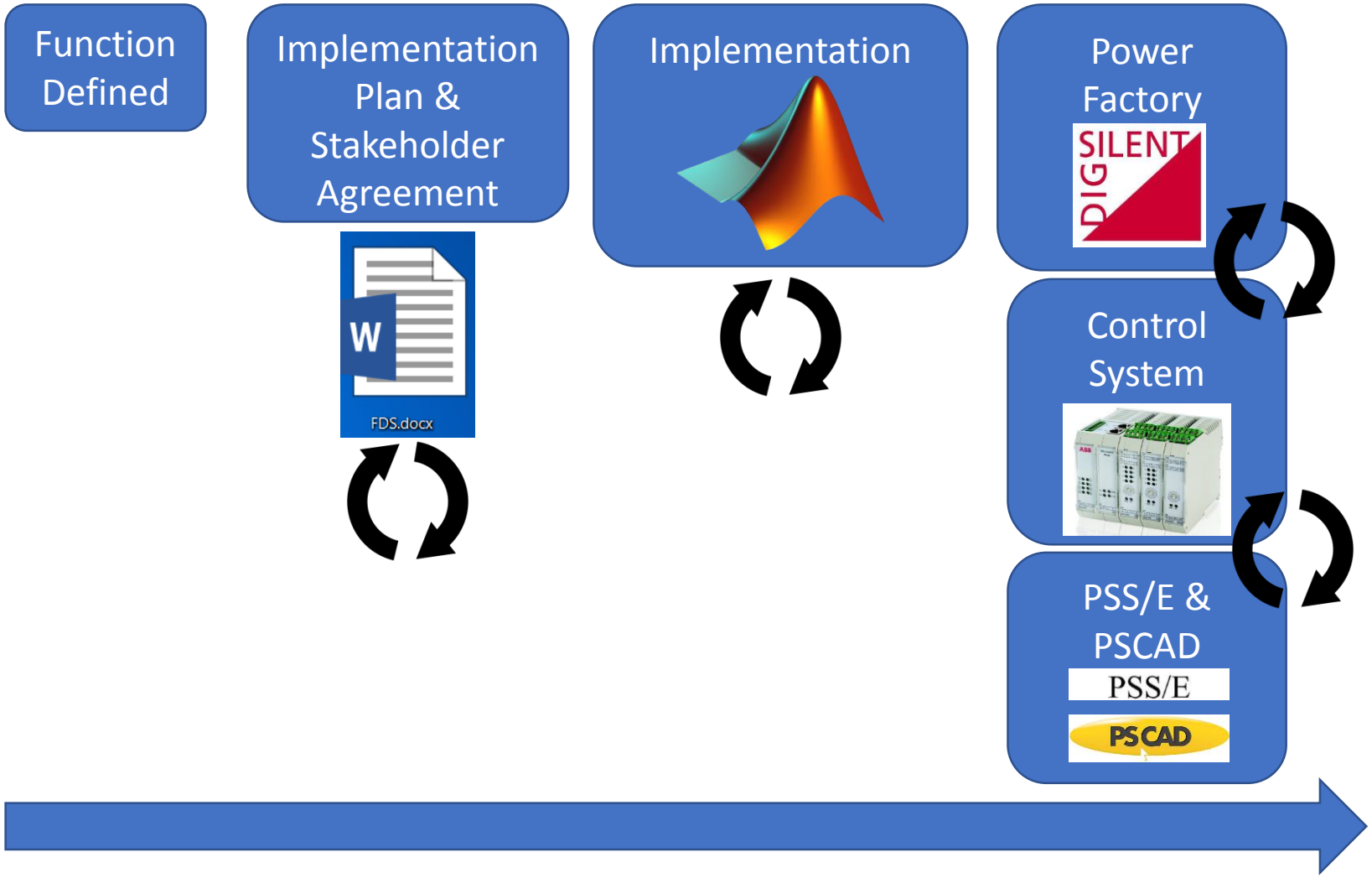
Modelling

- Function Development
  - Model Framework overview – Typical for new developments

  - Challenges in timeline and interdependency means shift to non-ideal process (next page)

Modelling

› Function Development - Realised



› Registration timeline leads to parallel of FDS and Model / function development

› All changes in the design required reflection and validation in all models in parallel – multiple releases.

Modelling

- Modelling – Registration
  - Changes in FDS and design require frequent reissuing of models
  - Model challenges a mix of design validation and implementation issues
  - Following modelling development difficult to isolate model implementation issues from functional changes
  - Model debugging and validation by ABB and partner consultants based on network assumptions which were different to the assumptions used by client consultants
  - Managing a diverse group of stakeholders with diverse drivers
  - Note the VGM model is a new approach - some performance criteria difficult to assess (e.g. Frequency Response requirements)
  - Aligning and benchmarking two modelling packages (PSS/E + PSCAD)

Testing

- Factory Testing (ABB Darwin)
  - Complex system simulation
  - Utilised Darwin grid to simulate NEM
  - Islanding / Resynchronisation tested successfully with real island
  - Yorke Peninsula load online
  - Wattle Point Wind Farm simulated

Testing

- Factory Testing (ABB Darwin)
  - Fast Frequency Response (**FFR**) requires utilisation of ‘Virtual Inertia’ within inverters
    - Parameterised for project specific response – “Keeping the lights on”
  - ‘**Network Support**’ speed response improvement - <250ms
  - Novel Frequency Control Ancillary Services **(FCAS)** – developed, incorporated and now standard

Network Response Test Results

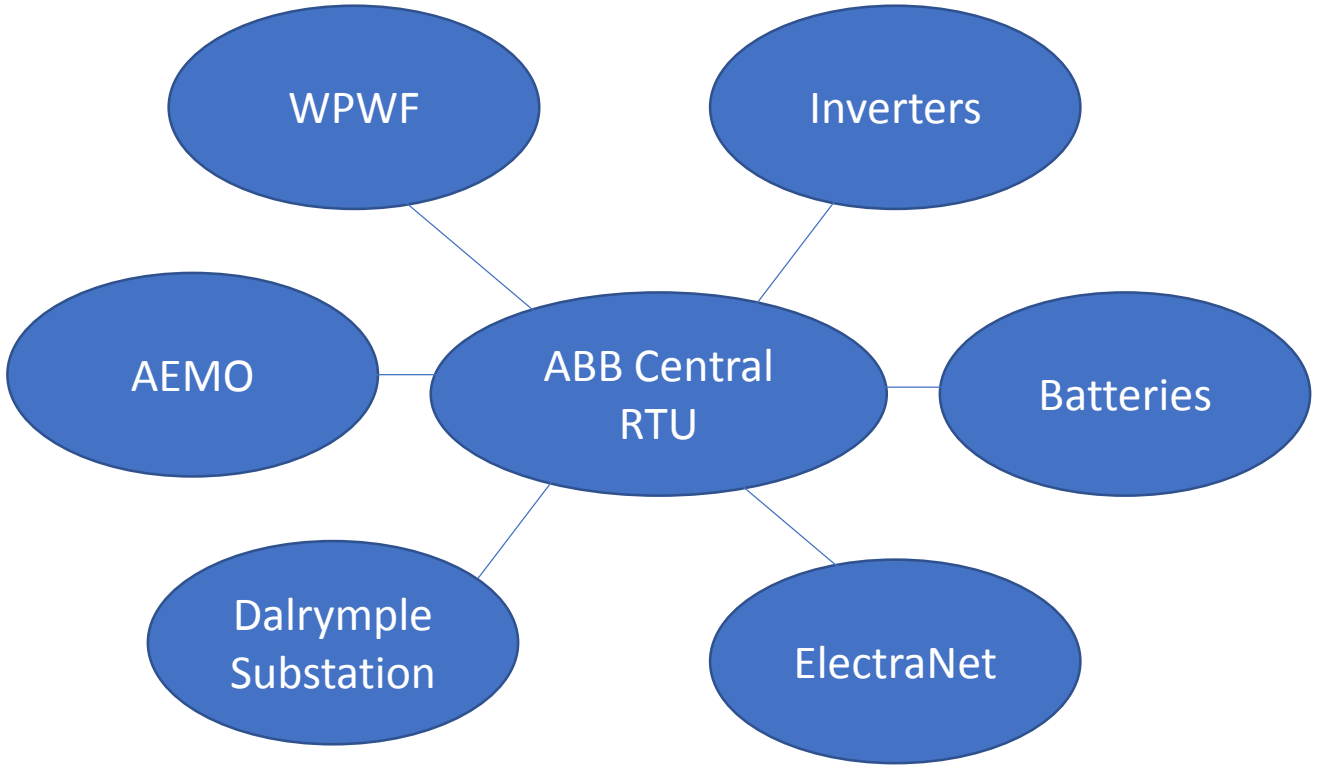
Inverter System Pre-Commissioning

- Multiple ABB factories supplying in to inverter solution
  - Napier, New Zealand for PCS100 inverters
  - Trutnov, Czech Republic - Electrical Panels
  - Assembly in Lobethal, South Australia
- Lifting/transportation – careful planning with local contractors

Inverter System Pre-Commissioning

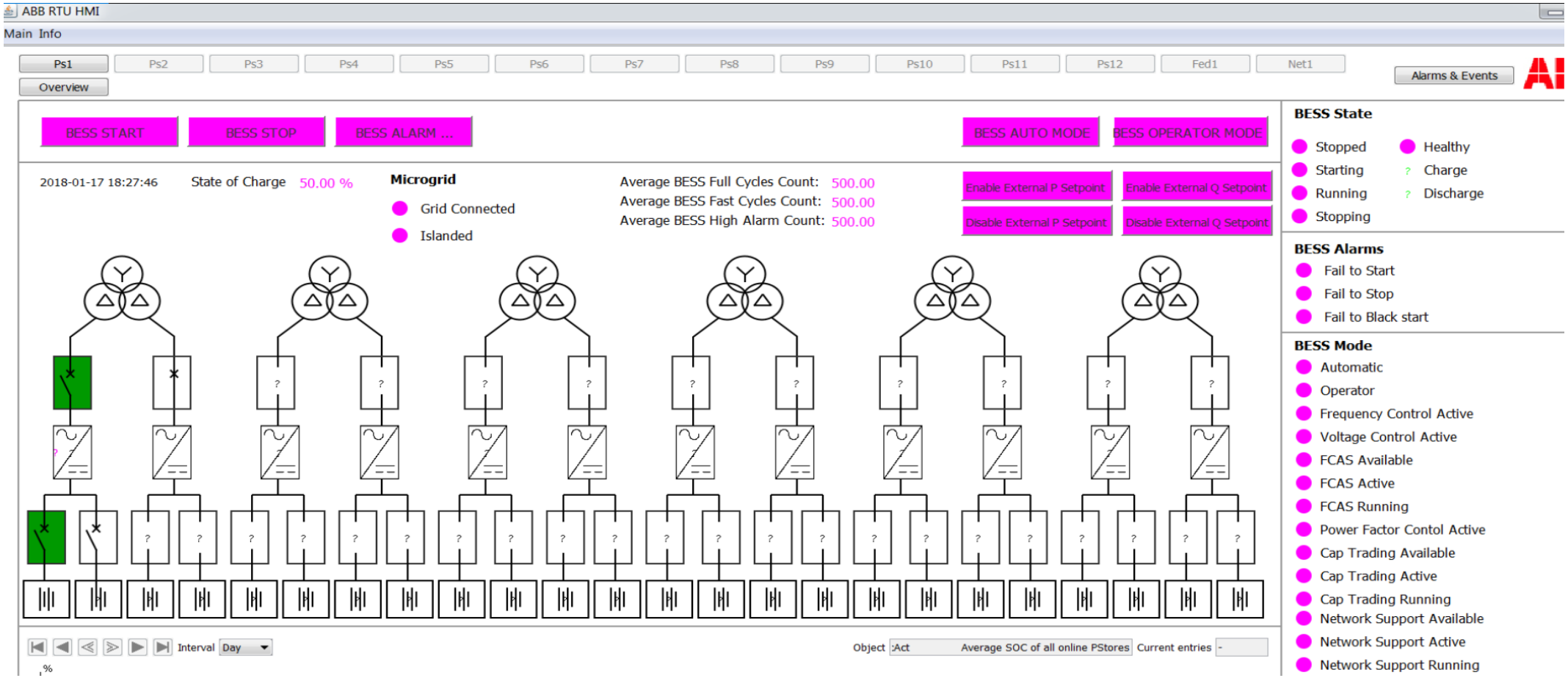
Control System Pre-Commissioning

- Multiple Communications Interfaces
  - Wattle Point Wind Farm
  - ElectraNet OPSWAN
  - Twelve Inverter/Battery Controllers
  - Existing Dalrymple Substation



Knowledge Sharing Portal

Knowledge Sharing long term data storage – Local Server engineered and supplied
High complexity data acquisition from multiple devices



Training

- Training Packages for separate audiences
  - Battery Operator (AGL)
  - Battery Owner (ElectraNet)
  - EPC Contract Partner (CPP)

In Summary

- A complex R & D project delivered in an accelerated timeframe
- A complex regulatory environment
- The first grid forming inverter
- Several design and application firsts