PECTEC

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Monday-Friday 08:00-17:00, Sat 8:00-12:00 GMT+7

Content

- Introduction
- Technical Specification
- System Test (Integration Test)
- Tender
  - Project Evaluation (Price Performance)
  - Required Documents

Introduction

1.2 MWh/2 MW BESS for substation

MEA's Pathum Wan Project

Install Energy Storage System Pilot Project at Pathum Wan substation

For support load without outage

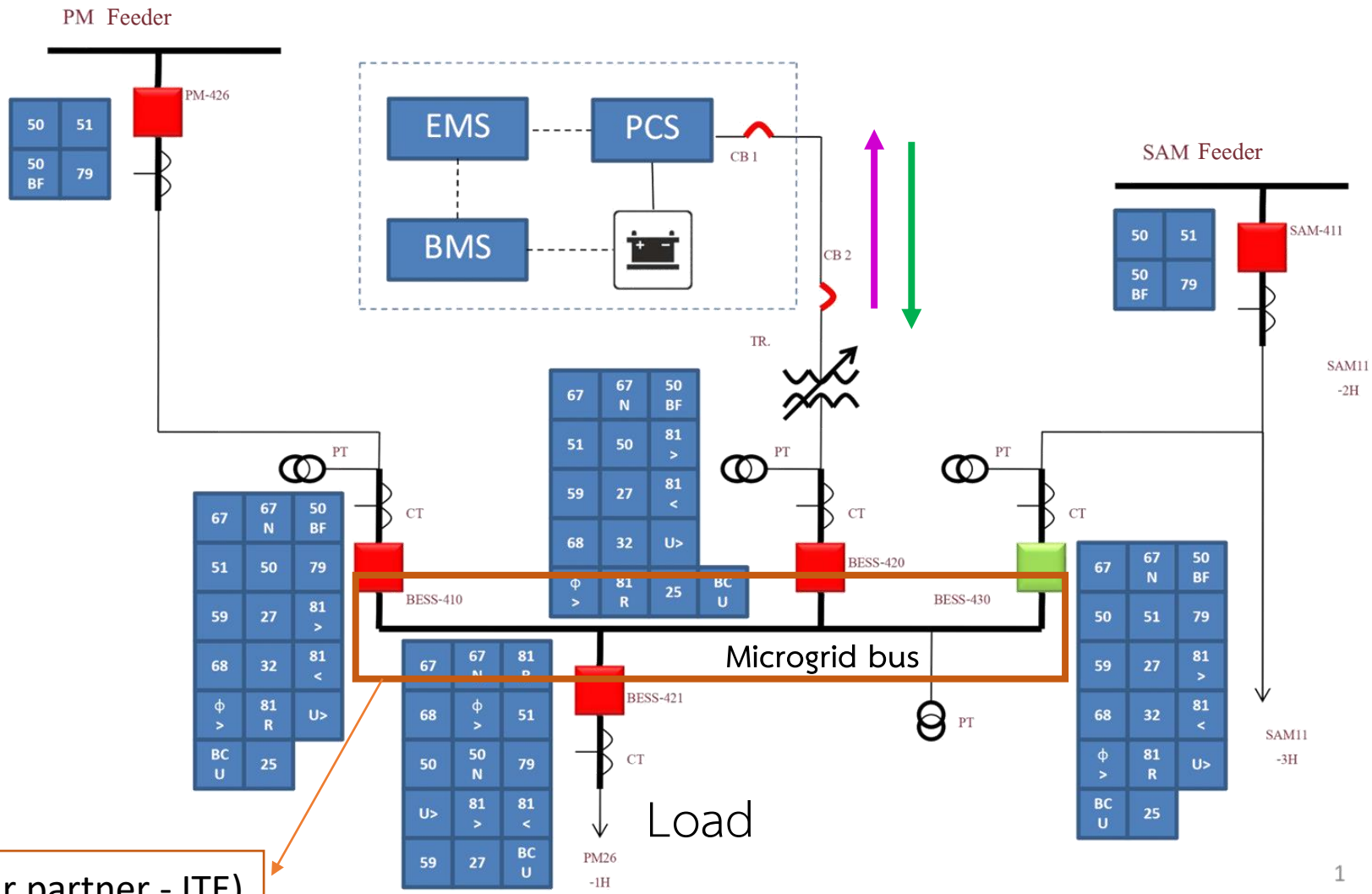
BESS(1.2 MWh/2 MW) with the following Applications

- Load Leveling
- Power Backup
- Resynchronize

Load Leveling

Light Load
ESS – On Grid mode
Charge Battery

Peak Load
ESS – On Grid mode
Discharge Battery



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GIS (Supplied by our partner - ITE)

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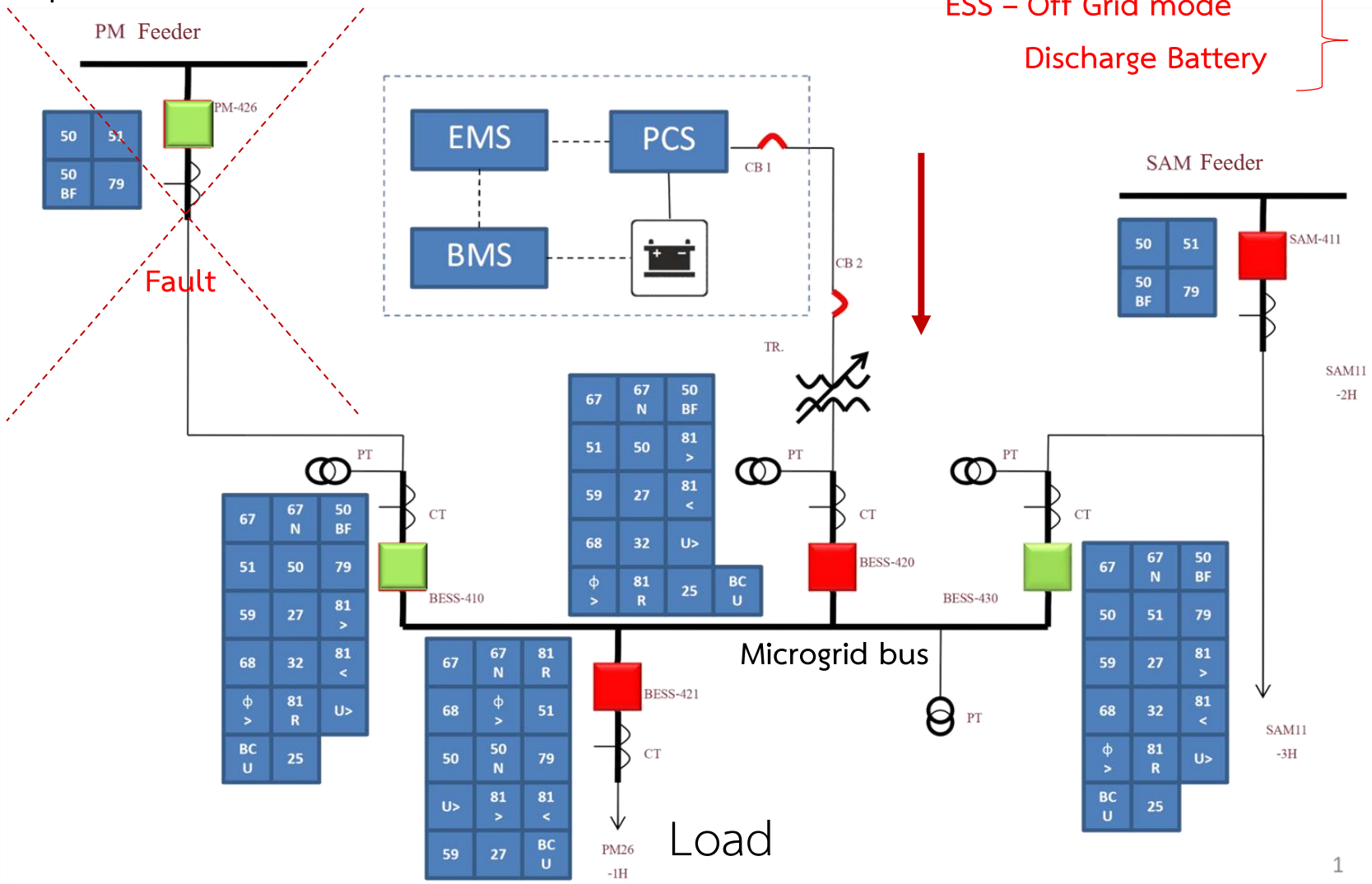
Power Backup Case 1



Fault occurs in PM

ESS – Off Grid mode

Discharge Battery

switch from on grid to off grid within 50 ms (After PCS receive the Command signal)

grid following mode

to

grid forming mode

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Power Backup Case 2

Fault occurs in PM

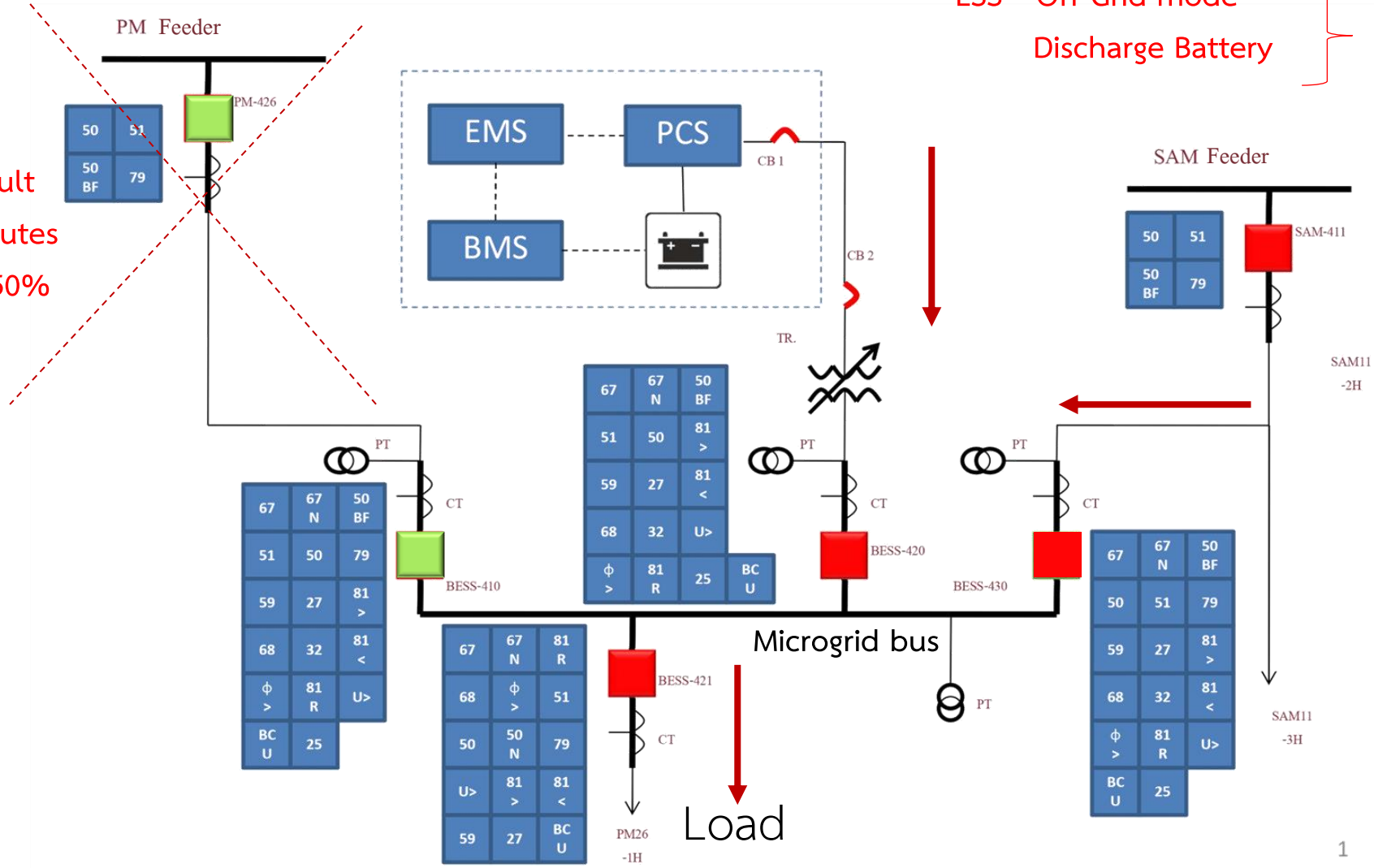
ESS – Off Grid mode synchronous ESS to SAM

Discharge Battery

Can't clear Fault

With in 5 minutes

OR Battery < 50%



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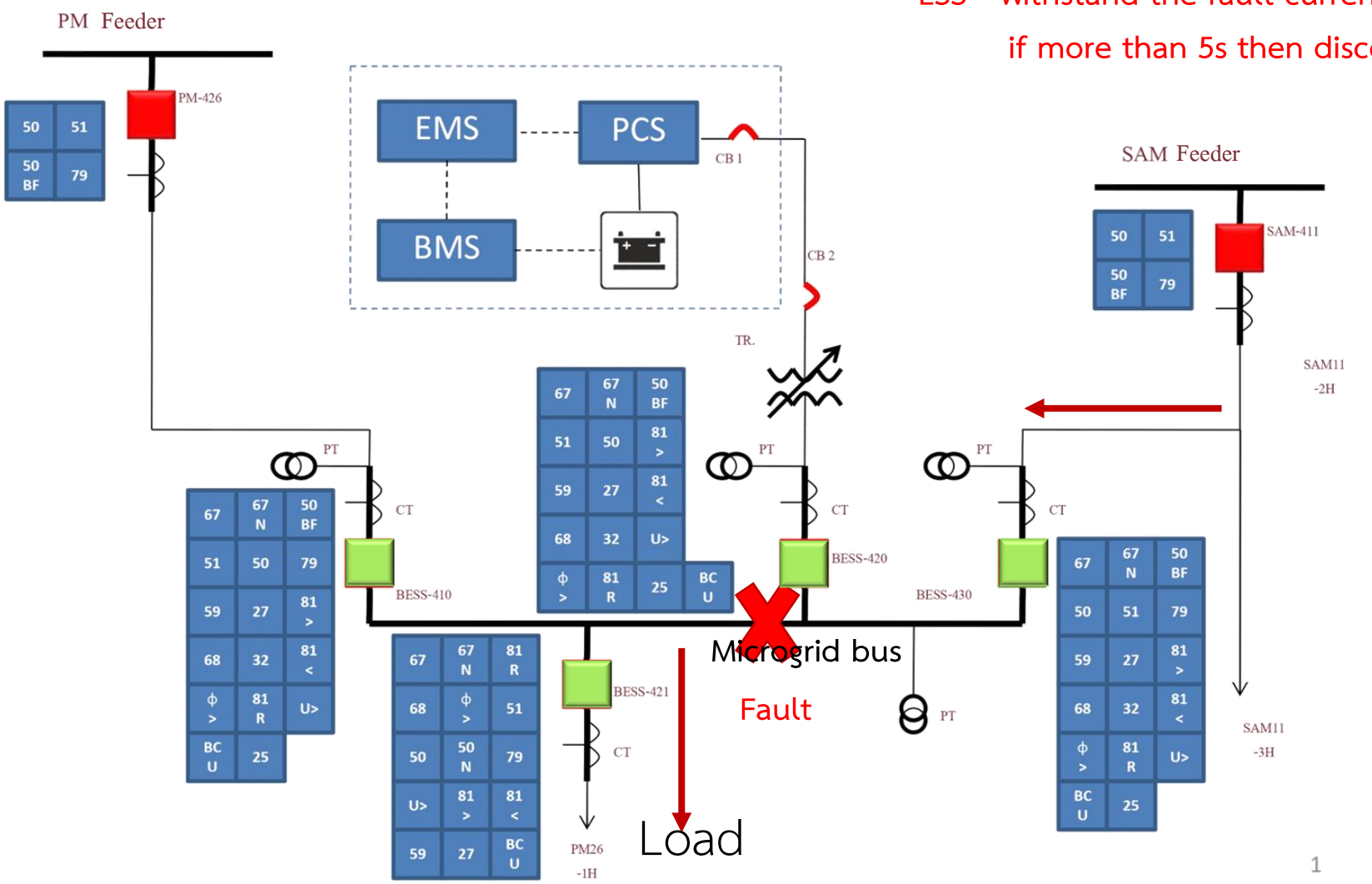
Power Backup Case 3

Fault occurs in Microgrid Bus

ESS – withstand the fault current within 3s (25kA)

if more than 5s then disconnect



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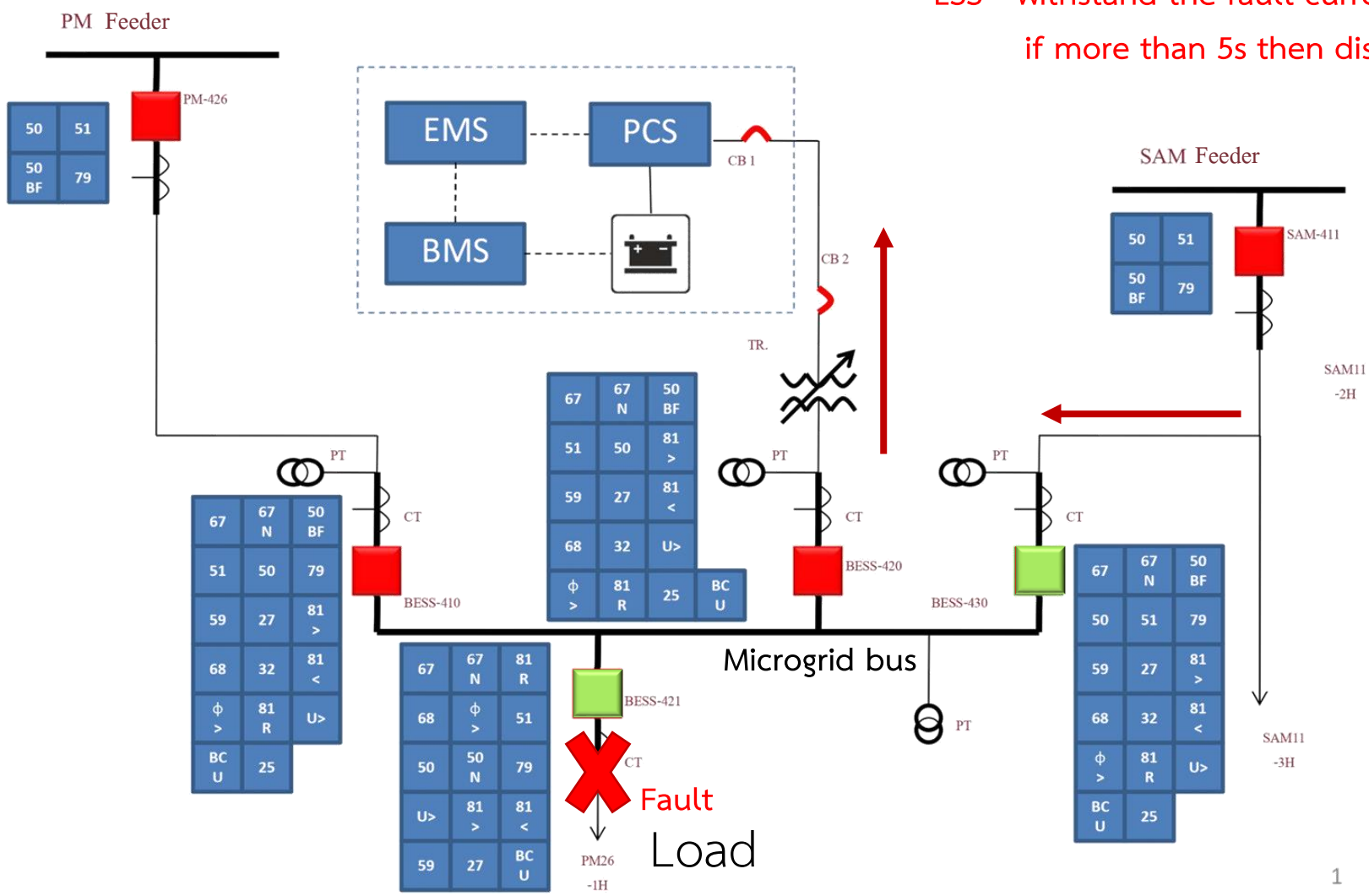
Power Backup Case 4

Fault occurs in load bus

ESS – withstand the fault current within 3s (25kA)

if more than 5s then disconnect

- On Grid mode
- Charge Battery



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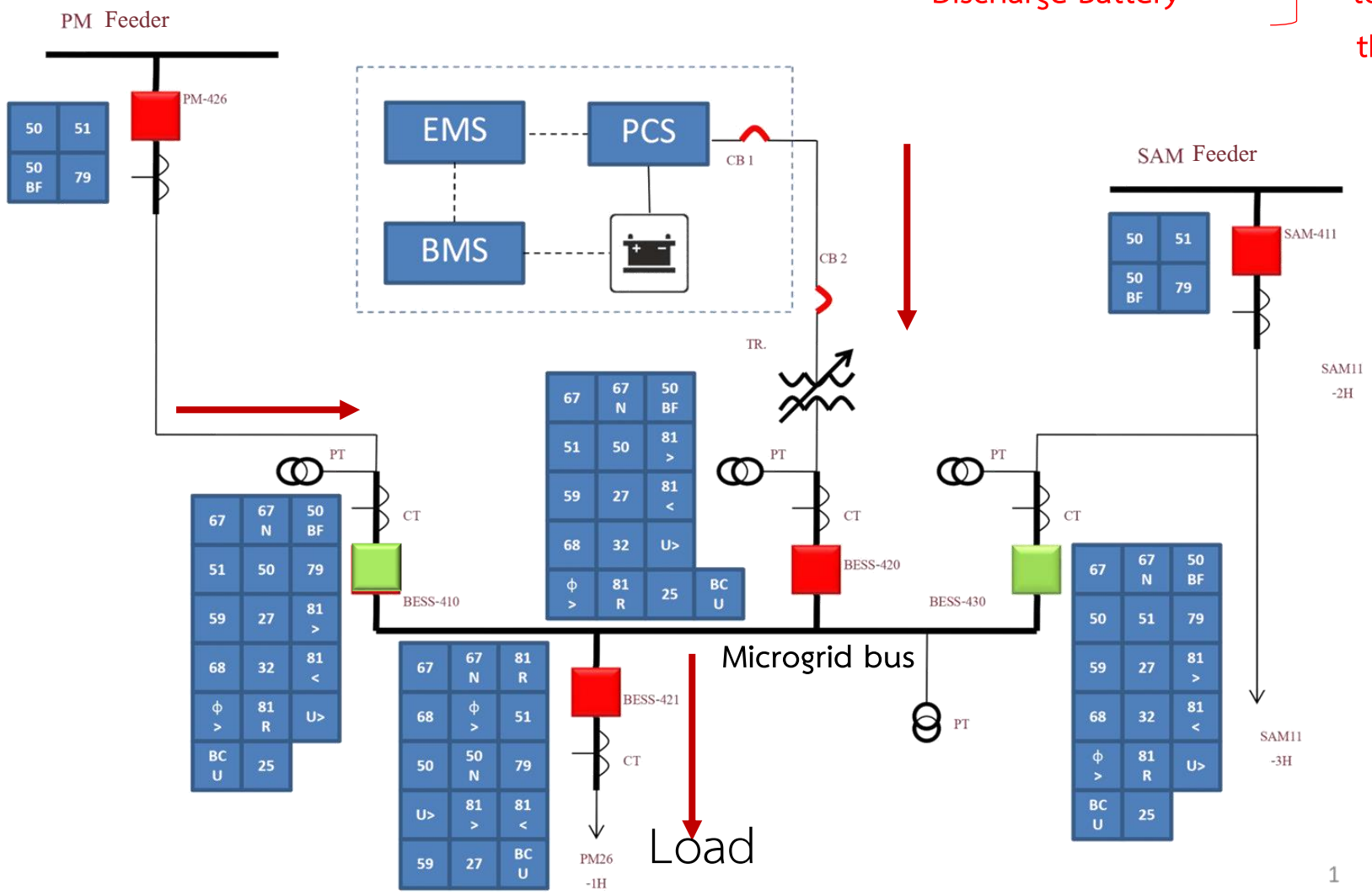
Resynchronize

ESS – On Grid mode
Discharge Battery

Relay send command to PCS
to synchronous ESS to PM
then disconnect SAM



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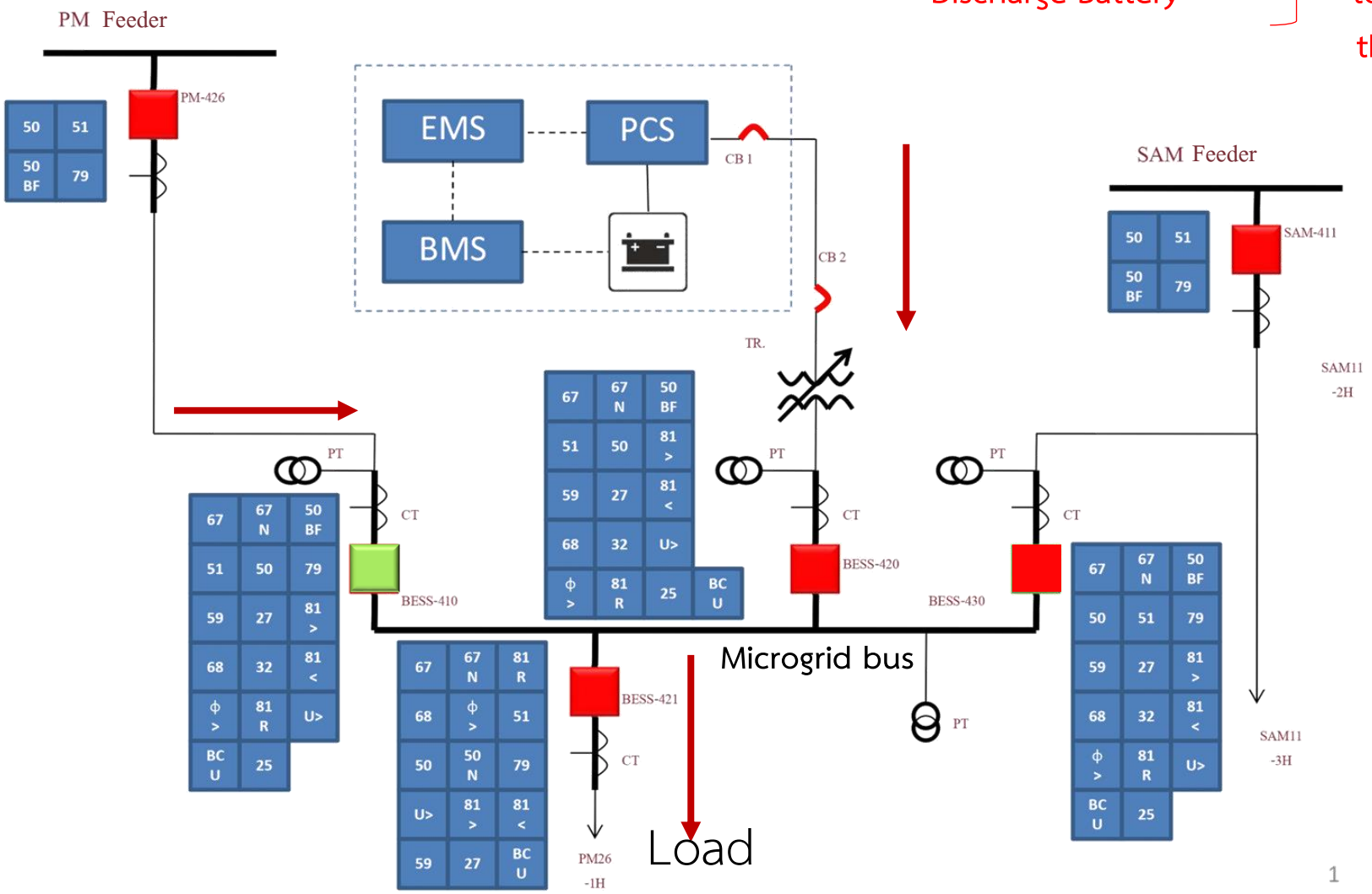
Resynchronize

ESS – On Grid mode
Discharge Battery

Relay send command to PCS
to synchronous ESS to PM
then disconnect SAM



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Gas isolated switchgear (GIS)

- GIS model is from Siemens.
- GIS will be supplied by our partner.

MGC shall be able to perfectly coordinate with GIS.

Conceptual Design

Considering battery capacity @ 80% DOD

1. *Load Leveling (55 % of battery capacity)*

   charges during low demand

   discharges during high demand

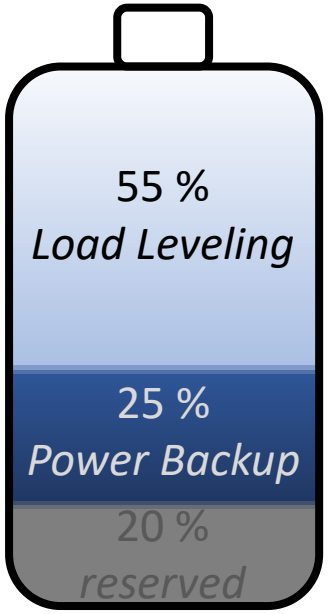
2. *Power Backup (25 % of battery capacity)*

   when the grid fails, the load disconnect from the grid

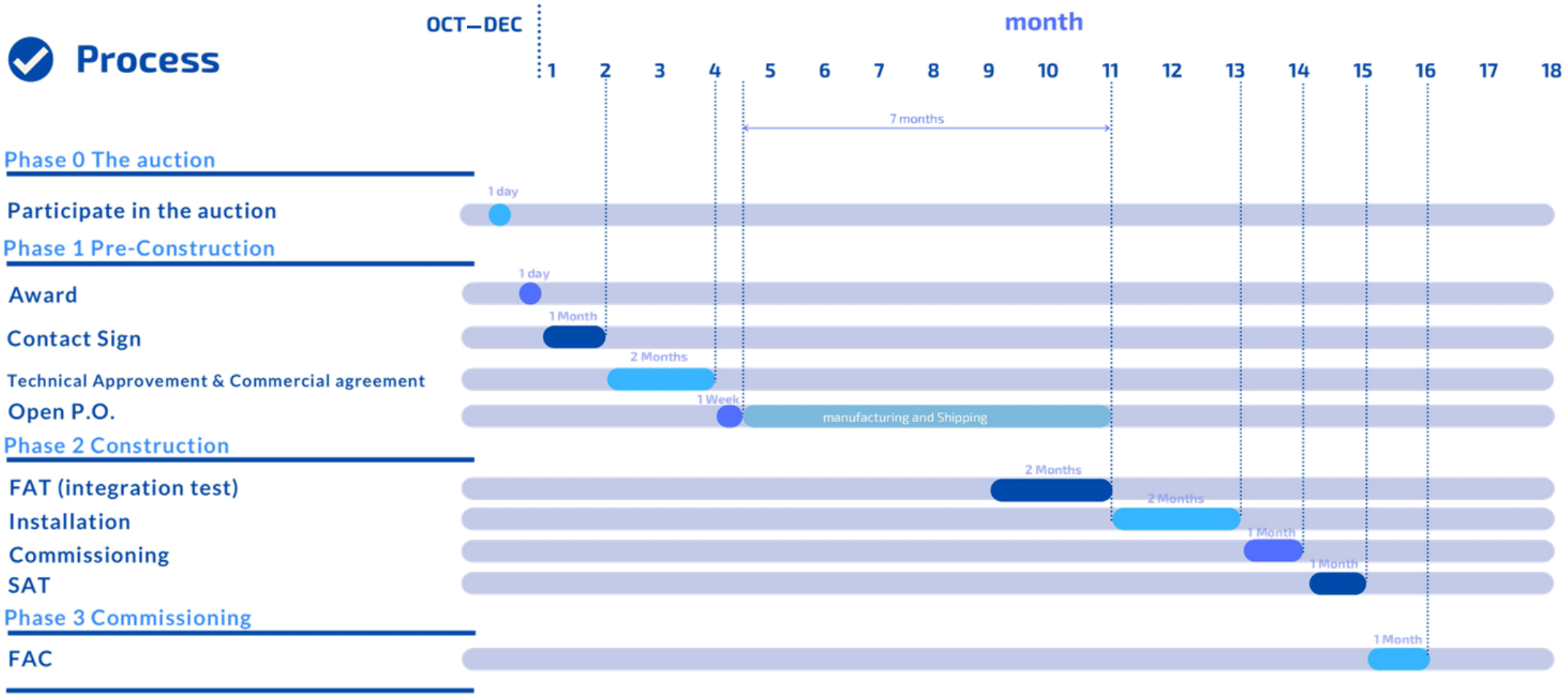
   BESS then supplies load (@ 2 MW for at least 10 min)

3. Resynchronize

   once the grid come back, safely reconnect to the grid



PLAN PROCESS (Tentative)



Technical Specification

Requirements for each main equipment

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MEA's Pathum Wan Project

Main Equipment

Lithium Ion Battery	1.2MWh
Power Conversion System	2MW
Microgrid Controller	
Gas Insulated Switchgear	

Lithium Ion Battery

<u>Type Test</u>

IEC 62619 (Altitude simulation, Thermal cycling, Vibration, Shock Test, Short circuit, Crush/Impact Test, Forced Discharge, Overcharge)

IEC 62620 (Discharge performance at 25°C, Discharge performance at low temperature, High rate permissible current, Charge (capacity) retention and recovery, Internal a.c. resistance, Internal d.c. resistance, Endurance in cycle, Endurance in storage at constant voltage (permanent charge life) which conducted in company's lab)

UN/DOT 38.3 6th Editions or IEC 62281
(Altitude, Thermal cycling, Vibration, Shock, External Short Circuit, Impact or crush Which test conducted in an institute with ISO/IEC 17025)

Power Conversion System

Type Test

IEC 62109 (Which test conducted in an institute with ISO/IEC 17025)

Routine Test

1. A report presenting that the PCS comply with the *project requirements*
   (the issuer shall certified by ISO/IEC 17025 or recognized by MEA)
2. A report presenting that the PCS comply with *MEA interconnection code*

PCS Requirements

AC ratings

1. Rate output power 2 MW
2. VAR Production 2 MVAR
3. AC three phase system

Function/Features

1. Power flow Operation : Four-Quadrant
2. Positive and Negative Real Power Control
3. Capacitive and Inductive Reactive Power Control
4. Combination of Real and Reactive Power Control
5. Low-Voltage Ride Through
6. Synchro-check
7. Withstanding fault current 25 kA for 3 sec without disconnection

Operation modes

1. Remote control to start/stop and command Real and Reactive power
2. Automatic Load Leveling
3. Automatic Power Backup
4. Scheduled Power
5. Automatic Black Start

Communication with MEA

1. DNP3.0/IEC61850
2. TCP/IP

Efficiency

1. Efficiency of Power conversion >= 95%

MEA Interconnection Code (for PCS Test)

- **Testing Institute**

  Inverters must be tested by a testing agency or institute with ISO / IEC 17025 test laboratory standards for inverters. Or must been verified by the Metropolitan Electricity Authority

- **Type of Testing**
  - **Design Test (Test 1 unit per model)**

    Harmonic , Voltage Fluctuation or Flicker, DC power supply , Voltage range , Frequency range , Protection of the occurrence of island landings and Resynchronization after power is restored.

  - **Routine Test (Test all units)**

    Voltage range , Frequency range , Protection of the occurrence of island landings and Resynchronization after power is restored.

MEA Interconnection Code

- Testing methods
  - **Harmonic Test**

    following IEEE 1547.1-2005 item 5.11.1

    (measuring harmonic current when the inverter is operating at 33%, 66% and 100% of the rated current)
  - **voltage fluctuations**

    following IEC 61000-3-5 for inverter with rating current greater than 75 A
  - **DC power supply test**

    following IEEE 1547.1-2005 item 5.6

    (measuring direct current when the inverter is operating at 33%, 66% and 100% of the rated current)

MEA Interconnection Code

- Testing methods
  - **Voltage range test**

    Overvoltage and Undervoltage
  - **Frequency range test**

    Overfrequency and Underfrequency
  - **Anti-Islanding measures**

    following IEC 62116
  - **Resynchronize**

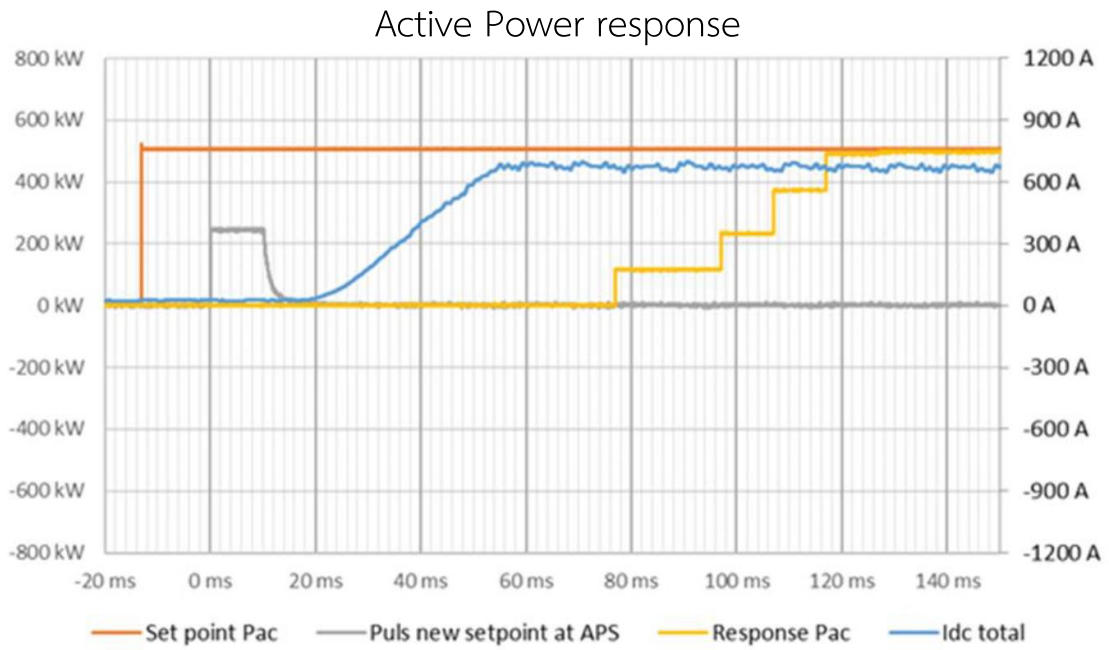
    following IEEE 1547.1 item 5.10

Power Conversion System

Additional Test Report

A test results (in graph or appropriate figure) presenting response time of switching operation.

Example



Change of the set point (0 kW to 500kW)

System Test

System integration test before and after system delivery, FAT and SAT

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test list	FAT	SAT	notes
Applications	✓	✓	
Transition time	✓	✓	
Short circuit withstanding	✓		
Actual energy capacity		✓	
Input/output power rating	✓	✓	
Roundtrip efficiency		✓	
Expected service life test		✓	
System response	✓	✓	
Auxiliary power consumption		✓	
Self-discharge of EES		✓	
Voltage & frequency ranges	✓		using grid simulator
Duty cycle round trip efficiency		✓	
Black start output voltage	✓		

Factory Acceptance Test (Integration Test)

To test the integrated system for following functions (*4 MEA staffs will participate in the test*)

- Application Test
  - Load Leveling
  - Power Backup
  - Resynchronization
- Transfer time between on-grid and off-grid mode
- Short Circuit Withstanding (25kA for 3s)
- Parameter & Performance Test *(IEC 62933-2-1 items 6.2 and 6.3)*
  - A small module or simulation can be used

IEC 62933-2-1: Parameter Test (item 6.2)

- Actual energy capacity test
- Input and output power rating test
- Roundtrip efficiency test
- Expected service life test *(simulation is acceptable)*
- System response test, step response time and ramp rate
- Auxiliary power consumption test
- Self-discharge of EES test
- Voltage range and frequency range test

Voltage range and frequency range test

- A tolerance on all the measurements of input power shall be within ±2%
- Test case 1 : $U = U_{min}$ and $f = f_{min}$ with constant rated active power output
- Test case 2 : $U = U_{max}$ and $f = f_{max}$ with constant rated active power output
- Test case 3 : $U = U_{min}$ and $f = f_{min}$ with constant rated active power input
- Test case 4 : $U = U_{max}$ and $f = f_{max}$ with constant rated active power input

1. The EES system shall be charged or discharged to 50% of full available energy level or specified energy capacity value agreed between system supplier and user.
2. Voltage at the POC shall be set to test case and frequency at the POC shall be set to test case
3. It shall be confirmed that the EES system can output rated active power for 5 min or a specified duration agreed between system supplier and user at the POC.

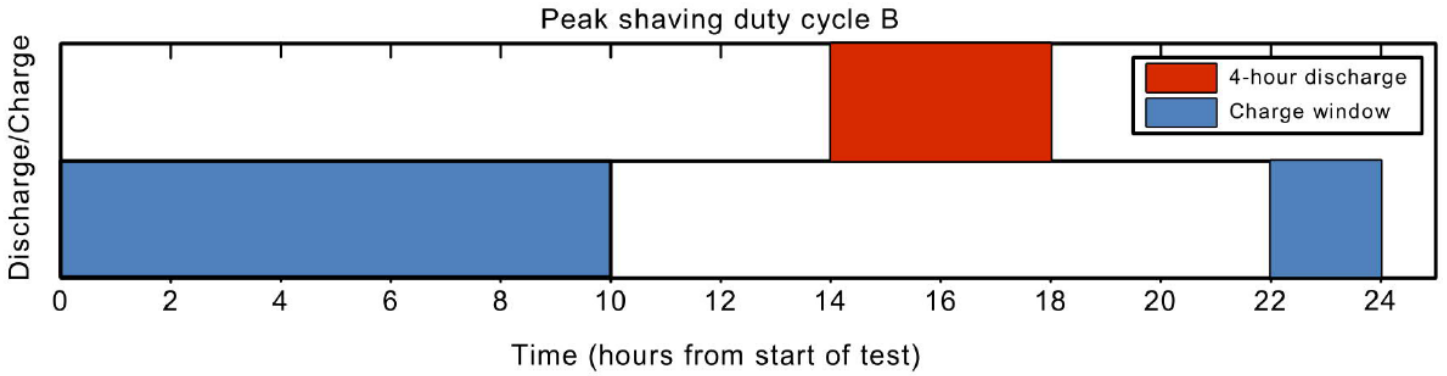
IEC 62933-2-1: Performance Test (item 6.3)

Duty cycle round trip efficiency test (item 6.3.3)

a) The ESS shall be set to the initial desired available energy

b) The ESS shall be subjected to the applicable duty cycle

c) At the end of cycle, the ESS shall be returned to the initial available energy



IEC 62933-2-1: Performance Test (item 6.3)

Black start output voltage test (item 6.3.4)

a) The power conversion subsystem shall be connected electrically to the POC, externally connected to the specified test load. The POC shall not be energized by any other power supply. No external auxiliary power source is allowed to feed the system in this test.

b) The signal, which indicates the start of the black start, shall be input to the EES system.

c) The entire voltage envelope of the POC during transition to the steady state shall be recorded to determine the tolerance band of the steady state voltage. The system provider and user should specify the recording interval.

FAT Location (Tentative)

The test will be held at Asefa's factory (Bangkok, Thailand)

Map: https://g.page/asefa?share

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Site Acceptance Test

- Parameter & Performance Test (IEC 62933-2-1 items 6.2 and 6.3)
  - in case of some test topic can not test at SAT, contractor must test at FAT
  - the parameters, system response, step response time, and ramp rate, must be tested at both SAT and FAT

Final Acceptance Certificates

- After finished SAT, had to report the test and delivery plan, known as "Commissioning test", to the Metropolitan Electricity Authority for consideration.
- *Commissioning test refer to standard IEC 62933-2-1 section 6.4 or equivalent.*
- **The contractor must submit an officer in charge of each device. To participate in the first power supply operation by coordinating with other parties to be completed before conducting the commissioning test and power distribution.**
- The winner of the electronic tender will be responsible for all risks, expenses, working hours and related work until the Metropolitan Electricity Authority issues a Final Acceptance Certificates (FAC) letter.

Supervisor Requirements

- Must have at least 2 years of experience in installing and testing energy storage systems.
- Must have at least 3 years experience in installation and test work related to substation.

Tender

Project evaluation and required documents

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Price Performance (Tentative)

Index	weight
Price	60%
Performance	40%

Required Documents

Battery

Type Test

- Document shows
  - IEC 62619
  - IEC 62620
  - UN/DOT 38.3 6th Editions or IEC 62281

Sale History

- The battery's proposed model must be produced from a manufacturer with a sales history of at least 2 countries and at least 2 years.

Required Documents

PCS

Type Test

- Document shows IEC 62109

Routine Test

- Test report showing that PCS meets the requirements.
- Test report showing that PCS meets the MEA Interconnection Code

Sale History

- The PCS's proposed model must be produced from a manufacturer with a sales history of at least 2 countries and at least 2 years.

Test Report

- Test results (in graph or appropriate figure) presenting response time of switching operation.

Required Documents

Microgrid Controller

Sale History

- The Microgrid's proposed model must be produced from a manufacturer with a sales history of at least 2 countries and at least 2 years.