



INSTITUTO DE ENGENHARIA ELÉTRICA

# Microgrid for Alcântara Launch Center in Brazil: CLA- $\mu$ Grid

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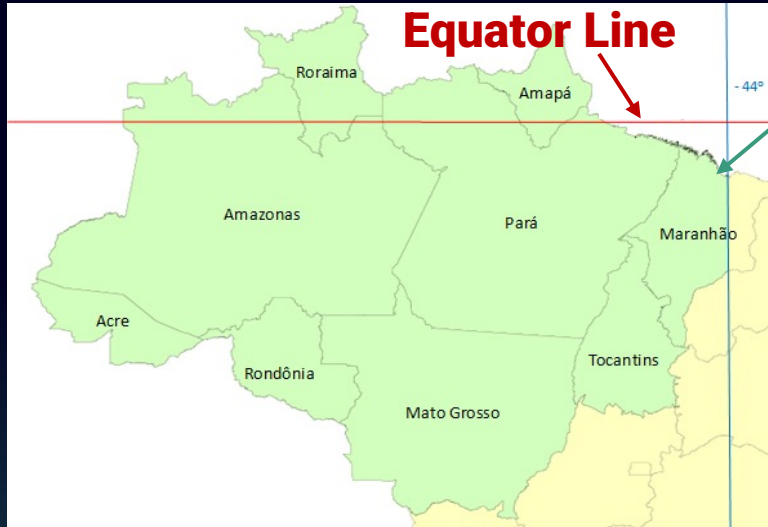
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# CLA- $\mu$ Grid

## Motivation

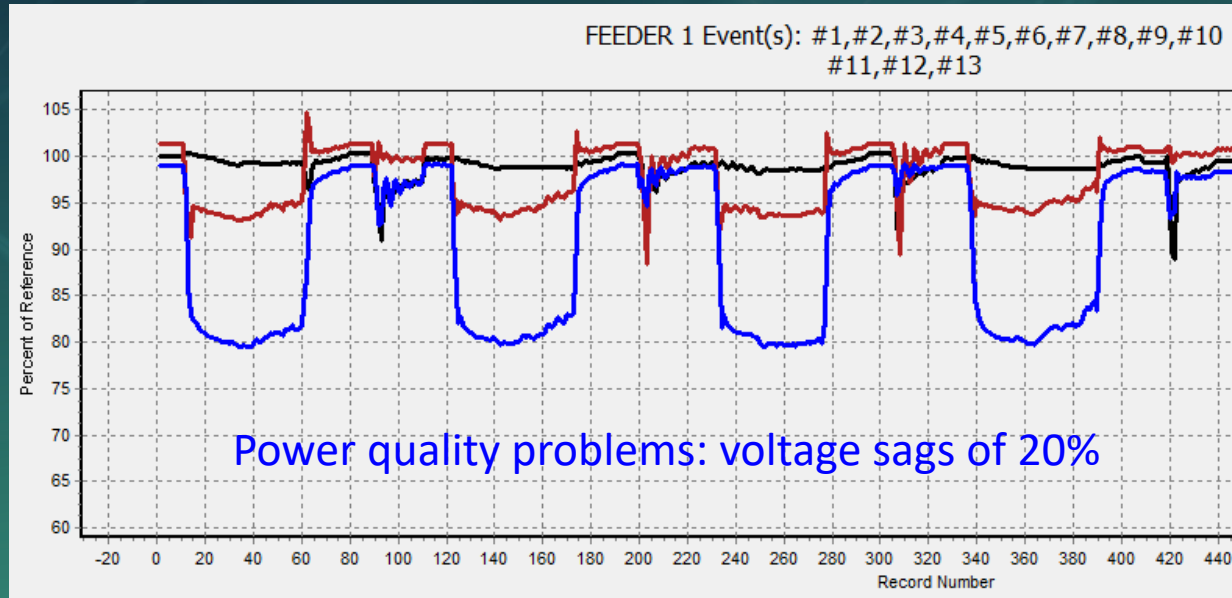
Brazil's Legal Amazon (BLA)



Alcântara/Brasil

Brazilian strategic plan to increase the rocket launches, including private companies launches

SEL – 735 Power Quality Meter



# CLA- $\mu$ Grid

## CRITICAL MISSIONS MICROGRIDS

Used in essential infrastructure for the proper functioning of a given society and its economy: **resilience and reliability are key issues**



Water  
supply  
facilities



Transport  
systems



Hospitals



Military  
areas



# CLA- $\mu$ Grid

Critical Microgrid

Resilience

Reliability

Reduction targets :

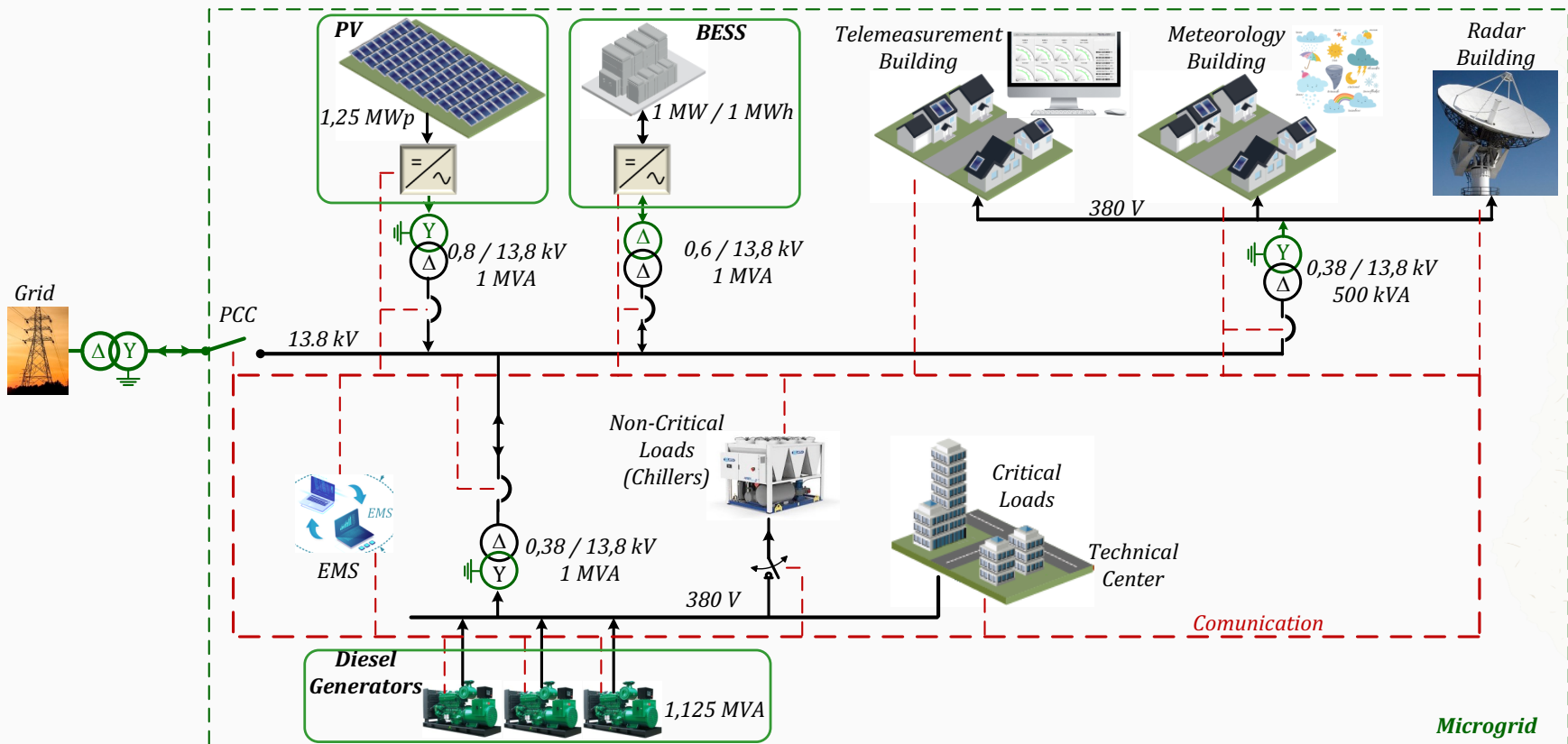
- CO<sub>2</sub> emissions
- Energy bill

Energy supply security during rocket launch campaigns

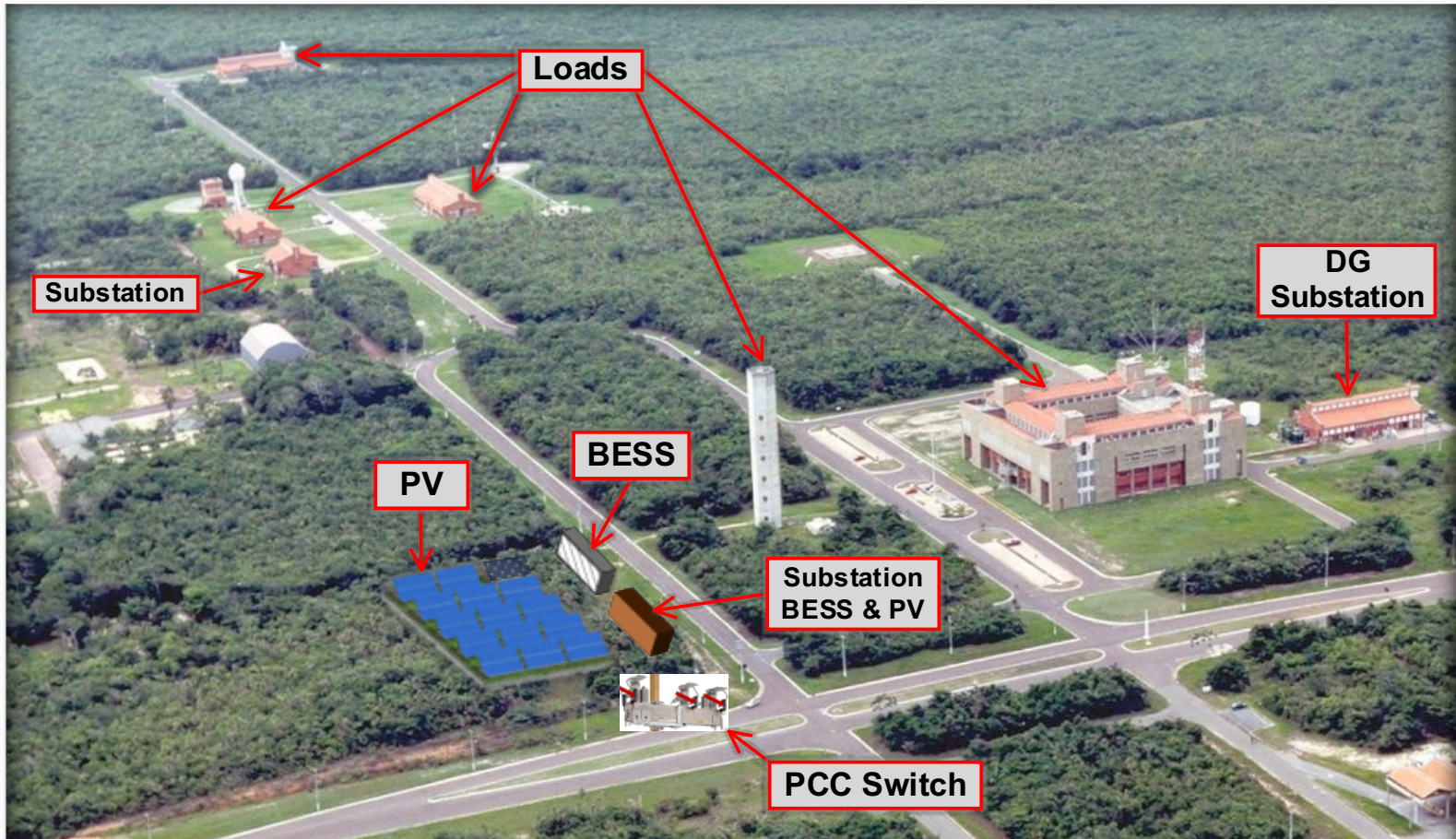
**CLA – CENTRO DE LANÇAMENTO DE ALCÂNTARA**  
(Alcântara, Maranhão, Brasil)



# CLA-μGrid



# CLA- $\mu$ Grid









**BESS: 1 MW/1 MWh**



# OPERATION MODES

## on-grid

Connected Mode

## off-grid

Isolated Mode

### **On-grid is goals:**

CO<sub>2</sub> emissions reduction

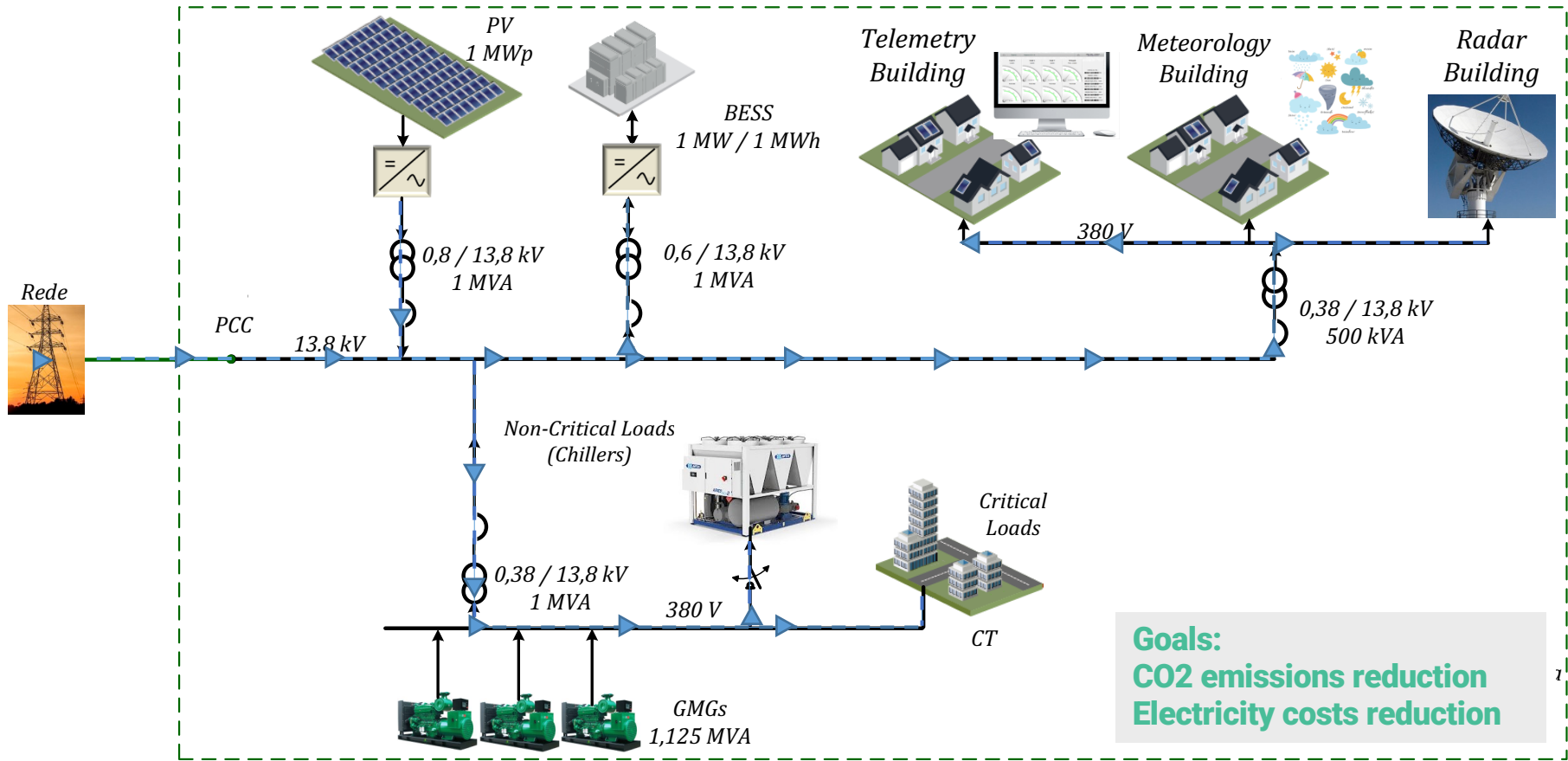
Reduction of electricity costs

### **Motivation for scheduled off-grid operation:**

Safety during rocket launches

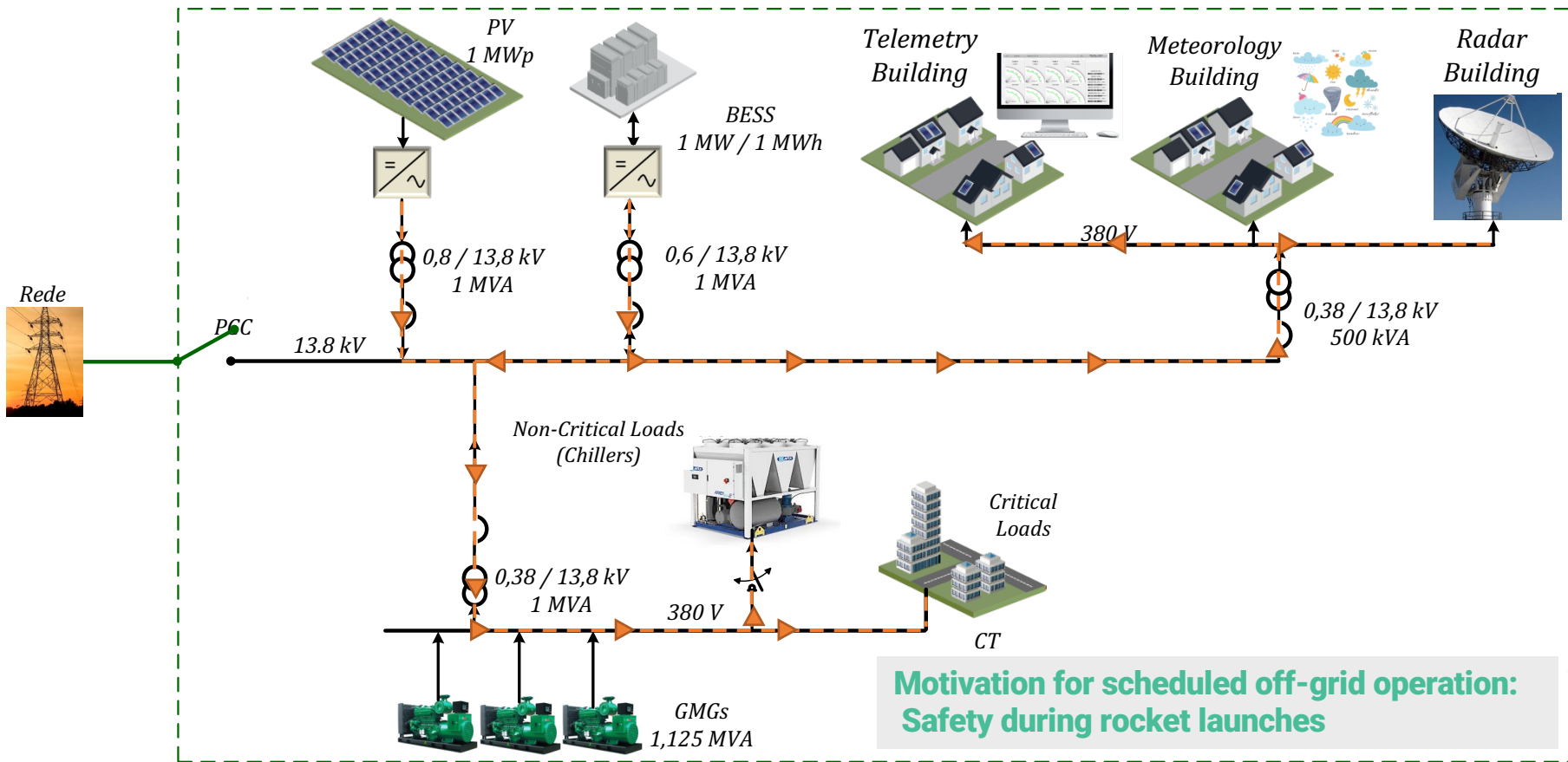


# CLA- $\mu$ Grid: On-grid



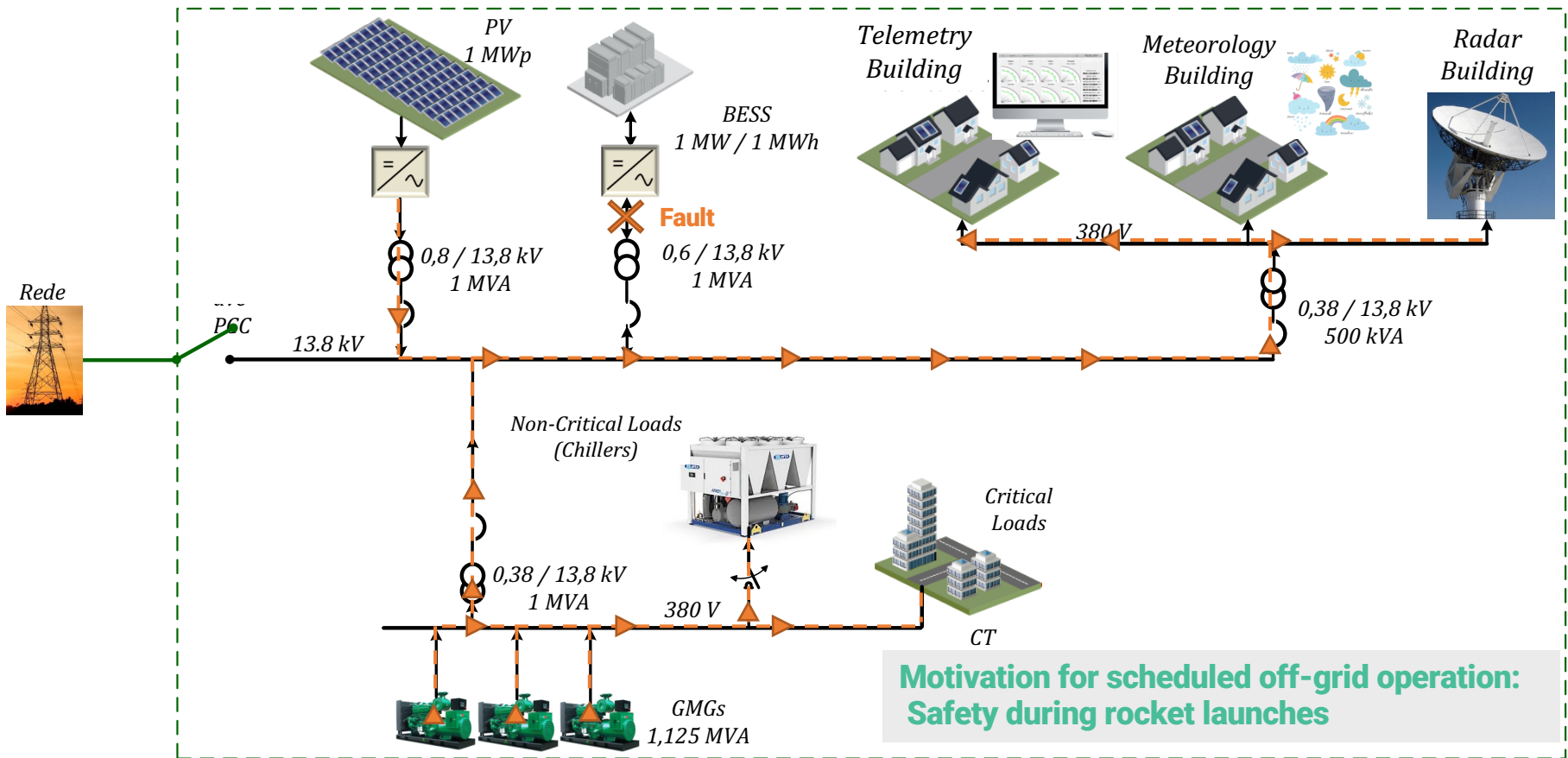


# CLA- $\mu$ Grid: Off-grid

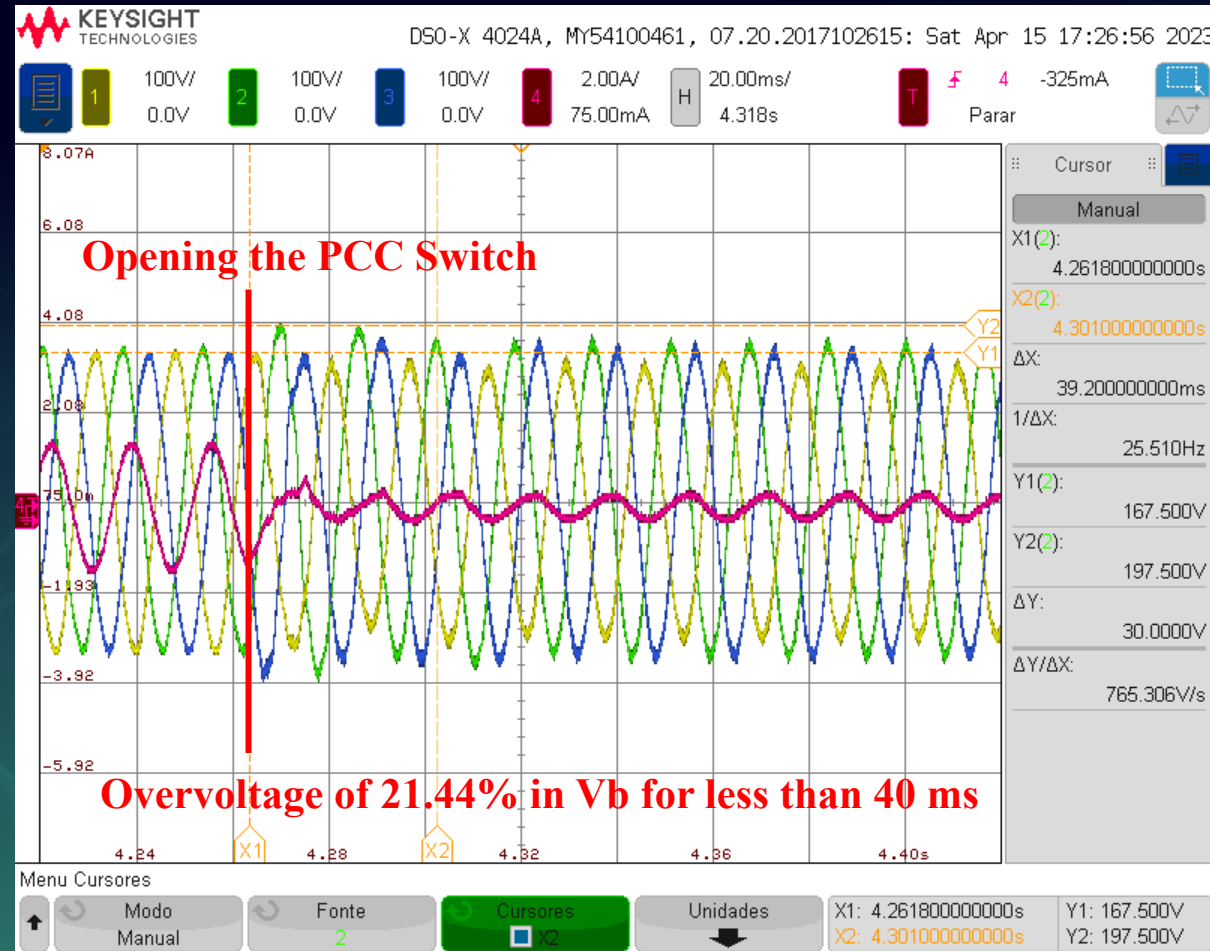


Motivation for scheduled off-grid operation:  
Safety during rocket launches

# CLA- $\mu$ Grid: Off-grid



# UNSCHEDULED TRANSITION FROM ON-GRID TO OFF-GRID

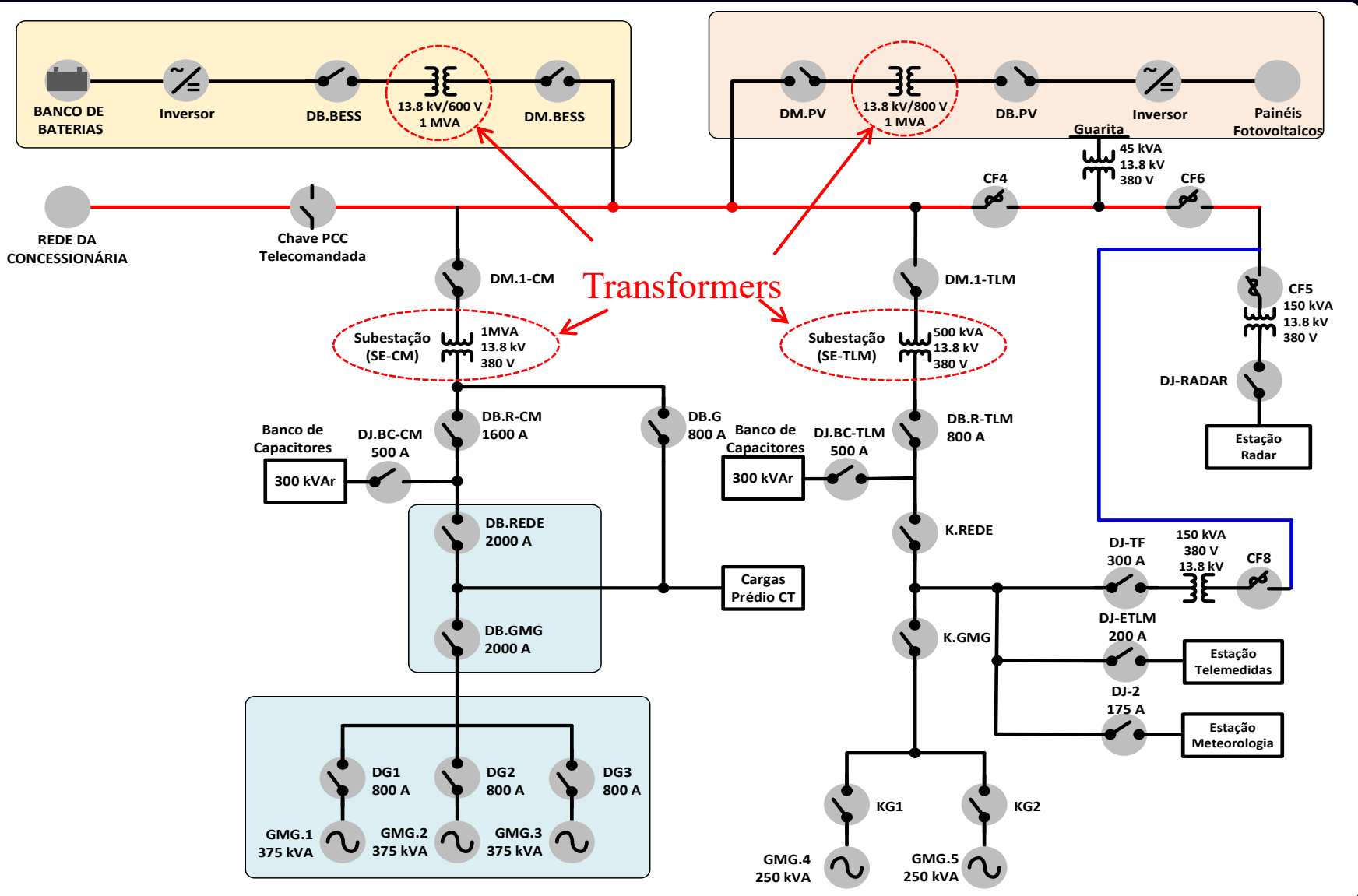


**Conditions in the transient**

- PV plant w/o generation
- BESS discharging 1 MW
- Load: 150 kW



# BLACK START



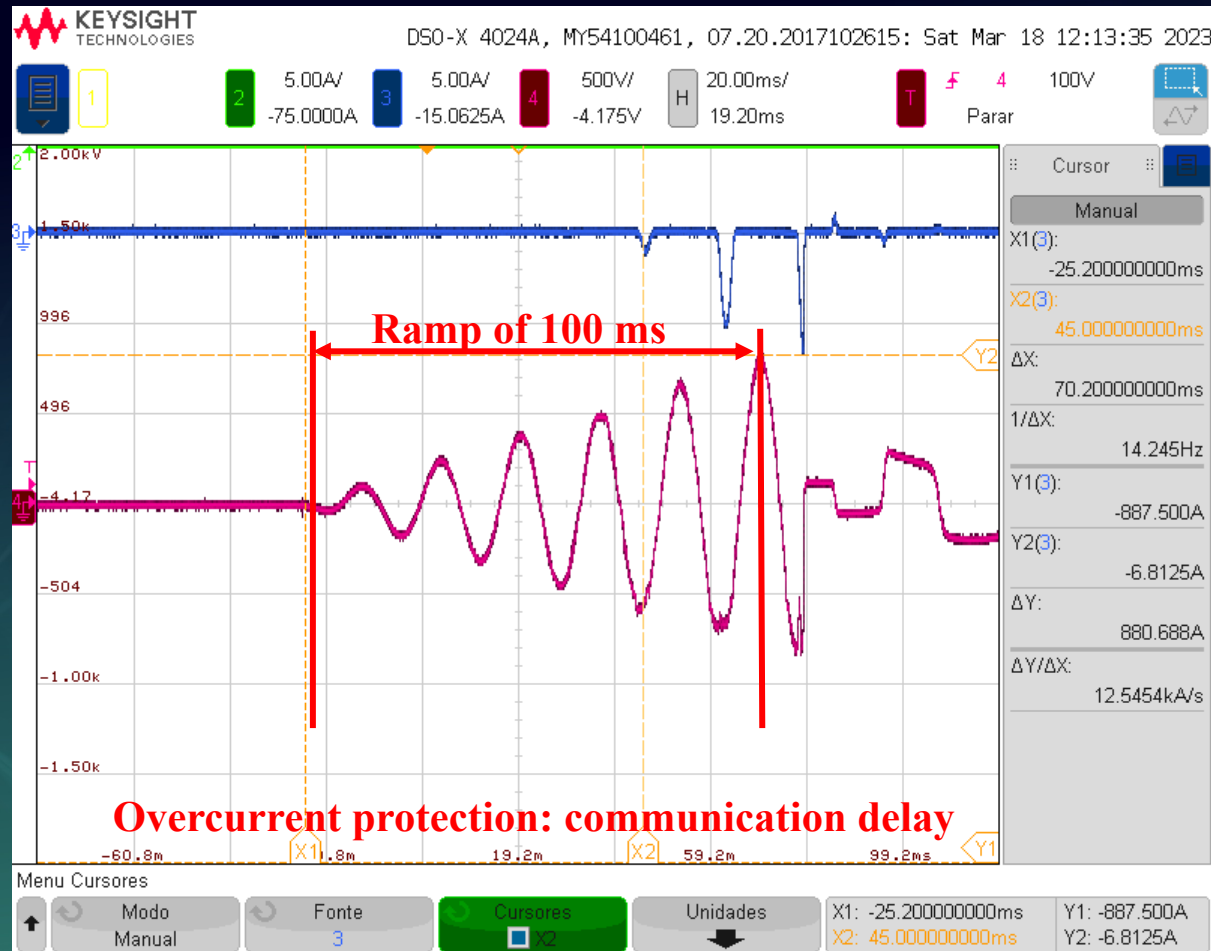
# BLACK START

## Conditions

Microgrid in blackout

MV circuit breaker relays have undervoltage protection inhibition to be closed

BESS starts on voltage ramp



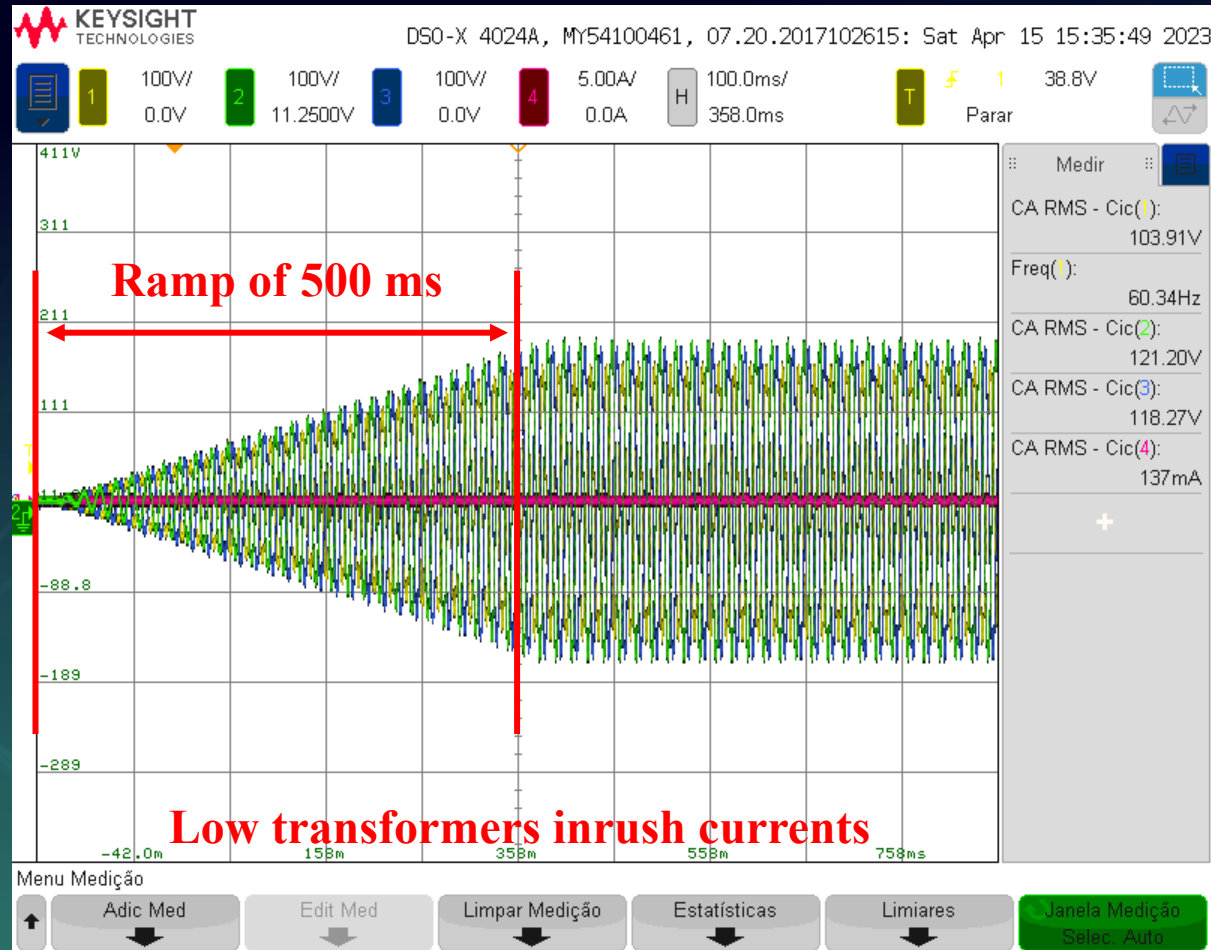
# BLACK START

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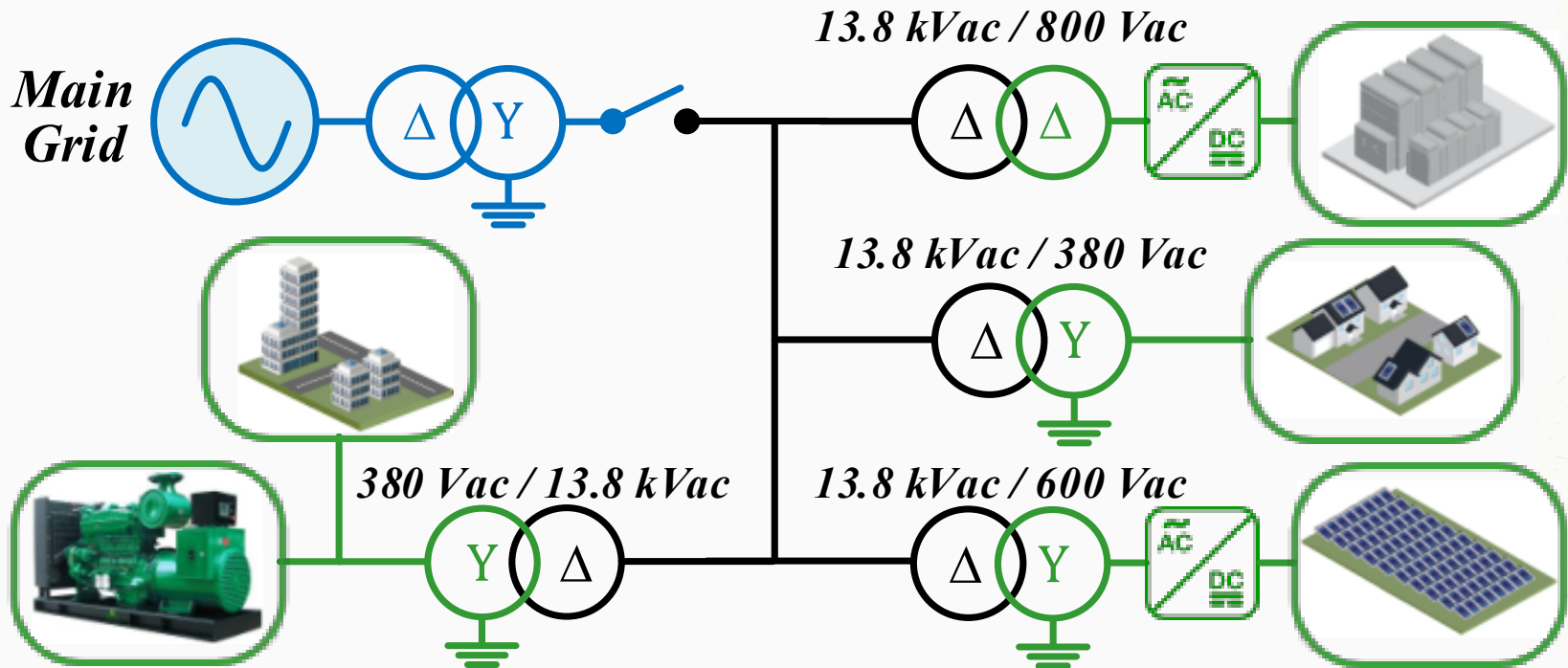
BESS starts on voltage ramp





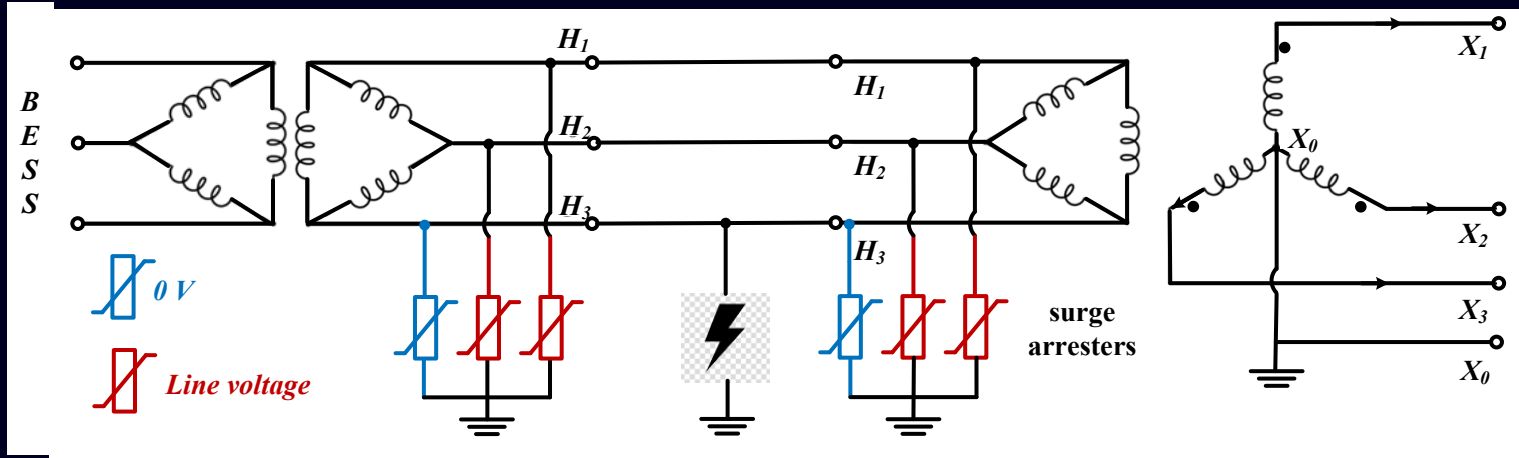
# OFF-GRID OPERATION

## Ungrounded Distributed Grid in $\Delta$



# OFF-GRID OPERATION

## Ungrounded Distributed Grid in $\Delta$



A single-phase earth fault does not activate the earth overcurrent protections in a distribution network whose transformers are in ungrounded delta

An alternative solution for a single-phase earth fault detection is to use three VTs connected in Y with the common point grounded and configure the neutral overvoltage function in the protection relay, using the neutral residual voltage ( $3V_0$ ) to activate the protection

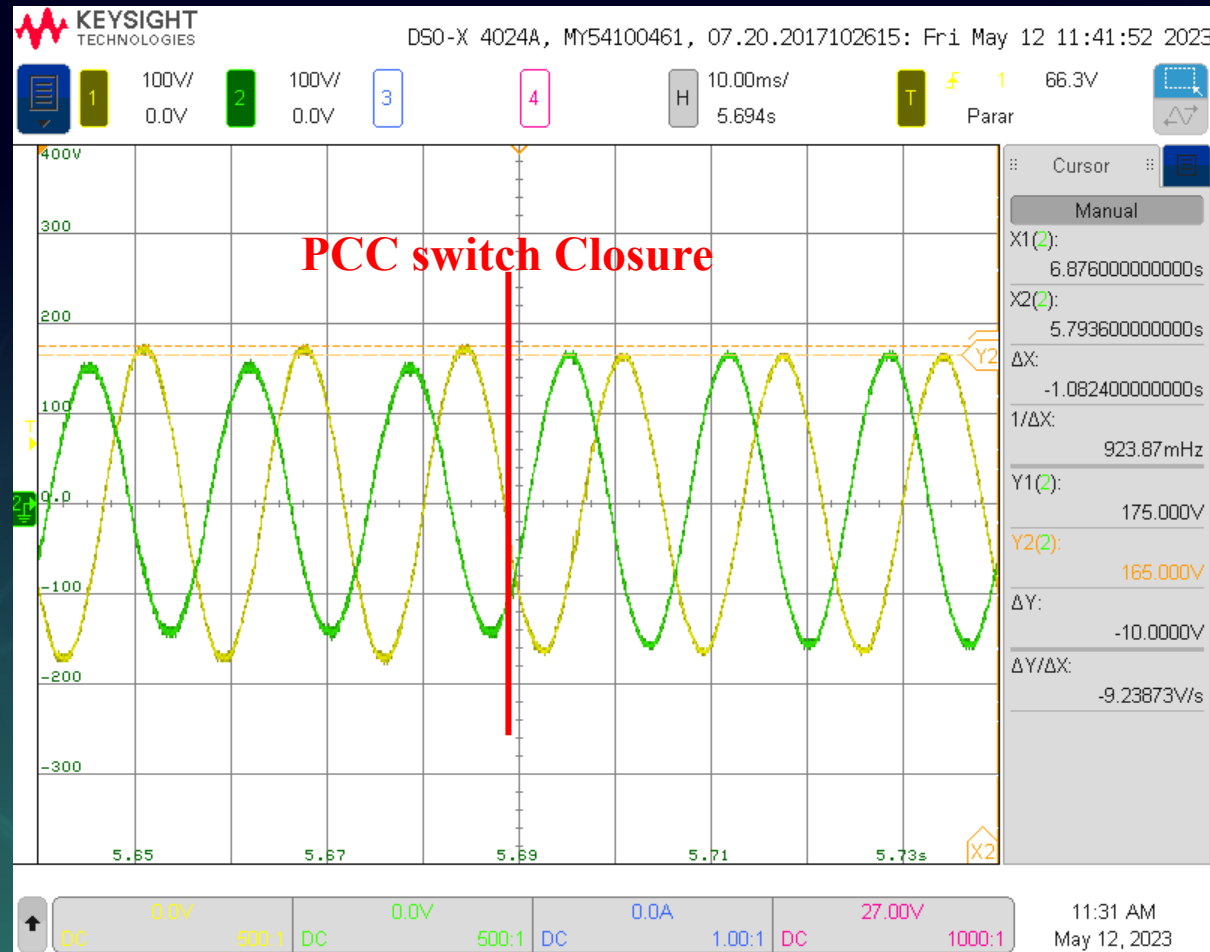


# SCHEDULED TRANSITION FROM OFF-GRID TO ON-GRID

## Conditions in the transient

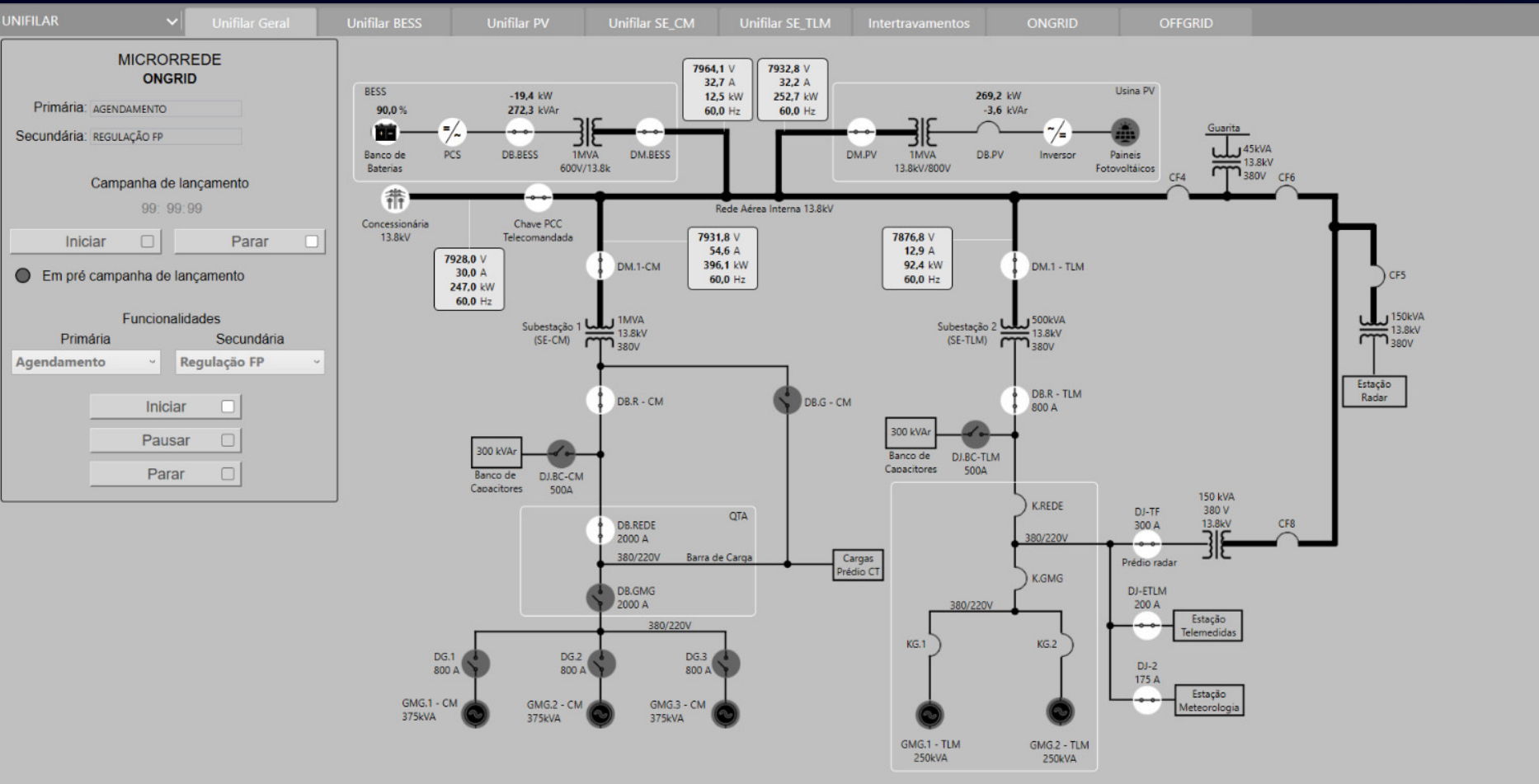
BESS doing power balance

Loads: 460 kW



The measurement and protection systems with three VTs in Y connected between phases-to-earth in the MV side of the circuit breakers of this  $\mu$ Grid form a load in Y with the common point without connection to the source (isolated neutral).

# SCADA





**Obrigado!**  
**Thanks!**  
**Bedankt!**  
Questions?