LARGE SCALE PV DIESEL STORAGE HYBRID SYSTEM
DIESEL OFF-MODE, GRID FORMING SCS, ST. EUSTATIUS

Today, solar energy covers 46% of St. Eustatius' total electricity need. Grid Forming SCS 2200 inverters allow to operate the island grid for 10.5 hours in Diesel Off-Mode operation with 100% Solar Power Fraction. In total a 5.9MWh Li-Ion storage facility has been integrated for energy shifting and grid services. Thanks to the SMA Fuel Solution about 4,560 tons CO2 per year can be saved. The project has been designed, and implemented by the SMA Sunbelt Energy GmbH.

Project "St. Eustatius Phase 1+2"

- Location: St. Eustatius, Caribbean
- Commissioning: November 2017
- Requirements: Grid Forming Inverter, overall power and energy management system

Plant information

- Installed PV power: 4.15 MWp
- Installed Storage capacity: 5.9 MWh
- Diesel capacity: 4 MVA
- Annual energy yield: 6,400 MWh
- Annual diesel savings: > 1,700,000 liters
- Island Load: ~2MW

System Technology

- Battery: 2 x SCS 2200 Grid Forming in 2 x MVPS 2200 and 1xSCS 1000 in MVPS 1000
- PV: 2xSC CP XT1000 in 1xMVPS 2000 and 74 SMA Sunny Tripower 25000TL-30
- Control: FSC 2.0 with Automatic Genset Shutdown

SMA system solutions for hybrid applications

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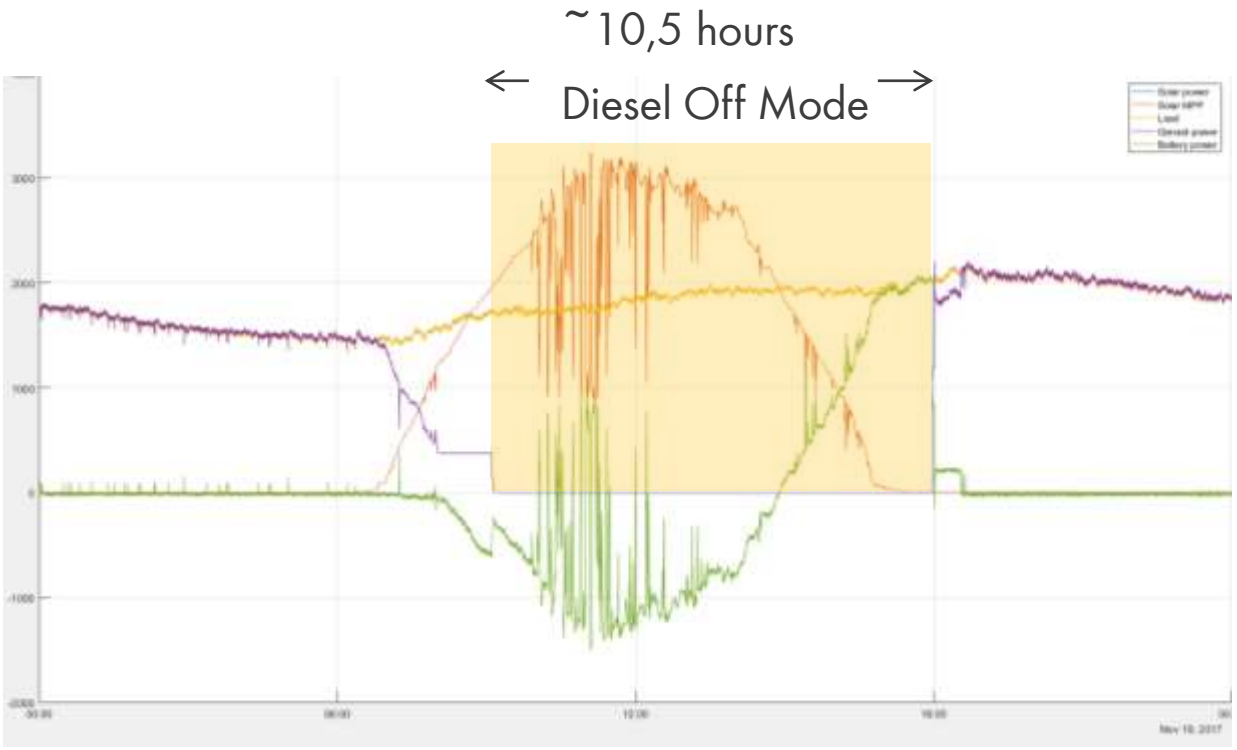

Unique Selling Points

- Automatic Genset Control and transition to Diesel Off-Mode and Diesel On-Mode
- Integration of all components and existing genset infrastructure into control scheme
- Co-generation with Diesel in Diesel-On Mode
- Voltage and frequency source in hot-standby for uninterrupted power supply also at night (UPS function)
- 3 layer built-in redundancy concept
- Short circuit clearance in 120ms
- European grid quality (± 0.005Hz deviation)
- Services in operation period

Partner

- End Customer: STUCO, Utility of St. Eustatius
- PV and Installation : Eco Energy, Curacao
- Finance: Dutch Ministry of Economic Affairs

SMA Sunbelt Energy

- Electrical Design, Network Design, Operation case definition, overall project management, procurement and delivery
- Containerized Li-Ion Storage Facility
- Supply of battery storage cells from Samsung SDI

SMA System Technology

- 2 Sunny Central Storage 2200 Grid Forming
- 1 FSC 2.0 with Automatic Genset Shutdown
- 2 Sunny Central 1000 in MVPS 2000
- 1 Sunny Central Storage 1000
- 74 SMA Sunny Tripower 25000TL-30

SMA System Solutions for hybrid applications

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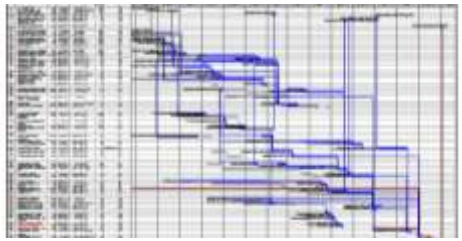
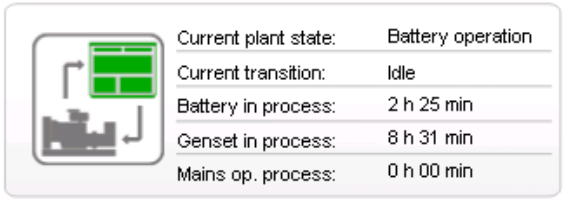




Key Personnel

- Project Engineer: Hamed Sadri (Sunbelt)
- Project Manager: Wiebke Krüger (Sunbelt)
- Commissioning: Paul Robert Stankat, Tobias Becker and Oliver Schoemann (SMA AG)

Project phases

- Tender: July 2016
- Signature of contract: August 2016
- Construction PV: Jan- May 2017
- Delivery Storage: September 2017
- Commissioning: October 2017
- Acceptance: 15. November 2017

Key strengths

- One system solution from one hand
- Overall System Engineering
- Turnkey delivery of integrated Li-Ion Storage Systems
- Inhouse Matlab based model for battery usage and heat generation; fuel saving forecasting

SMA system solutions for hybrid applications

TECHNICAL OVERVIEW

GRID FORMING BATTERY INVERTERS

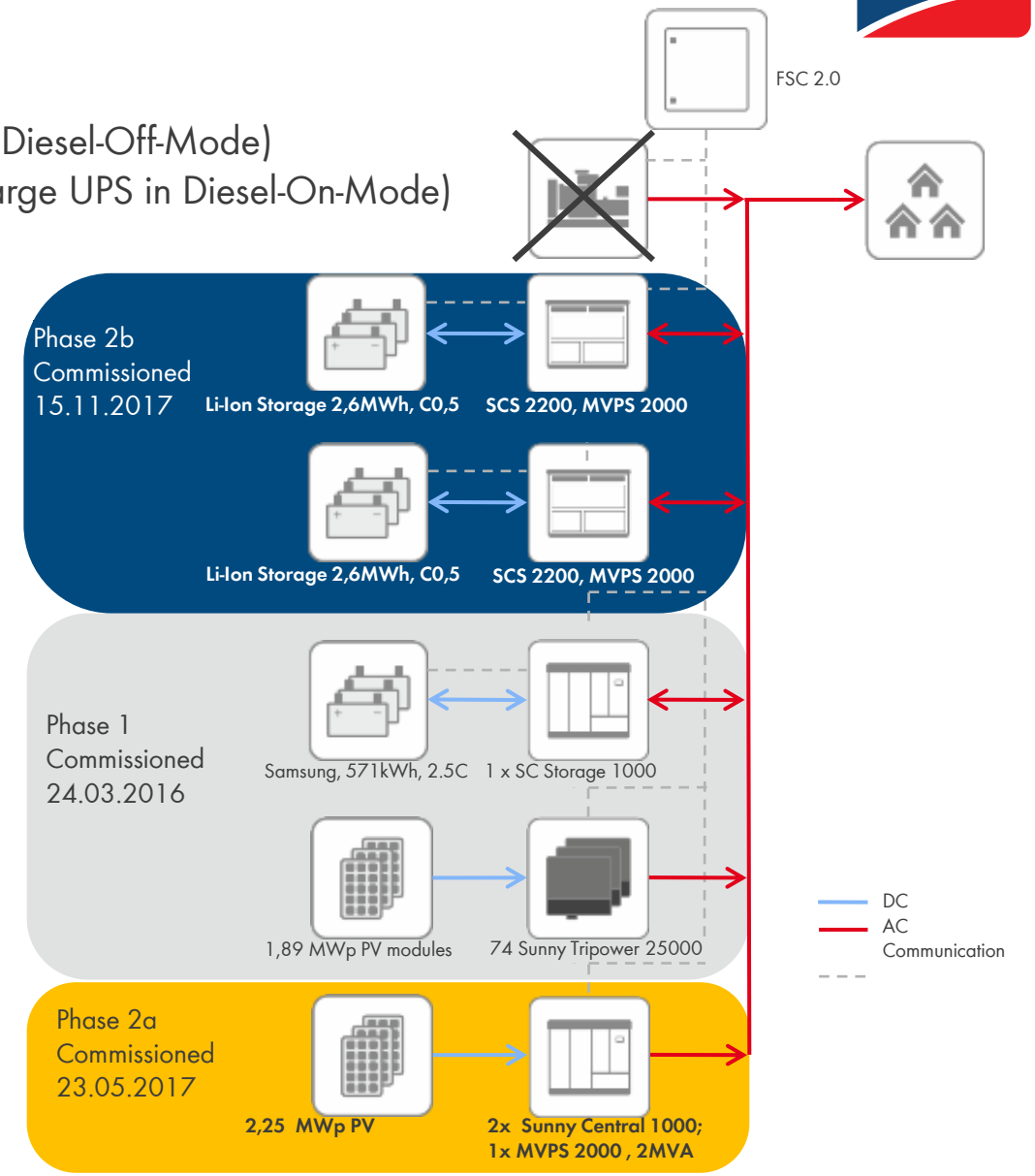
Day operation without Diesel Generators (Diesel-Off-Mode)

Full redundancy for generator operation (large UPS in Diesel-On-Mode)

- **Voltage source**
- Frequency regulation
- Spinning Reserve Provision
- Synchronisation Diesel On-Mode

Diesel Off-Mode

St. Eustatius II	
Estimated fuel savings	1 728 000 liters/a
Solar Energy Produced (net)	6,4 GWh /a
CO2 savings	4,561 to CO^2/a
Used PV energy	6 494 547 kWh
Solar energy fraction	46%

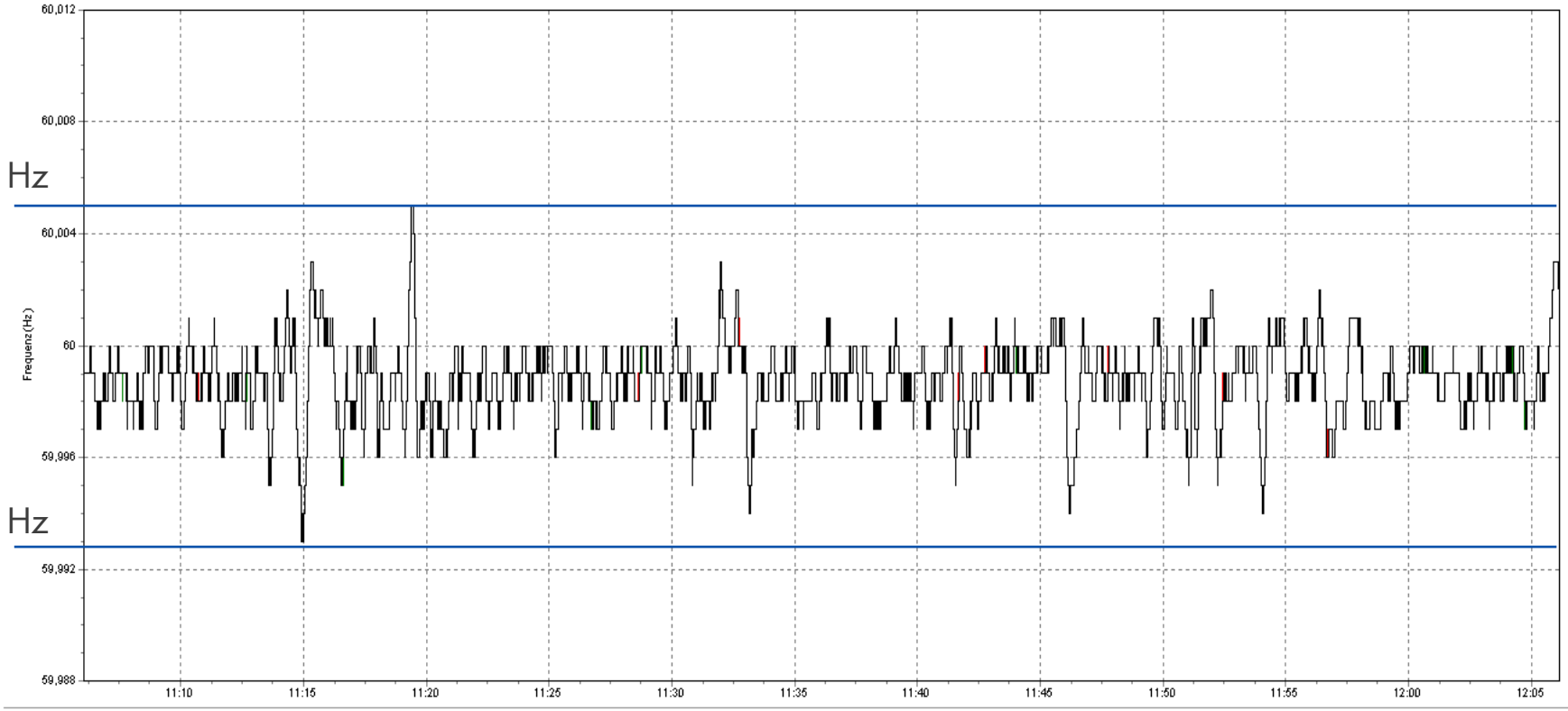


FREQUENCY STABILITY IN DIESEL OFF MODE

Frequency bandwith of 0,013Hz

60,005 Hz

60,992 Hz



› **Recording on 31.10.2017 from 11.00 am to 12.05pm during step load tests**

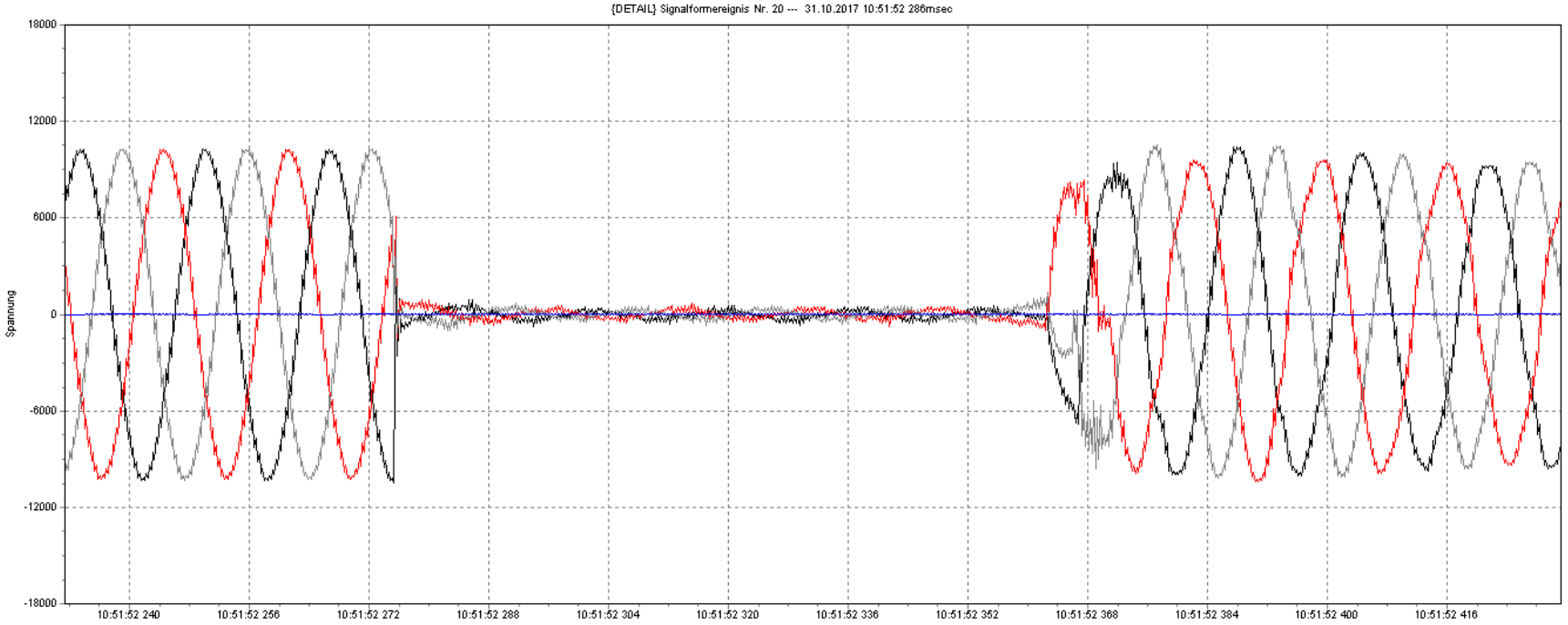
VOLTAGE STABILITY IN DIESEL OFF-MODE WITH 1MW STEP LOAD TESTS (50% LOAD SHEDDING)

The voltage stays between 12,43kV and 12,37 kV → Voltage Fluctuation of 0,4%

› **Recording on 31.10.2017 from 11.00 am to 12.05pm during step load tests**

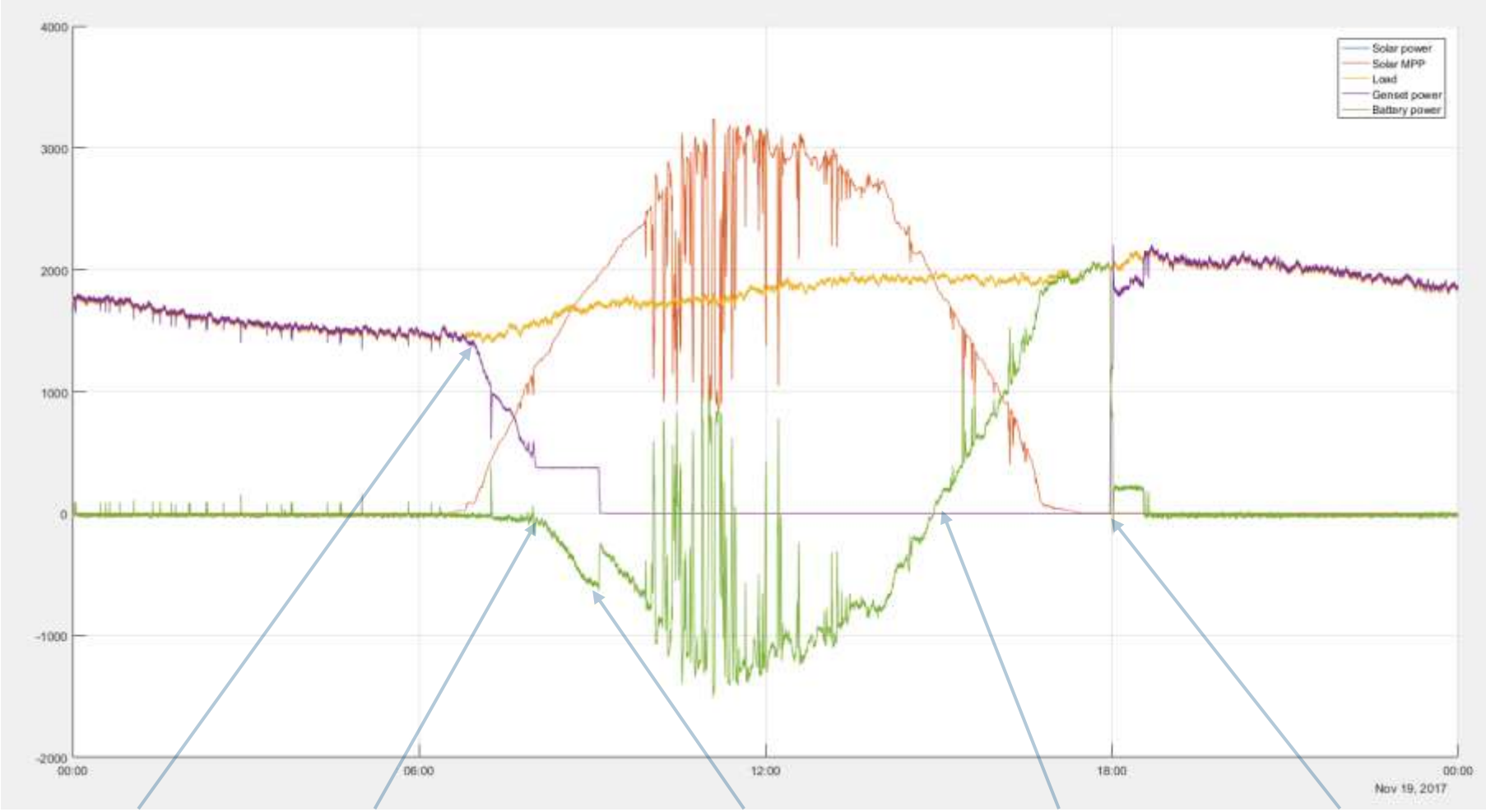
1.The regular load is around 2MW in St. Eustatius.

3 PHASE SHORT CIRCUIT CLEARANCE IN 120MS



Recording 31.10.2017

FUEL SAVE CONTROLLER „DIESEL OFF MODE“ DAYTIME WITHOUT DIESEL



PV on sunrise begins reducing fuel consumption

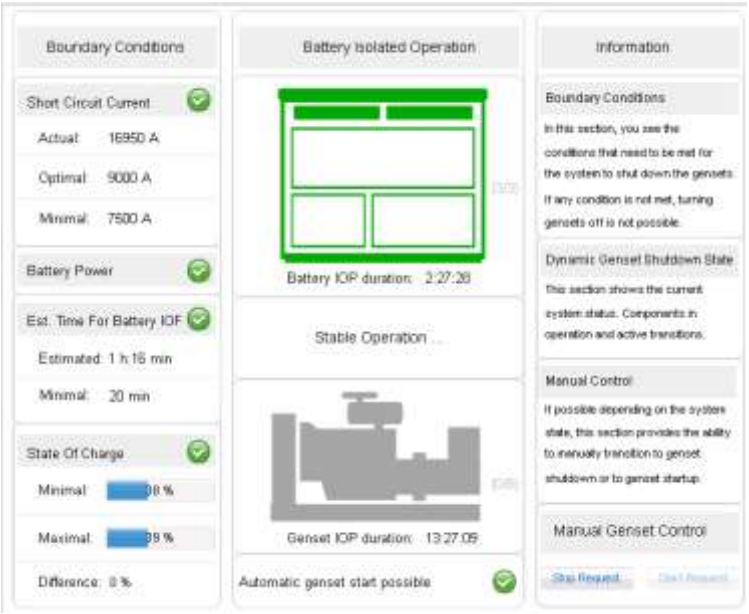
Genset at minimum load. Battery begins to charge

Battery energy sufficient for some minutes of genset-off
➔ Automatic transition to genset-off

Solar output drops – battery covers missing energy

Battery depleted ➔ Automatic transition to genset-on

GRAPHICAL USER INTERFACE FSC



ST. EUSTATIUS IN THE MEDIA

YouTube Long version https://youtu.be/xBM7Rdz5ajA
YouTube Short version: https://youtu.be/vP8ljKZnoO8

PM https://www.sma.de/en/newsroom/current-news/news-details/news/2876-system-solution-from-sma-provides-caribbean-island-with-100-solar-power-supply.html

Blog https://en.sma-sunny.com/en/st-eustatius-100-solar-power-in-the-caribbean/