PV Development and Grid Access Study for a Club Resort in Indonesia

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PV Project Development by

Horst Kruse, Jakarta
On behalf of
GIZ Indonesia, Promotion of Least Cost Renewables in Indonesia (LCORE)

Study works supported by

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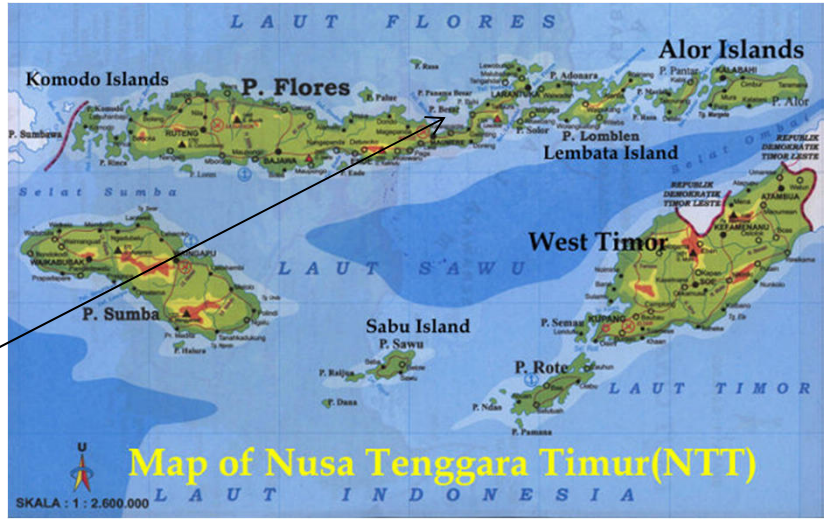
1. Maumere Club Resort and PV Project
2. Electrical Infrastructure on the Maumere Island
3. Grid Measurements and Data Evalutation

Location and Project Target

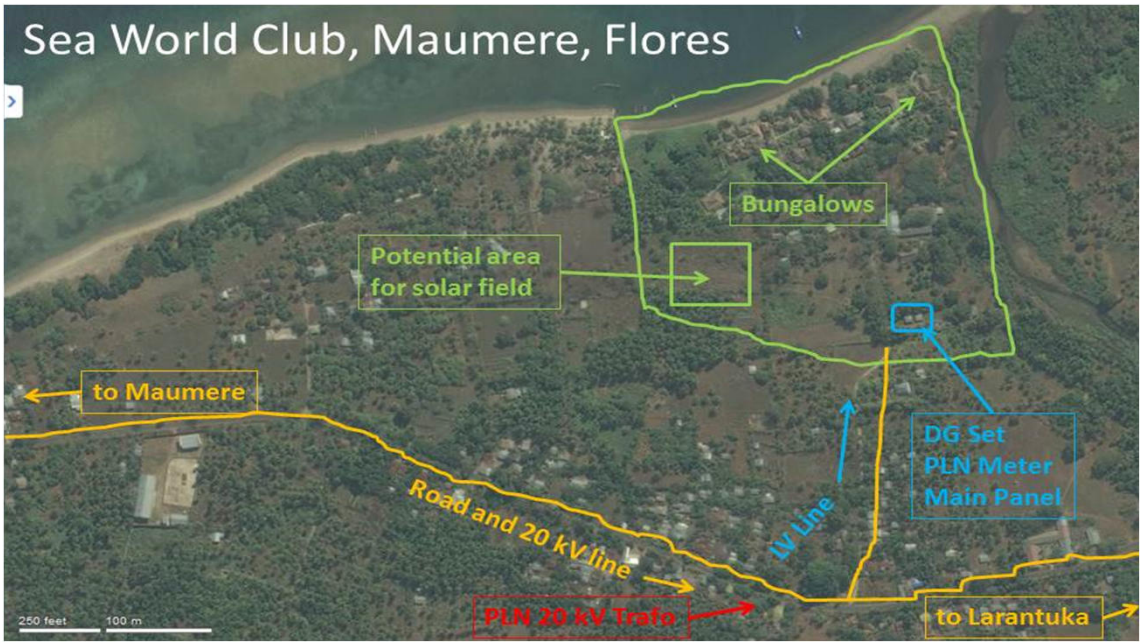
- North coast of Flores Island about 10 km from nearby town of Maumere.
- Sea World Club (SWC) is a sea side resort with gross land area approximately 2.16 hectars and consist of 25 bungalows.
- GIZ LCORE intends to initiate a pilot PV project, considering:
  - Energy consumption to be covered by PV on a net metering basis (yearly balance).
  - Grid downtime should be bridged by a battery storage system.



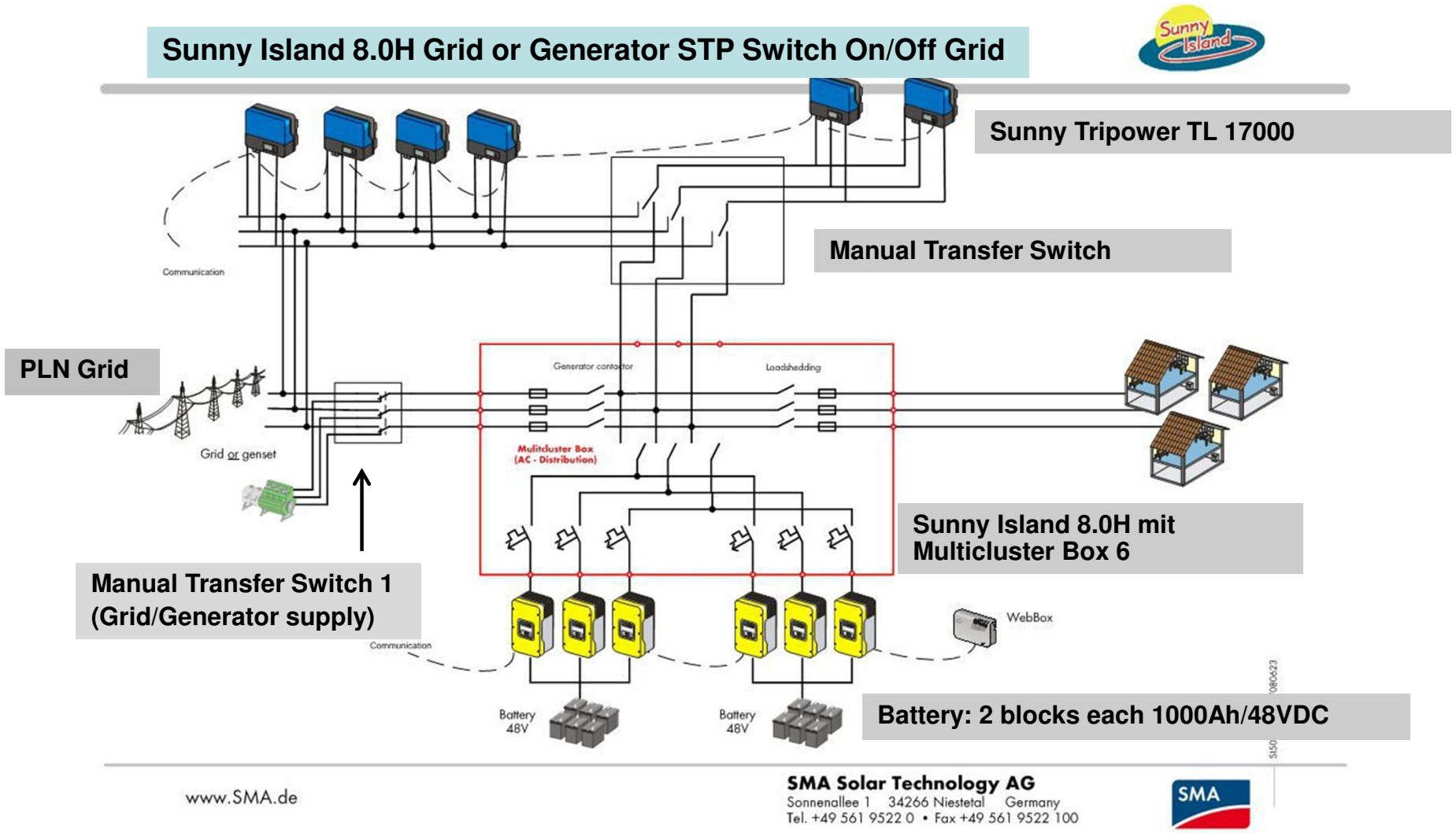
Maumere

Power Supply and Conditions

- Electricity supply: 20 kV/380 V transformer 100 kVA
- Supplier: PT PLN through their 8 MW diesel powered grid network (02/2013)
- Customers: private customers and the sea resort
- The installed capacity of the resort: 41.5 kVA, at 380/220 VAC
- The PLN connection point of the sea resort is in the generator house
- The distance between transformer and the generator house is about 300m



Solar System - Principal Design



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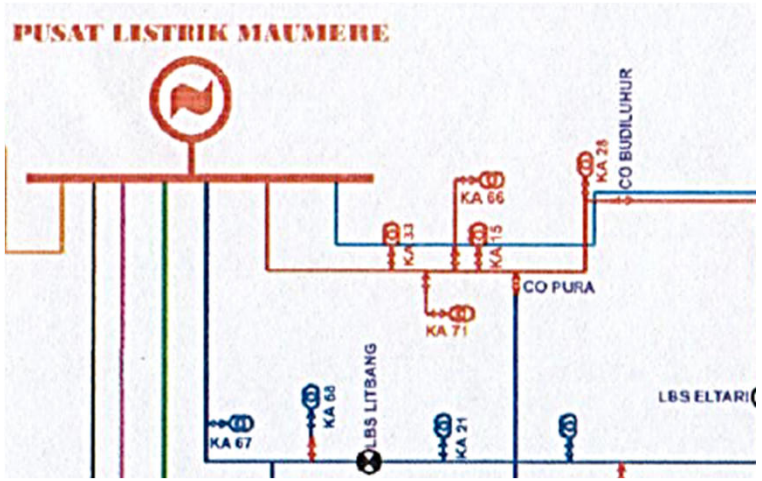
PLN Maumere Grid

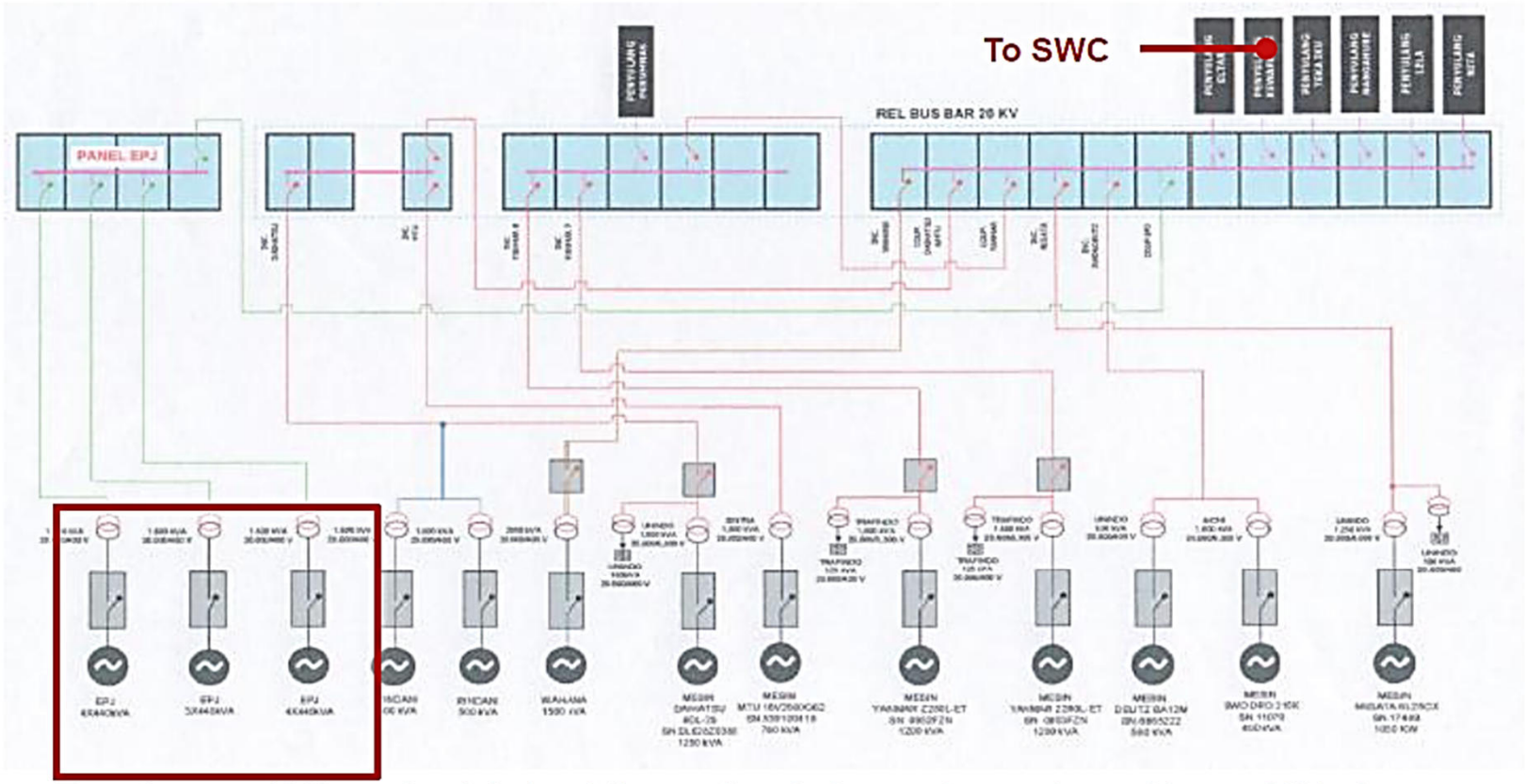
- Around 13.78 MVA installed capacity
- Capable / planned capacity is around 9.7 MVA
- 25 diesel generators
  - 7 PLN owned
  - 18 rented
- Peak load in the evening 8.785 MVA max
- Load during noon 5.62 MVA max
- The predicted / estimated peak load in 2013 is 9.68 MVA (average)

Data February 2013



Source: GIZ LCORE

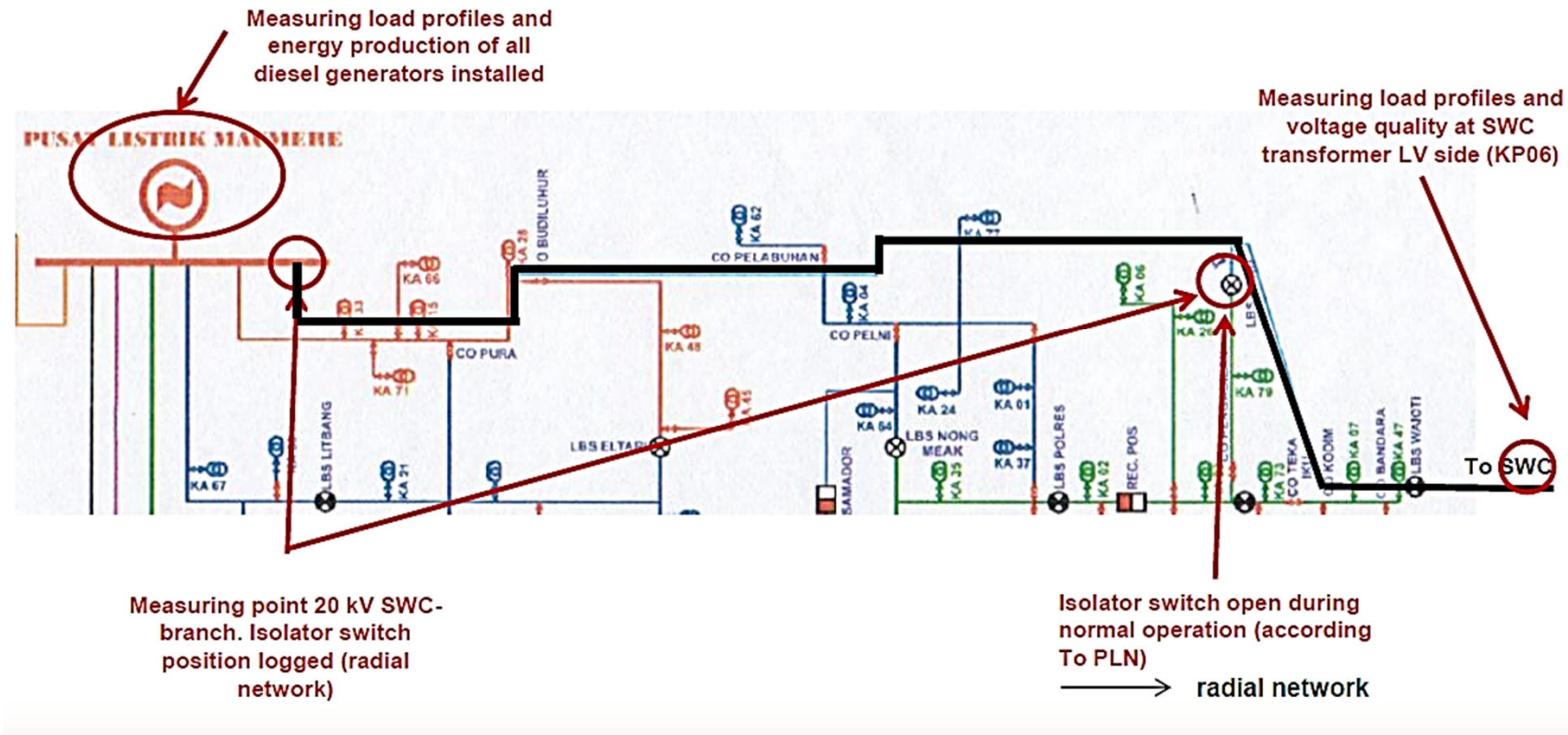
Overview PLN Maumere DGS Busbar



Transformers 10% overload during full operation, but gensets are planned to run 62% of rated capacity (average)

Source: GIZ LCORE

Overview 20 kV Distribution Network and Measuring Points



Source: GIZ LCORE

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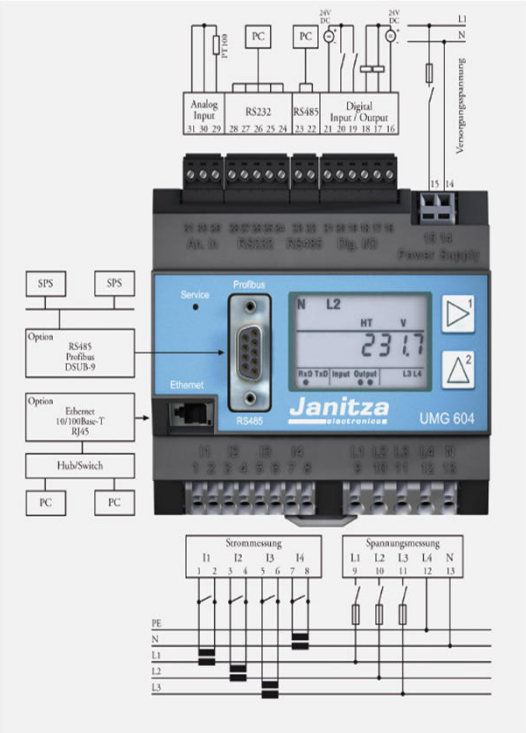
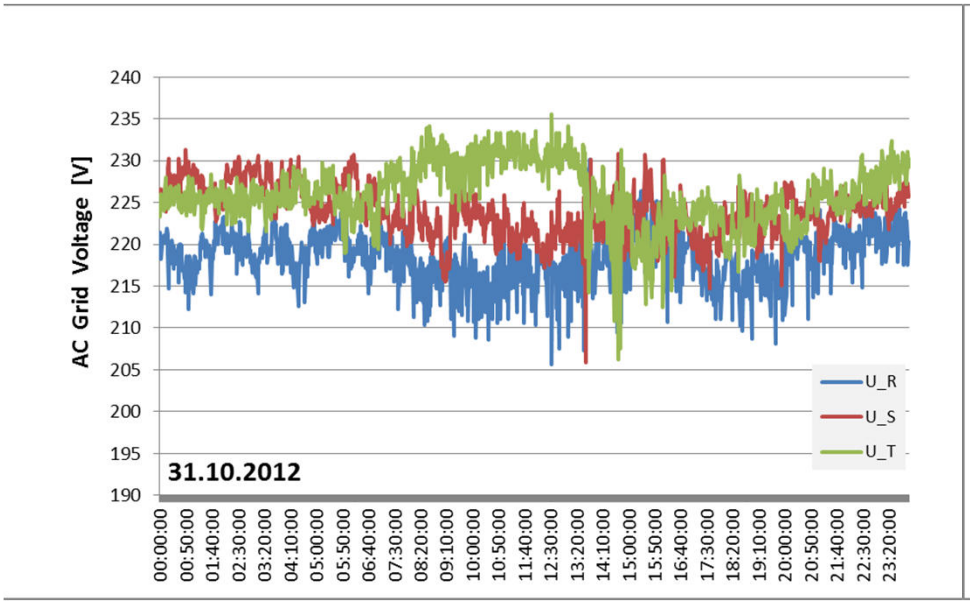
Load-Management and Grid-Evaluation

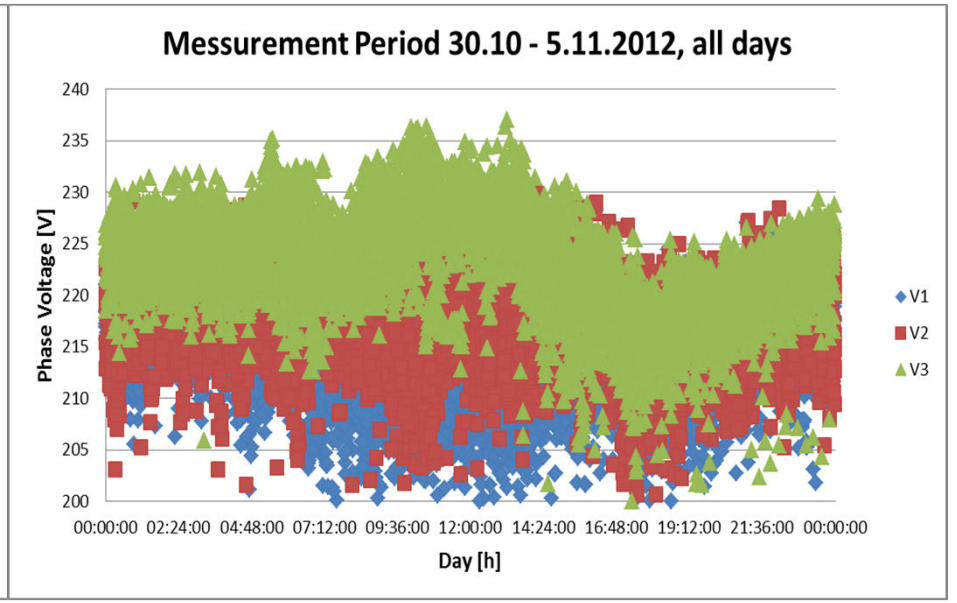
- Detailed grid measurement and evaluation

  - Grid monitoring for technical reliable interconnection
  - Evaluation influence PV-System before and after installation
  - Further grid studies for next-step decentralized PV-Systems
  - Diesel Generator operation strategy
  - Diesel-Fuel Consumption



Example Grid Measurement before PV Installation





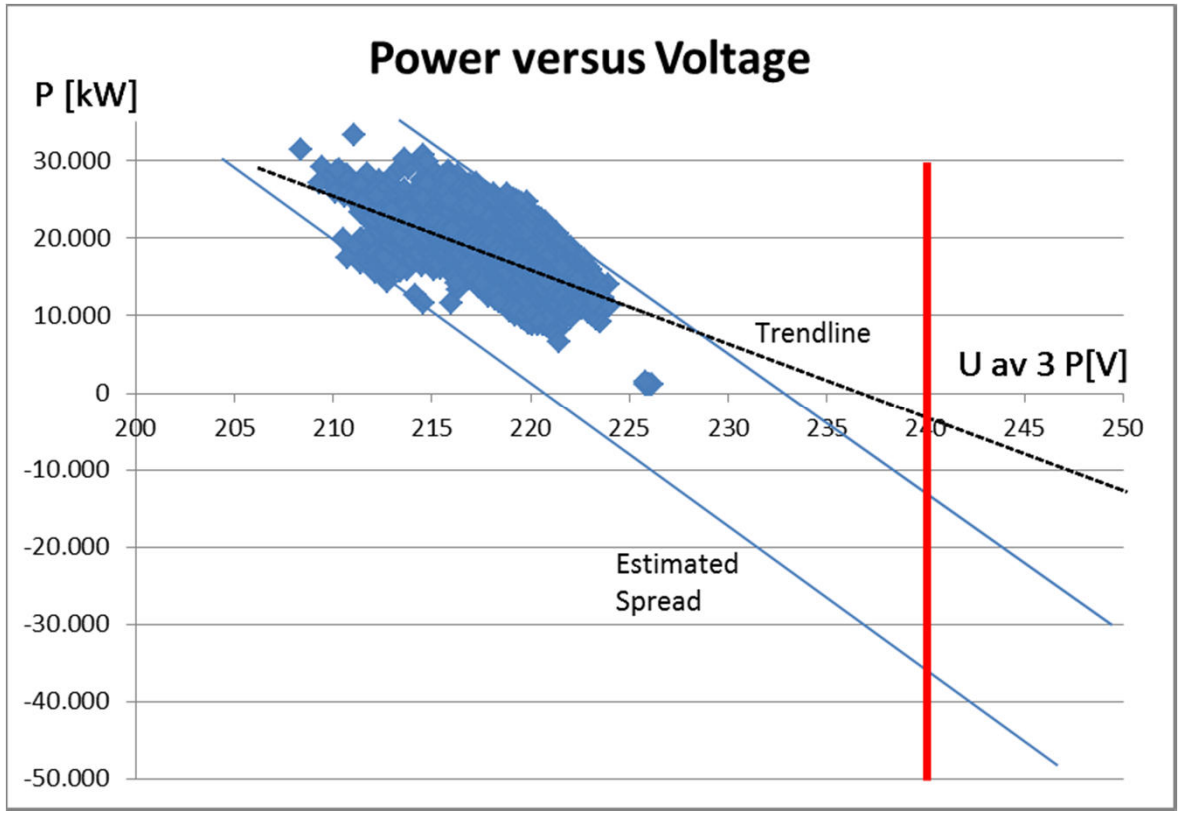
Findings:

- Voltage fluctuations 205 to 236 V
- Asymmetric phase voltage
- Asymmetric demand to be assumed

Question:

- **Maximum PV power feasible?**

Example Grid Measurement – Demand Side



First Findings:

- Demand side power range
- voltage spread

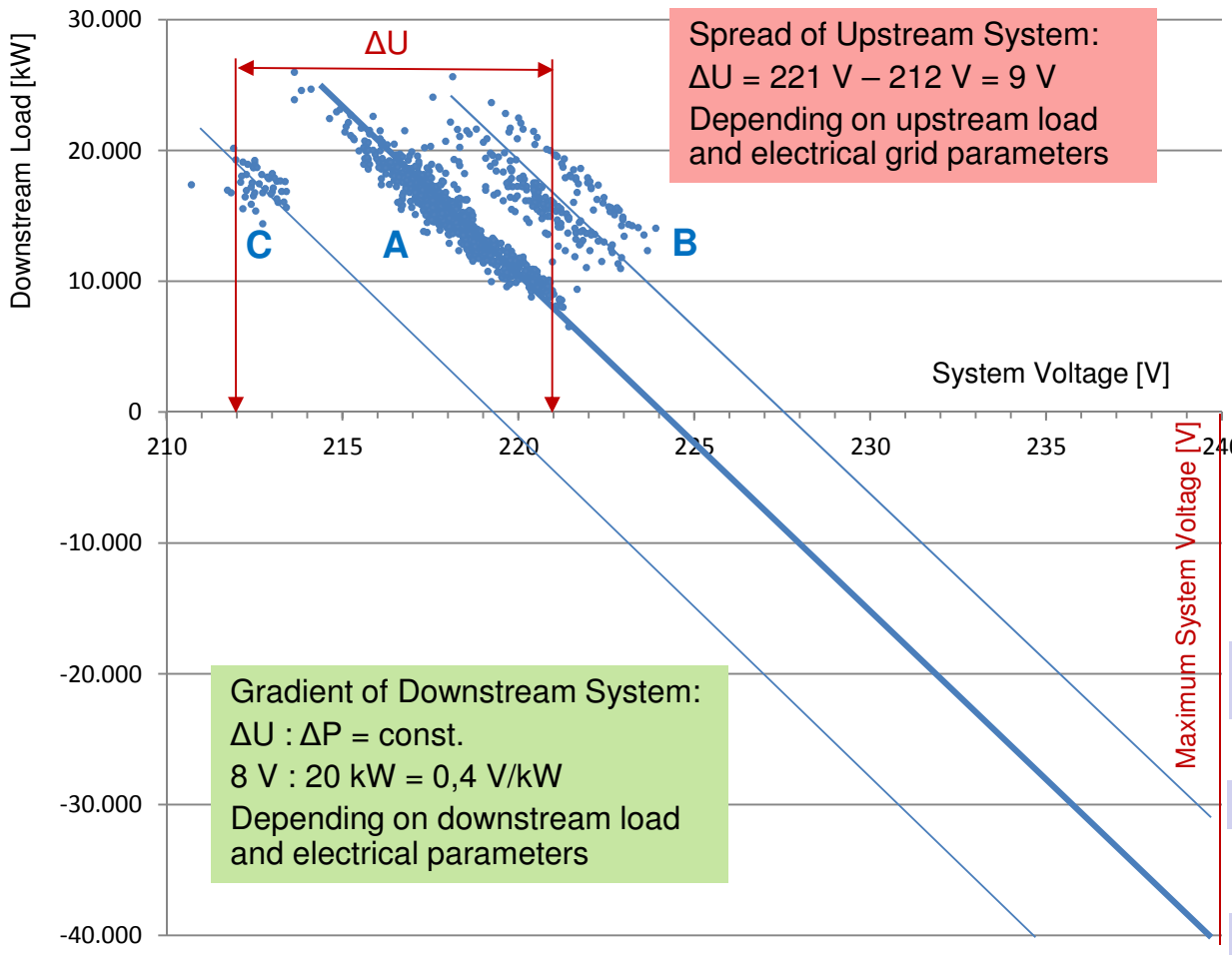
Questions:

- Demand profile
- PV input profile
- Maximal PV power
- **Extra PV grid cable to transformer**
- **Extra transformer**

- **Maximum PV power to be determined**

Source: Calculations and estimations by E.Quadrat

Evaluation of Parameters to define max PV installation



Spread of Upstream System:
ΔU = 221 V – 212 V = 9 V
Depending on upstream load and electrical grid parameters

Evaluation of the crucial time between 11.00 hrs to 14.00 hrs over one week.

- Voltage spread due to upstream load changes
  - Majority operational point A
  - Minority operational points B, C
- Gradient voltage to load behavior downstream

Gradient of Downstream System:
ΔU : ΔP = const.
8 V : 20 kW = 0,4 V/kW
Depending on downstream load and electrical parameters

PV max (net AC) = downstream $load_{min}$ + abs (- P_{240VAC})

PV max: 10 kW + abs (-30 kW) = 40 kW

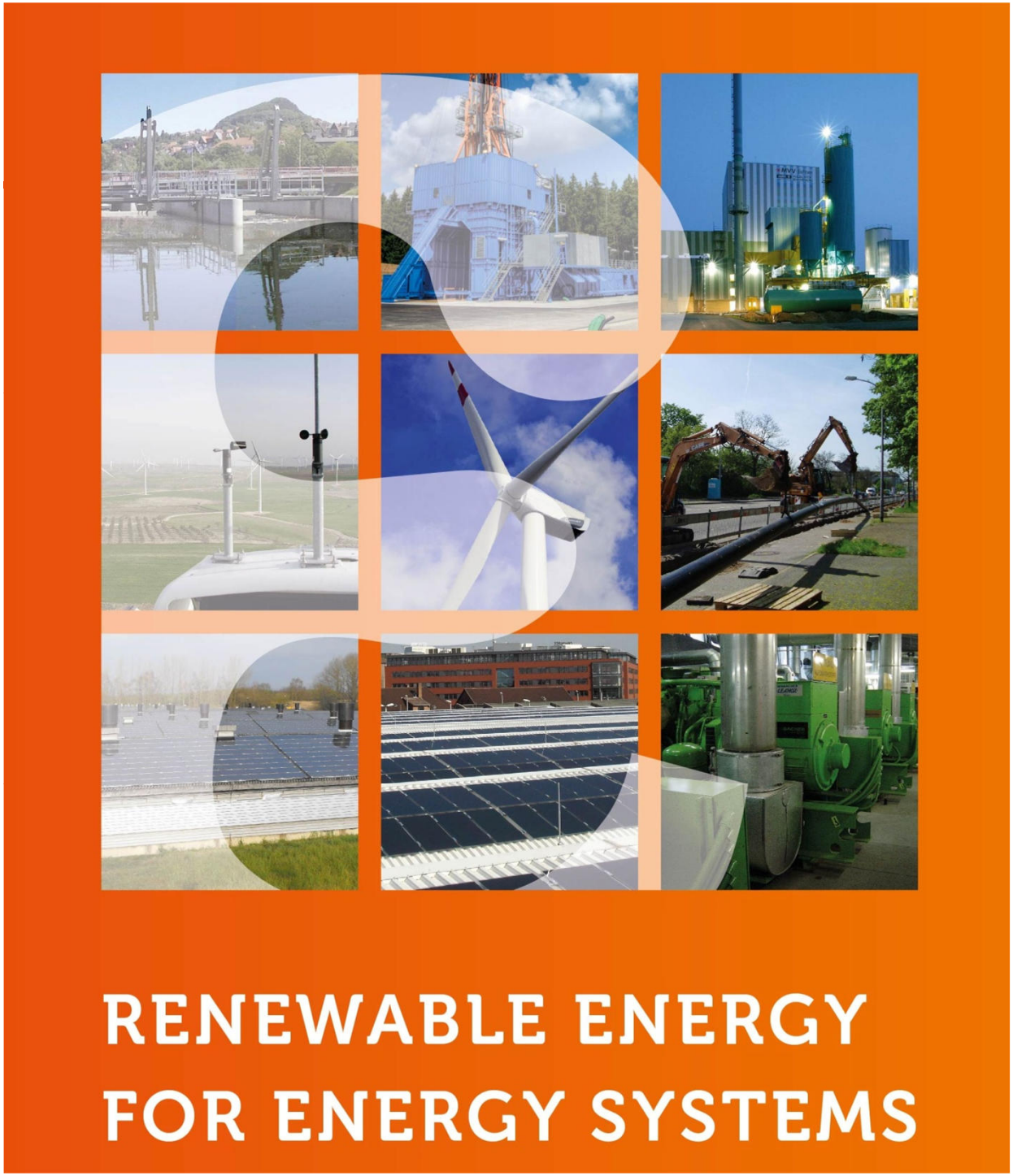
PV max: 10 kW + abs (-40 kW) = 50 kW

Source: Calculations and estimations by E.Quadrat

Conclusions

- Recommended PV installation at SWC: 60 kW peak
  PV max connection point = 50 kW (net) + 20% (losses due to PR)
- Grid data evaluation developed methodology to estimate maximum PV power
- Methodology evaluates specific grid data as
  - Voltage to load *Downstream* gradient
  - Voltage spread of *Upstream* system behavior

  from grid connection point.



Thank You for Your Attention!

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