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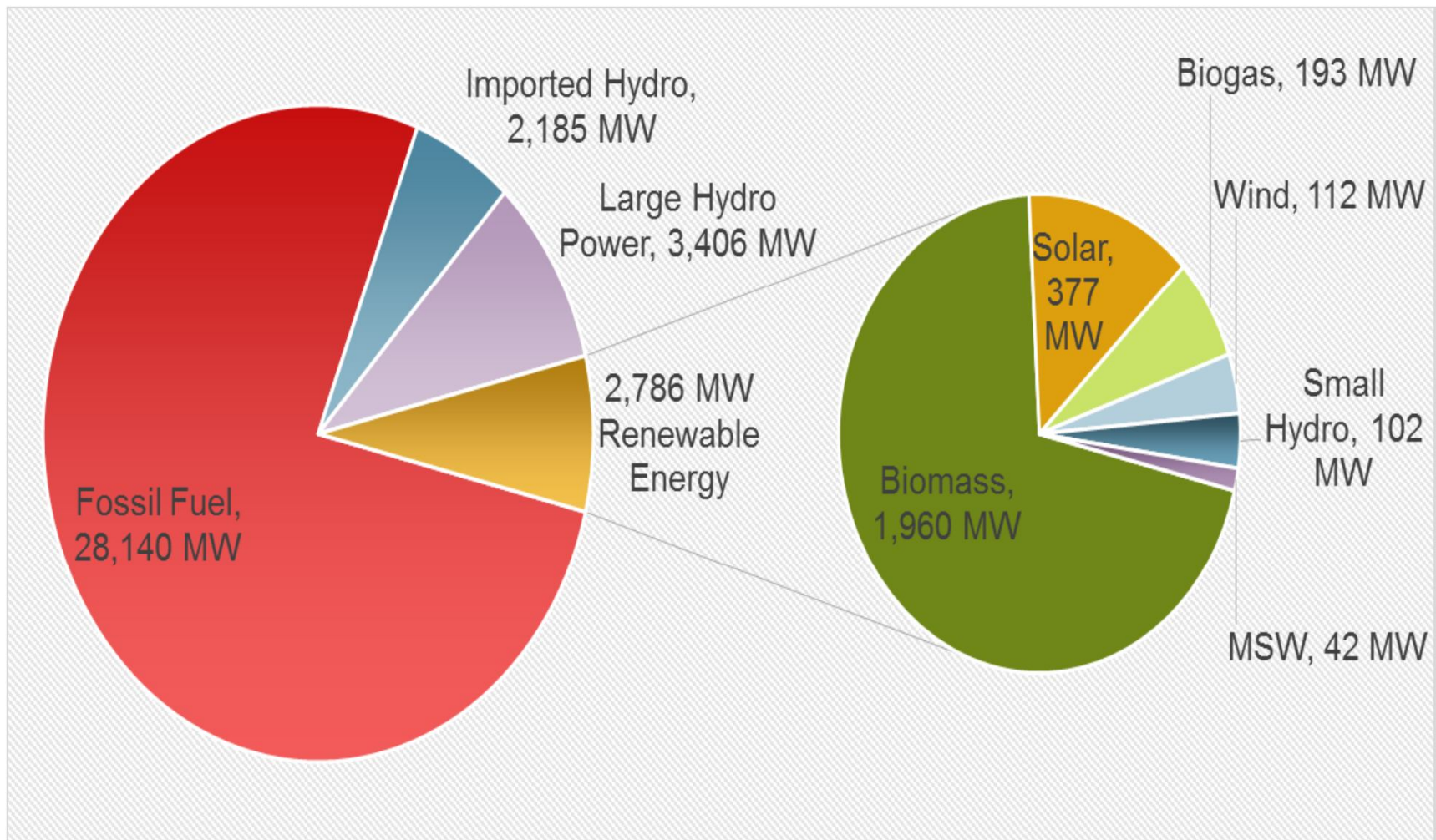
# Evaluation of Solar Roof from PQ Monitoring

**Panida Boonyaritdachochai** / Power Quality Engineer  
PEA Petchaburi Team

# Outline

- Promoting Solar in Thailand
- Solar Roof Case Study
- PQ Evaluation for Solar Roof
- Conclusion

# Thailand Power Generation Capacity



Source: DEDE

# Promotion of Solar Roof in Thailand

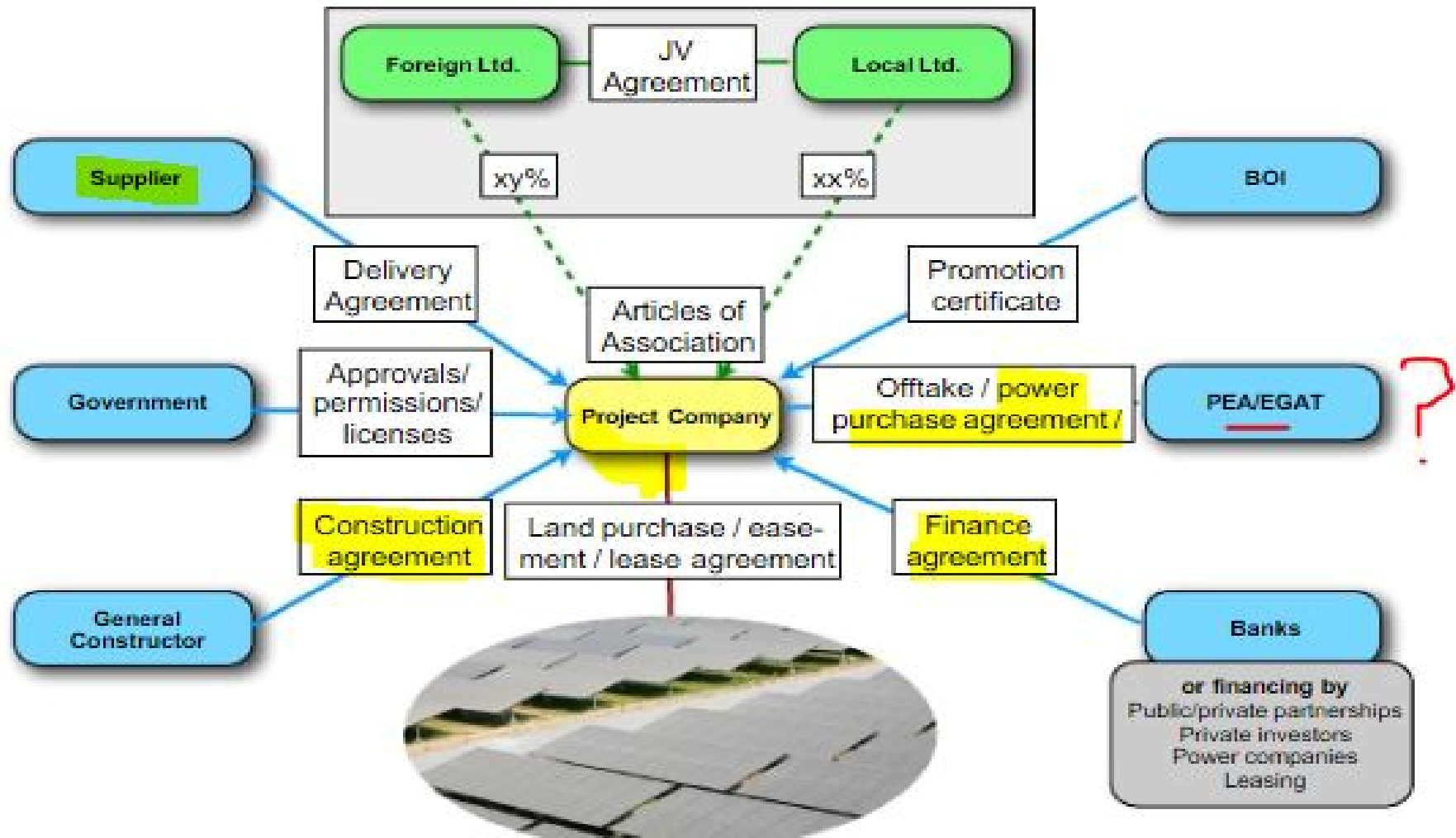
- Full Feed-in Tariff (**25 years**) for Solar PV Rooftop to
- encourage private & community investments
- minimize peak load
- contribute to energy security

## New Initiatives I: PV Rooftop Program *Classification*

<i>Classification</i>	<i>Scale</i>	<i>FiT Rate (Baht/kWh)</i>	<i>Quota</i>
Residential	0-10 kW	6.96 (~0.22 US\$)	100 MW
Small/Medium Commercial	10-250 kW	6.55 (~0.21 US\$)	100 MW
Medium/Large Commercial	250 kW-1 MW	6.16 (~0.20 US\$)	

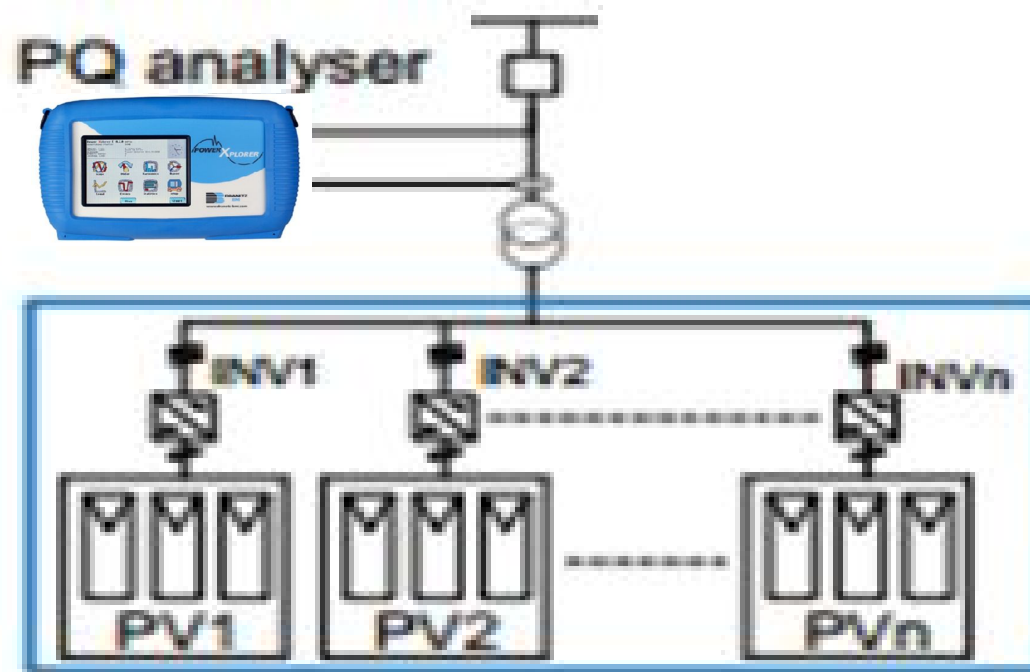
Update: 2014

# Simplified Contractual Structure for a Solar Project in Thailand



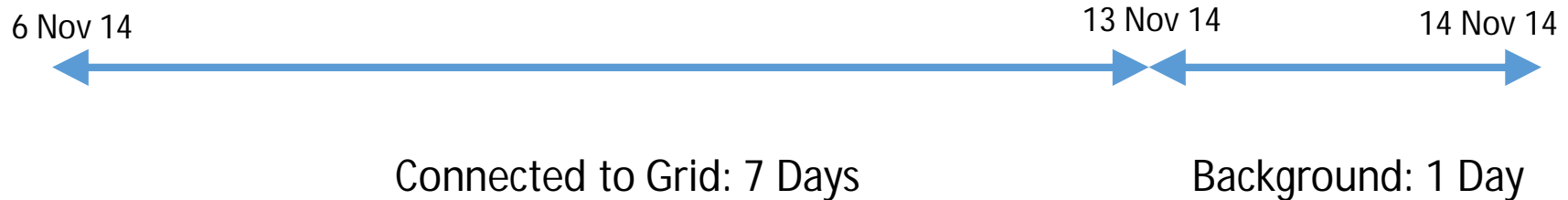
# Case Study Solar Roof

Capacity: 1 MW  
Location: Prachuab Khiri Khan  
Investment: appx. 70 MTHB



# PQ Evaluation

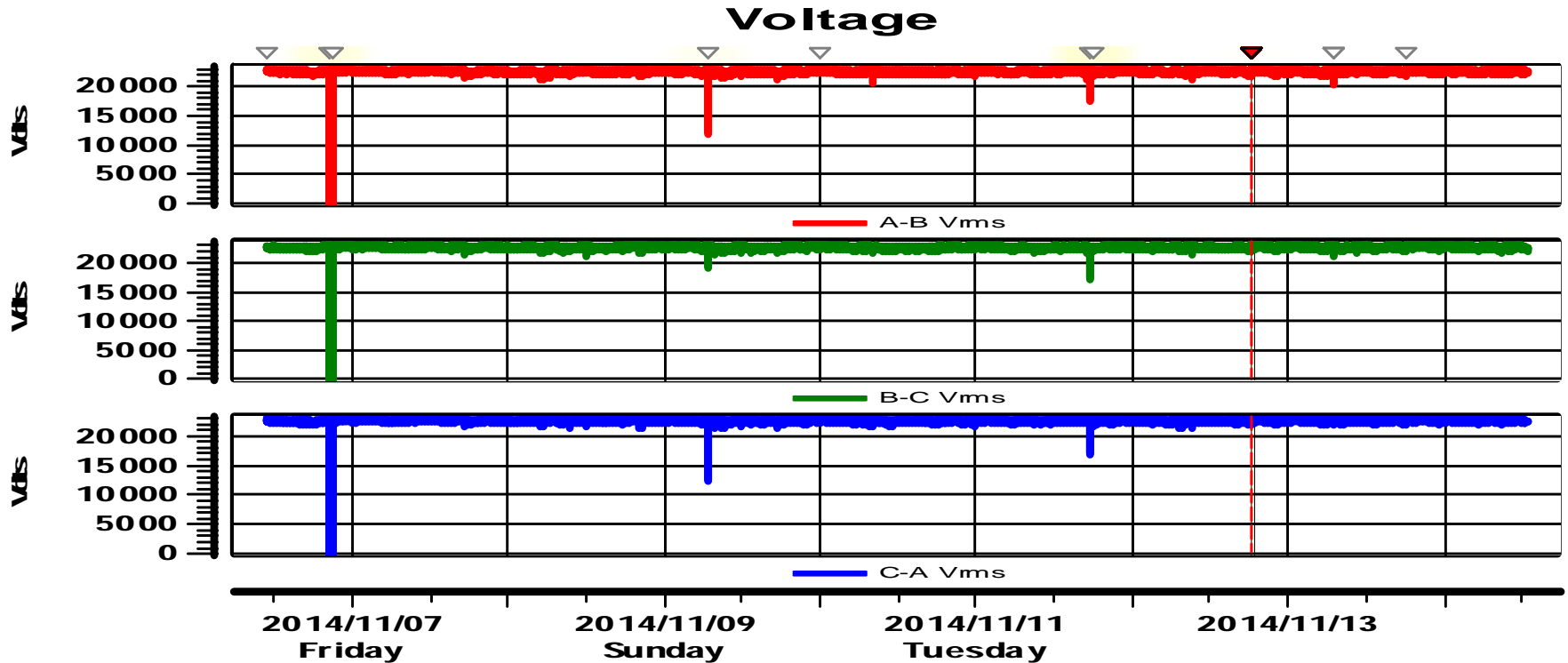
## Evaluation Period



Evaluation Standard: EN50160

Evaluation PQ Parameter: Vrms, THDv,  
Freq, Plt,

# PQ Parameter Evaluation

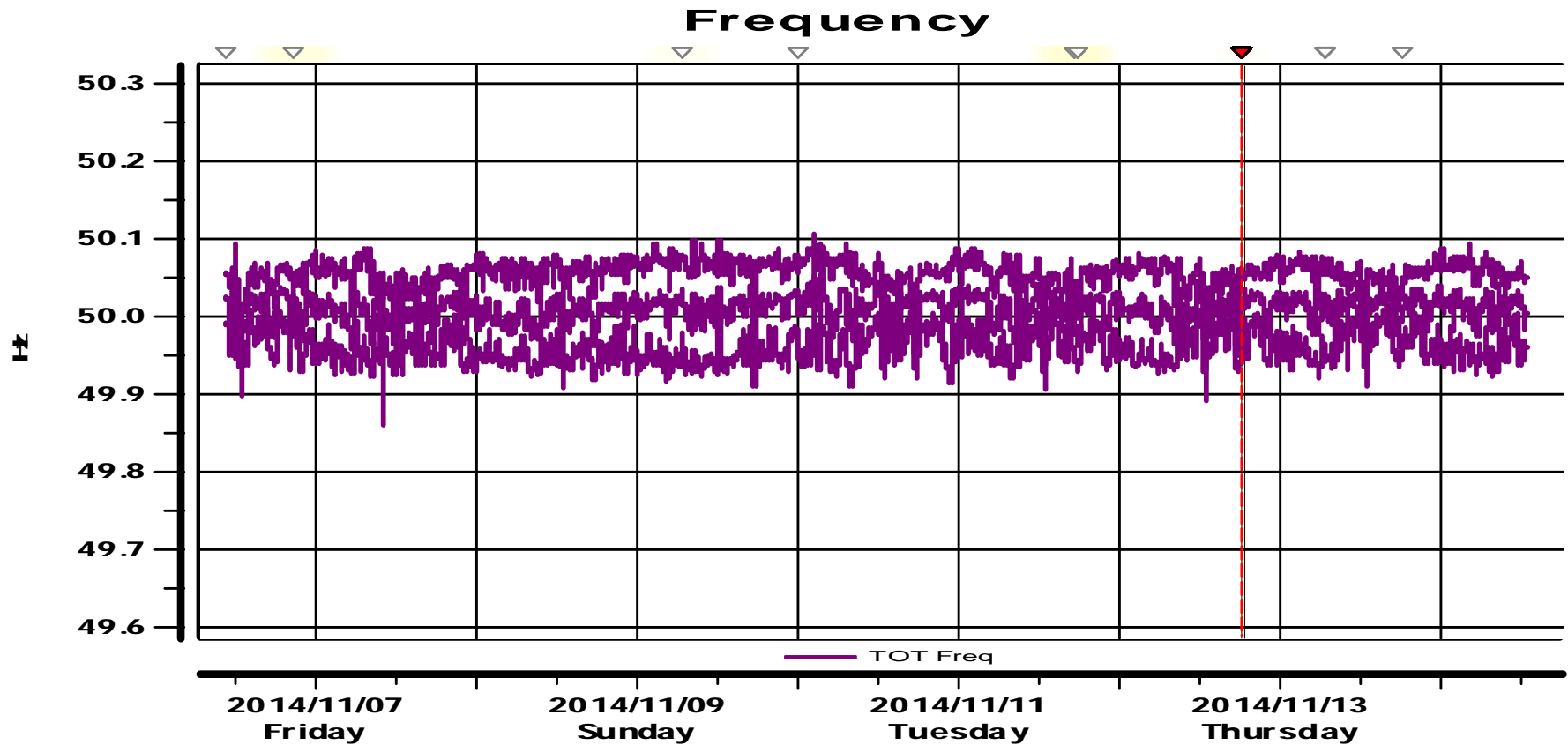


	<b>95%</b>
<b>A-B Vrms</b>	<b>22835</b>
<b>B-C Vrms</b>	<b>22975</b>
<b>C-A Vrms</b>	<b>22810</b>

Event #145 at 2014/11/12 18:33:31.059  
BVPeak High To Normal



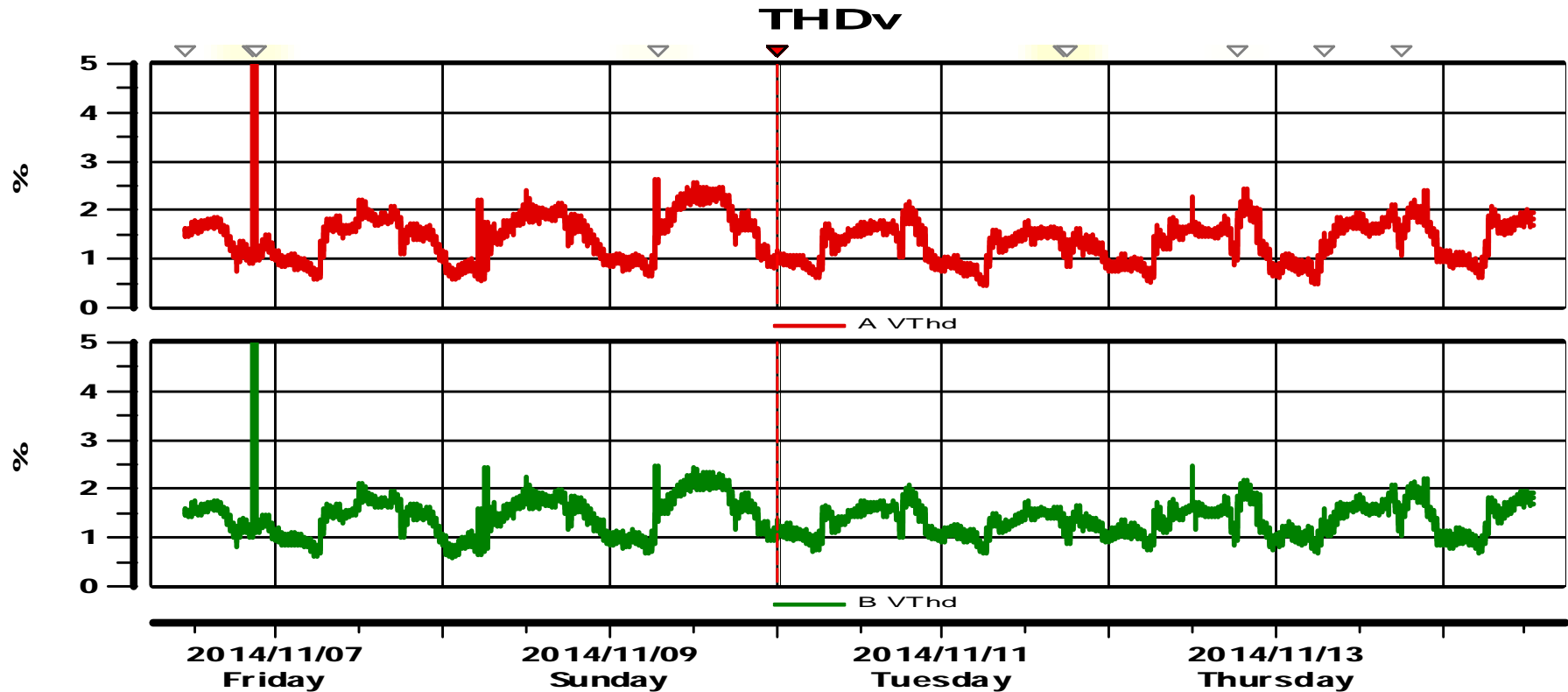
# PQ Parameter Evaluation



	<b>95%</b>
<b>TOTFreq</b>	<b>50.03</b>

Event #145 at 2014/11/12 18:33:31.059  
BVPeak High To Normal

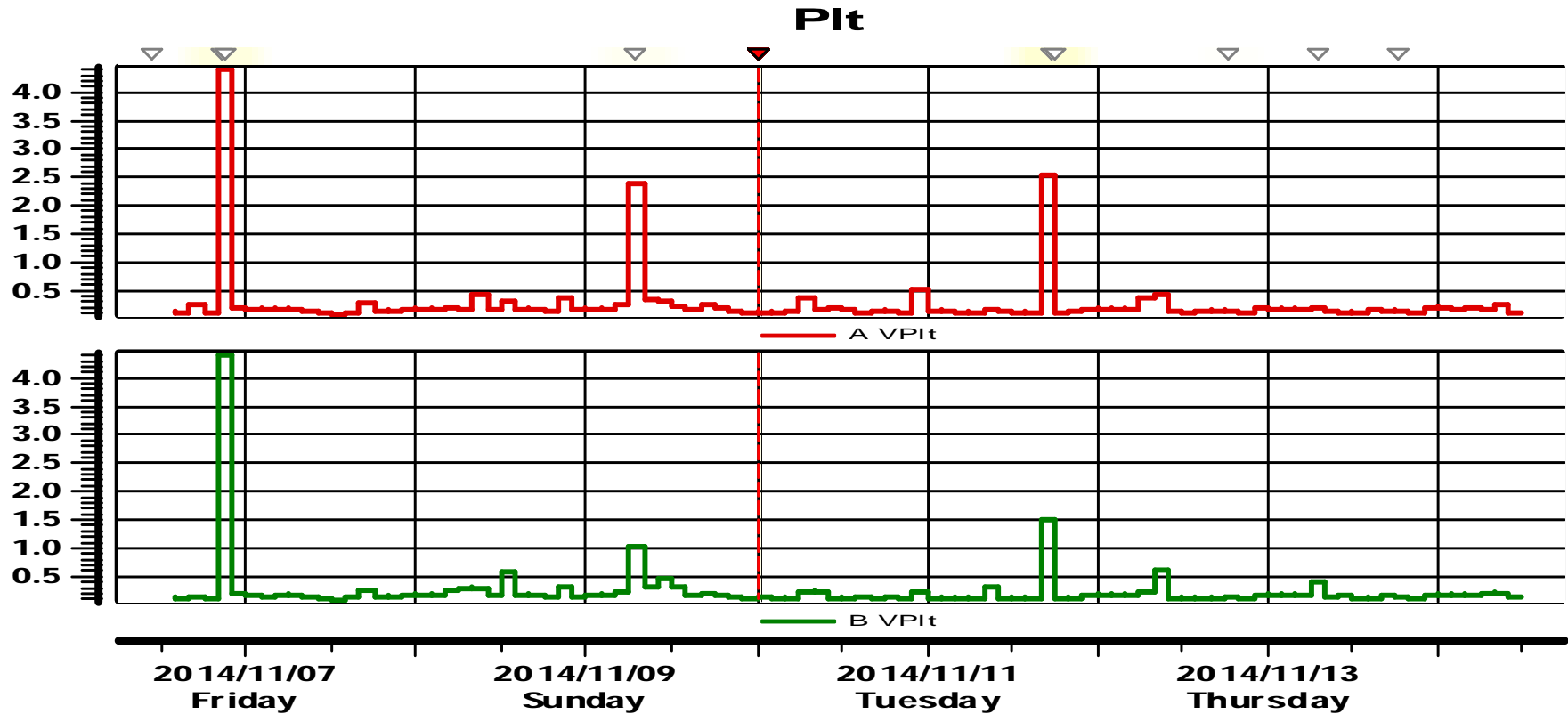
# PQ Parameter Evaluation



	<b>95%</b>
<b>AVThd</b>	<b>2.088</b>
<b>BVThd</b>	<b>1.986</b>

Event #73 at 2014/11/10 00:00:00.000  
EN50160 Uncompleted - Pass

# PQ Parameter Evaluation



	<b>95%</b>
<b>AVPIt</b>	<b>0.4392</b>
<b>BVPIt</b>	<b>0.5756</b>

Event #73 at 2014/11/10 00:00:00.000  
EN50160 Uncompleted - Pass

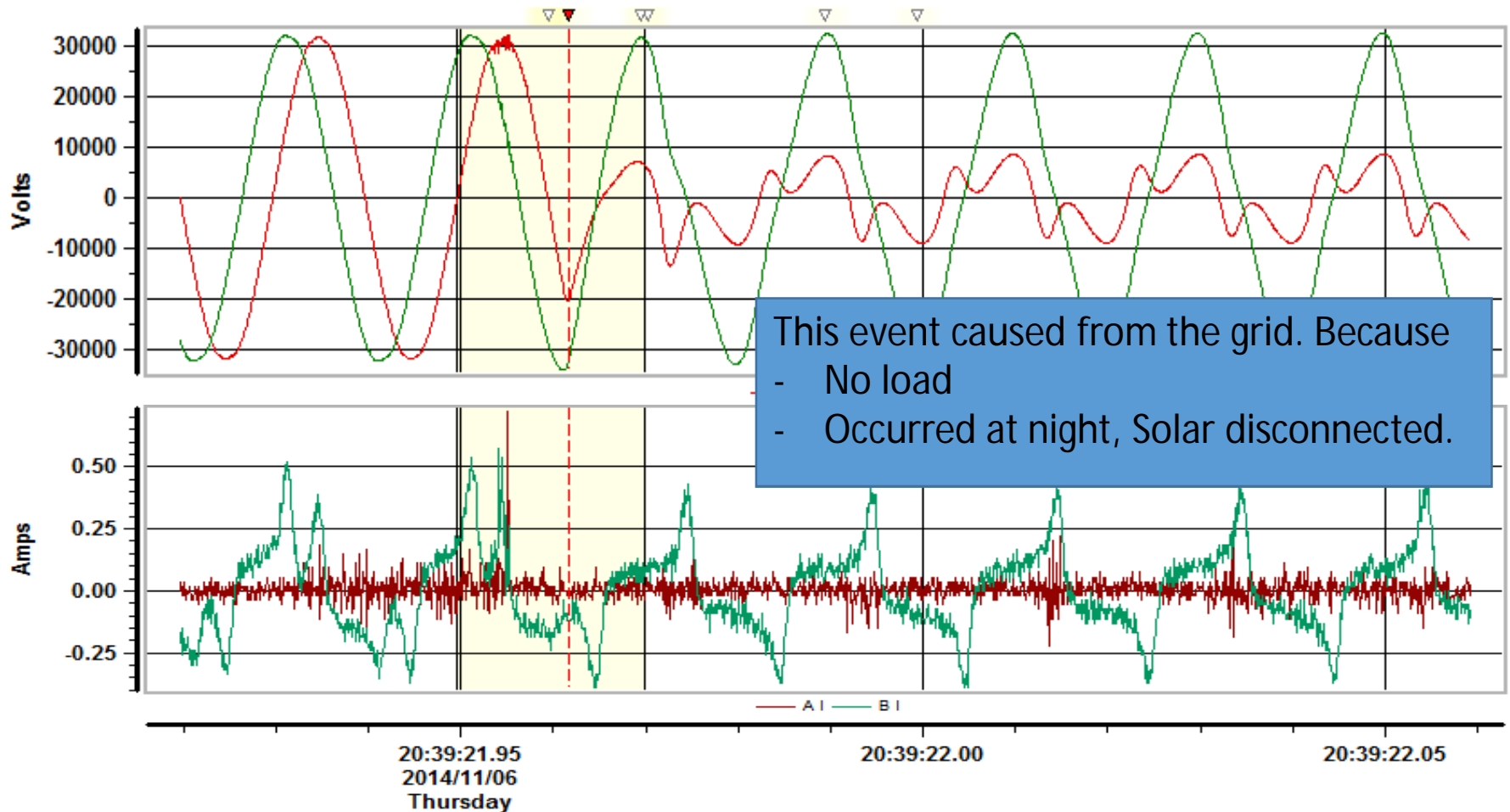
# PQ Parameter Evaluation

Parameters	Phase	EN50160	PEA Standard	Result CP95	Evaluation
Vrms	AB	Not more than 22± 5% (20.9-23.1 kV)	Not more than 22± 5% (20.9-23.1 kV)	22.835	Pass
	BC			22.975	Pass
	CA			22.810	Pass
Freq		49.9 – 50.1 Hz	49.9 – 50.1 Hz	50.03	Pass
THD <sub>v</sub>	A	< 8 %	< 4 %	2.088	Pass
	B			1.986	Pass
Plt	A	-	< 0.8	0.4392	Pass
	B			0.5756	Pass

Using IEC868 std

# Monitoring Reveals the Effect

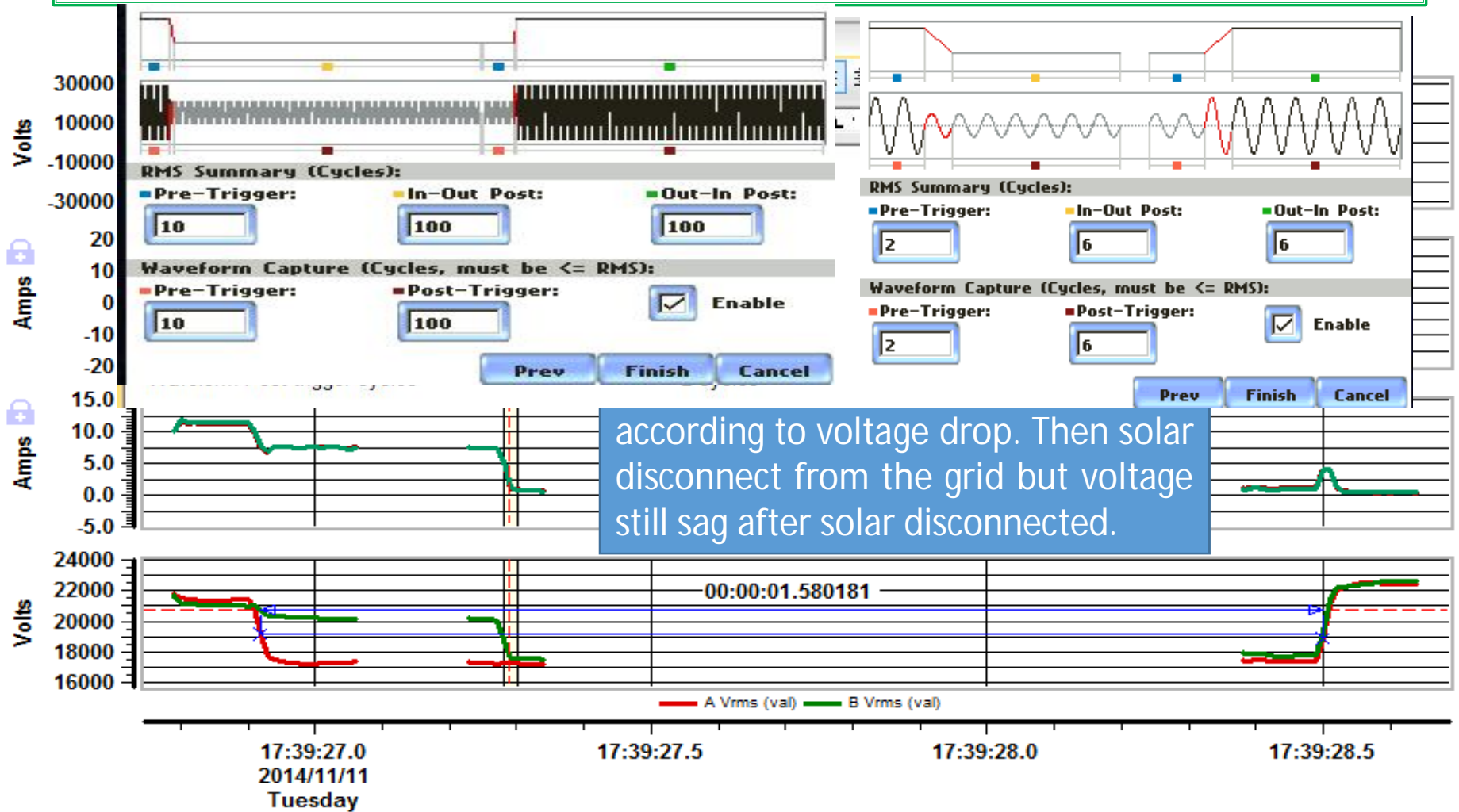
Event Details/Waveforms



Event #3 at 2014/11/06 20:39:21.949

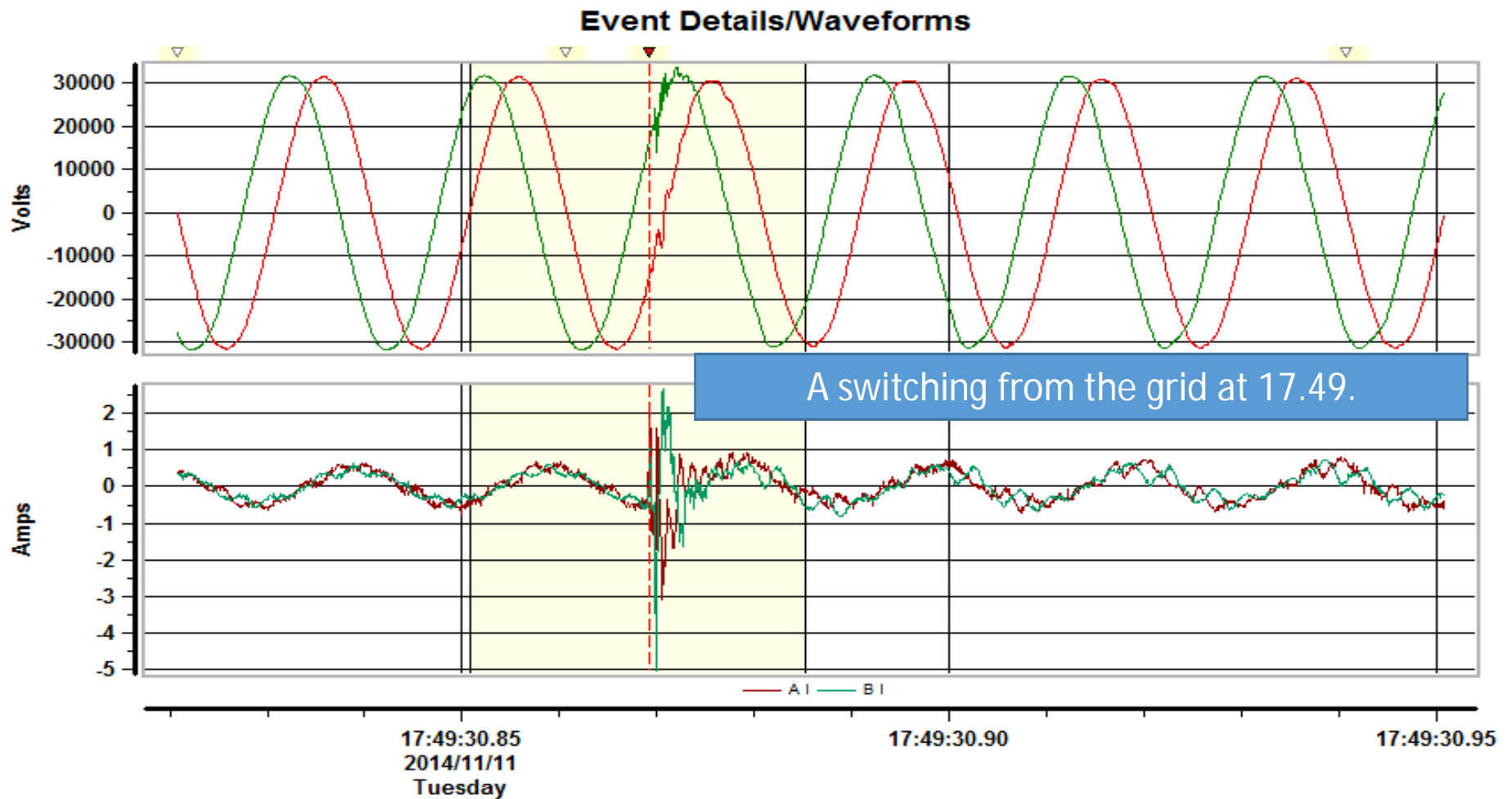


# Monitoring Reveals the Effect



Event #83 at 2014/11/11 17:39:27.280

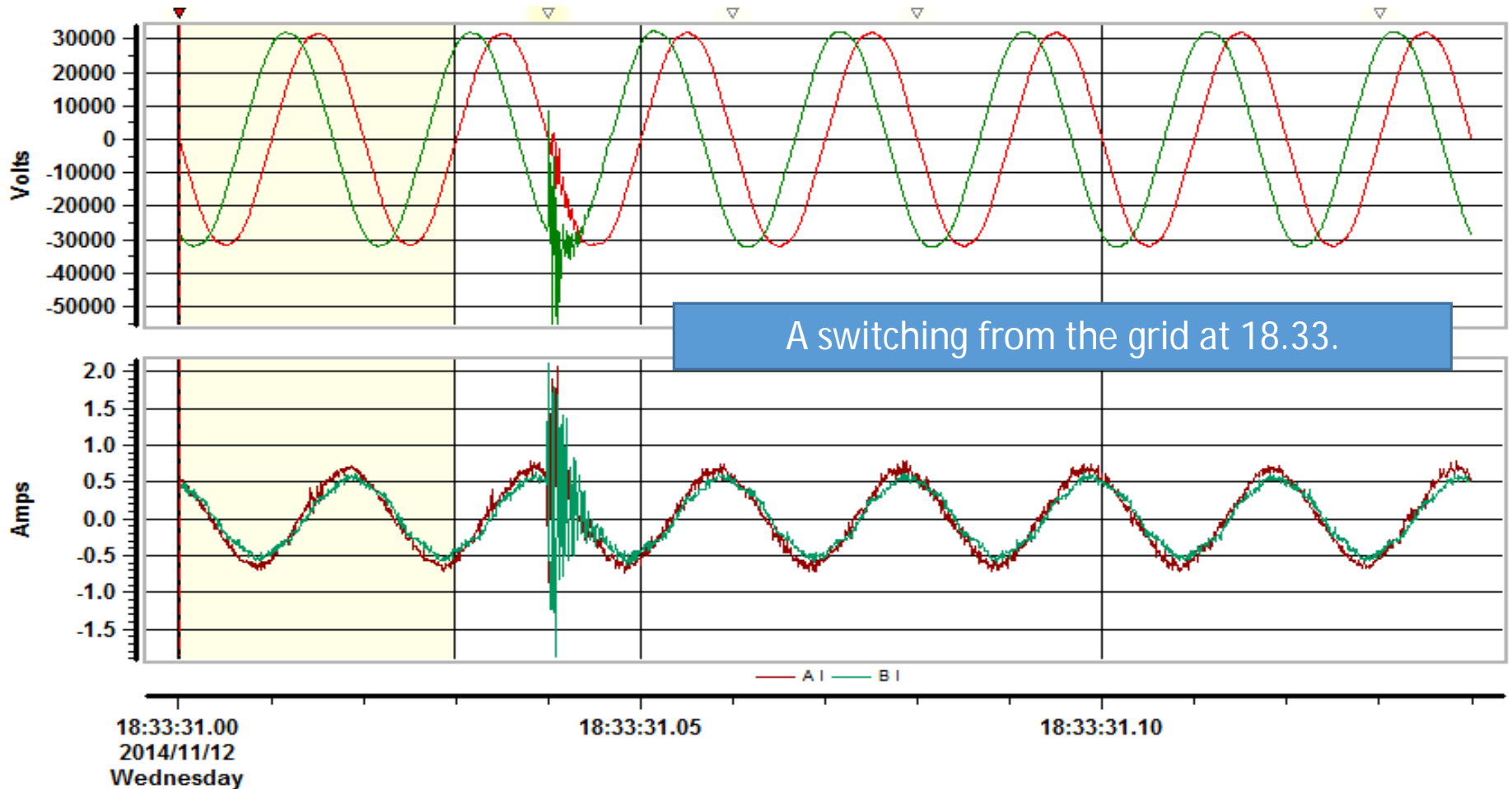
# Monitoring Reveals the Effect



Event #137 at 2014/11/11 17:49:30.850

# Monitoring Reveals the Effect

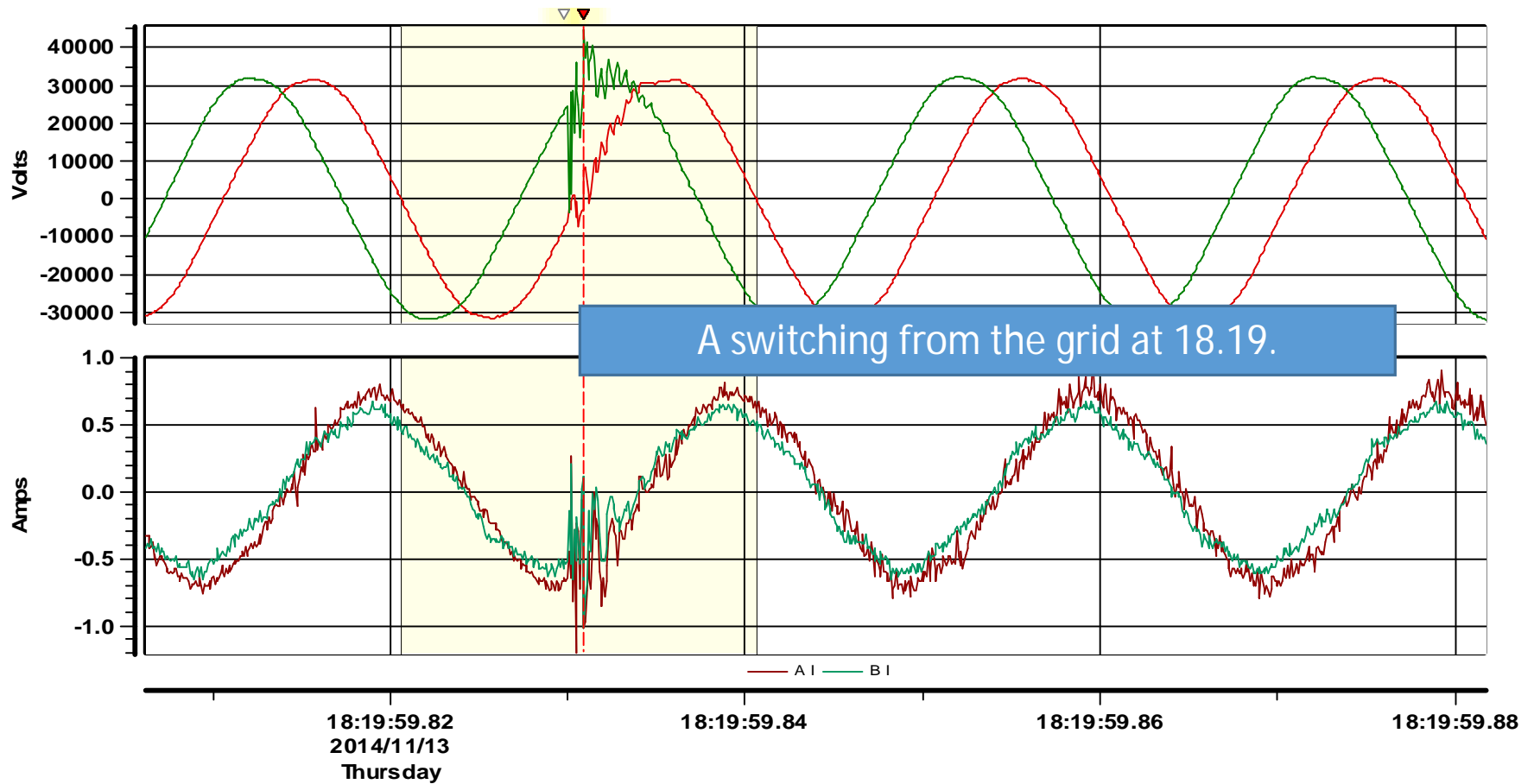
Event Details/Waveforms



Event #140 at 2014/11/12 18:33:31.000



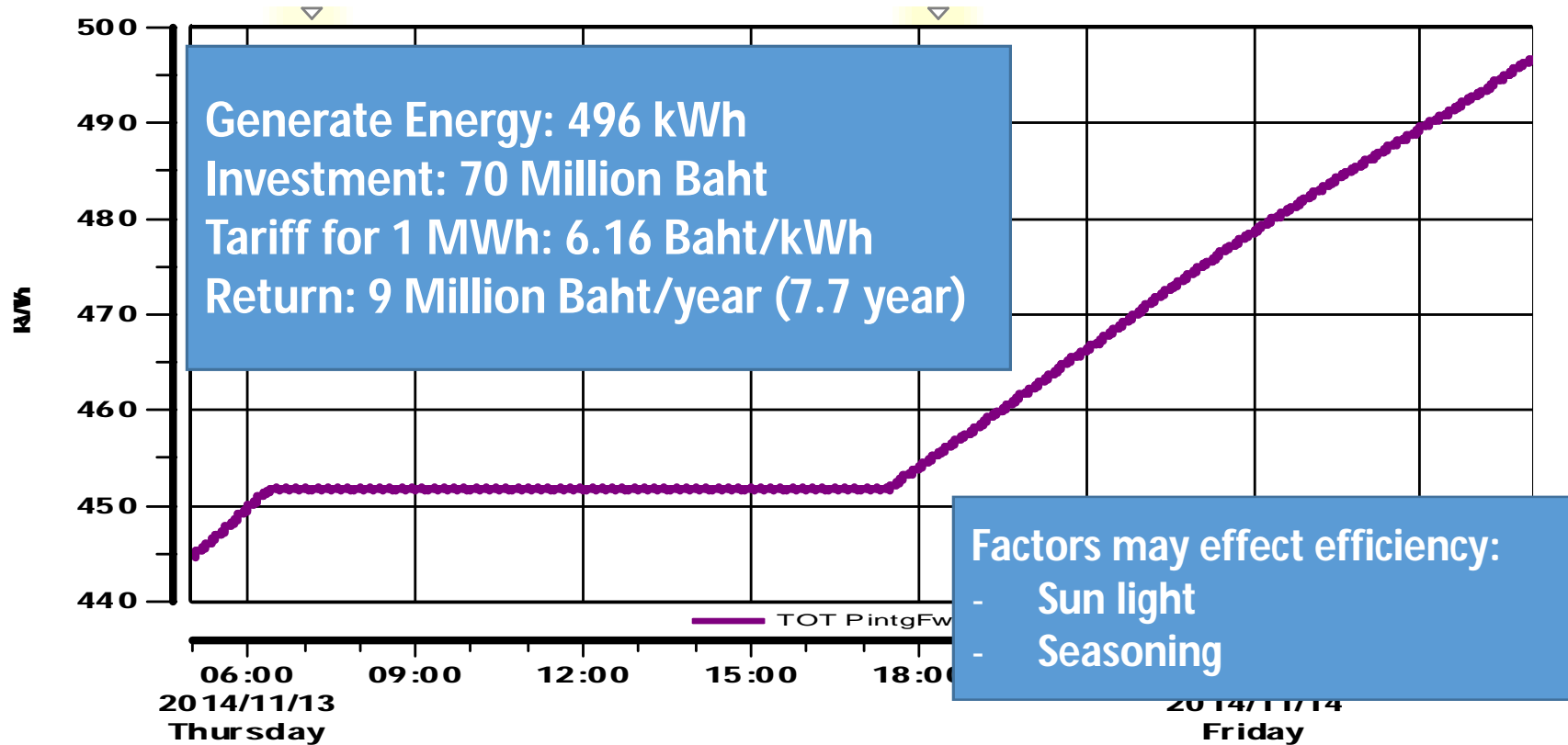
# Monitoring Reveals the Effect



Event #153 at 2014/11/13 18:19:59.820  
AV Mult Z Cr  
Phase 191.2 Deg

# Monitoring Reveals the Effect

**Integrated Energy (kWh)**



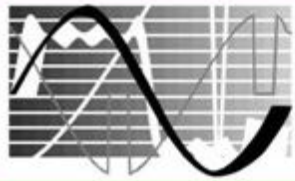
	Min	Max	Avg
<b>TOTPintgFwd (kWh)</b>	<b>444.4</b>	<b>496.7</b>	<b>462.5</b>

Event #142 at 2014/11/12 18:33:31.039  
 BVPeakNormal To High



# Conclusions

- Renewable Energy promoting plan in Thailand encourages Solar project due to attractive tariff and contract period.
- PQ monitoring at Solar site helps
  - evaluate PQ parameter according to std.
  - identify the effect between solar site vs the grid.
  - assess plant efficiency
  - cross check with the grid operation
  - Calculate the return on investment base on actual data.



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# Thank you



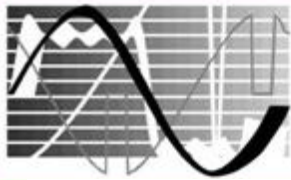
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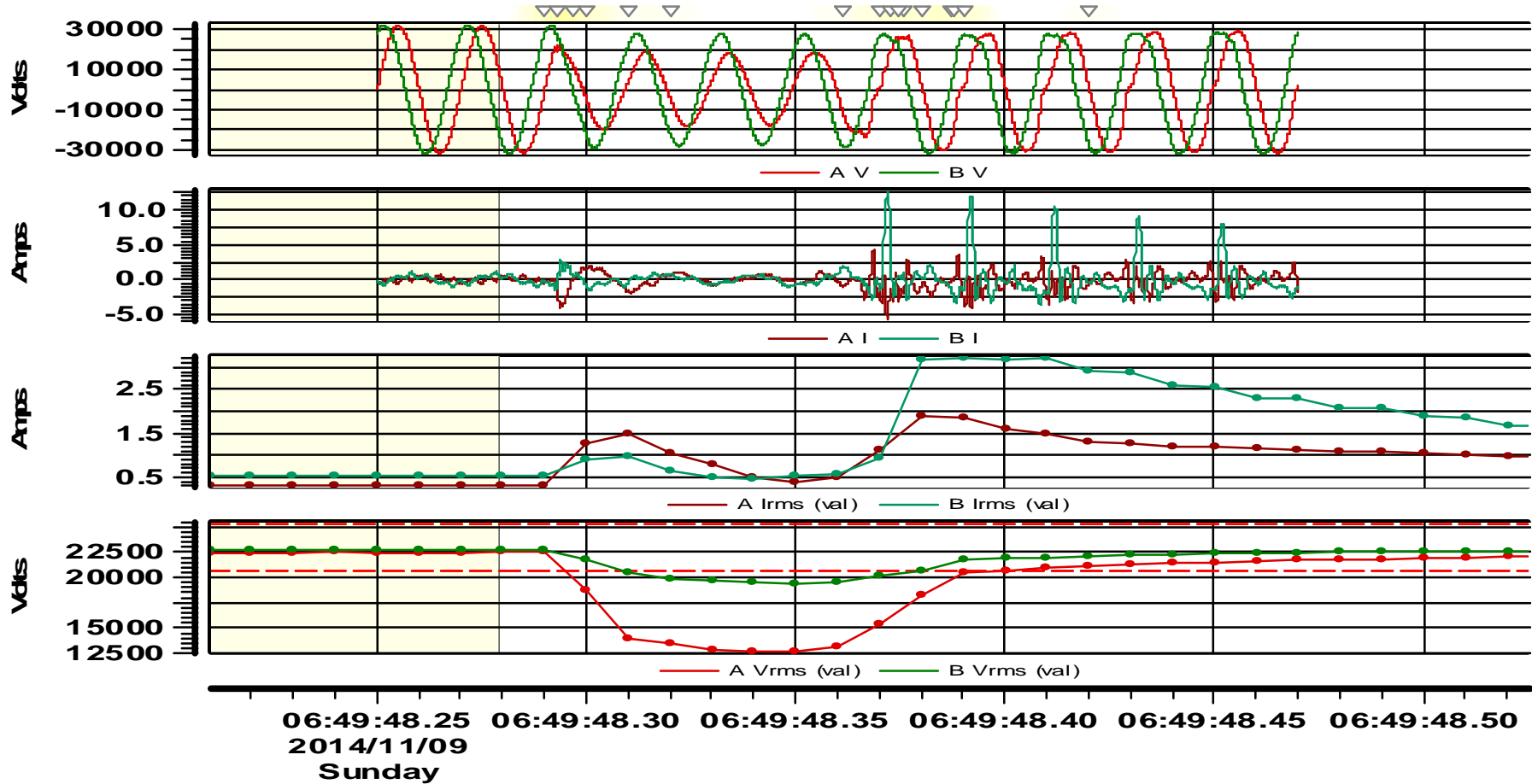




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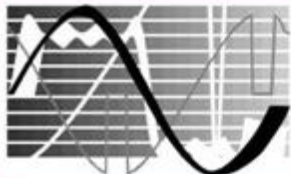
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### Event Details/Waveforms



Event #51 at 2014/11/09 06:49:48.170  
Pre-trigger

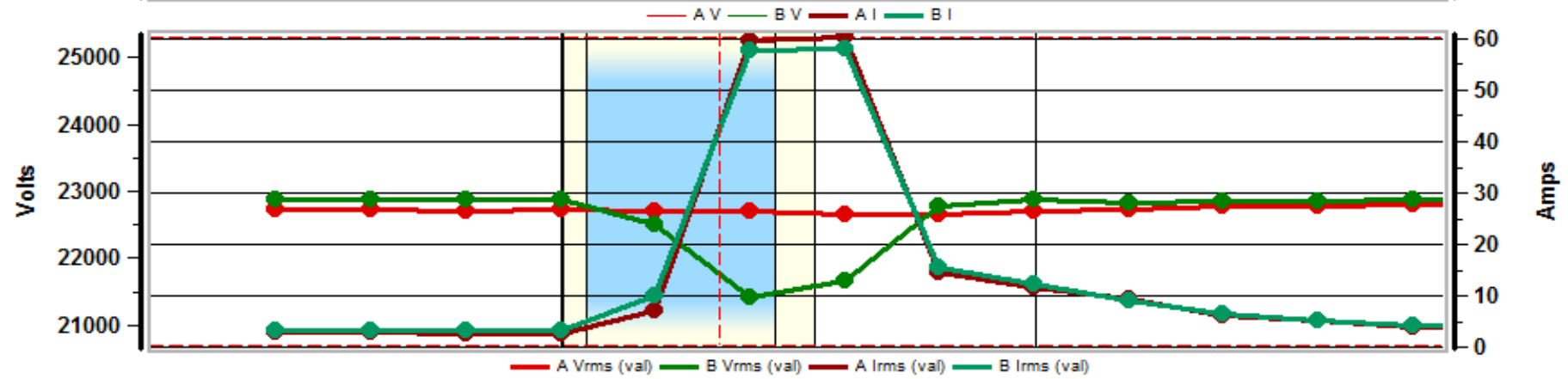
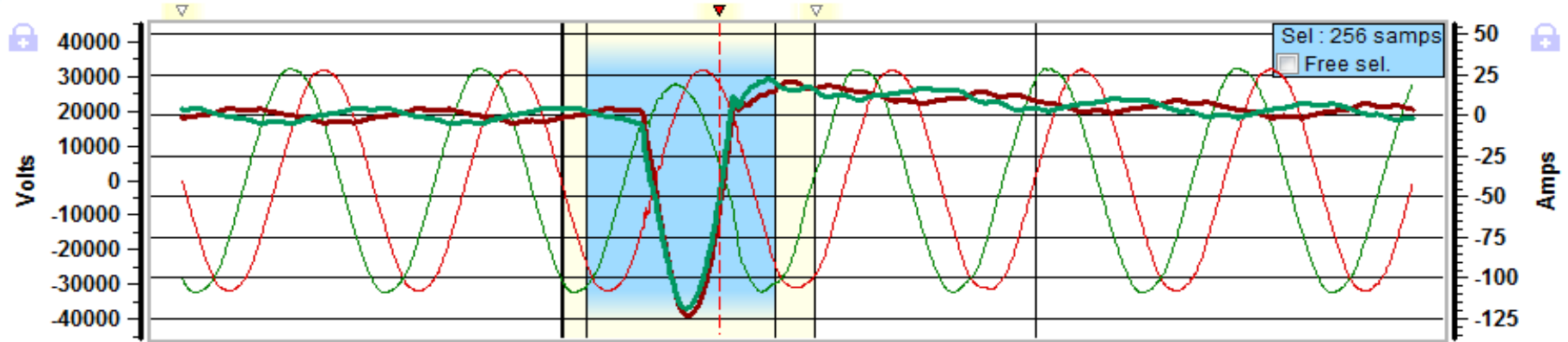




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### Event Details/Waveforms



07:07:38.30  
2014/11/13  
Thursday

07:07:38.35

Event #149 at 2014/11/13 07:07:38.299

