

# Power Quality: Causes and Effects with Biomass Power Plant

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# Power Quality : Causes and Effects with Biomass Power Plant



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# Topics

- *Introduction*
- *Power Quality standard*
- *Single line diagram*
- *Results*
  - *Power Quality Diagnostic*
- *Conclusion*
- *Q&A*





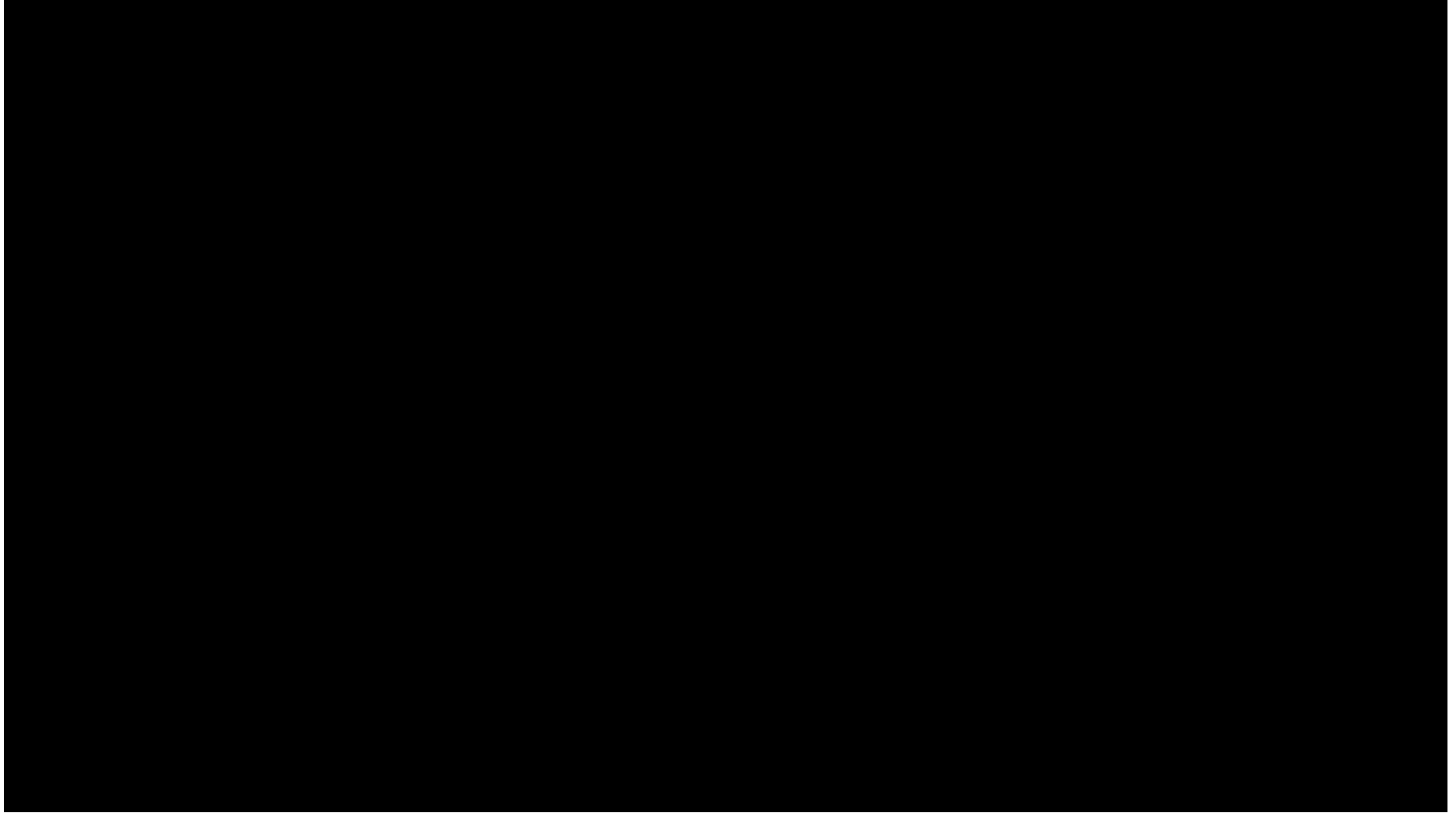
# What is “Biomass”?

**Biomass is a renewable energy source and can be anything from energy crops to agricultural or forestry residues and biogenic waste. Biomass can be used to produce both heat and electricity. It plays a key role in reducing CO<sup>2</sup> emissions from existing coal power plants by co-firing and producing green heat.**



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# What is "Biomass"?





# Conducted phenomena (IEEE 1159/1995)

1. Transients
2. Short duration variations
3. Long duration variations
4. Voltage unbalance
5. Waveform distortions
6. Voltage fluctuations
7. Power frequency variations

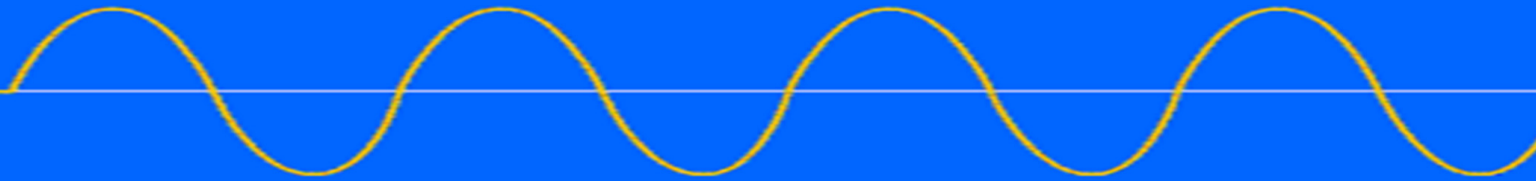


# Short Duration Variation

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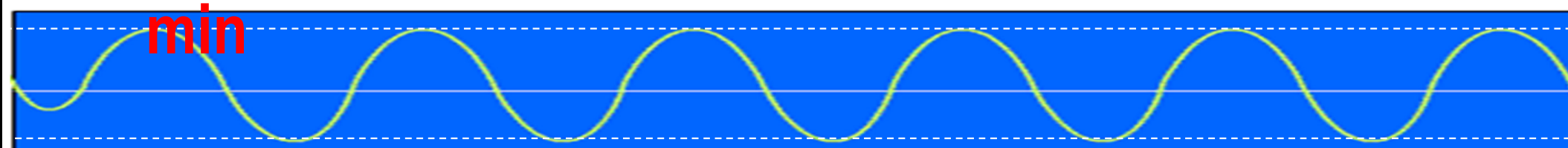
**Interruption < 1**

**min**



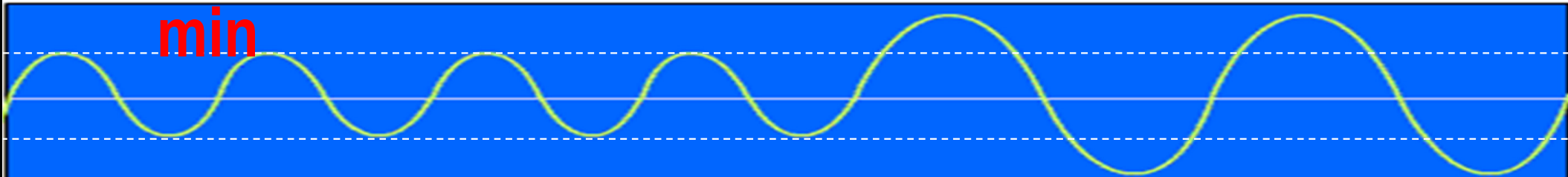
**Voltage Sag < 1**

**min**



**Voltage Swell < 1**

**min**

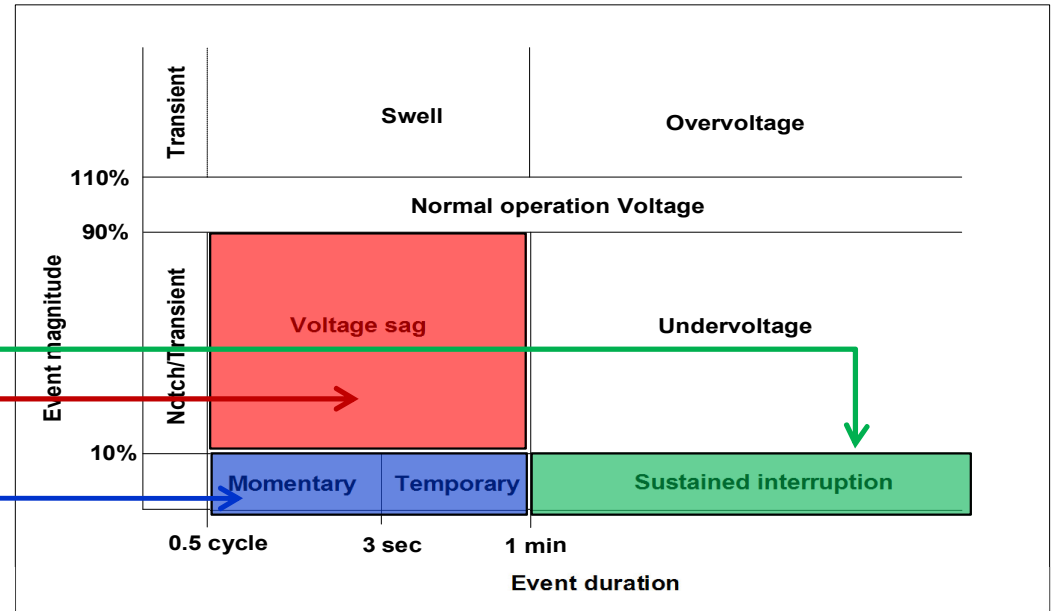




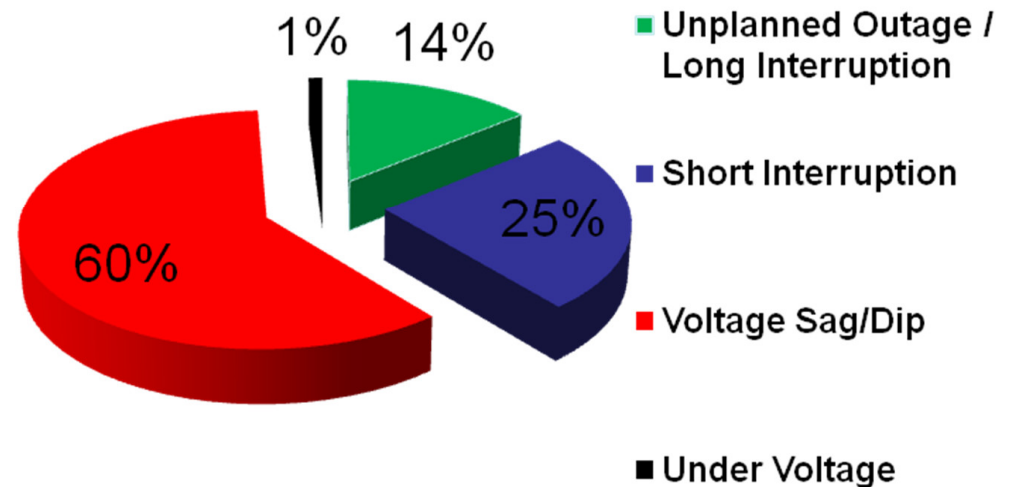
# PQ Problem effect to customer

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- **Planned Outage**
- **Unplanned Outage/ Long Interruption**
- **Short Interruption**
- **Voltage Sag/Dip**
- **Under Voltage**
- **Unbalance Voltage**



Definitions of voltage magnitude events as used in IEEE std.1159-1995

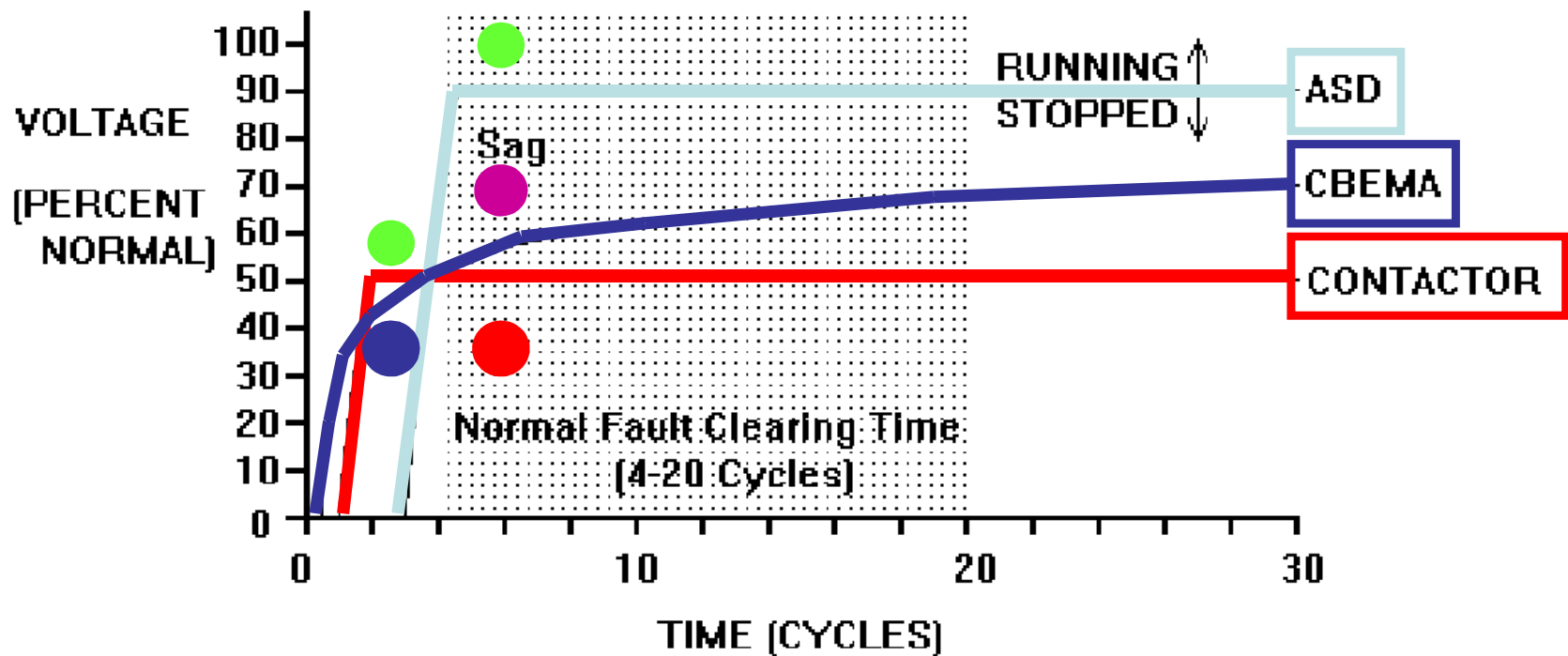






# Why are Voltage sag important?

Voltage sags are important because they cause equipment misoperation!







# Power Quality standard

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Voltage	Normal		Emergency	
	MAX	MIN	MAX	MIN
115 kV	120.7	109.2	126.5	103.5
33 kV	34.7	31.3	36.3	29.7
22 kV	23.1	20.9	24.2	19.8
380 V	418	342	418	342
220 V	240	200	240	200



# Power Quality standard

Point of Common Coupling : PCC (kV)	Total Harmonic Distortion Voltage THDv (%)	Individual Harmonic Distortion Voltage(%)	
		Odd	Even
0.4	5	4	2
11,12,22 and 24	4	3	1.75
33	3	2	1
69	2.45	1.63	0.82
115 and above	1.5	1	0.5

Harmonic : referring to PRC-PQG-01/1998



# Power Quality standard

Point of Common Coupling : PCC (kV)	Pst	Plt
Below 115 kV	<b>1.0</b>	<b>0.8</b>
More than 115 kV	0.8	0.6

Pst ; Short-Term Severity Values (10 minutes)

Plt : Long-Term Severity Values (2 hours)

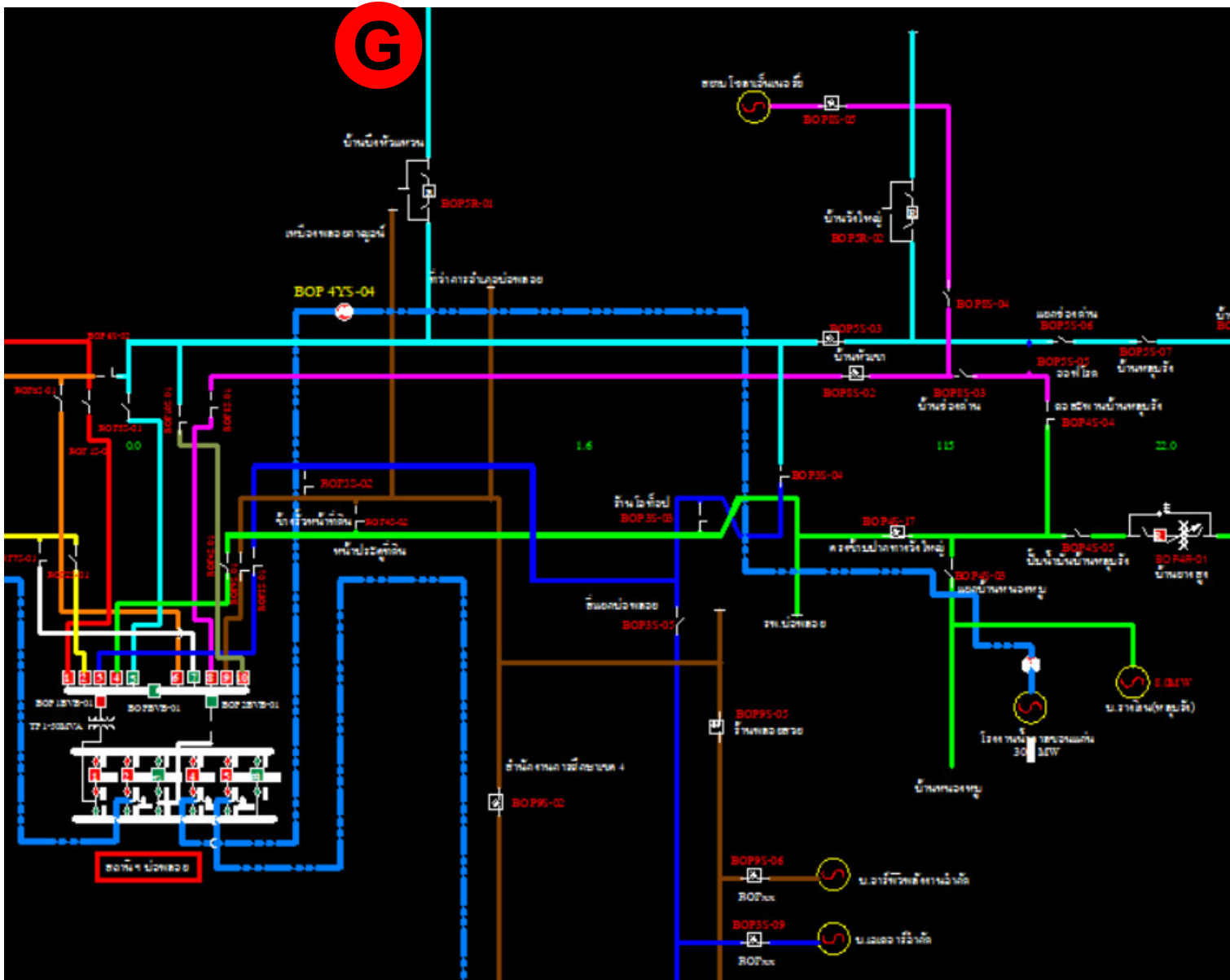
$$\sqrt[3]{\frac{1}{n} \sum_{j=1}^{j=n} (Pst_j)^3}$$

Voltage fluctuation : referring to PRC-PQG-02/1998



# Biomass Power Plant

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# Biomass Power Plant

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# Biomass Power Plant







# Biomass Synchronous Generator

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## Palm Waste

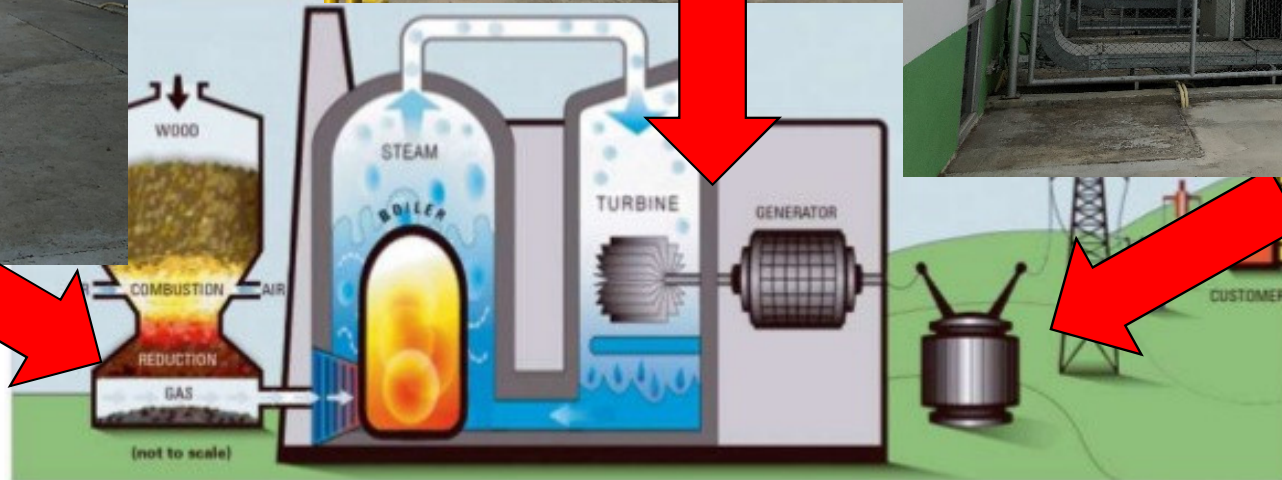


BIOGAS  
MODE  
CLASSIFICATION  
solid bio  
gas.  
Biomass  
GASIFICATION



GENERATION

## Transformer 10 MVA





# Monitoring

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**ACP**

โรงไฟฟ้าพลังงานสะอาดบ่อพลอย

ร้านนิตยภัต บ่อพลอย(เจ้าเก่า)

แอท เมืองพลอย รีสอร์ท At MuangPloy Resort

**BOP Substation**

สถานีไฟฟ้าบ่อพลอย

ข้อมูลสดการจราจร | เร็ว | ช้า



# Power Quality monitoring

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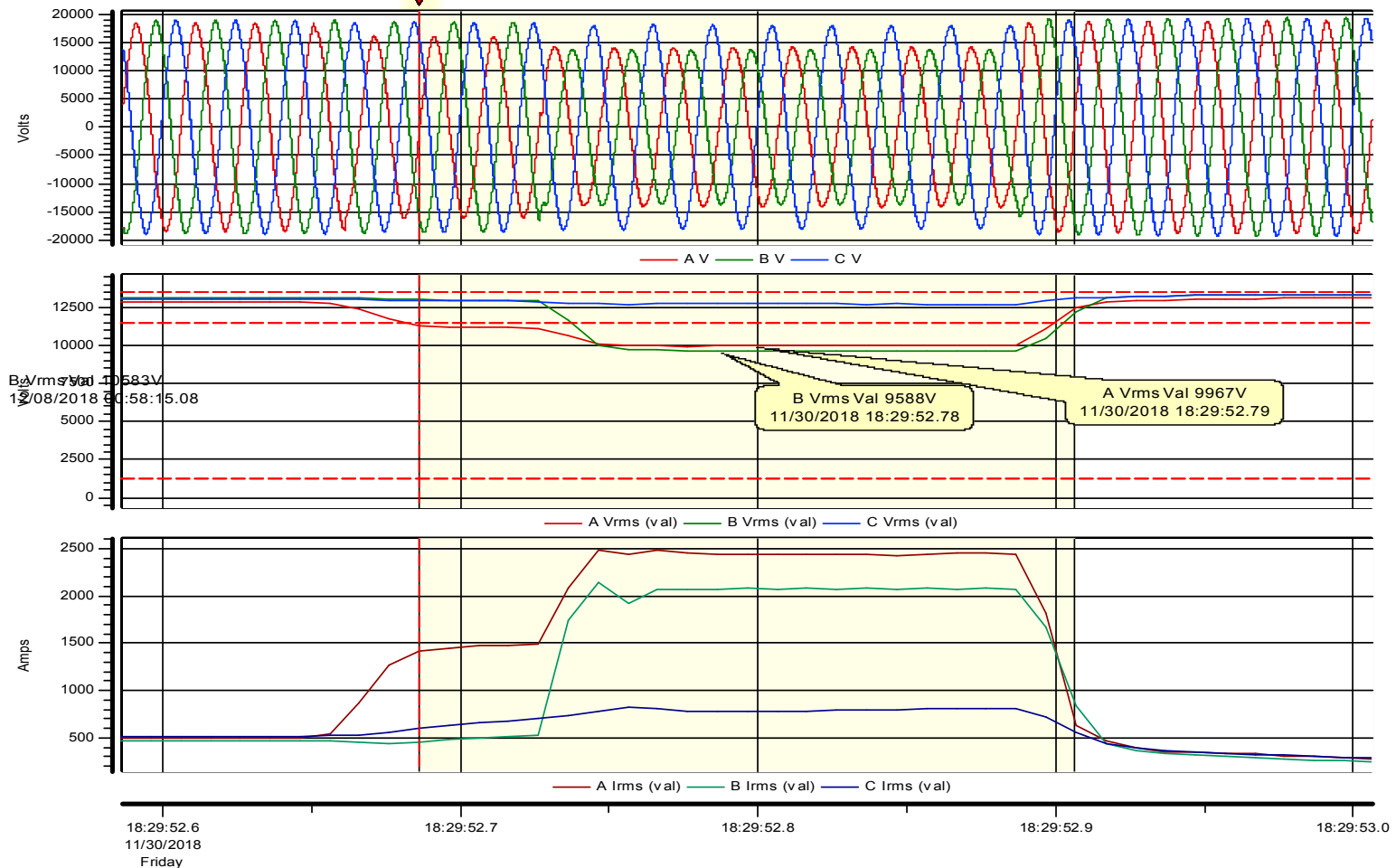


# Results : Power Quality Diagnostic

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Case 1  
Past 1

Event Details/Waveforms



**BOP : Voltage DIP**

Event #648 at 11/30/2018 18:29:52.686  
 AVrms, BVrms Instantaneous Sag  
 CATEGORY: Short Duration Instantaneous Sag

	AV	BV
Threshold crossed (V)	11430	11430
Magnitude (V)	9953	9586
MaxRMS (V)	11290	10474
Duration (sec.)	0.22	0.22

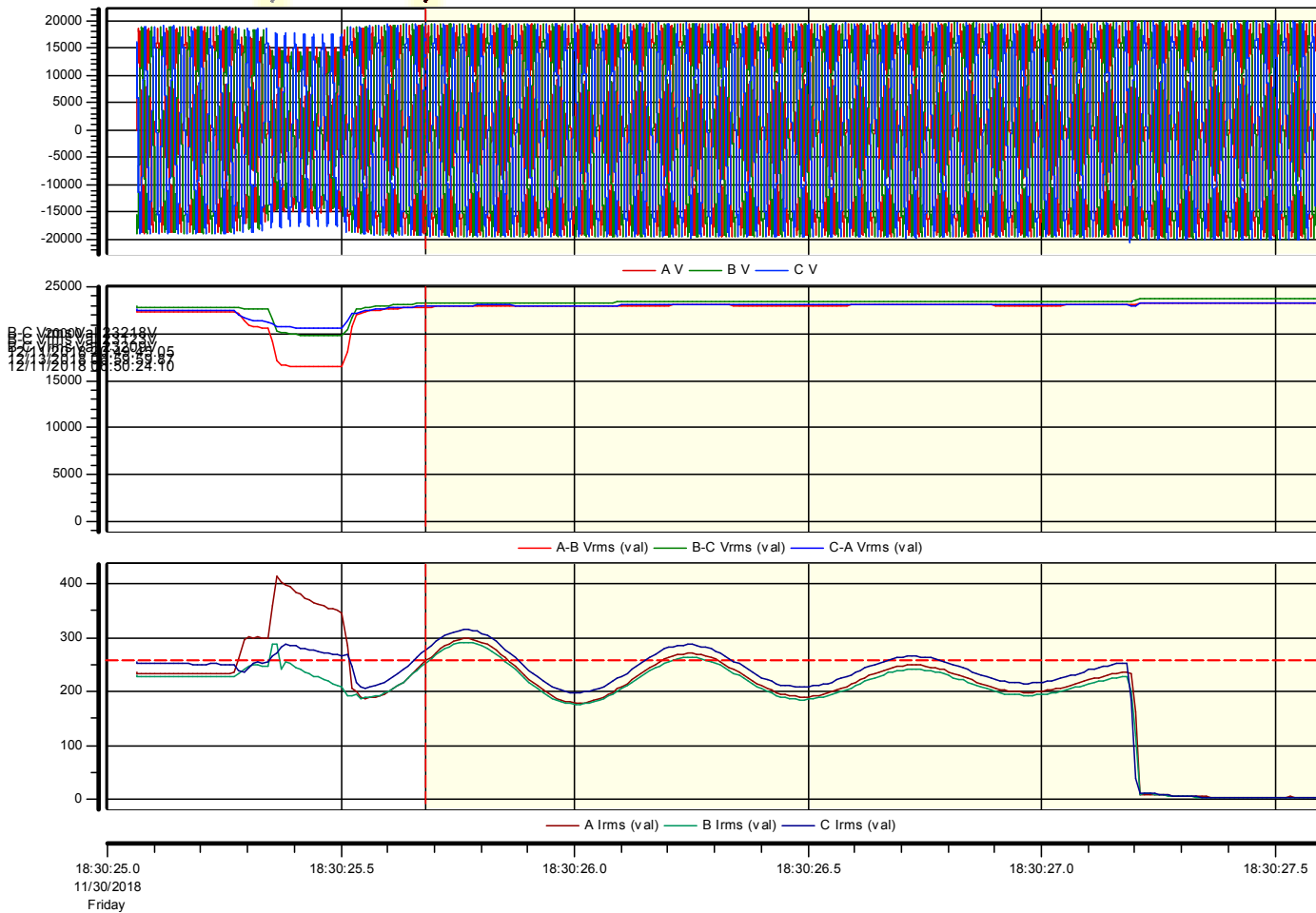


# Results : Power Quality Diagnostic

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Case 1  
Past 1

Event Details/Waveforms



Event #1040 at 11/30/2018 18:30:25.682  
AVrms, BVrms, CVrms Undervoltage  
CATEGORY: Long Duration Undervoltage

	AV	BV	CV
Threshold crossed (V)	11430	11430	11430
Magnitude (V)	231.4	219.9	245.2
MaxRMS (V)	13389	13650	13643
Duration (sec.)	113.2	113.2	113.2

ACP Trip

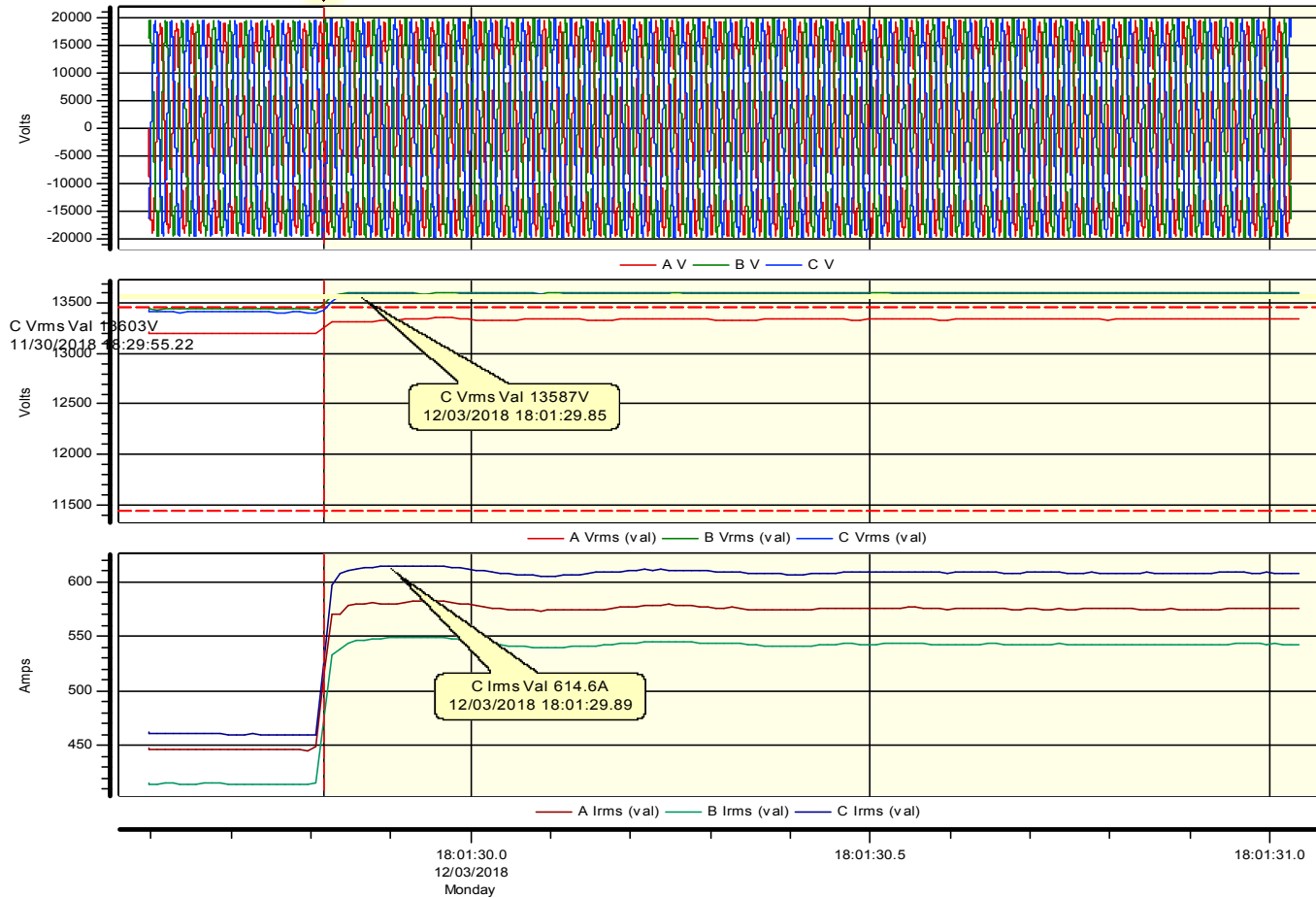


# Results : Power Quality Diagnostic

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## Case 2 Past 1

### Event Details/Waveforms



Event #1944 at 12/03/2018 18:01:29.816  
BVrms, CVrms Temporary Swell  
CATEGORY: Short Duration Temporary Swell

	BV	CV
Threshold crossed (V)	13462	13462
Magnitude (V)	13613	13595
MinRMS (V)	13263	13264
Duration (sec.)	23.57	23.57

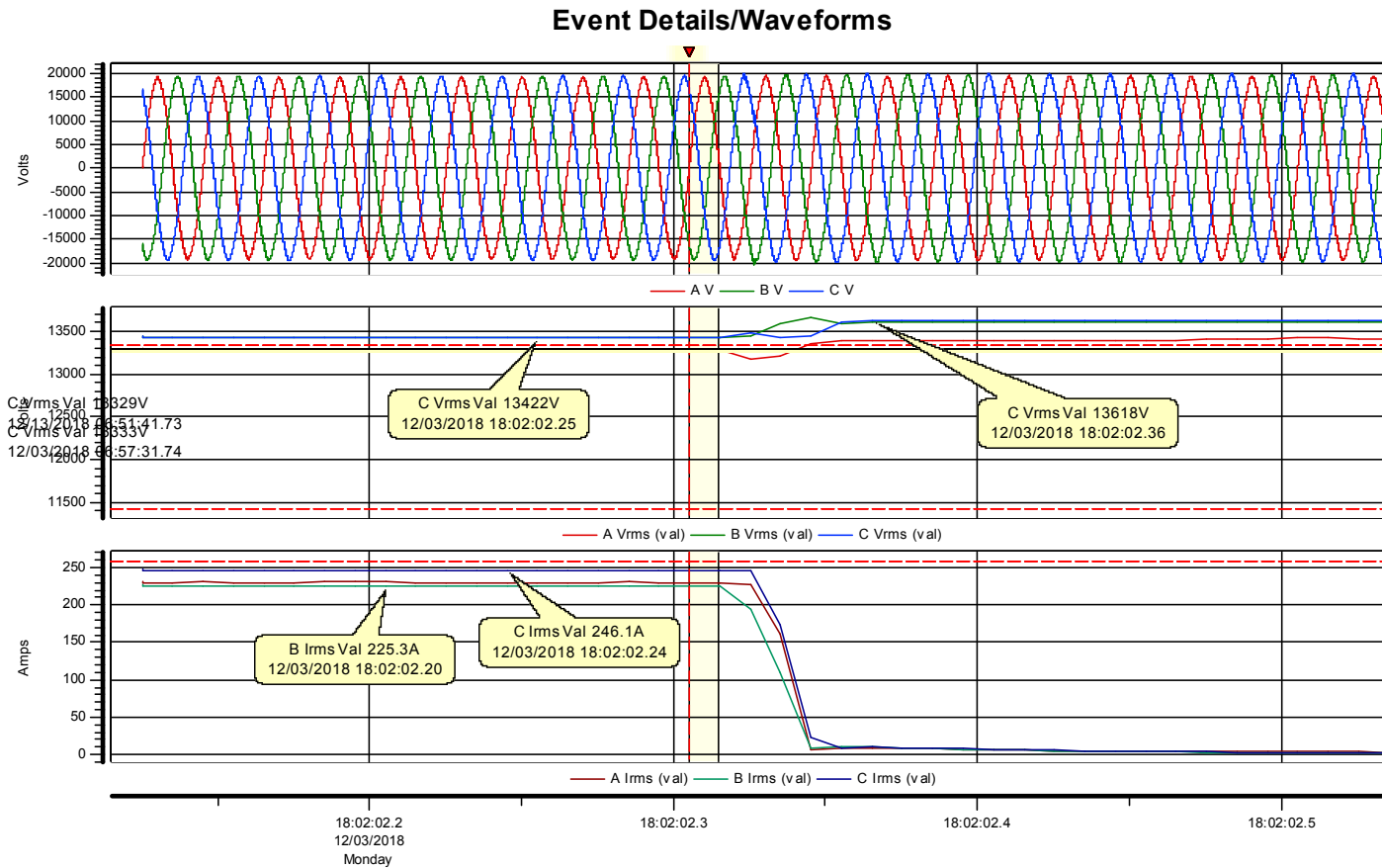
## BOP : NO Event



# Results : Power Quality Diagnostic

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## Case 2 Past 1



## ACP : Islanding Mode

Event #3034 at 12/03/2018 18:02:02.305

BV Mild Bipol Trans Neg 1/8 Cyc

CATEGORY: Transient

10% Ampl 6397  
50% Ampl 5870  
90% Ampl 5334  
10% Offset (usec) 15971  
50% Offset (usec) 16069  
Rise time 10-90% (usec) 165.3  
Worst Peak-to-Peak 2080

	A	B	C	D	A-B	B-C	C-A
<b>Vrms</b>	13279	13421	13420	16.14	23003	23395	23092
<b>VPeak</b>	19288	19349	19466	45.93			
<b>Irms</b>	230.0	225.3	246.2	44.86			
<b>IPeak</b>	331.1	327.0	367.1	51.20			

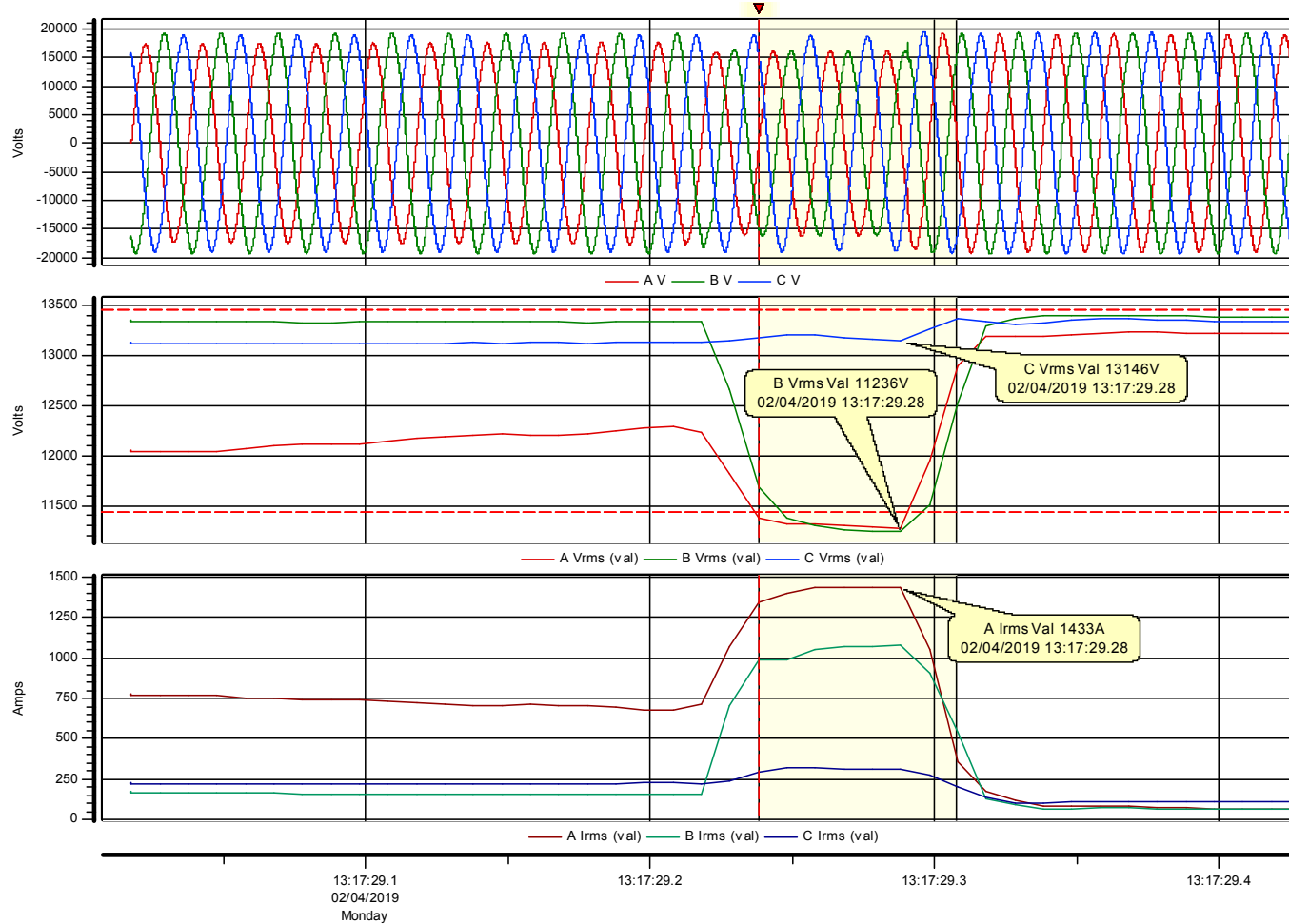


# Results : Power Quality Diagnostic

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## Case 1 Past 2

Event Details/Waveforms



Event #11881 at 02/04/2019 13:17:29.238  
AVrms, BVrms Instantaneous Sag  
CATEGORY: Short Duration Instantaneous Sag

	AV	BV
Threshold crossed (V)	11430	11430
Magnitude (V)	11272	11235
MaxRMS (V)	11382	11513
Duration (sec.)	0.07	0.07

## BOP : Voltage DIP



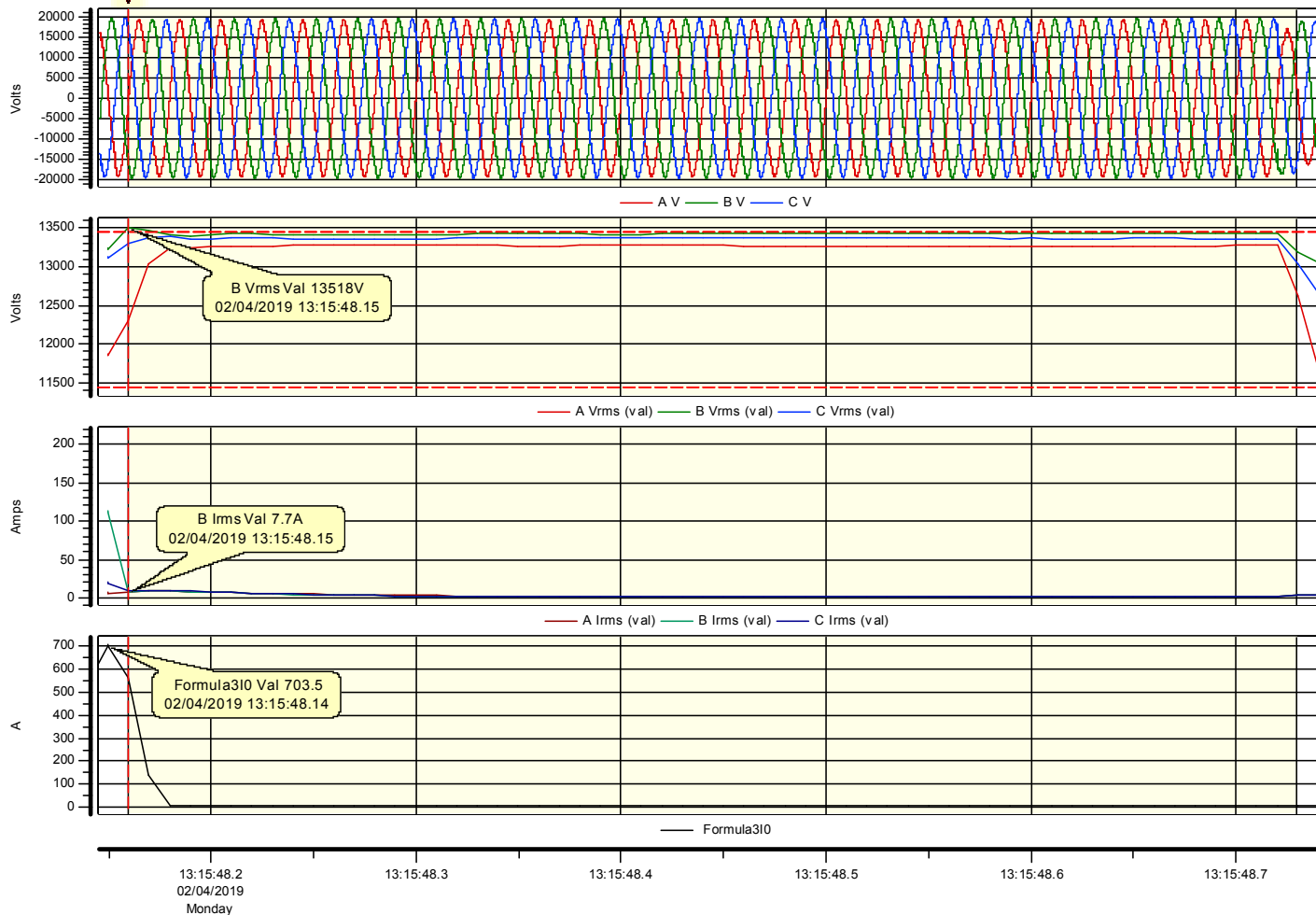


# Results : Power Quality Diagnostic

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## Case 1 Past 2

Event Details/Waveforms



Event #23711 at 02/04/2019 13:15:48.159  
BVrms Instantaneous Swell  
CATEGORY: Short Duration Instantaneous Swell  
Threshold crossed 13462 V  
Magnitude 13518 V  
MinRMS 13404 V  
Duration 0.57 Sec.

## ACP : Islanding Mode

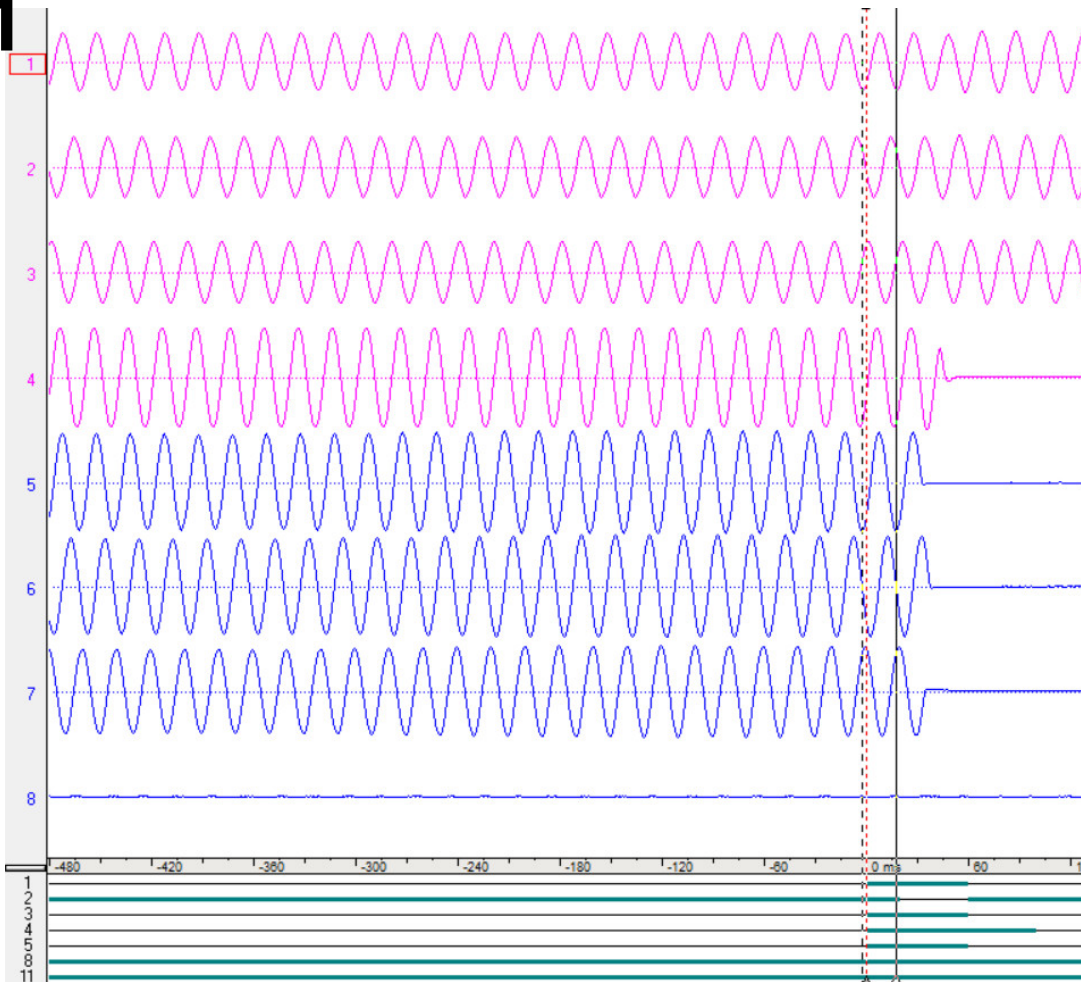


# Results : Power Quality Diagnostic

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## Disturbance Records from Easergy MiCOM P431 | Schneider Electric

Case 1  
Past 2



83558.2 V/m	12237.028	-17373.728	173.302 <sub>s</sub>	-17373.728	-13341.600	19014.832
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### ACP : Islanding Mode

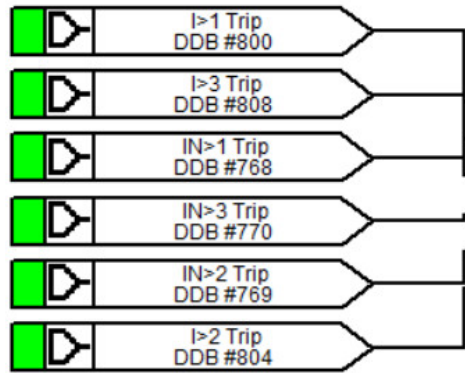


# Results : Power Quality Diagnostic

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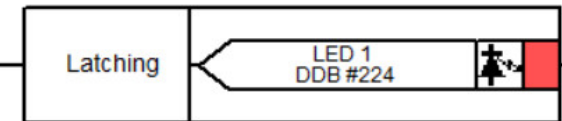
## Event from Easergy MiCOM P431 | Schneider Electric

### Case 1 Past 2



```

Output Contacts1
MiCOM P341
MiCOM
P341311E2M0710J
001 Column:00 Row:21
Device output changed state
00000011111
CN
CN
CN
  
```



```

Any Start On
IN>1 Start ON
MiCOM P341
MiCOM
P341311E2M0710J
001 Column:0F Row:3F
Standard Event
00000000000000000100000000000000
  
```

## ACP : Islanding Mode

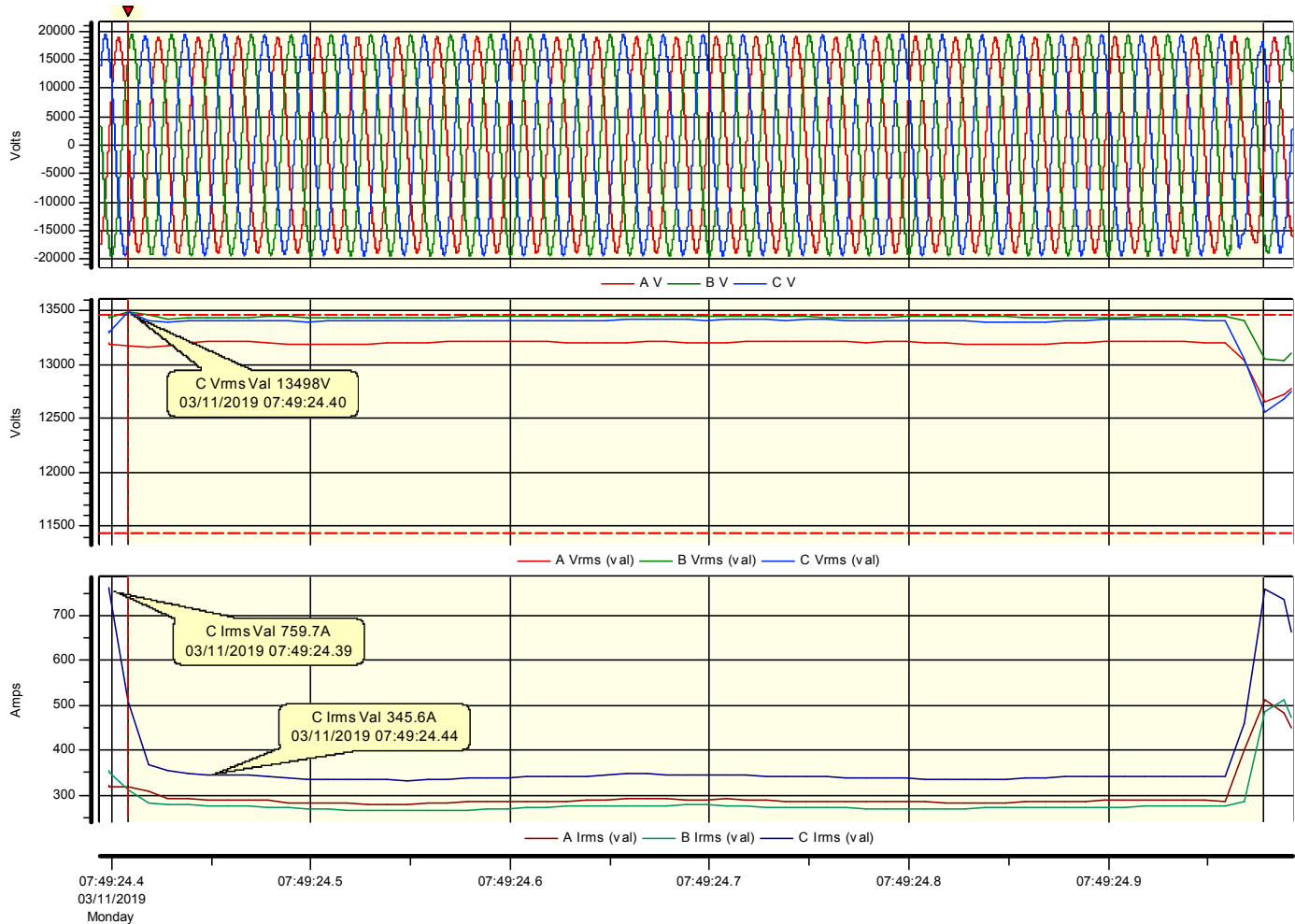


# Results : Power Quality Diagnostic

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## Case 1 Past 3

Event Details/Waveforms



## BOP : Voltage DIP

Event #9811 at 03/11/2019 07:49:24.408  
BVrms, CVrms Instantaneous Swell  
CATEGORY: Short Duration Instantaneous Swell

	BV	CV
Threshold crossed (V)	13462	13462
Magnitude (V)	13497	13498
MinRMS (V)	13403	13391
Duration (sec.)	0.569	0.569

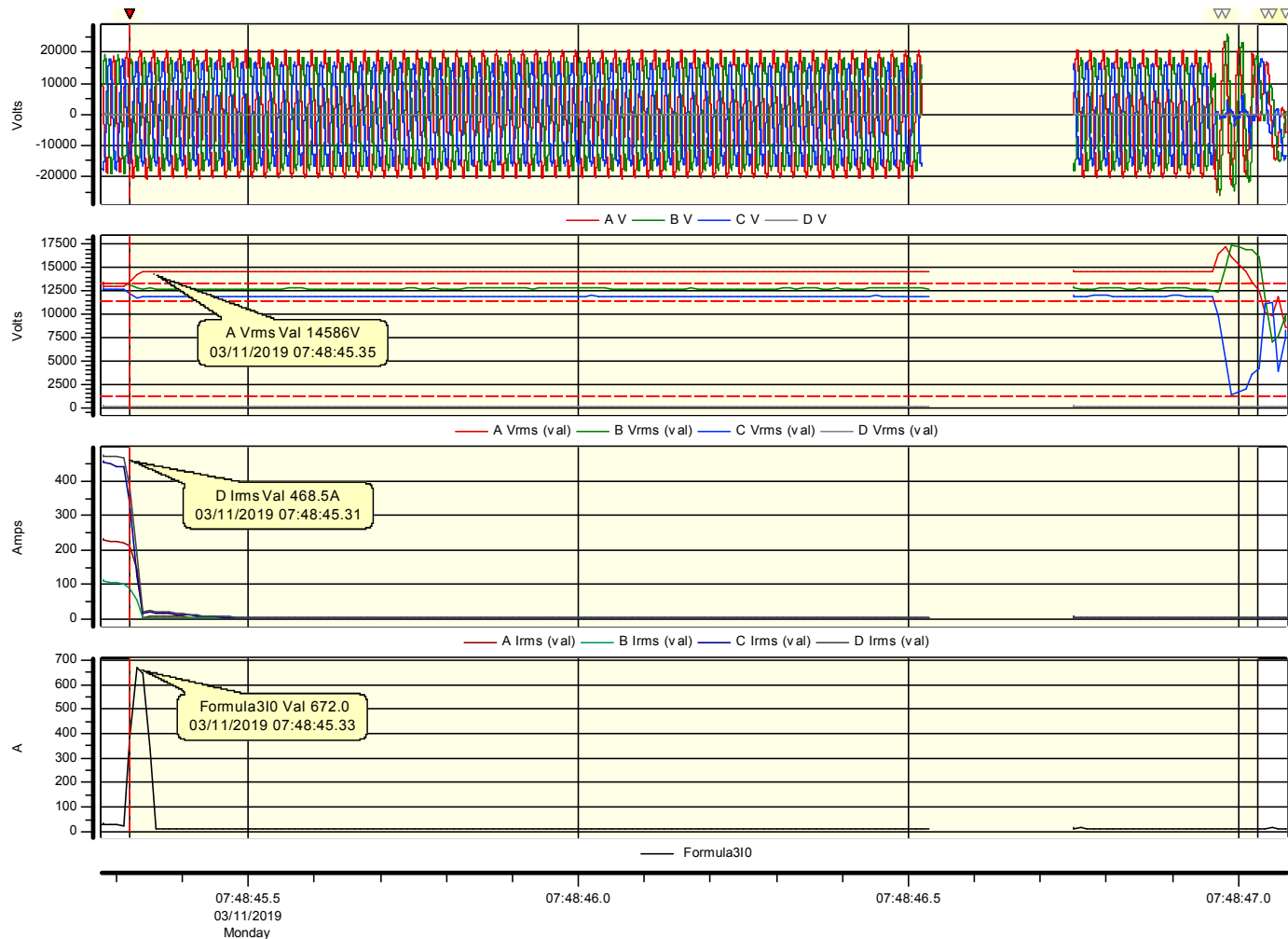


# Results : Power Quality Diagnostic

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## Case 1 Past 3

### Event Details/Waveforms



## ACP : Islanding Mode

Event #16311 at 03/11/2019 07:48:45.320  
 AVrms Momentary Swell  
 CATEGORY: Short Duration Momentary Swell  
 Threshold crossed 13335 V  
 Magnitude 17300 V  
 MinRMS 13458 V  
 Duration 1.71 Sec.





# Results : Power Quality Diagnostic

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## Case 1 Past 3

```

Fault Alarms: 00001000000
0 CB Fail 1: OFF
1 CB Fail 2: OFF
2 VTS: OFF
3 CTS: OFF
4 VCO: OFF
5 CLP: OFF
6 AR Trip 1: ON
7 AR Trip 2: OFF
8 AR Trip 3: OFF
9 AR Trip 4: OFF
10 AR Trip 5: OFF

Fault Time: Monday 11 Mar
Active Group: 1
System Frequency: 49.98 H
Fault Duration: 1.739 s
CB Operate Time: 35.00ms
Relay Trip Time: 1.699 s
Fault Location: -1.789mi
IA: 220.1 A
IB: 88.86 A
IC: 234.5 A
VAB: 22.79kV
VBC: 23.21kV
VCA: 22.21kV
IN Measured: 135.8 A
IN Derived: 137.9 A
IN Sensitive: 0 A
VAN: 12.92kV
VBN: 13.37kV
VCN: 13.10kV
VN Derived: 218.9 V

Trip Elements 1: 000000000000000000010010001
0 Any Trip: ON
1 Trip I>1: OFF
2 Trip I>2: OFF
3 Trip I>3: OFF
4 Trip I>4: ON
5 Unused: OFF
6 Trip Broken Line: OFF
7 Trip IN1>1: ON
8 Trip IN1>2: OFF
9 Trip IN1>3: OFF
10 Trip IN1>4: OFF
11 Trip IN2>1: OFF
12 Trip IN2>2: OFF
13 Trip IN2>3: OFF
14 Trip IN2>4: OFF
15 Trip ISEF>1: OFF
16 Trip ISEF>2: OFF
17 Trip ISEF>3: OFF
18 Trip ISEF>4: OFF
19 Trip IREF>: OFF
20 Trip NVD VN>1: OFF
21 Trip NVD VN>2: OFF
22 Trip Thermal: OFF
23 Trip V2>: OFF
24 Trip I>5: OFF
25 Trip I>6: OFF

Monday 11 March 2019 07:40:15.518 : Fault Recorded
Description: 22kV Outgoing8
Plant reference: BO PHLOI
Model number: P142311D1M0440J
Address: 001 Column:01 Row:00
Event type: Fault record
Event Value: 0

Faulted Phase: 11001100
0 Start A: OFF
1 Start B: OFF
2 Start C: ON
3 Start N: ON
4 Trip A: OFF
5 Trip B: OFF
6 Trip C: ON
7 Trip N: ON

```

## BOP : Voltage DIP



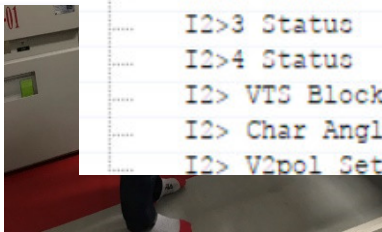
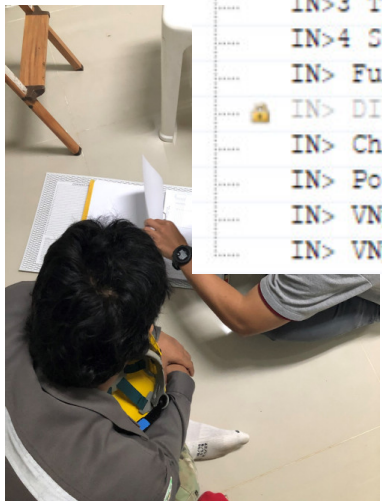
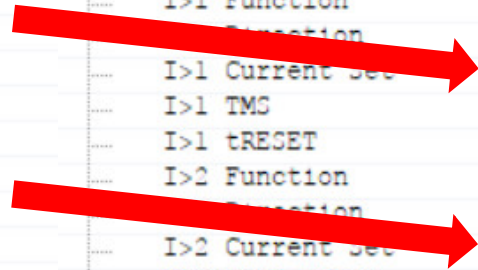
# Conclusion

## Power Quality issues in ACP Biomass Power Plant

1.

GROUP 1 EARTH FAULT	
IN> Input	Derived
IN>1 Function	IEC S Inverse
IN>1 Direction	Non-Directional
IN>1 Current	230.0 mA
IN>1 TMS	75.00e-3
IN>1 tRESET	0 s
IN>2 Function	DT
IN>2 Direction	Directional Fwd
IN>2 Current	500.0 mA
IN>2 Time Delay	30.00 ms
IN>2 tRESET	0 s
IN>3 Status	Enabled
IN>3 Direction	Non-Directional
IN>3 Current	2.000 A
IN>3 Time Delay	30.00 ms
IN>4 Status	Disabled
IN> Func Link	1111
IN> DIRECTIONAL	
IN> Char Angle	-45.00 deg
IN> Pol	Zero Sequence
IN> VNpol Input	Derived
IN> VNpol Set	5.000 V

GROUP 1 OVERCURRENT	
PHASE O/C	
I>1 Function	IEC S Inverse
I>1 Direction	Non-Directional
I>1 Current Set	680.0 mA
I>1 TMS	75.00e-3
I>1 tRESET	0 s
I>2 Function	DT
I>2 Direction	Directional Fwd
I>2 Current Set	1.750 A
I>2 Time Delay	30.00 ms
I>2 tRESET	0 s
I>3 Status	Enabled
I>3 Direction	Non-Directional
I>3 Current Set	1.500 A
I>3 Time Delay	30.00 ms
I>4 Status	Disabled
I> Char Angle	45.00 deg
I> Function Link	1111
NPS OVERCURRENT	
I2>1 Status	Disabled
I2>2 Status	Disabled
I2>3 Status	Disabled
I2>4 Status	Disabled
I2> VTS Blocking	1111
I2> Char Angle	45.00 deg
I2> V2pol Set	5.000 V







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# Conclusion

## Power Quality issues in ACP Biomass Power Plant

### 2. Patrol 5 kM reduce T/R in PEA





# Q&A