

# PQ Event Analysis

- By referring to the Daily Transmission Lines Report, the consultant team managed to identify the origin of the voltage sag events that occurred due to external factor.
- The Consultant team has also liaised through email with TNB representative, Ir. Dr. Mohammed Fuad to help in identifying the probable causes of voltage sag events that cannot be determined from the Daily Transmission Lines Report.

## Triggered Event at Monitoring Sites

Date and Time	Second	Monitoring Sites																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
2 Jan 2011 13:19:23	0.376980									0.89																		
2 Jan 2011 13:19:24	0.216090									0.87																		
2 Jan 2011 13:19:37	0.047048									0.88																		
17 Jan 2011 17:46:58	0.361546				0.55																							
19 Jan 2011 17:46:59	0.123944																					1.10						
19 Jan 2011 17:46:59	0.284455																					1.10						
19 Jan 2011 17:47:30	0.467748																					1.10						
19 Jan 2011 17:47:30	0.918107																					1.10						
19 Jan 2011 17:47:31	0.118130																					1.10						
19 Jan 2011 17:48:24	0.274849																					1.10						
19 Jan 2011 17:58:25	0.748488																					1.10						
19 Jan 2011 17:58:26	0.148466																					1.10						
19 Jan 2011 17:58:27	0.033802																					1.10						
19 Jan 2011 17:58:28	0.148225																					1.10						
19 Jan 2011 17:58:28	0.548146																					1.10						
19 Jan 2011 17:58:31	0.146862																					1.10						
19 Jan 2011 17:58:31	0.546705																					1.10						
19 Jan 2011 17:58:54	0.138271																					1.10						
19 Jan 2011 17:58:59	0.740535																					1.10						
19 Jan 2011 17:59:22	0.161142																					1.10						
19 Jan 2011 17:59:22	0.761498																					1.10						
19 Jan 2011 17:59:30	0.165879																					1.10						
19 Jan 2011 17:59:36	0.170664																					1.10						
19 Jan 2011 18:01:17	0.082280																					1.10						
19 Jan 2011 18:01:29	0.085331																					1.10						
19 Jan 2011 18:01:30	0.085369																					1.11						
19 Jan 2011 18:37:10	0.800159																					1.11						
19 Jan 2011 18:37:11	0.112475																					1.10						
19 Jan 2011 18:39:29	0.089797																					1.10						
19 Jan 2011 18:50:38	0.061970																					1.11						
19 Jan 2011 19:07:20	0.868061																					1.10						
19 Jan 2011 19:07:38	0.866651																					1.10						
19 Jan 2011 19:07:45	0.779223																					1.10						
19 Jan 2011 19:07:45	0.798986																					1.10						
19 Jan 2011 19:07:46	0.665973																					1.10						
19 Jan 2011 19:07:50	0.865450																					1.10						
19 Jan 2011 19:08:38	0.873102																					1.10						
19 Jan 2011 23:21:00	0.494615																					1.10						
19 Jan 2011 23:25:35	0.037105																					1.10						
19 Jan 2011 23:31:25	0.116491																					1.10						
19 Jan 2011 23:32:26	0.965725																					1.10						
19 Jan 2011 23:32:41	0.953598																					1.10						
19 Jan 2011 23:32:56	0.943173																					1.10						
19 Jan 2011 23:32:58	0.142421																					1.10						
19 Jan 2011 23:32:59	0.277822																					1.10						
19 Jan 2011 23:33:14	0.938367																					1.10						
19 Jan 2011 23:33:20	0.939330																					1.10						
19 Jan 2011 23:33:26	0.333431																					1.10						
19 Jan 2011 23:39:09	0.065380																					1.10						
19 Jan 2011 23:39:15	0.055502																					1.10						
19 Jan 2011 23:39:34	0.031295																					1.10						
19 Jan 2011 23:39:39	0.025795																					1.10						
20 Jan 2011 0:00:01	0.999376																					1.10						
20 Jan 2011 0:00:23	0.995334																					1.10						
20 Jan 2011 0:00:33	0.000964																					1.13						
20 Jan 2011 6:34:28	0.220228																					1.10						
20 Jan 2011 6:34:28	0.428252																					1.10						

Note: Yellow Shade Indicate Event Occurred about the same time. Values show are in P.U.

- 1 Carsam
- 2 Agilent
- 3 Bangunan Gunasama Ipoh
- 4 Malaysia Airport
- 5 Tasek Corporation
- 6 NTFM Holdings Bhd
- 7 Flextronic Technology Sdn Bhd
- 8 Kordron Design Manufacturing
- 9 Hospital Besar Pulau Pinang
- 10 Knowles Electronic (M) Sdn Bhd
- 11 Bangunan Persekutuan alor Setar
- 12 Hospital Sultanah Bahiyah
- 13 Sitera Malaysia Sdn Bhd
- 14 Intel Products (M) Sdn Bhd
- 15 HICOM Honda Manufacturing (M) Sdn Bhd
- 16 Bangunan Tun HJ Abdul Razak
- 17 Hunstman Trioxide (M) Sdn Bhd
- 18 Perwaja Steel
- 19 Wisma Persekutuan Kuala Terengganu
- 20 KOWA-WAKO Electronics (M) Sdn Bhd
- 21 BASF Petronas Chemicals Sdn Bhd
- 22 Kinsteel Sdn Bhd
- 23 ORB HICOM Auto Solution Sdn Bhd
- 24 Vibrant Waves Sdn. Bhd.
- 25 Elektrisola (M) Sdn Bhd



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Date and Time	Second	Monitoring Sites																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
20 Jan 2011 6:51:47	0.999773																										1.10	
20 Jan 2011 6:52:45	0.025683																											1.10
20 Jan 2011 6:53:35	0.999533																											1.10
20 Jan 2011 6:53:53	0.979877																											1.10
20 Jan 2011 6:53:59	0.974915																											1.10
20 Jan 2011 6:54:08	0.966268																											1.10
20 Jan 2011 6:54:14	0.963994																											1.10
20 Jan 2011 6:54:32	0.950844																											1.10
20 Jan 2011 6:55:02	0.924914																											1.10
20 Jan 2011 6:55:08	0.922731																											1.10
20 Jan 2011 6:57:08	0.759546																											1.10
20 Jan 2011 6:58:32	0.649459																											1.10
20 Jan 2011 7:00:02	0.545332																											1.10
20 Jan 2011 7:10:14	0.983585																											1.11
20 Jan 2011 16:24:52	0.632086																											1.10
20 Jan 2011 16:25:58	0.428340																											1.10
20 Jan 2011 16:25:58	0.488217																											1.10
20 Jan 2011 16:25:58	0.638223																											1.10
20 Jan 2011 16:25:58	0.718111																											1.10
20 Jan 2011 16:26:48	0.386584																											1.10
20 Jan 2011 16:32:40	0.119996																											1.10
20 Jan 2011 16:32:40	0.738143																											1.10
20 Jan 2011 16:35:41	0.820138																											1.10
20 Jan 2011 16:35:43	0.121378																											1.10
20 Jan 2011 16:36:48	0.107247																											1.10
20 Jan 2011 16:37:42	0.091206																											1.10
20 Jan 2011 16:37:57	0.089170																											1.10
20 Jan 2011 16:38:15	0.095693																											1.10
20 Jan 2011 16:38:42	0.110281																											1.10
20 Jan 2011 16:39:24	0.128519																											1.10
20 Jan 2011 16:41:12	0.040113																											1.13
20 Jan 2011 19:15:47	0.940960																											1.10
20 Jan 2011 19:15:48	0.101029																											1.10
20 Jan 2011 19:15:48	0.201143																											1.10
20 Jan 2011 19:15:51	0.097781																											1.10
20 Jan 2011 19:16:15	0.129417																											1.10
20 Jan 2011 19:21:15	0.132341																											1.10
20 Jan 2011 19:21:21	0.222263																											1.10
20 Jan 2011 19:21:21	0.332344																											1.10
20 Jan 2011 19:21:21	0.748268																											1.10
20 Jan 2011 19:21:22	0.349157																											1.10
20 Jan 2011 19:21:48	0.177025																											1.10
20 Jan 2011 21:59:15	0.106752																											1.10
20 Jan 2011 21:59:15	0.136685																											1.10
20 Jan 2011 22:22:04	0.439381																											1.10
20 Jan 2011 22:22:04	0.457537																											1.10
20 Jan 2011 22:22:06	0.242558																											1.10
20 Jan 2011 22:22:26	0.678287																											1.10
20 Jan 2011 22:23:45	0.418874																											1.10
20 Jan 2011 22:23:46	0.901278																											1.10
20 Jan 2011 22:24:21	0.838786																											1.10
20 Jan 2011 22:24:22	0.847660																											1.10
20 Jan 2011 22:25:33	0.917121																											1.10
20 Jan 2011 22:26:44	0.290543																											1.15
21 Jan 2011 12:46:46	0.268390																											1.10
21 Jan 2011 12:46:48	0.277962																											1.10
21 Jan 2011 12:46:54	0.281732																											1.10

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- 13 Siltera Malaysia Sdn Bhd
- 14 Intel Products (M) Sdn Bhd
- 15 HICOM Honda Manufacturing (M) Sdn Bhd
- 16 Bangunan Tun Hj Abdul Razak
- 17 Hunstman Tioxide (M) Sdn Bhd
- 18 Perwaja Steel
- 19 Wisma Persekutuan Kuala Terengganu
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# Triggered Event at Monitoring Sites

Date and Time	Second	Monitoring Sites																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
22 Jan 2011 15:49:02	0.453784	0.88																										
22 Jan 2011 15:49:23	0.820172							0.89		0.89																		
22 Jan 2011 15:51:59	0.218292																											
22 Jan 2011 15:52:03	0.153563																											
22 Jan 2011 15:52:17	0.860990							0.88																				
22 Jan 2011 15:52:33	0.253497																											
22 Jan 2011 15:52:34	0.592295																											
22 Jan 2011 22:14:51	0.484330																											0.90
22 Jan 2011 22:14:51	0.594505																											0.90
23 Jan 2011 1:05:08	0.683620																											0.89
24 Jan 2011 3:25:35	0.947761																											0.90
24 Jan 2011 11:19:08	0.668206	0.90																										
24 Jan 2011 11:19:08	0.718463	0.90																										
24 Jan 2011 11:19:09	0.148864	0.90																										
24 Jan 2011 11:19:20	0.940339	0.89																										
24 Jan 2011 11:19:22	0.262127	0.89																										



## Triggered Event at Monitoring Sites

<http://cees.utm.my>

Date and Time	Second	Monitoring Sites																										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
19 Feb 2011 9:34:05	0.298551																											0.82
19 Feb 2011 9:34:22	0.751992																											0.87
19 Feb 2011 9:34:47	0.492558																											0.79
19 Feb 2011 9:35:31	0.080361																											0.89
19 Feb 2011 9:35:52	0.912425																											0.81
19 Feb 2011 10:21:16	0.671236																											0.87
19 Feb 2011 11:49:27	0.272376																											0.85
19 Feb 2011 19:13:14	0.030244	0.84																										
19 Feb 2011 19:13:17	0.122542																											
20 Feb 2011 11:50:52	0.630578		0.87																									
21 Feb 2011 7:46:02	0.106222																											0.89
22 Feb 2011 8:48:04	0.899487																											0.90
23 Feb 2011 20:22:11	0.405605																											0.90
23 Feb 2011 20:22:11	0.475597																											0.90
23 Feb 2011 20:22:11	0.555409																											0.90
23 Feb 2011 21:05:15	0.564693	0.89																										
24 Feb 2011 19:45:01	0.513038																											0.31
24 Feb 2011 20:54:56	0.930368																											0.31
25 Feb 2011 14:45:35	0.552666																											0.89
27 Feb 2011 14:10:51	0.668892																											0.88
28 Feb 2011 12:19:12	0.167244																											0.64
28 Feb 2011 12:21:34	0.565196																											0.88
28 Feb 2011 21:12:00	0.108265																											0.90
28 Feb 2011 21:12:00	0.168463																											0.90
28 Feb 2011 21:12:00	0.248387																											0.90
1 Mar 2011 5:34:02	0.782046																											0.89
1 Mar 2011 8:58:33	0.112079																											0.90
1 Mar 2011 8:58:33	0.132206																											0.90
1 Mar 2011 14:26:35	0.186545																											0.86
1 Mar 2011 23:33:19	0.074094																											0.90
2 Mar 2011 2:48:04	0.503704																											0.90
2 Mar 2011 2:48:04	0.624941																											0.90
2 Mar 2011 2:48:04	0.665693																											0.90
2 Mar 2011 21:17:21	0.806059																											0.90
2 Mar 2011 21:17:21	0.876202																											0.90
4 Mar 2011 7:32:54	0.944384																											0.44
6 Mar 2011 13:27:19	0.336030																											0.87
6 Mar 2011 13:27:38	0.640891																											0.57
6 Mar 2011 13:27:47	0.694998																											0.74
7 Mar 2011 22:45:11	0.165229																											0.90
7 Mar 2011 22:45:11	0.575549																											0.89

Note: Yellow Shade Indicate Event Occurred at the same time. Values show are in P.U.

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- 16 Bangunan Tun Hj Abdul Razak
- 17 Hurstman Tioxide (M) Sdn Bhd
- 18 Perwaja Steel
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- 25 Elektrisa (M) Sdn Bhd



POWER QUALITY BASELINE STUDY FOR PENINSULAR MALAYSIA



## Voltage Sag Events Detected by more than One Monitor

<http://cees.utm.my>

Event	No. of monitoring site affected	Date	Time
#1	6	22 - 1 - 2011	15:50
#2	3	24 - 1 - 2011	11:19
#3	2	25 - 1 - 2011	11:11
#4	2	04 - 2 - 2011	22:44
#5	3	09 - 2 - 2011	19:41
#6	2	19 - 2 - 2011	19:13
#7	2	28 - 2 - 2011	12:19
#8	3	06 - 3 - 2011	13:27
#9	4	18 - 3 - 2011	16:23
#10	4	21 - 3 - 2011	05:02
#11	6	17 - 4 - 2011	16:20
#12	6	18 - 4 - 2011	10:37
#13	5	18 - 4 - 2011	19:05
#14	2	22 - 4 - 2011	17:37
#15	9	26 - 4 - 2011	17:24
#16	6	28 - 4 - 2011	18:51
#17	2	30 - 4 - 2011	08:07
#18	8	07 - 5 - 2011	20:00
#19	6	12 - 5 - 2011	08:35
#20	2	21 - 5 - 2011	10:05
#21	6	28 - 5 - 2011	12:26
#22	2	31 - 5 - 2011	17:15
#23	2	01 - 6 - 2011	09:38
#24	2	01 - 6 - 2011	10:21
#25	9	10 - 6 - 2011	23:37
#26	3	12 - 6 - 2011	01:13
#27	4	15 - 6 - 2011	15:31
#28	5	15 - 6 - 2011	17:36
#29	9	03 - 7 - 2011	07:00

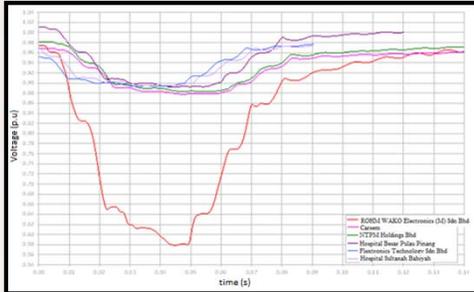
During the analysis, the consultant has discovered 29 voltage sag events that have been also detected by other monitor locations.



POWER QUALITY BASELINE STUDY FOR PENINSULAR MALAYSIA

# PQ Event Analysis

Example of Voltage Sag Event ( 22<sup>nd</sup> January 2011, 3:50pm)

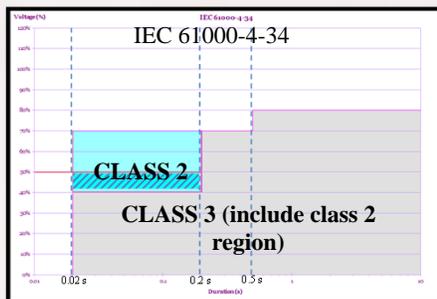


## Affected Monitoring Sites

1. Rohm Wako Electronics Sdn Bhd
2. Hospital Besar Pulau Pinang
3. Carsem Sdn Bhd
4. Flextronics Technology Sdn Bhd
5. Nibong Tebal Paper Mill (NTPM) Sdn Bhd
6. Hospital Sultanah Bahiyah

# PQ Event Analysis

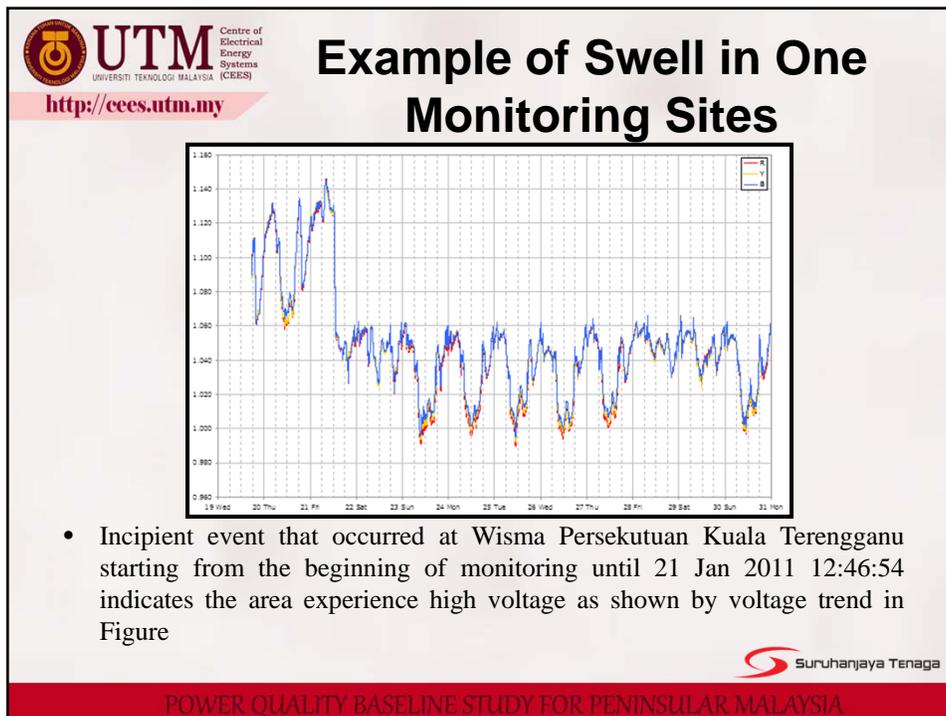
- From the total external events, the consultant has identified and analysed 29 of them. These events were plotted in IEC 61000-4-34 Curve in order to determine the severity of each event.



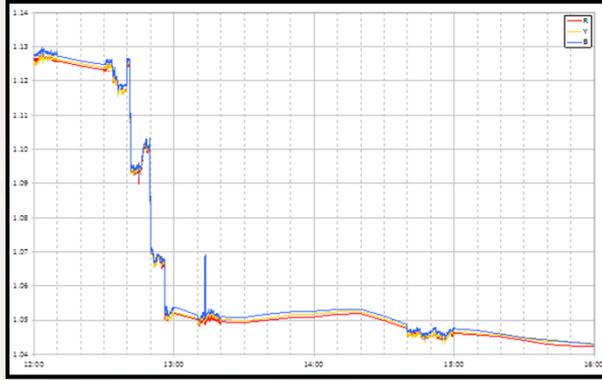
Class	Pass	Fail
1	29	0
2	9	20
3	25	4

Sites falls under class 3	Sites	Voltage (%)	Duration (sec)
1	Knowles Electronics (M) Sdn Bhd	35.57	0.5
2	Bang. Persekutuan Kangar	27.19	0.08
3	Silterra Malaysia Sdn Bhd	77.96	1.82
4	Agilent Technologies Sdn Bhd	39.30	0.15

 <b>UTM</b> Centre of Electrical Energy Systems (CEES) <b>Event not Meeting SEMI F47 Standard</b>						
No	Event	Site affected	Duration (s)	Voltage (%)	Cause	No of customer affected
1	Fri, 4 Feb 2011	Knowles Electronics (M) Sdn Bhd	0.5033162	35.57%		211
2	Wed, 9 Feb 2011	Knowles Electronics (M) Sdn Bhd	0.1506796	40.53%		326
		Agilent Technologies (M) Sdn Bhd	0.1502901	39.30%		
3	Mon, 21 Mar 2011	Bangunan Persekutuan Kangar	0.0791742	27.19%	Bukit Keteri – Chuping/Sadao 132 kV Line tripped	8
4	Sat, 7 May 2011	Silterra Malaysia Sdn. Bhd.	1.8166391	77.96%	Bukit Tengah 132kv Main Bus Bar tripped	12
5	Thu, 12 May 2011	Perwaja Steel Sdn Bhd	0.0998704	47.14%	Kampong Awah – Paka P/S 275 KV L2 tripped	45
6	Sat, 28 May 2011	Perwaja Steel Sdn Bhd	0.0815360	42.42%	YTL Paka P/S ST 20 tripped	45
7	Wed, 15 Jun 2011	Carsem Semiconductor Sdn Bhd	0.5204545	74.74%	Sg Siput - Lower Piah 132kV line 1 tripped	57
		Bangunan Gunasama Persekutuan Ipoh	0.5102322	73.40%		
8	Sun, 3 Jul 2011	Kontron Design Manufacturing Services (M) Sdn Bhd	0.0715026	49.03%	Prai GIS – Bukit Tengah 132 kV L1 tripped	97



- Improvement action has been taken to improve the voltage as shown by more refined voltage trend in figure below.

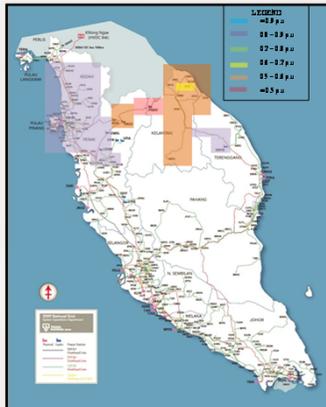


**Refined Voltage Trend at  
 Wisma Persekutuan Kuala Terengganu on  
 21 January 2011 from 12:00pm to 4:00pm**

## PQ Event Analysis

### Area of Vulnerability

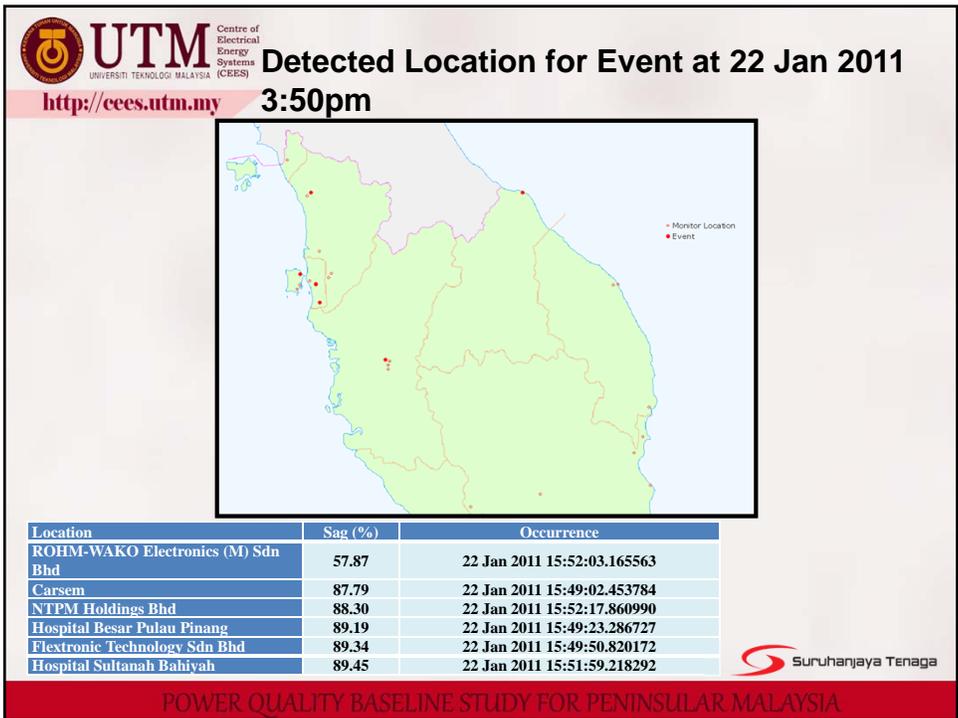
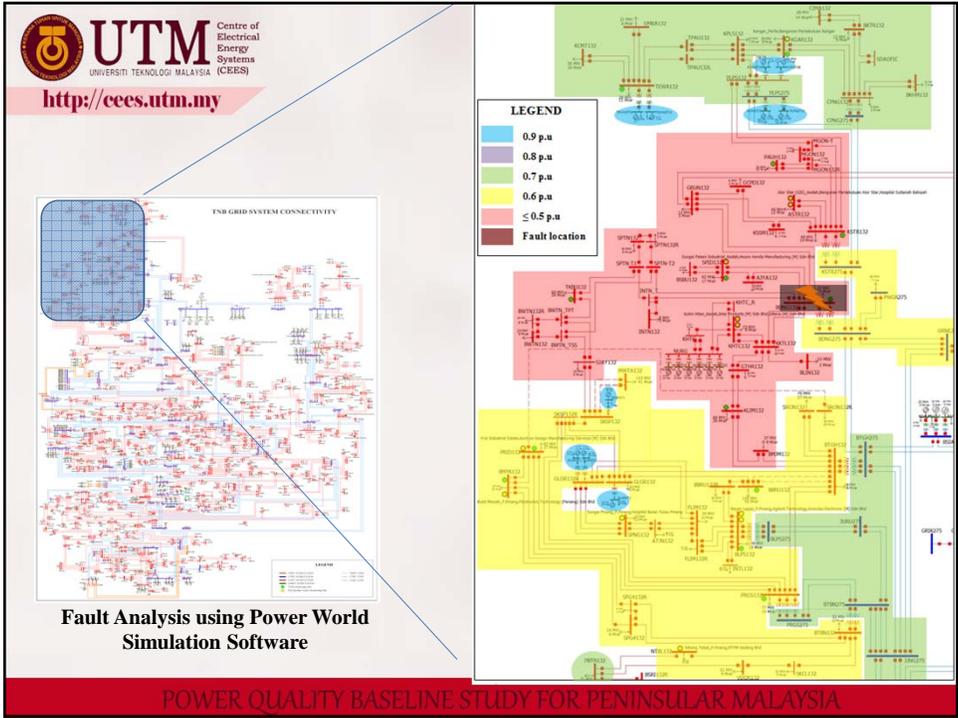
- From voltage sag analysis, the consultant determines the number of customers affected by the event.



Area of Vulnerability due to Fault on 22 Jan 2011, where it is estimated that there are 260 customers affected by PQ events

The process of determined the area of vulnerability is as follows:

- ✓ Estimate the fault location based on monitoring data.
- ✓ Check with Utility their fault records
- ✓ Run fault analysis by using Power World simulation software.
- ✓ Compare the affected area with the list of TNB customers to determine the number of customers affected by power quality events.





## Detected Location for Event at 24 Jan 2011 11:19:32am



Location	Sag (%)	Occurrence
Carsem	81.00	24 Jan 2011 11:19:32.871826
Bangunan Gunasama	82.52	24 Jan 2011 11:19:33.896114
Ipoh	87.94	24 Jan 2011 11:19:38.168463

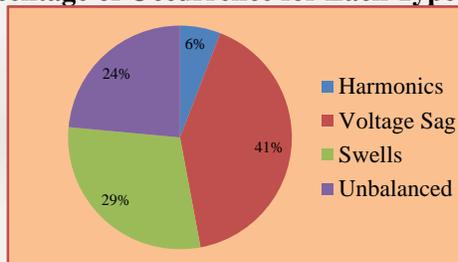


## Economic Analysis

### Response from Customer Regarding Power Quality Events

- Power quality questionnaire has been distributed to the industry sites through email and by hand in order to estimate the economic loss due to power quality events.
- The questionnaire is also available online.
- Up-to-date, 4 types of power quality events have been detected in the Malaysia industries; voltage sag, voltage swell, voltage unbalanced and harmonics.

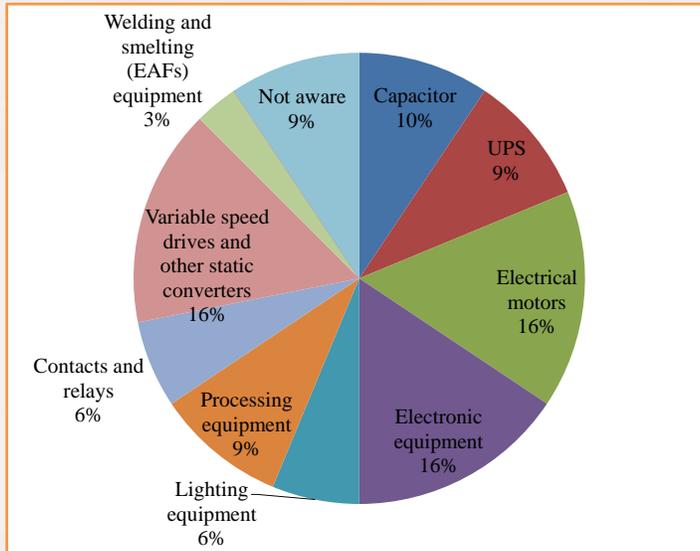
### Percentage of Occurrence for Each Type of PQ events





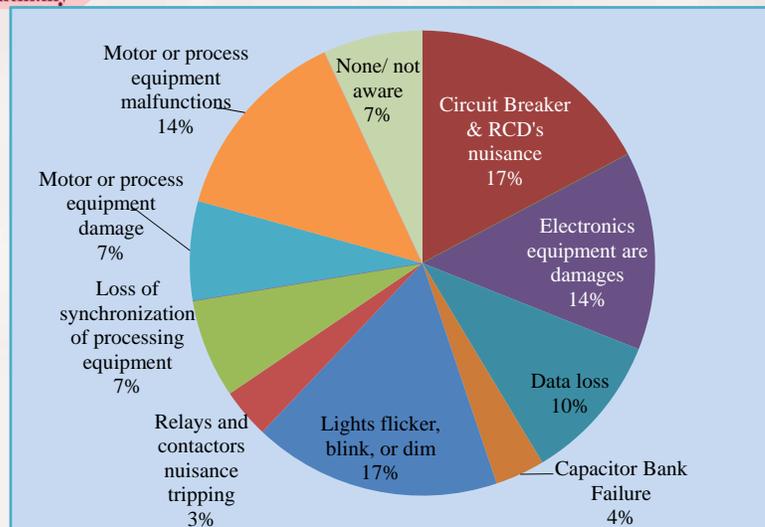
## Main Sources of PQ Events in Industry

<http://cees.utm.my>

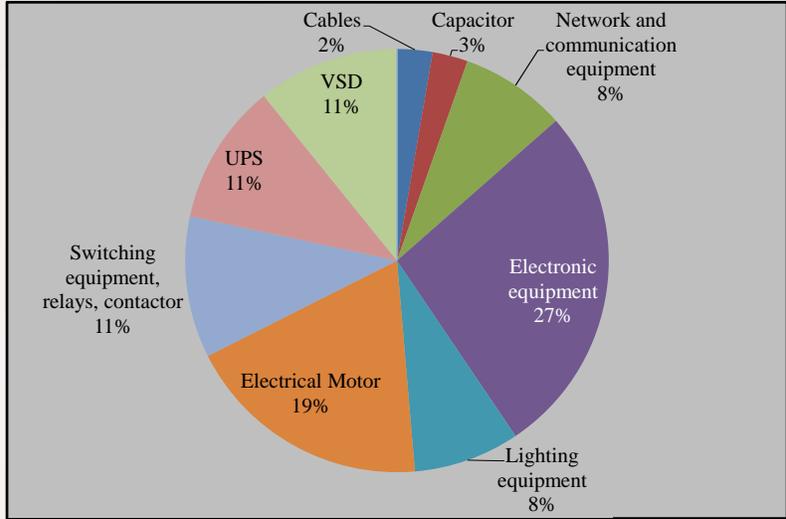


## Effect of the Occurrence of PQ Event

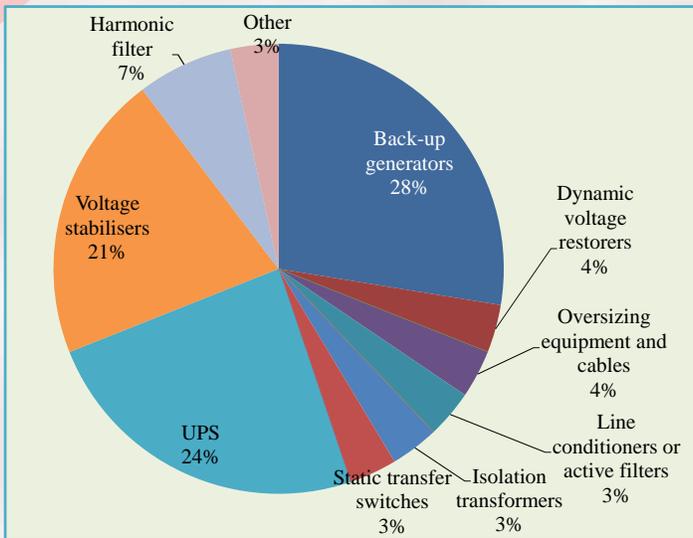
<http://cees.utm.my>



### Equipment Affected by the PQ Event



### Commonly Used Mitigation Method





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## Preliminary Suggestions

- Relook at nominal operating voltage of LV.
- Consider the effect of harmonics on true power factor which also affects energy efficiency and efficient utilization of network capacity.
- Determine comprehensively the extent of harmonics level in Malaysian industry.
- Re-examine the impact of transmission forced switching event on power quality.
- More rigorous survey on voltage sag and harmonic cost will be carried out.



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## Issues on Logging Sites

- Some potential participants are apprehensive in case it may lead to exposure of wrong poor practice.
- Some companies thought they need to shut-down the production to install the PQ logger.
- Some are afraid that the logging activity will disturb their operations.
- Participant is selected as a representative for each industry sector. No penalty will be charged if there is power quality event recorded.



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## Issue on Survey

- Participant do not know how to answer the power quality survey.
- Person who have to answer the questionnaire is too junior.



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# THANK YOU



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