



2006 PQWG Annual Report

March, 2007

CONTENTS

1. INTRODUCTION	1
2. MISSIONS AND OBJECTIVES	1
3. PQWG MEMBERS	2
4. 2006 PQWG ACHIEVEMENTS	3
4.1 PQWG Achievements – 1 st Meeting	3
4.2 PQWG Achievements – 2 nd Meeting	4
4.3 PQWG Achievements – 3 rd Meeting	7
5. FOLLOW UP THE 4th PQ WORKSHOP RECOMMENDATIONS IMPLEMENTATION	9
6. 2006 BULK CUSTOMERS DISTURBANCES	12
6.1 Disturbance Records – Trend Data	12
6.2 Disturbance Records – Causes	13
6.3 Disturbance Records – Voltage Levels.....	14
6.3 Disturbance Records – Locations	16
7. CONCLUSIONS	18
8. 2006 PQWG RECOMMENDATIONS	19
9. 2007 PQWG PLAN	20
Appendix (A)	A-1
Appendix (B)	B-1
Appendix (C)	C-1
Appendix (D)	D-1

1. INTRODUCTION

The Power Quality Working Group (**PQWG**) was formed according to the recommendations of 2004 PQ Workshop held in Riyadh March, 2004. The PQWG is a permanent committee with membership comprising of major industries, institutional firms and Saudi Electricity Company (SEC), chaired by the representative of the hosting organization.

One of the important recommendations of the 2004 PQ Workshop is to start establishing an annual report dealing with the existing PQ levels across SEC transmission network and its relative impacts upon SEC bulk industrial customers. The main objective of the desired annual report is to:

- Exchange information of PQ related topics between all PQWG members
- Extract lessons learned from discussing disturbances and fault incidents reported by SEC transmission systems and reported by bulk customers.
- Develop PQ database identifying records of disturbances and their effects upon the operation of their major industrial customers specifically Saudi Aramco and SABIC companies.
- Recommend for follow up actions so that secure supply system and high quality of power supply can be verified.

The purpose of implementing the work is to coordinate between all PQWG members, information and experiences, to ensure secure supply electricity delivered by SEC transmission networks to its major industrial customers so that adequate quality of power supply that meets customer's requirements and needs can be obtained.

For the work to be implemented three meetings have been scheduled by PQWG members during the year of 2006 and the last meeting has been scheduled on the 28th of February 2007. The assigned meetings were useful where PQ related topics have been discussed, recent customer or university PQ studies and projects have been demonstrated, and follow up actions and recommendations have been reviewed.

2. MISSIONS AND OBJECTIVES

PQWG will exchange information and technical data and unify procedures related to PQ issues in the Kingdom through the year of 2006. The group will form a good interconnection tool between SEC, its major bulk customers (Saudi Aramco and SABIC), and Kingdom research institutes. Supplying system disturbances that cause bulk customer's miss-operations or stop of production will be recorded, manipulated and analyzed. Identifying and following causes of disturbances and providing recommendations to enhance the performance of the supplying systems will also be carried out.

The main objectives of the desired PQWG- annual report are:

- **Reporting Disturbances:**

The performance of the supplying system will be identified throughout reporting disturbances that affect the operation of SEC bulk customers. Any event in the power systems, that results in deviation of the supplying system voltage from the normal ($\pm 5\%$) and emergency ($\pm 10\%$) conditions are planned to be collected.

- **Identifying PQ Problems:**

Analysis tools will be executed to identify disturbances, its origin and causes. This will be useful in providing suitable remedy action to reduce the possibility of disturbance occurrence.

- **Recommend Follow up actions:**

Following the analysis procedures, certain recommendations might be stated for specific remedy actions to be followed.

- **Enhance coordination between all parties:**

Coordination between all parties is one of the PQWG objectives. Coordination between SEC supplying system capabilities and bulk customer's needs, exchange information and experiences, and scheduled meetings between all parties will be useful to verify the maximum secure operating conditions and decrease the possibility of disturbance re-occurrence.

- **Develop PQ database:**

Finally, SEC will develop the PQ database required to evaluate the PQWG annual disturbance report during the year of 2006.

3. PQWG MEMBERS

Members who are willing and able to commit or engage their organization or institution in PQWG activities consists of:

- Saudi Electricity Company (SEC).
- The Royal Commission for Jubail and Yanbu (RCJY).
- King Abdulaziz City for Science and Technology (KACST).
- King Abdulaziz University (KAU).
- King Fahd University of Petroleum & Minerals (KFUPM).
- Saudi Aramco.
- SABIC.
- Power & Water Utility Company for Jubail & Yanbu (MARAFIQ).

Detail contact information, name, affiliation, contact phone and e-mail of all the PQWG members are listed in appendix (A)

4. 2006 PQWG ACHIEVEMENTS

PQWG has been verifying certain achievements throughout definite schedule meeting during the year of 2006. Dates, hosts, locations, and PQWG discussion points of the assigned meetings are explained in the following sub-sections.

2006 MEETING SCHEDULE

Meeting #	Meeting Date	Host	Location
1	May 03, 2006	SEC	Riyadh
2	September 13, 2006	SABIC	Jubail
3	December 13, 2006	KFUPM	Dhahran

4.1. PQWG Achievements – 1st Meeting

The meeting was on Wednesday 3rd of May, 2006 and hosted by SEC in Riyadh Marriott Hotel.

It started at 10:15; three new members attended the meeting, Dr. Ahmed Abdulwahab from KAAU, Mr. Ali Al-Shubaili from MARAFIQ and Mr. Hamad Al-Khaldi from Saudi Aramco. Mr. Al-Khaldi will replace Mr. Khaled Al-Ghadhban as an Alternate member for Saudi Aramco. Appendix (B) shows the full minutes of this meeting which includes the following discussion points:

I. Review Last Minutes of Meeting

- The last minutes of Meeting were reviewed with no comments from the members.

II. Review the Fourth Power Quality Workshop

- The group discussed the last power quality workshop, the group agreed to have a questionnaire during the workshop as Mr. Abdullah Al-Quraishi suggested.
- The group agreed to have one of it meeting one month before the next workshop.

III. Discuss the Fourth Power Quality Workshop Recommendations

- The group reviewed and agreed on the workshop recommendation which was sent to them by Mr. Khalid Al-Ghamdi, with few editorial comments, except Saudi Aramco requested to remove recommendation number # 9 ("Saudi Aramco shall present in the next workshop the findings and results of their study of Power Supply Integrity at Saudi Aramco Facilities in the Southern Area of the Eastern Province") from the 4th PQ workshop recommendations list, which will be reviewed by SEC and finalized within two weeks.

IV. Discuss the Working Group Objectives for 2006

- The group agreed to continue the last year practice of having at least two presentations on each meeting.
- Universities representatives will invite their visiting consultants to the group meeting.

V. Review 2006 Electric Disturbances Event for Customers Facilities

- Mr. Navin Joshi suggested moving the dead line of sending the monthly disturbances report to the 15th of each month instead of the 5th and the group agreed.

VI. Discuss Any Other Issues

- Members should confirm their attendance to the group secretary at least two days ahead of the meeting.
- The group members agreed on re-inviting SEC's generation and distribution sectors to the group meetings.
- Dr. Ahmed Abdulwahab will review the group disturbances reporting practice based on Canadian experience, and give a presentation in this regard on the next meeting, Mr. Abdullah Al-Quraishi and Mr. Khaled Al-Ghamdi will send him the related information next week.
- The group agreed on KFUPM suggestion to host the third PQWG meeting.
- The group members agreed to have the workshop as a reference for the group meetings.
- The group agreed on the meetings calendar as follows:
 - ✓ Second meeting on September 13th at Jubail host by SABIC.
 - ✓ Third meeting on December 13th at Dhahran host by KFUPM.
 - ✓ Fourth meeting on February 28th at Dhahran host by Saudi Aramco.

4.2. PQWG Achievements – 2nd Meeting

The meeting was on Wednesday 13th of September, 2006 and hosted by SABIC in Petrokemya Administration Building in Jubail.

Mr. Husain Al-Abbad, SABIC member started the meeting by welcoming all attendees. Also, he introduced the new Saudi Aramco member Mr. Khaled Al-Shammari (replacement for Mr. Abdullah Al-Guraishi). Also, he introduced Mr. Abdullah Al-Shehri from SEC-CTA system operation (Invited Guest to handle the SEC-CTA 2006 Summer Load Management Presentation). Appendix (C) shows the full minutes of this meeting which includes the following discussion points:

I. Review Last Minutes of Meeting

- Members discussed with KFUPM the possibility to invite one consultant to the next group meeting.

- Mr. Laith Al-Bassam will continue following up with Distribution and Generation sectors of SEC to attend power quality working group meetings.
- Group agreed from the next meeting to discuss only the action items in every minutes of meeting.

II. SEC Presentation: SEC-CTA Load Management during Summer 2006

Mr. Abdullah Al-Shehri presented the SEC-CTA (Consolidated Transmission Area) load management during summer 2006. The presentation mainly was about the following:

- SEC Preparation for 2006 Summer Demand.
- Lose of Generation Units (Ghazlan 3, Qurayyah 1 & others).
- 2006 Summer Load Management.
- SEC expectation for 2007 Summer Demand.
- Members agreed to include the load management during summer 2006 in their presentation in the 5th PQ workshop.

III. Saudi Aramco Presentation: Power System Performance

Mr. Khalid Al-Shammari presented the Saudi Aramco Power System Performance. The presentation mainly was about the following:

- Saudi Aramco Loads & Generation.
- 2005 & 2006 Outages Statistics.

IV. SABIC Presentation: Power Crises Faced by SABIC in Jubail during August 2006

Mr. Navin Joshi presented the Power Crises Faced by SABIC in Jubail during August 2006. The presentation mainly was about the following:

- Load shedding implemented by SEC from 18 Aug to 31 Aug 2006.
- History of Load shedding implemented by SEC.
- Reson for power crises during August 2006.
- SABIC Observations.
- Part I – Effect of power interruptions to Petrochemical Plants – Safety & Environment Issues.
- Part II – Effect of power interruptions to Petrochemical Plants – Technical issues.
- Part III – Effect of power interruptions to Petrochemical Plants – Commercial issues.
- Actions taken by SABIC companies.
- Short & Long term Recommendation for Petrochemical Industries.

PQWG Recommendations on SEC Presentation "SEC-CTA Load Management during Summer 2006":

- 1- Arrange a meeting between SEC, SABIC and ARAMCO to set a plan of action to mitigate the effect of such interruption.
- 2- Yearly meeting to be arranged by SEC (1st quarter) to share power forecast during summer and the requirements from bulk users.
- 3- Revised the load management procedure of bulk customers based on their priorities.
- 4- SEC needs to have adequate spinning reserve through a certain standby generation capacity according to general practice of utilities.
- 5- SEC needs to look distributed generation for special big customers such as, SABIC, Refineries....etc...
- 6- SEC needs to increase the satisfaction of bulk customer and to improve Network Reliability, therefore SEC needs to invest in new generation and transmission capacity.
- 7- SEC needs to boost the inter-connection with Gulf countries and other neighboring countries.

V. Discuss the 4th PQ Workshop Recommendations Implementation Status

- Members illustrated the 4th Power Quality workshop recommendations.
- Members requested SEC to send official invitation letter to Electricity and Co-Generation Regulatory Authority (ECRA) to nominate their representatives to attend power quality working group meeting. Mr. Laith Al-Bassam will follow up this item.

VI. Discuss the Next Power Quality Workshop Title and Agenda

- Group agreed the Power Quality Workshop Title will be 5th Power Quality Workshop.
- Group agreed that every member suggest agenda and discuss all suggestion in the next meeting (3rd 2006 meeting).

VII. Discuss Any Other Issues

- No other issues had been discussed.

VIII. Appointed The Next PQWG Meeting Locations & Agenda

- Group agreed that the next PQWG Meeting Location & Agenda (3rd 2006 Meeting) will be as scheduled.

4.3. PQWG Achievements – 3rd Meeting

The meeting was on Wednesday 13th of December, 2006 and hosted by KFUPM in the Research Institute Building in Dhahran.

The meeting started at 10:00, Dr. Mahmoud Kassas, the meeting chairman, started the meeting welcoming the attendees. Dr. Kassas introduced Dr. Mohamed Shwehdi as a new representative of KFUPM in the group, and then he reviewed the meeting agenda. Appendix (D) shows the full minutes of this meeting which includes the following discussion points:

I. Review Last Minutes of Meeting

- Collecting the PQWG recommendations regarding the 2006 summer interruptions and load management.
 - ✓ Mr. Khaled Al-Gamdi confirmed that he received three replies from Dr. Mohamed Salah Smiai, Mr. Asaad Al-Eesa and Mr. Hussain Al-Abbad regarding the PQWG recommendations.
- Invite one consultant to the 3rd meeting.
 - ✓ This item was replaced by KFUPM presentation.
- Following up with SEC Distribution and Generation to attend PQWG meeting.
 - ✓ Mr. Laith A. Al-Bassam confirmed that the generation sector agreed verbally to attend the next PQWG meetings.
 - ✓ Mr. Hamed Al-Saggaf will contact distribution sector – EOA to send representative to the group meetings.
- Inviting (ECRA).
 - ✓ Mr. Laith A. Al-Bassam confirmed that a letter was sent to ECRA to attend.
- Suggest Agenda for PQ Workshop.
 - ✓ This item is one of this meeting agenda points; therefore the group will discuss it later.

II. KFUPM Presentation by Dr. Tareq Abdulgalil

- The group members agreed to have the presentation at the end of this meeting.

III. Discuss PQWG Recommendations Regarding Summer 2006 Load Management

The group reviewed and agreed on the PQWG recommendations regarding summer 2006 load management, suggested by Dr. Mohamed Salah Smiai, Mr. Asaad Al-Eesa and Mr. Hussain Al-Abbad.

1. Due to shortage of generation capacity, SEC needs to maintain the reserve margin for the short-term (operation) and long-term (planning).

2. SEC needs to encourage co-generation for bulk customers (i.e. Saudi Aramco, SABIC...etc...).
3. SABIC are urge direct communication with SEC to discuss major interruptions and summer planning and report the outcome to PQWG.

IV. Discuss The Agenda of The Next PQ Workshop

- The group discussed the next power quality workshop which will be held in Riyadh, and agrees on the title as "The 5th PQ Workshop".
- The group suggested Wednesday March 28, 2007 as a date of the next workshop.
- The group suggested a total of six presentations instead of seven, as suggested in the last power quality workshop recommendations, for the up coming workshop.
- The group agreed on the following outline for the workshop:
 1. One presentation by SEC.
 2. One common presentation by PQWG members.
 3. One presentation by KFUPM.
 4. One presentation by SABIC.
 5. One presentation by Saudi Aramco.
 6. One presentation about regulation to be confirmed by Mr. Hamed Al-Saggaf.

V. Appointed The Next PQWG Meeting Location & Agenda

Next meeting will be as scheduled.

At the end of this meeting Dr. Tareq Abdelgalil presented KFUPM presentation "Investigation of Voltage Harmonics and Unbalance in Transmission Network, Preliminary Results" followed by group discussion.

5. FOLLOW UP THE 4th PQ WORKSHOP RECOMMENDATIONS IMPLEMENTATION

One of the main PQWG objectives is to follow recommendations that already assigned in the previous PQ workshop by Disturbance Analysis Working Group (DAWG 2005 Recommendations). Following are the 2005 – the 4th power quality workshop recommendations and the implementation status:

- **Recommendation No. 1**

SEC should continue development and installation of PQ monitoring system at the interface common coupling points between SEC supplying systems and the major bulk customers to follow quality of electricity supply delivered by SEC.

Action Taken

- SEC issuing Power Quality Monitoring project titled "Integrating Permanent Power Quality Monitoring System within SEC Transmission Network".

- **Recommendation No. 2**

Coordination and meetings between SEC and its customer should continue to insure adequate system capabilities to serve all bulk customers' needs, and to exchange information and experiences, and scheduled meetings between all parties.

Action Taken

- This is done through PQWG and direct between SEC and bulk customers.

- **Recommendation No. 3**

In future workshops, strategies and experiences in implementing quality of service regulation in different parts of the world EU, NA, and Asia should be presented (if possible).

Action Taken

- ECRA have been invited to present about this subject in the 5th PQ workshop.

- **Recommendation No. 4**

In SEC system interruption presentation, SEC should, starting next workshop, list all major interruptions and Blackout incidents experienced during the year and present details of a selected case.

Action Taken

- SEC presentation in the 5th PQ workshop will address this issue.

- **Recommendation No. 5**

Starting next workshop in PQWG presentation, major interruptions and Blackout incidents experienced by Saudi Aramco and SABIC during the year should be classified by voltage level with details of the worst to both customers.

Action Taken

- This will be addressed in the 5th PQ workshop PQWG presentation.

- **Recommendation No. 6**

SEC should present in future workshops, the results of its Voltage Harmonic & Unbalances study with KFUPM.

Action Taken

- KFUPM study consultant will present about the study in the 5th PQ workshop.

- **Recommendation No. 7**

All attendees have shown the urgent need to start the PQ standards Study. Hence, SEC shall finalize its efforts with KACST to award this study.

Action Taken

- Three new proposals have been submitted to SEC and the evaluation sent to KACST to select the consultant.

- **Recommendation No. 8**

SEC shall present, starting next workshop, a summary of its transmission reinforcement plans Kingdom wide.

Action Taken

- SEC will present this subject in the 5th PQ workshop.

- **Recommendation No. 9**

Saudi Aramco shall present in the next workshop the findings and results of their study of Power Supply Integrity at Saudi Aramco Facilities in the Southern Area of the Eastern Province.

Action Taken

- The study is not yet finished and finalized.

- **Recommendation No. 10**

Extend invitation for Electricity and Co-Generation Regulatory Authority (ECRA), representatives to attend power quality working group meetings.

Action Taken

- Official invitation has been sent to ECRA.

- **Recommendation No. 11**

PQWG shall continue following up with Distribution and Generation sectors of SEC to attend power quality working group meetings.

Action Taken

- Distribution sector has started attending the PQWG meeting. Generator will be started to attend next year (2007).

6. 2006 BULK CUSTOMERS DISTURBANCES

6.1 Disturbance Records – Trend Data

During the year of 2006, PQWG reported (143) fault incidents that having major effects upon the operation of Saudi Aramco & SABIC industrial bulk customers. The major effects were recorded in Saudi Aramco where 92% of the total disturbances introduce significant effects on Saudi Aramco operating systems.

Figure (6.1) shows numbers of disturbance records reported by each of the two industrial customers (Saudi Aramco and SABIC) while, for comparison, Figure (6.2) shows number of disturbances that have been recorded during the last four years.

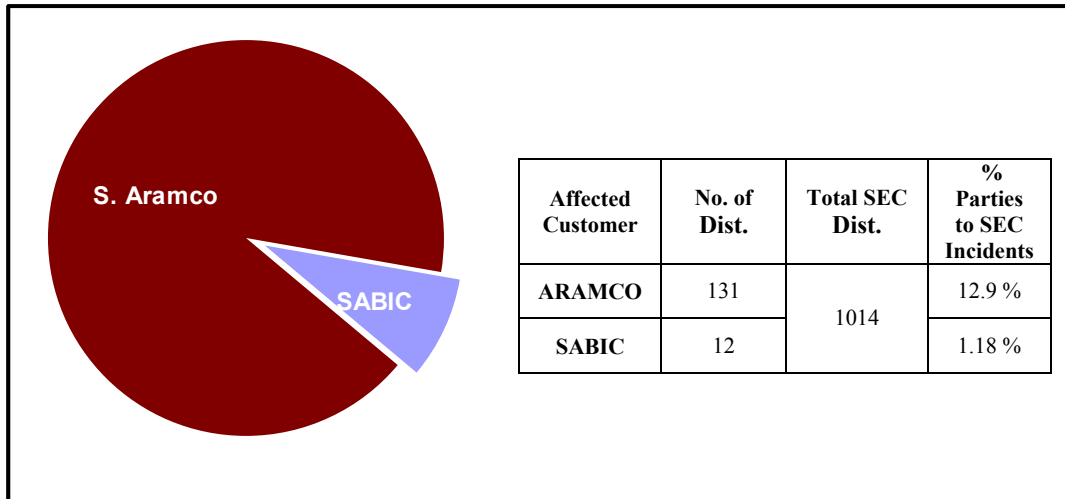


Figure 6.1: 2006 Total Number of Disturbances Affected Saudi Aramco & SABIC

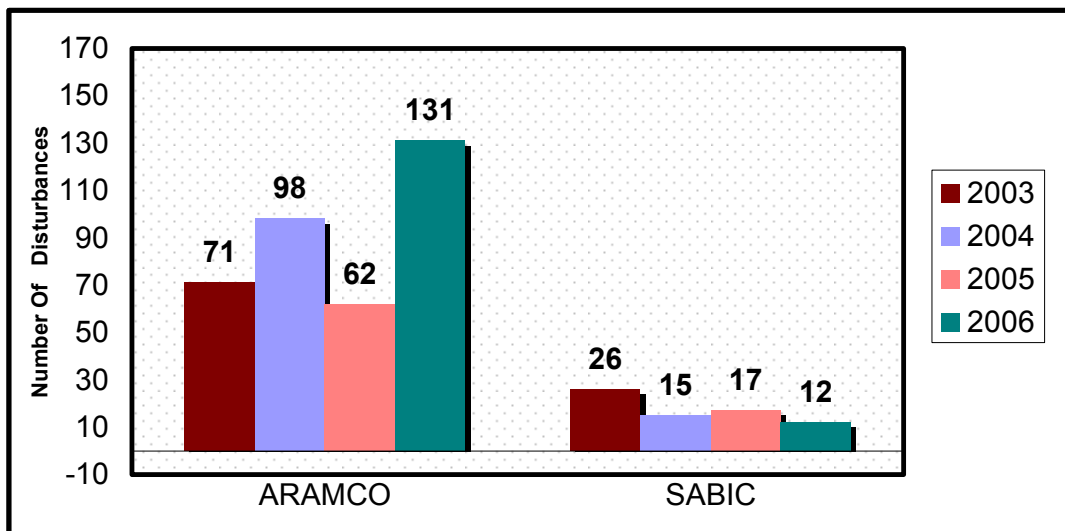


Figure 6.2: Number of Disturbances Affected Saudi Aramco & SABIC

6.2 Disturbance Records – Causes

The potential of disturbances could be resulted from number of basic causes that may include Weather Related Conditions, Equipment Failure (system component damages), Human Errors, Protection Mal-Operation, System Deficiency (weakness of the supplying system), and Miscellaneous. Figures 6.3 and 6.4 show the distribution of disturbances causes and their percentage parties that effected each of the industrial companies (Saudi Aramco and SABIC).

Results obtained from cause of disturbances representing figures indicate that, among the different cause of interruption classes, the Weather Related class is the major cause in the Saudi Aramco while it has no significant effects upon system operation of SABIC. The obtained results showed that 73% of the total Saudi Aramco disturbances are due to whether related conditions.

On the other hand, the Equipment Failure class is the major cause in SABIC while it has the second effects upon system operation of Saudi Aramco. The obtained results showed that 67% and 14% of the total SABIC and Saudi Aramco respectively disturbances are due to equipment failure.

In addition to that, human error, as not effective cause of disturbance, shows a low effects upon Saudi Aramco and SABIC operating system where it records 5% and 33 % respectively of the total Saudi Aramco and SABIC disturbances.

Also, miscellaneous as a third cause of disturbance upon Saudi Aramco where it records 7% of the total Saudi Aramco disturbances.

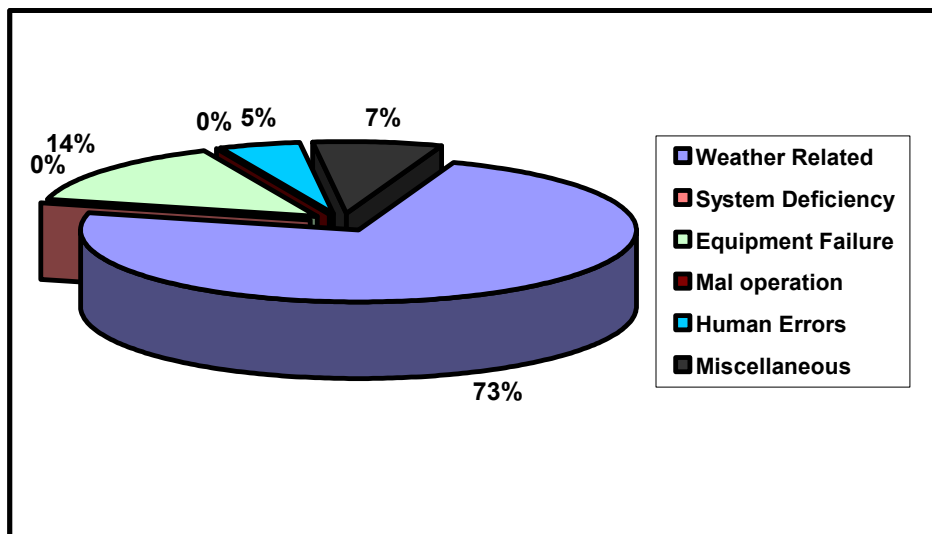


Figure 6.3: 2006 Cause of Disturbances affected Saudi Aramco

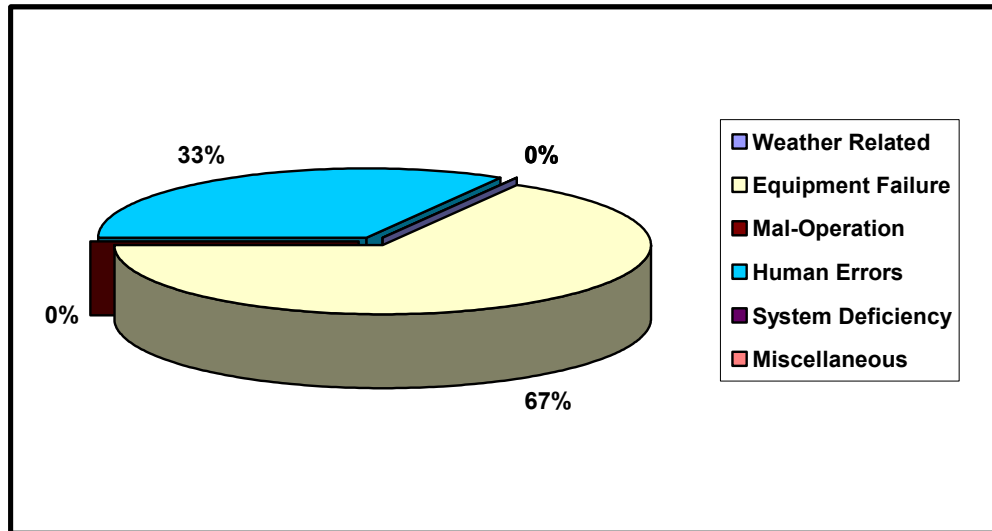


Figure 6.4: 2006 Cause of Disturbance affected SABIC

6.3 Disturbance Records – Voltage Levels

The reliability / Availability of the supplying system provided by SEC should also be taken in considerations when evaluating SEC – Customers nature of disturbances. Means of supplying systems provided by SEC to the major bulk customers (Saudi Aramco and SABIC) include different kV transmission levels (380, 230, and 115 kV levels).

Table 6.1 shows the 2006 records of disturbances. As it can be seen from the table, the majority of the fault incidents that affect the operation system in Saudi Aramco are due to disturbances within the 115 kV supplying transmission systems (91% of the interruptions are due to 115 kV faults). In the other hand, most of the SABIC disturbances are due to faults within the 230 kV faults (75% of the interruptions are due to 230 kV faults). See the below table 6.1 and figures (6.5 and 6.6).

Table 6.1: 2006 Disturbance Records – Related Voltage Levels

Bulk Customers	Supplying kV Levels	Number of Interruptions	Total Interruptions
Saudi Aramco	230 kV	12 (9%)	131
	115 kV	119 (91%)	
SABIC	380 kV	3 (25%)	12
	230 kV	9 (75%)	

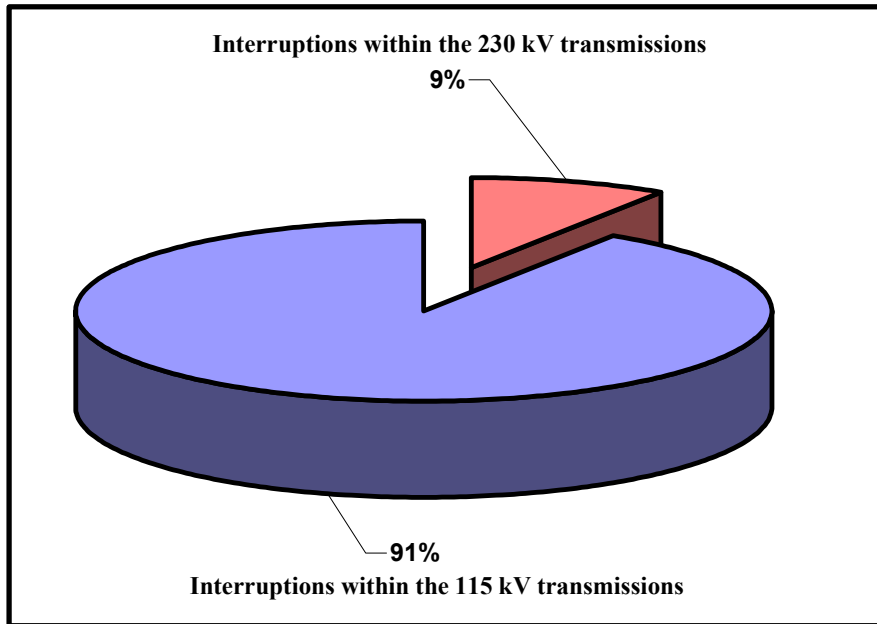


Figure 6.5: 2006 Percentage Parties of Voltage Levels Disturbance Affected Saudi Aramco

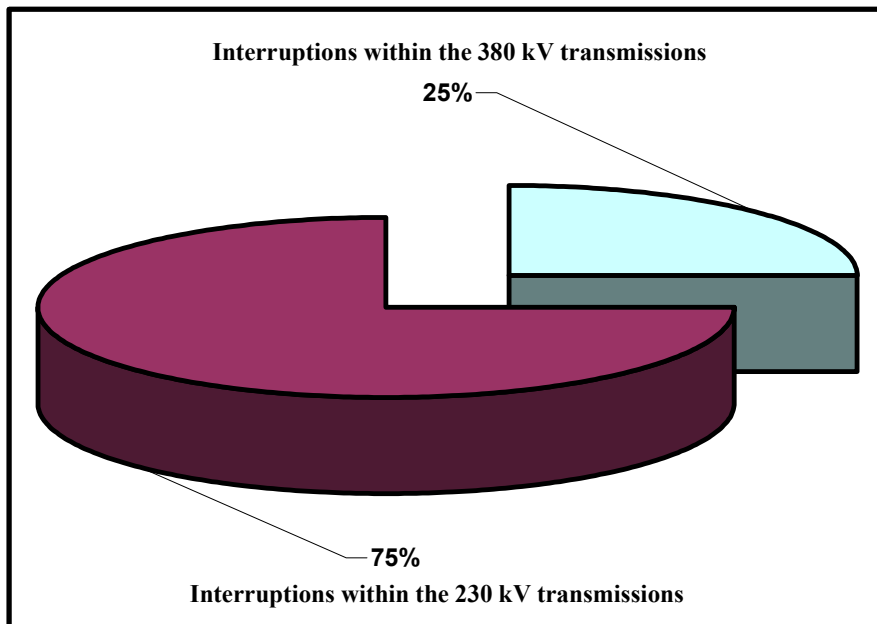


Figure 6.6: 2006 Percentage Parties of Voltage Levels Disturbance Affected SABIC

6.4 Disturbance Records – Locations

Defining locations that disturbances were originates is another aspect to be taken in consideration when analyzing disturbance records. This may help in building predictive or defense actions such as increasing maintenance processes and inspection tests at the interrupted locations that may result in decreasing the possibility of disturbances re-occurrences.

Among the different disturbance locations, the higher interruption frequency of occurrence that effect Saudi Aramco was reported by **EOA-South Area S/Ss** (Abqaiq, Shedgum, Faras, Ain Dar, Uthmaniyah, Hawiyah, and Khurais S/Ss) where 81% of the total effected disturbances were originated from these **EOA- South Area S/Ss**. On the other hand, **Ghazlan and Jubail Area S/Ss** are the main severe disturbance locations affected SABIC where 84 % of the total disturbances were originated from **Ghazlan and Jubail Area S/Ss**.

Tables (6.2 and 6.3) show lists of disturbances locations that affect Saudi Aramco as well as SABIC facilities while figures 6.7 and 6.8 indicate for the distribution of the percentage parties.

**Table 6.2: 2006 Disturbance Locations
Affected Saudi Aramco**

Disturbance Location	No. of Disturbances
Safaniyah	2
Khursaniyah	12
Berri	6
Juaymah	5
Abqaiq	8
Shedgum	3
Faras	2
Ain Dar	15
Uthmaniyah	27
Hawiyah	37
Khurais	14
Total	131

**Table 6.3: 2006 Disturbance Locations
Affected SABIC**

Disturbance Location	No. of Disturbances
Ghazlan	5
Riyadh S/S	1
Qurrayah	1
Jubail	5
Total	12

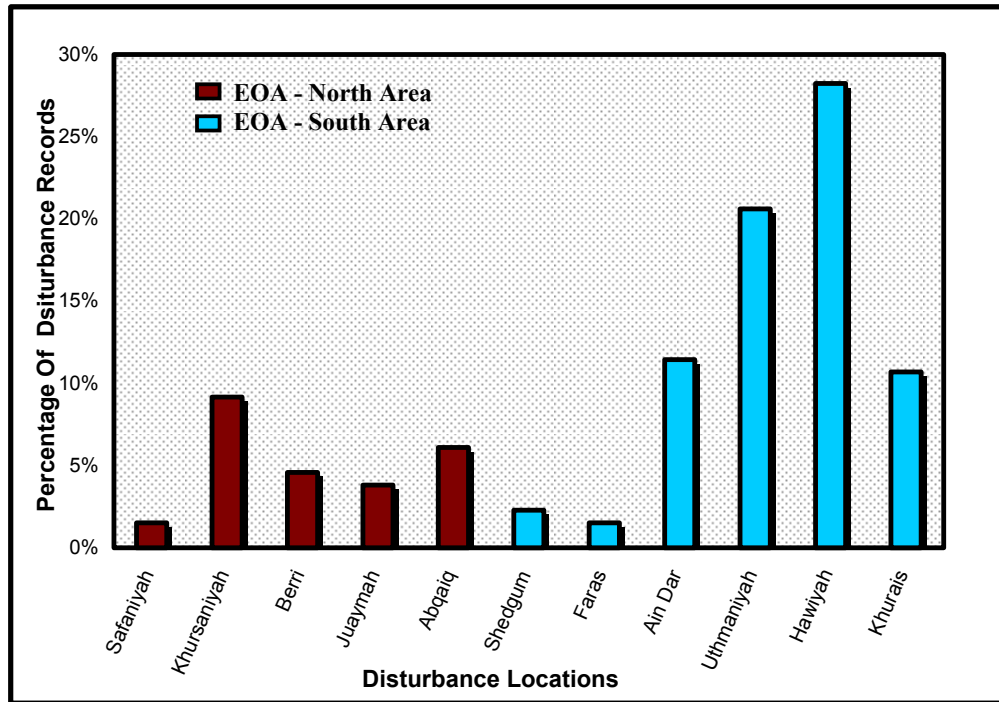


Figure 6.7: 2006 Percentage Parties of Disturbance Locations Affected Saudi Aramco

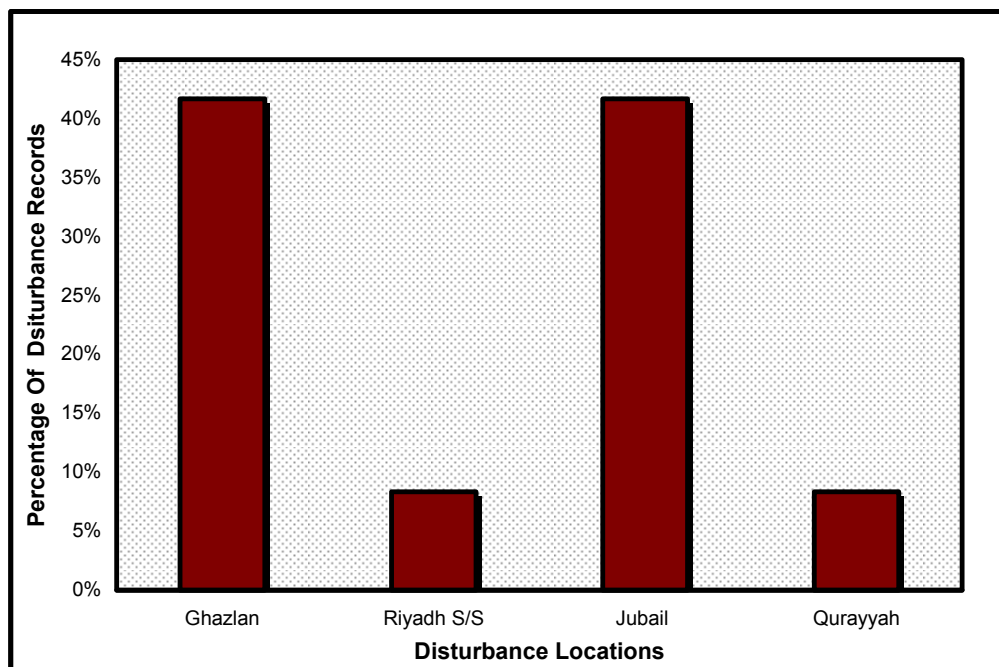


Figure 6.8: 2006 Percentage Parties of Disturbance Locations Affected SABIC

7. CONCLUSIONS

During the 2006 three meetings that have been assigned by the PQWG, the following conclusions have been drawn:

- Valuable information, technical data, and unify procedures related to PQ issues have been exchanged between SEC and the major bulk customers (Saudi Aramco and SABIC).
- Industrial bulk customer's PQ related experiences have been demonstrated throughout three successful presentations:
 - a- The first presentation "SEC-CTA Load Management during Summer 2006" by SEC which members have been agreed to include it in their presentation in 5th PQ workshop.
 - b- The second presentation "Power System Performance" by Saudi Aramco.
 - c- The third presentation "Power Crises Faced by SABIC in Jubail during August 2006" by SABIC.
- Recommendations that already assigned in the 4th PQ workshop have been followed by the PQWG. The most significant actions taken are
 - a- SEC issuing Power Quality Monitoring project titled "Integrating Permanent Power Quality Monitoring System within SEC Transmission Network".
 - b- Official Invitations have been sent for Distribution business Unit and Electricity and Co-Generation Regulatory Authority (ECRA) to attend power quality working group meetings.
 - c- Electricity and Co-Generation Regulatory Authority (ECRA) have been invited to present about the experiences in implementing quality of service regulation in different parts of the world EU, NA, and Asia should be presented (if possible).
 - d- The results of SEC Voltage Harmonic & Unbalances study will be presented in the next 5th PQ workshop.
- Records of the 2006 bulk customers' disturbances have been discussed and analyzed by the PQWG. The analysis of the records reveal that:
 - a- PQWG reported (143) fault incidents that having major effects upon the operation of Saudi Aramco & SABIC industrial bulk customers. The major effects were recorded in Saudi Aramco where 92% of the total disturbances introduce significant effects on Saudi Aramco operating systems.
 - b- Whether related conditions are the main cause of Saudi Aramco Disturbances (73%) while equipment failure class is the major cause of SABIC related disturbances (57%).
 - c- Majority of the fault incidents that affect the operation system in Saudi Aramco are due to disturbances within the 115 kV supplying transmission systems (91% of the interruptions are due to 115 kV faults) while most of

SABIC disturbances are due to faults within the 230 kV faults (75% of the interruptions are due to 230 kV faults).

8. 2006 PQWG RECOMMENDATIONS

Following are the 2006 PQWG recommendations:

- Explore power quality experience and related practices for countries with similar environment.
- Enhance power quality awareness of concern staff through training and seminars.
- Follow up the recent projects and studies relative to the development of national power quality standards.
- Diagnose problems in transmission systems to evaluate the related PQ problems of customers, if any.
- Conduct comprehensive studies showing the possibility of implementing certain power quality mitigation techniques to improve service of quality supply delivered to the customers.
- Exchange and discuss findings of some of the international Power Quality Groups / Committees and explore those that can have great effect in improving the issue of PQ in Saudi Arabia.
- Due to shortage of generation capacity, SEC recommends to maintain the reserve margin for the short-term (operation) and long-term (planning).
- SEC needs to encourage for implementing Co-Generation systems with bulk customers (i.e. Saudi Aramco, SABIC...etc...).
- SEC is encouraged to plan direct communication and meetings with its bulk customers to discuss summer operational strategy and load management plans.
- Establish a PQWG Web-Page.
- Re-inviting ECRA to attend PQWG meeting.
- PQWG is encouraged to produce Request for Proposals which aims to enhance supply power quality for bulk customers.
- PQWG is to work on inviting Concerned Bulk Customers, ECRA, and utilities to fund these proposals.

9. 2007 PQWG PLAN

- Follow up the 5th PQ workshop recommendations.
- Participate in the proposed transmission Power Quality Standards Study through project monitoring committee which will review and assess the study outcome.
- Continue exchanging Power Quality data and information between PQWG members.
- Prepare for the 2007 PQWG annual report of achievement and shortcoming.
- Prepare for the 2007 PQWG final presentation.
- Define topics for the next 6th PQ workshop.
- Following represent the 2007PQWG scheduled meeting:

Meeting No.	Date	Host	Location
1	Wednesday 28 th February 2007	Saudi Aramco	Khobar
2	Wednesday 2 nd May 2007	KACST	Riyadh
3	Wednesday 5 th September 2007	SABIC	Eastern province
4	Wednesday 5 th December 2007	Saudi Aramco	Eastern Province

Appendix (A)

PQWG Members

Name	Affiliate	Tel.	Fax	E-mail
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Dr. Tareq Abdelgalil	KFUPM (Alternate member)	03-8603511	03-8603535	TKAbdelg@kfupm.edu.sa
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Appendix (B)

Power Quality Working Group (PQWG)

MINUTES OF MEETING # 9

Date : Wednesday, 03-05-2006 (05-04-1427)

Time : 10:00 AM- 01:00 PM

Venue : Riyadh Marriott Hotel.

Attendees:

S.N	NAME	affiliate
1.	Dr. Yusuf Al-Turki	KAAU – (Main member)
2.	Dr. Ahmed Abdulwahab	KAAU – (Alternate member)
3.	Dr. Mohamed Salah Smiai	KACST – (Alternate member)
4.	Dr. Mahmoud Kassas	KFUPM – (Main member)
5.	Dr. Tarek Abdulgalil	KFUPM – (Alternate member)
6.	Asaad Al-Eesa	RCJY – (Main member)
7.	Ali Al-Juaib	SEC – (Main member)
8.	Abdulrahman Al-Shabnan	SEC – (Main member)
9.	Khaled Al-Ghamdi	SEC – (Main member)
10.	Naif Felmban	SEC – (Main member)
11.	Abdul Aziz Binkhamis	SEC – (Alternate member)
12.	Navin Joshi	SABIC – (Alternate member)
13.	Abdullah Al-Guraishi	Saudi Aramco – (Main member)
14.	Hamad Al-Khaldi	Saudi Aramco – (Alternate member)
15.	Ali Al-Shubaili	MARAFIQ – (Main member)

Power Quality Working Group (PQWG)

Minutes:

The meeting started at 10:15, three new members attended the meeting, Dr. Ahmed Abdulwahab from KAAU, Mr. Ali Al-Shubaili from MARAFIQ and Mr. Hamad Al-Khaldi from Saudi Aramco. Mr. Al-Khaldi will replace Mr. Khaled Al-Ghadhban as an Alternate member for Saudi Aramco.

The following are the agenda points:

1. Review Last Minutes of Meeting

The last minutes of Meeting were reviewed with no comments from the members.

2. Review The fourth Power Quality Workshop

- The group discussed the last power quality workshop, the group agreed to have a questionnaire during the workshop as Mr. Abdullah Al- Quraishi suggested.
- The group agreed to have one of its meeting one month before the next workshop.

3. Discuss the fourth Power Quality Workshop Recommendations

The group reviewed and agreed on the workshop recommendation which was sent to them by Mr. Khalid AL-Ghamdi, with few editorial comments, except Saudi Aramco requested to remove recommendation number # 9 ("Saudi Aramco shall present in the next workshop the findings and results of their study of Power Supply Integrity at Saudi Aramco Facilities in the Southern Area of the Eastern Province") from the 4th PQ workshop recommendations list, which will be reviewed by SEC and finalized within two weeks.

4. Discuss the working group objectives for the year 2006

- The group agreed to continue the last year practice of having at least two presentations on each meeting.
- Universities representatives will invite their visiting consultants to the group meetings.

Power Quality Working Group (PQWG)

5. Review 2006 electric disturbances events for customers facilities

Mr. Navin Joshi suggested moving the dead line of sending the monthly disturbances report to the 15th of each month instead of the 5th and the group agreed.

6. Discuss any other issues

- Members should confirm their attendance to the group secretary at least two days ahead of the meeting.
- The group members agreed on re-inviting SEC's generation and distribution sectors to the group meetings.
- Dr. Ahmed Abdulwahab will review the group disturbances reporting practice **based on Canadian experience**, and give a presentation in this regard on the next meeting, Mr. Abdullah Al- Quraishi and Mr. Khaled Al-Gahmdi will send him the related information next week.
- The group agreed on KFUPM suggestion to host the third PQWG meeting.
- The group members agreed to have the workshop as a reference for the group meetings.
- The group agreed on the meetings calendar as follows:
 - Second meeting on September 13 2006, at Jubail host by SABIC.
 - Third meeting on December 13 at Dhahran host by KFUPM.
 - Fourth meeting on February 28 at Dhahran host by Saudi Aramco.

The meeting adjourned at 01:00 PM.

Power Quality Working Group (PQWG)

2004 MEETINGS SCHEDULE

Meeting #	Meeting Date	Host	Location
1	May 17, 2004	SEC	Riyadh
2	September 22, 2004	SABIC	Jubail
3	December 15, 2004	Saudi Aramco	Dhahran

2005 MEETINGS SCHEDULE

Meeting #	Meeting Date	Host	Location
1	march 30,2005	SEC	Riyadh
2	June 15, 2005	SEC	Jeddah
3	September 14, 2005	SABIC	Jubail
4	December 14, 2005	Saudi Aramco	Dhahran

2006 MEETINGS SCHEDULE

Meeting #	Meeting Date	Host	Location
1	May 03,2006	SEC	Riyadh
2	September 13 2006	SABIC	Jubail
3	December 13	KFUPM	Dhahran
4	February 28, 2007	Saudi Aramco	Dhahran

ACTION ITEMS

ITEM	RESPONSIBLE	DUE DATE	COMMENTS
Disturbances report	Saudi Aramco SABIC	The 5 th of each month	
Update 4 th PQWS Recommendations	Mr. Khaled Al-Gahmdi	May 20, 2006	

Appendix (C)



Power Quality Working Group (PQWG)

2nd 2006 PQWG MINUTES OF MEETING

Date : Wednesday, 13-09-2006 (20-08-1427)
Time : 10:00 A.M.
Venue : Petrokemya Administration Building, Jubail

Attendees:

S.N	NAME	JOB TITLE
1.	LAITH A. AL-BASSAM	SEC – Asset Performance & Service quality
2.	HAMED AL-SAQAAF	SEC – Transmission Asset Regulation
3.	KHALED AL-GAHMDI	SEC – Asset Performance & service Quality
4.	ABDUL AZIZ BINKHAMIS	SEC – System Operations, DTA
5.	ABDULLAH AL-SHEHRI	SEC – System Operations, CTA
6.	DR. YOUSEF AL-TURKI	KAUU
7.	DR. AHMED ABDULWAHAB	KAUU
8.	HUSAIN AL-ABBAD	SABIC (Chairman)
9.	NAVIN JOSHI	SABIC
10.	KHAILD AL-SHAMMARI	Saudi Aramco
11.	ASAAD AL-ESAA	RCJY
12.	DR. MAHMOUD KASSAS	KFUPM
13.	DR. TAREK ABDULGALIL	KFUPM

Headlines of Meeting Agenda:

1. Review Last Minutes Of Meeting
2. SEC Presentation: SEC-CTA Load Management during Summer 2006
3. Saudi Aramco Presentation: Power System Performance
4. SABIC Presentation: Power Crises Faced by SABIC in Jubail during August 2006
5. Discuss the 4th PQ Workshop Recommendations Implementation Status
6. Discuss The Next Power Quality Workshop Title And Agenda
7. Discuss Any Other Issues.
8. Appointed The Next PQWG Meeting Location& Agenda



Power Quality Working Group (PQWG)

Mr. Husain Al-Abbad, SABIC member started the meeting by welcoming all attendees. Also, he introduced the new Saudi Aramco member Khalid Al-Shammari (replacement for Mr. Abdullah Al-Guraishi). Also, he introduced Mr. Abdullah Al-Shehri from SEC-CTA system operation (Invited Guest to handle the SEC-CTA 2006 Summer Load Management Presentation).

1. **Review Last Minutes Of Meeting:**

- Members discussed with KFUPM the possibility to invite one consultant to the next group meeting.
- Mr. Laith Al-Bassam will continue following up with Distribution and Generation sectors of SEC to attend power quality working group meetings.
- Group agreed from the next meeting to discuss only the action items in every minutes of meeting.

2. **SEC Presentation: SEC-CTA Load Management during Summer 2006**

Mr. Abdullah Al-Shehri presented the SEC- CTA (Consolidated Transmission Area) load management during summer 2006. The presentation mainly was about the following:

- SEC Preparation for 2006 Summer Demand
- Lose of Generation Units (Ghazlan 3, Qurayyah 1 & others)
- 2006 Summer Load Management
- SEC expectation for 2007 Summer Demand

Members agreed to include the load management during summer 2006 in their presentation in 5th PQ workshop.

3. **Saudi Aramco Presentation: Power System Performance**

Mr. Khalid Al-Shammari presented the Saudi Aramco Power System Performance. The presentation mainly was about the following:

- Saudi Aramco Loads & Generation
- 2005 & 2006 Outages Statistics

**Power Quality Working Group (PQWG)**

4. SABIC Presentation: Power Crises Faced by SABIC in Jubail during August 2006

Mr. Navin Joshi presented the Power Crises Faced by SABIC in Jubail during August 2006. The presentation mainly was about the following:

- Load shedding implemented by SEC from 18 Aug to 31 Aug 2006
- History of Load shedding implemented by SEC
- Reason for power crises during August 2006
- SABIC Observations
- Part I - Effect of power interruptions to Petrochemical Plants – Safety & Environmental Issues
- Part II - Effect of power interruptions to Petrochemical Plants – Technical issues
- Part III - Effect of power interruptions to Petrochemical Plants – Commercial issues
- Actions taken by SABIC companies
- Short & Long term Recommendation for Petrochemical Industries

PQWG Recommendations:

- 1- Arrange a meeting between SEC, SABIC and Aramco to set a plan of actions to mitigate the effect of such interruption.
- 2- Yearly meeting to be arranged by SEC (1st quarter) to share power forecast during summer and the requirements from bulk users.
- 3- Revised the load management procedure of bulk customers based on their priorities.
- 4- SEC needs to have adequate spinning reserve through a certain standby generation capacity according to general practice of Utilities.
- 5- SEC needs to look Distributed generation for special big customers such as, SABIC, Refineries...etc...
- 6- SEC needs to increase the satisfaction of bulk customer and to improve Network Reliability, therefore SEC needs to invest in new generation and transmission capacity.
- 7- SEC needs to boost the inter-connection with Gulf countries and other neighboring countries.



Power Quality Working Group (PQWG)

5. Discuss the 4th PQ Workshop Recommendations Implementation Status

- Members illustrated the 4th Power Quality workshop recommendations.
- Members requested SEC to send official invitation letter to Electricity and Co-Generation Regulatory Authority (ECRA) to nominate their representatives to attend power quality working group meetings. Mr. Laith Al-Bassam will follow up this item.

6. Discuss The Next Power Quality Workshop Title And Agenda

- Group agreed the Power Quality Workshop Title will be 5th Power Quality Workshop.
- Group agreed that every member suggest agenda and discuss all suggestion in the next meeting (3rd 2006 meeting)

7. Discuss Any Other Issues

- No other issues had been discussed.

8. Appointed The Next PQWG Meeting Location& Agenda

- Group agreed that the next PQWG Meeting Location& Agenda (3rd 2006 meeting) will be as scheduled.



Power Quality Working Group (PQWG)

2006 MEETING SCHEDULE

Meeting #	Meeting Date	Host	Location
1	May 03, 2006	SEC	Riyadh
2	September 13 2006	SABIC	Jubail
3	December 13	KFUPM	Dhahran
4	February 28, 2007	Saudi Aramco	Dhahran

ACTION ITEMS

ITEM	RESPONSIBLE	DUE DATE	COMMENTS
Collecting the PQWG recommendations regarding the 2006 summer interruptions and load management	SEC	September 20, 2006	Done
Invite one consultant to the 3 rd meeting	KFUPM	3 rd 2006 Meeting	
Following up with SEC D & G to attend PQWG meetings	SEC	Before 3 rd 2006 Meeting	
Inviting (ECRA)	SEC	Before 3 rd 2006 Meeting	
Suggest Agenda for PQ Workshop	ALL	Before 3 rd 2006 Meeting	

Appendix (D)

Power Quality Working Group (PQWG)

MINUTES OF MEETING # 3

Date : Wednesday, 13-12-2006 (22-11-1427)
Time : 10:00 AM- 01:00 PM
Venue : Research Institute, Building 15, King Fahd University.

Attendees:

S.N	NAME	affiliate
1.	Dr. Yusuf Al-Turki	KAU – (Main member)
2.	Dr. Mohamed Salah Smiai	KACST – (Alternate member)
3.	Dr. Mahmoud Kassas	KFUPM – (Main member)
4.	Dr. Tarek Abdulgalil	KFUPM – (Alternate member)
5.	Dr. Mohamed Shwehdi	KFUPM – (Main member)
6.	Asaad Al-Eesa	RCJY – (Main member)
7.	Laith A. Al-Bassam	SEC – (Main member)
8.	Hamed Al-saggaf	SEC – (Main member)
9.	Ali Al-Juaib	SEC – (Main member)
10.	Abdulrahman Al-Shabnan	SEC – (Main member)
11.	Khaled Al-Ghamdi	SEC – (Main member)
12.	Abdul Aziz Binkhamis	SEC – (Alternate member)
13.	Hussain AL-Abbad	SABIC – (Main member)
14.	Hamad Al-Khaldi	Saudi Aramco – (Alternate member)

Power Quality Working Group (PQWG)

Minutes:

The meeting started at 10:00, Dr. Mahmoud Kassas, the meeting chairman, started the meeting welcoming the attendees.

Dr. Kassas introduced Dr. Mohamed Shwehdi as a new representative of KFUPM in the group, and then he reviewed the meeting agenda.

The following are the agenda points:

1. Review Last Minutes of Meeting

- a)** Collecting the PQWG recommendations regarding the 2006 summer interruptions and load management.
 - ✓ Mr. Khaled Al-Ghamdi confirmed that he received three replies from Dr. Mohamed Salah Smiai, Mr Asaad Al-Eesa and Mr. Hussain AL-Abbad regarding the PQWG recommendations.
- b)** Invite one consultant to the 3rd meeting.
 - ✓ This item was replaced by KFUPM presentation.
- c)** Following up with SEC D & G to attend PQWG meetings.
 - ✓ Mr. Laith A. Al-Bassam confirmed that the generation sector agreed verbally to attend the next PQWG meetings.
 - ✓ Mr. Hamed Al-saggaf will contact distribution sector - EOA to send representative to the group meetings.
- d)** Inviting (ECRA).
 - ✓ Mr. Laith A. Al-Bassam confirmed that a letter was sent to ECRA to attend.
- e)** Suggest Agenda for PQ Workshop.
 - ✓ This item is one of this meeting agenda points; therefore the group will discuss it later.

2. KFUPM presentation by Dr. Tarek Abdelgalil.

The group members agreed to have the presentation at the end of this meeting.

3. Discuss PQWG recommendations regarding summer 2006 Load management

The group reviewed and agreed on the PQWG recommendations regarding summer 2006 Load management, suggested by Dr. Mohamed Salah Smiai, Mr Asaad Al-Eesa and Mr. Hussain AL-Abbad:

- 1) Due to shortage of generation capacity, SEC needs to maintain the reserve margin for the short-term (operation) and long-term (planning).
- 2) SEC needs to encourage co-generation for bulk customers (i.e. Saudi Aramco, SABIC ...etc).
- 3) SABIC are urge direct communication with SEC to discuss major interruptions and summer planning and report the outcome to PQWG.

4. Discuss the agenda of the next PQ Workshop

- The group discussed the next power quality workshop which will be held in Riyadh, and agreed on the title as **"The 5th PQ workshop"**.
- The group suggested Wednesday March 28, 2007 as a date of the next workshop.
- The group suggested a total of six presentations instead of seven, as suggested in the last power quality workshop recommendations, for the up coming workshop.
- the group agreed on the following outline for workshop:
 1. One presentation by SEC.
 2. One common presentation by PQWG members.
 3. One presentation by KFUPM.
 4. One presentation by SABIC.
 5. One presentation by Saudi Aramco.
 6. One presentation about regulation to be confirmed by Mr. Hamed Al-saggaf.

5. Appointed the next PQWG Meeting Location & Agenda

Next meeting will be as scheduled.

Power Quality Working Group (PQWG)

6. Discuss Any Other Issues.

No other issues had been discussed.

At the end of this meeting Dr. Tarek Abdelgalil presented KFUPM presentation "Investigation of Voltage Harmonics and Unbalance in Transmission Network, Preliminary Results" followed by group discussion.

There being no further items, the meeting was adjourned at 01:00 P.m.

Power Quality Working Group (PQWG)

2006 MEETINGS SCHEDULE

Meeting #	Meeting Date	Host	Location
1	May 03,2006	SEC	Riyadh
2	September 13 2006	SABIC	Jubail
3	December 13	KFUPM	Dhahran
4	February 28, 2007	Saudi Aramco	Dhahran

ACTION ITEMS

ITEM	RESPONSIBLE	DUE DATE	COMMENTS
Following up with SEC D & G to attend PQWG Meetings.	SEC	4 th Meeting	
Inviting (ECRA)	SEC	4 th Meeting	
Regulation presentation	SEC	4 th Meeting	