# ASSESSMENT OF POWER QUALITY PROBLEMS FOR REAKTOR TRIGA PUSPATI (RTP)

***Mohd Fazli Bin Zakaria[1], Vigna K. Ramachandaramurthy[2]***

*[1]Pusat Teknologi Reaktor, Bahagian Sokongan Teknikal, Agensi Nuklear Malaysia, Kementerian Sains Teknologi dan Inovasi, Bangi, 43000 Kajang, Selangor Darul Ehsan,MALAYSIA*

*[2]Department of Electrical Power Engineering, Universiti Tenaga Nasional (UNITEN) Putrajaya Campus, Jalan IKRAM-UNITEN, 43000 Kajang Selangor*

*[1]fazli@nuclearmalaysia.gov.my*

## ABSTRACT

The electrical power systems are exposed to different types of power quality disturbances. Investigation and monitoring of power quality is necessary to maintain accurate operation of sensitive equipment especially for nuclear installations. This paper will discuss the power quality problems observed at the electrical sources of PUSPATI TRIGA Reactor (RTP). Assessment of power quality requires the identification of any anomalous behavior on a power system, which adversely affects the normal operation of electrical or electronic equipment. A power quality assessment involves gathering data resources; analyzing the data (with reference to power quality standards) then, if problems exist, recommendation of mitigation techniques must be considered. Field power quality data is collected by power quality recorder and analyzed with reference to power quality standards. Normally the electrical power is supplied to the RTP via two sources in order to keep a good reliability where each of them is designed to carry the full load. The assessment of power quality during reactor operation was performed for both electrical sources. There were several disturbances such as voltage harmonics and flicker that exceeded the thresholds.

## INTRODUCTION

The fundamental concept of power quality has often been misunderstood and oversimplified in most industrial cases. The assessment of power quality has become very important nowadays with the emerging of sophisticated electronics and the widespread use of high-tech devices. These devices are not only more sensitive to the effects of power quality but can also give a negative impact on the operation of the device. Poor power quality also can result in less productivity, lost or corrupted data, damaged equipment and poor power efficiency. For example in the case of momentary interruption occurs in a process line in a factory or in a nuclear facility, the result can be a costly equipment breakdown and facility shutdown. It is this vulnerability of modern technology that has brought an increased awareness of power quality assessment, a reality of life that has always been present.

The causes and solutions of power quality problem is usually site dependent, so the power quality assessment is very important for sensitive projects such as nuclear research reactor. Under normal conditions (ideal sinusoidal, balanced, and symmetric) power quality is basically a loading problem. But with the growth in the power electronics and control systems industry, the once known as majority linear customer loads, are now being dominated by a majority of non-linear customer loads. Such loads like: switch mode power supplies used in both industrial and commercial computers / microprocessors; variable speed drives used in process control; arcing device like welders and arc furnaces; silicon controlled rectifiers used in air-conditioners; and basically any electronic device which draws current in pulses are termed to be non-linear. So the power quality of a system is equally the customers concern as much it is the supply authorities concern.

## MEASUREMENT RESULTS OF SOURCE 1

### Harmonics

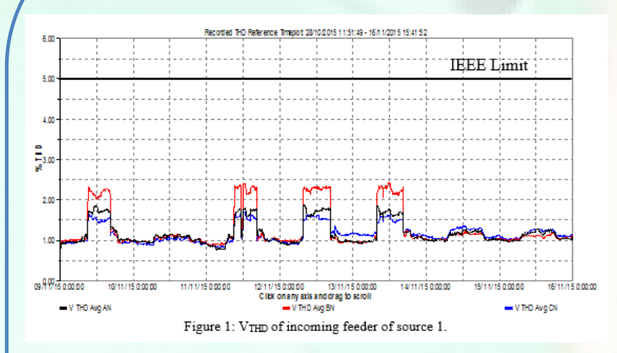


Figure 1: $V_{THD}$ of incoming feeder of source 1.

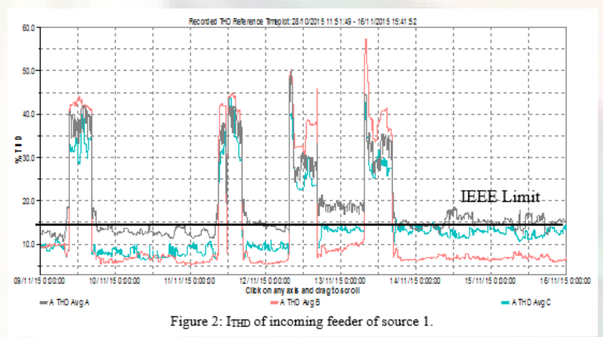


Figure 2: $I_{THD}$ of incoming feeder of source 1.

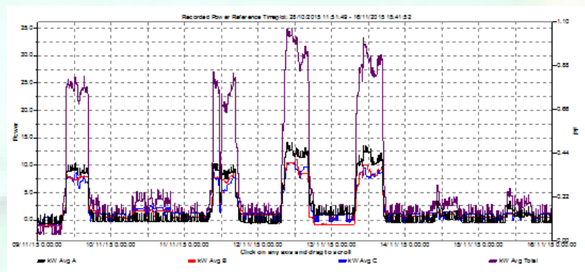

Figure 3: Power variation of source 1.

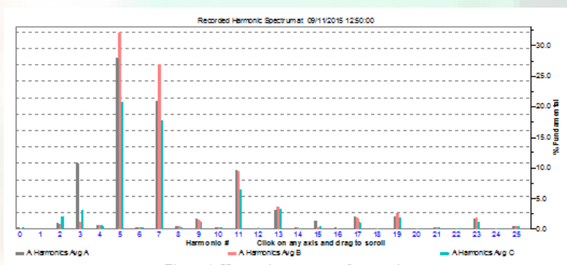

Figure 4: Harmonic spectrum of source 1.

## MEASUREMENT RESULTS OF SOURCE 1

### Voltage Sag

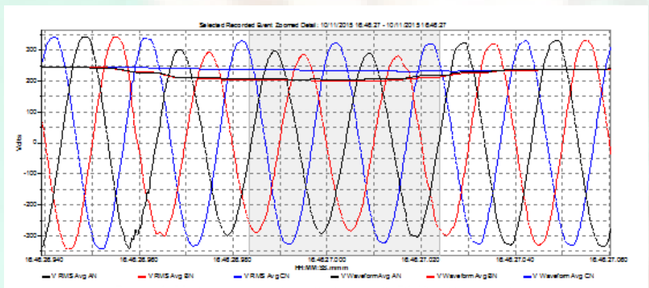

Figure 5: Voltage sag event on all phase with RMS voltage overlay

### Flicker

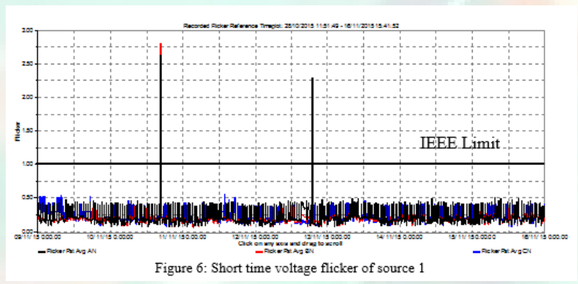


Figure 6: Short time voltage flicker of source 1

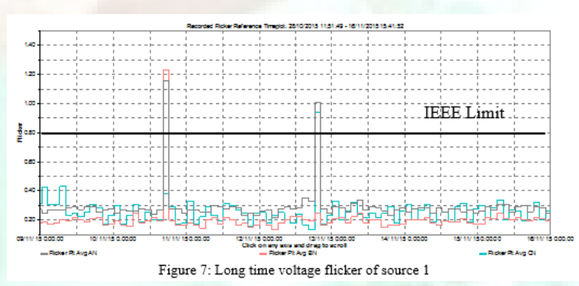


Figure 7: Long time voltage flicker of source 1

## MEASUREMENT RESULTS OF SOURCE 2

### Harmonics

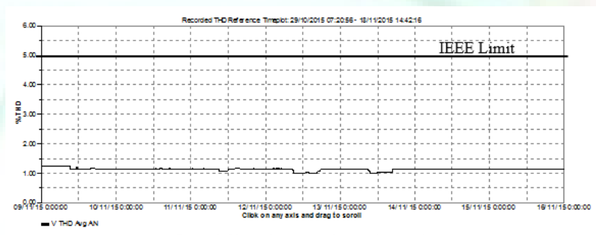


Figure 8: $V_{THD}$ of incoming feeder of source 2

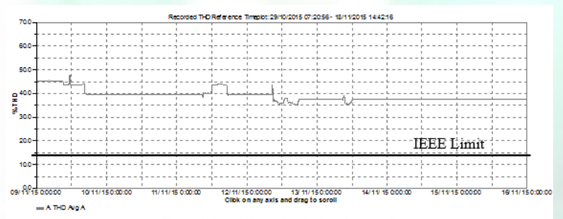


Figure 9: $I_{THD}$ of incoming feeder of Source 2.

### Flicker

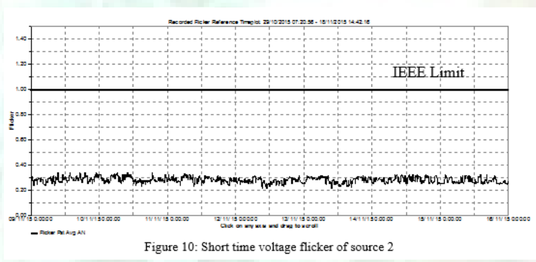


Figure 10: Short time voltage flicker of source 2

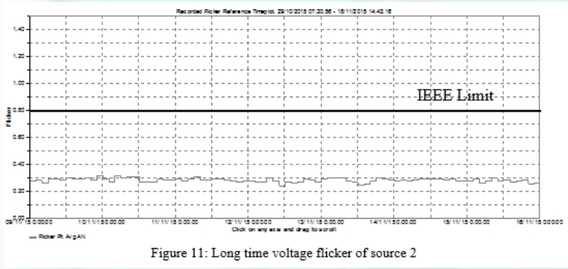


Figure 11: Long time voltage flicker of source 2

## MONITORING RESULTS

**The results of monitoring for source 1**

VTHD does not exceed the 5% of IEEE limits.

ITHD exceed the 15% of IEEE limits.

The fifth harmonic exceeds 3% of IEEE limits.

Voltage deviation does not exceed the 5% of IEEE limits.

Voltage imbalance does not exceed the 2% of IEEE limits.

Power frequency variations does not exceed the ±1% of IEEE limits.

Flicker exceeds the IEEE limits.

Occurrence of few irregular disturbances (voltage sag and flicker).

**The results of monitoring for source 2**

VTHD does not exceed the 5% of IEEE limit.

ITHD exceed the 15% of IEEE limit.

Voltage deviation does not exceed the 5% of IEEE limit.

Power frequency variations does not exceed the ±1% of IEEE limit.

No occurrence of irregular disturbances (voltage sag, voltage swell, voltage transients and flicker).

## CONCLUSION AND RECOMMENDATIONS

This paper presents the investigation and influence of power quality problems on the behavior of the electrical system of nuclear installations. The analysis of the recorded data at the point of common coupling yields that, fifth harmonics and flickers are the most severe events and should be taken in consideration for any evaluation.

It is recommended that mitigation technique should be done to keep good performance of the electrical system and then void operation problems of the nuclear installations. The passive filters and uninterruptible power supply (UPS) are effective solutions to mitigate power quality problems.

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