

# PQ Issues – Gaps today and Challenges for the future

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## Introduction

It's an interesting time for everyone concerned with the power domain in India. From 100% electrification of villages to achieving a power surplus state, we seem to have solved the problem of availability of power. Well, there are hiccups in these achievements, but that's a separate discussion.

But the real question we want to address today is how do we look at the situation now?

How many of us here feel that it's about time for the performance of power sector in India today to see that the glass is full?

Can we have a quick show of hands?

For the rest, I believe it is like various shapes of glass is half empty.

We are going to reflect on whether it is finally the time to see the glass is full? Or will it be unrealistically positive to say so? Will saying that the glass is empty mean a too pessimistic view?

And this contemplation is required because the point of view is largely going to decide how far we go from here...over the next 5 years. There are multiple scenarios – we may see the glass as empty and set really aggressive goals or we may bask in the glory of what we have achieved as we see the glass is full.

If we agree on the conclusion that India has largely solved the problem of availability of power, it just opens the next level of problems to focus on. And the prominent among all is the problem of Quality of power that's being made available.

There are many questions to be answered...what is the length, breadth and depth of the challenges of Quality Power? Is it comparable in magnitude to the 'availability' problem? How long will it take us to solve? Are we ready to meet it? But before that, it's interesting to see how it has always been there and at times challenging the availability of power as well.

## **Understanding PQ – perception beats the truth, so far.**

Take for instance the changing role of electricity in the life of a consumer in the city. With extensive applications of power electronic equipment, other needs of Heating, Lighting, Communication, Entertainment etc; which are dependent on reliable power, have become a part and parcel of the consumers' daily lives that is quality life. In fact, the use of some of this equipment has become imperative. For e.g. the consumers who face life and death situation because they cannot use their life saving medical devices due to power outage and whose devices breakdown due to frequent interruptions have to put up with the indirect costs of poor power quality (e.g. medical, repair and replacement costs) or take the case of a person losing all her/his contacts, communication and even memorable photographs due to crash of computer hard disk impacted by poor power quality; it means a lifetime memory erased forever that cannot even be valued.

As a common man, 'Power Quality' would generally mean supply without interruptions and at an affordable rate per unit. However, PQ actually refers to the extent to which the power received at our homes is free of disturbances or distortion which would otherwise cause equipment to malfunction or fail.

The common perception of masses is that PQ is the power distribution utility's responsibility and all issues/interruptions are because of their network infrastructure and services. It is being understood that as an end-user neither we have any control over it nor are we responsible for it. While there are certain external factors such as lightning, rain, winds, etc. that because PQ problems, it will be hard to imagine that many of the PQ issues are due to what happens inside customer's premises full of modern electronic appliances.

About 70-80% of power quality problems are caused inside a premise, due to equipment/appliance with low immunity or inadequate building wiring or incorrect grounding and also including large loads sharing the same circuits. These problems can be compounded by more frequent starting, running and stopping of electronic appliances and critical systems. If a building is more than 15 years old, it probably wasn't designed to meet the demands of today's consumer devices and appliances.

For the industrial or commercial consumers, impact of poor PQ comes in more complex forms. With the increasing use of sensitive electronic equipment and addition of non-linear loads including renewable energy grids, PQ is a concern for industrial customers. Whether it's voltage spikes, dips, harmonics or interruptions

that last for only for a few milliseconds, the PQ issues can damage equipment, create nuisance disruptions in day-to-day operations and in worst cases pose a severe risk to safety and reliability of power systems as a whole. In addition to the indirect costs, industrial customers are penalised directly by the Utility companies for not maintaining their PF. In worst cases, the penalties have been in excess of 10% of the total energy bills.

So, on one hand we have the Indian consumers who now expect electricity to be a product where availability is taken for granted and quality is the focus. For the industrial and commercial customers, PQ is vital to defining the competitive capability of their infrastructure at every level - may it be modern industry 4.0 production facility or a sim operated Internet of Things (IoT) based control for oil pump in DG set working in a remotely located telecom tower.

But in spite of its severe consequences the awareness about PQ is low. The perception that availability, and not the quality, is a real win, still remains dominant in the circle of people concerning the power.

### **Solving PQ – do we have the right attitude and mind-set?**

More concerning is the fact that we have unknowingly accepted bad PQ as a norm and worked around the solutions. “Chalta hai” and Manage are potent booster for this trend. For instance, the fact that the Indian UPS market is almost equal to the Chinese market size in spite of demand in India being 1/3rd as compared to that in China. Imagine the inefficiencies we are adding in our system due to unreliable power. That also brings me to an important question concerning the ‘quality’ of power, what kind of power quality are we seeking?

Because you have customers who are just fine installing one equipment after the other to reduce the risk from poor PQ. You also have consumers who have learnt to live with the circumstances of poor PQ, as a standard operating risk in the business. Added to that, PQ is also perceived differently at different levels. What I think is bad PQ may not be so for another. 1 min interruption at Mumbai may be too bad but at rural village 1 hr may not be so.

In such a precarious situation, who owns the responsibility towards PQ – do the consumers pay for their protection against risks? Or the aim should be to permanently eliminate the risks, uncertainties and free the consumers from additional costs of poor PQ? The Utilities, another key stakeholder in improving PQ also does not have clear answers. But in changing times utility can make PQ as their key business differentiator.

That's the key gap in addressing the PQ challenges before India.

And it's here that a strong case for regulations to show the way comes in to the picture. Any Quality aspiration must be backed up by strong standard and supported by equally robust regulation. More importantly, the efforts to improve standard and enforce the regulation too for PQ have to be at all the levels, from the Utility, Feeder to the end consumers.

### **Improving PQ – Can regulations show the way?**

In the context of Power Quality, we can see many examples of how the steps to improve PQ are deeply correlated with advancements of the economy, well-being and quality of life for individuals. We see the evidence for this in many countries that have successfully achieved good PQ.

- Since 1992, Norway has had a Voltage quality measurement program with mandatory reporting of interruptions implemented in 1995.
- The Japanese introduced a guideline, back in 2000, for Reduction of Harmonic Emission caused by electrical and electronic equipment for household use. Interestingly, the guidelines specify the limits for harmonic current emissions by equipment and "the measuring methods" for a range of household equipment including TVs, Luminaries, Washing Machines, Microwaves, and also the then popular video tape recorders and players.

All these countries, large and small, which are today recognised to have significantly better quality of life for their citizens have taken cognisance of importance of improving the Power Quality early on. They seem to be preparing for it from the early 90's. Also, they tend to address the PQ aspects first, whenever the profile of the electrical network is set to undergo a rapid modification.

In contrast, a study of Power Quality Regulation in India and Abroad by IIT Delhi, INDIA - published by APQI in 2011 observed that in India, the power quality standards are yet to be evolved although there are general guide lines regarding supply code and standards of performance.

In India, we are racing against time to establish high level of PQ standards in a short time. As Power Systems in India face introduction of an unprecedented number of sensitive equipment, non-linear loads, renewable energy integration and a numerous other factors hampering the Power Quality, pulling off the feat to achieve high PQ is a stretch target for everyone involved.

In the recent past, the industrial sector in India has been witnessing weekly interruptions ranging from less than one hour to more than 40 hours. Assuming an average interruption of say 30 minutes per week to the Industrial load (connected load is approx. 170 GW) in India, the average cost escalation accounts to be around Rs.2.65 Lakh Cr. per year (assuming a very conservative cost escalation of Rs.10 per minute per kW of connected industrial load). Hence, it is required in India, that a nation-wide survey is conducted to evaluate the various economic impacts of Poor Power Quality & bring awareness about the same.

That may be too large a canvass but if utilities are serious about meeting the challenges of PQ then it is time that carry out an evaluation study on how poor PQ is affecting the distribution sector and push for stringent regulation based on rationale that is well explored.

### **PQ Regulations in India – the first important step.**

Well, having said that, India has also taken a big step in framing the regulations for improving PQ. The recent report on PQ for Electricity Consumers in India released in end 2018 and prepared by the sub-committee of Forum of Regulators, directs to include the power factor, frequency, reliability of supply and voltage regulations as Power Quality parameters. The key PQ parameters as identified by the Forum of Regulators to be monitored for compliance include Frequency deviations, Harmonics, Voltage variations and Flicker, Voltage unbalance, Voltage dips and swells, Voltage Transient, Supply voltage interruptions, Power Factor. You will notice that it is first major attempt to go beyond just the PF and look at a broader range of parameters that justify the true expanse of PQ. Until recently, there was no comprehensive national Power Quality Standard issued by Bureau of Indian Standards. And this is an important step.

But even with this, the PQ regulation in India can be said to address only the tip of the iceberg. The Power Grid's "Swachh Power report" estimates the total investment required in initial phase for Power Quality improvement for the industrial, domestic and commercial loads to be about Rs. 24,840 Cr. This considers both installation of Power Conditioning devices and PQ monitoring devices at the LT level. But the Utilities also face the inevitable – lack of finances added with inability of their engineers and technicians, who lack the skills and experience to solve these problems. The dominant rhetoric so far has always been "when there is no availability what is the point of worrying about Quality". The government-controlled utilities are in many ways detached from the situation with regard to PQ issues.

While we may have achieved a great feat in our rapid march towards ensuring affordable electrical power to every 'willing' consumer, we certainly cannot ignore that it's still a long way from claiming a victory. Especially, when we compare to the best examples, globally, we find ourselves lagging behind by a generation or two when it comes to ensuring better quality of power and as a resultant - a whole new quality of life.

So far as the question of glass being seen as empty or full or half-empty as some may argue, I leave it to your judgement. But before I conclude, I must caution you that progress can only be made if there is a common understanding about the glass being full or empty among the consumers, regulators, utilities and equipment providers. I hope through forums like Energy Ensemble's Energy Forum 2019 we will be able to spread the word, drive awareness and sensitise everyone on the need to improve PQ. If we do right at the first time with basics in place, we need not worry for end result.

It is time that power sector stakeholders join hands together and put efforts that will serve as a worth reference to improve the 'quality' of power in India that impacts "Quality of Life" in India.

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