Electricity in India

Fulfilling Demand Through Positive Measures

GRID20/20
Optimize Energy Efficiency

Electricity in India: Fulfilling Demand Through Positive Measures

India is revered as one of the wealthiest countries in the world. It is blessed with terrifically industrious people, a resource-richness, and a will to succeed.

Yet, without a stable supply of electricity, made economically available to all of India's inhabitants, this amazing country will remain hamstrung with respect to achieving its maximum potential. In contrast, most leading nations of the world that possess electricity service stability have and will continue their advancements, thus competitively distancing from India in some respective fashion.

Electricity is a fundamental resource that must be presented to any population desiring to succeed in a world driven by technology. However, India has been plagued by localized blackouts, an inadequate power infrastructure, crippling power shortages, limiting power quotas, and an apparent policy paralysis that has stymied solutions in the past. Thankfully, the winds of change are beginning to blow in favor of the desperate upgrades needed within India. The generation, transmission and distribution sectors are all receiving increased attention from India's electricity leadership.

Privatization of electricity distribution is seemingly underway in India (Khurana, 2013). And, in part due to the largest blackout in world history (i.e., July 2012), India is now welcoming various solution providers from within its borders, and from the international community. The time is now for the establishment of smart grid solutions that will lift India's electricity service shortfalls to acceptable delivery levels. Now is also the time to prepare this great country for a future that will enjoy growth at all levels once the staple service of electricity is sufficiently and consistently provided.

The notable problems within India consist of an apparent lack of generation capacity, an aged infrastructure that is inferior to its demand, significant power theft which is siphoning from the system at a painful rate of loss, a multitude of grid inefficiencies, and an economic climate that has not been eager to fund the necessary changes.

As noted above, the historic two-day black out event of July 2012 shone an important public spotlight on the electricity challenges of India. Approximately 10% of the entire world's population (i.e., 600+ million people) was without power; an embarrassing situation that was showcased around the globe. It was this unprecedented outage event that brought much-needed awareness and attention to an electricity service problem that has challenged India for decades. The amount of power consumed by the average household in India ranges from $12/month - $65/month (US) depending upon dwelling size and location within the country (Jain, 2012). This level of consumption is considered to be very nominal by the standards of most industrialized countries, and therefore should be reasonably deliverable by the providers.

However, when factoring the impact of power theft within India, which is documented to range from 25% to 55% depending upon the location within the country, it becomes evident as to why electricity is not routinely available to the people, regardless of their comparatively low level of monthly demand. Combine this colossal system 'leak' rate with the fact that India's population has seemingly outstripped its existing power generation capacities, and you begin to understand why power quotas are used on a

state-wide basis, and why rolling blackouts are a routine way of life in India for many of its citizens. Finally, the India power grid was initiated in the early 1900's era, prior to its notable population growth. Since deployment inception, the grid has undergone minimal upgrading. Thus, these now aged assets are prone to routine failure and an increasing inefficiency that continues to compound through time. These realities are also contributing to the overall electrical service deficiencies.

To summarize, generation capacities appear to be well below demand, the aged infrastructure is fraught with maintenance and performance challenges, and power theft is virtually rampant within certain areas. Collectively, by any reasonable sense of measure, India's electricity system is currently in a significantly subpar condition.

There is a myriad of secondary problems associated with the lack of sufficient electricity. For example, business production is slowed, intra-country and inter-country commerce is lessened, civil challenges result from dissatisfied citizens, illegal activity is escalated so as to bypass the inherent limitations of the service, health care is impacted, and public safety is affected in multiple ways. The lack of a proper electricity solution for India produces a very grave vision for the future of this otherwise mighty country. Authorities need to remedy this distressing condition by leveraging solutions made available from the world's smart grid revolution; a movement that has been progressively evolving for several years, and is gaining traction annually. As noted earlier, there are promising signs that India's leadership is indeed welcoming assistance, and turning ample focus toward measurably improving the situation.

The basic solution for India will stem from a comprehensive view, and a commitment to strategically enact a series of fundamental improvement procedures. While the initial temptation may be to predominantly attack the power generation deficiencies which seemingly appear to be the root cause, perhaps a somewhat non-traditional view will be more effective. Specifically, it will be very difficult to synchronize generation capabilities with demand if the transmission and distribution spaces are functionally insufficient. And in India's case, transmission and distribution are indeed requiring of rehabilitation.

To focus predominantly on increased generation first would be akin to stating that we need a larger spigot to deliver much more water into the bathing tub while there are massive holes in the tub itself; which, regardless of how much water we add, are leaking uncontrollably. Supply is always important, but when inefficiencies downstream are so significant, there is no fiscal or moral justification to fixing the problem by first expanding supply.

Using this basic analogy, it is reasonable for India's leadership to first enact serious improvements within the grid system interior, or at least in parallel with generation expansion, thereby identifying the benefits and savings that can be achieved. Once these types of valuable implementations have been performed, and evaluated, the results will then offer better information for determining proper decisions required to more efficiently address generation, and possibly transmission shortfalls. If the distribution sector is improved in such a way whereby infrastructure can be retrofitted with devices to improve the understanding of asset performance, it will allow for failing and inefficient assets to be located and remediated; while permitting the effective existing assets to remain in operation. This

general approach allows for informed review and surgical re-tooling of the distribution asset system and will be the least costly method to begin the improvement process of the India grid. This overhaul method serves to cull out weakened assets, and preserve acceptable assets, thus lessening the gross investment required to bolster the distribution segment.

Once the distribution asset improvement process is significantly underway, market-available solutions can be deployed to create data reconciliation points throughout the targeted distribution spaces. It is this kind of solution that will permit utility operators to gather critical information from within the heart of the distribution grid. Items such as, but not limited to, Asset Loading (e.g., substations, feeders, line sections, distribution transformers, etc…) data, Technical and Non-Technical (i.e., theft) Loss pinpointing, Conservation Voltage Reduction practices (i.e., CVR), and Peak Capacity Contribution information can be levied from within the distribution deployment space. This level of information, and a host of additional data points, can indeed be extracted from within the heart of the distribution grid. In turn, this level of grid intelligence can provide utility operators with definitive information which they can then act upon. An approach of this nature provides a vital sense of vision into the grid. Currently, there is a terribly limited use of such tools, and therefore an inability for operators to proactively improve the distribution grid performance. At present, albeit some exceptions do exist, reactive practices dominate the work efforts applied to the distribution grids of India.

Using this optimization methodology, which begins with a distribution overhaul, benefits include surgically removing mal-performing assets, gaining actionable access to vital information from within the distribution space, plus empowering utility operators to anticipate and remedy problems. These efficiency enhancement practices will help to maximize distribution performance within India. Once the distribution space is refurbished and firmly stabilized, then analyses involving costly transmission and/or generation enhancements can be more objectively viewed, and subsequently enacted. Otherwise, we are hoping to solve the problem of poor distribution capability by supplying the system with more power. This ill-advised approach of using brute to solve the problem will simply serve to exacerbate the existing delivery condition shortfalls. A more tenacious approach is required.

The GRID20/20 contribution to help remedy India's distribution challenges consists of a multi-layered, turnkey solution, aimed at improving distribution grid efficiencies.

The first component of the solution is the GRID20/20 OptaNODE™ Distribution Transformer Monitor (i.e., DTM); a device that acquires key data elements from transformers, and allows for the deep level, ongoing evaluation of different parameters, such as active and apparent Energy, Current, Voltage, Line Frequency, and Temperature. Each OptaNODE™ DTM is equipped with an onboard communications module that is best suited for various grid deployment nuances that exist throughout the world.

The OptaNODE™ DTM was created with direct input from utility line and C-level personnel. The result is a device that is easily deployed upon distribution transformers in various world markets. It can be installed quickly by a lineman using standard tools in a variety of configurations, without the need to de-energize the transformer. The GRID20/20 OptaNODE™ DTM also possesses a firmware upgrade path to ensure that future proofing of the deployment investment is protected.

The GRID20/20 OptaNODE™ DTM is designed and optimized for quick deployment in a variety of transformer monitoring applications, including overhead pole mount transformers, as well as pad mounted applications. The devices are attached to secondary Buss Bars, or Insulated Cables depending upon the application instance, while visual indicators allow for a rapid plug-and-play installation. Metrology, sensors and communications are integrated inside the completely self-contained sealed OptaNODE™ DTM to meet the harsh requirements of continuous outdoor use. Non-saturating, patented current sensors provide for unprecedented accuracy in all approved ranges of operation.

The Mechanical Specifications of the OptaNODE™ DTM are focused around ease of installation, durability and endurance. Testing of the devices has been performed in the areas of UV Resistance, Shake and Vibration Tests, Salinity Exposure, Humidity, Temperature variances, and Accuracy (i.e., Energy Accumulation based upon ANSI C12.20) among others. Requiring no operational maintenance, the GRID20/20 OptaNODE™ DTM has proven to be easily installed, and well constructed thereby setting the stage for an anticipated 15-20 year legacy asset expectation. A series of Standards Compliances, based upon various IEC requirements like Electrostatic Discharge, Radiated and EMF Field Immunity among others, ensure the OpatNODE™ DTM devices are indeed safe to operate within the targeted applications.

As OptaNODE™ DTM devices are deployed throughout a line section, feeder, substation or an entire utility, increased data granularity is achieved thus improving the utility operator's management capabilities. Such information enables predictive measures to be employed, and post-event autopsies to be performed so that proactive corrections can be made to prevent future problematic occurrences.

Each OptaNODE™ DTM device extracts key data points, then uses its onboard communications module to transmit the data packets to a centralized point; typically a utility Network Operation Center (NOC). Using industry standard Distributed Networking Protocol (DNP3), the OptaNODE™ DTM devices deliver data to utility SCADA Master stations, and/or to the GRID20/20 proprietary Headend system (i.e., OptaNODE™ HESS).

Once the data is centralized from within the heart of the distribution grid, OptaNODE™ INSIGHT, GRID20/20's Advanced Analytics platform powered by GRIDiant, uses its proprietary analytics calculations to reveal a multitude of valuable, actionable data for utilities. The analytics step represents the final component of the turnkey solution offered by GRID20/20. The list of direct analytics benefits includes, but is not limited to, Energy Diversion (i.e., technical losses and theft) pinpointing for subsequent remediation by utilities, valuable Asset Loading analyses to ensure proper asset sizing and to spotlight preventive maintenance needs, Capacity Contribution whereby peak load contributors can be isolated by utilities then approached for targeted Demand Response programs, and meter reading reconciliation within segments of the distribution space. Further, to help perfect the efficiencies of a distribution grid, Conservation Voltage Reduction enhancements can be derived from the GRID20/20 OptaNODE™ DTM, along with several other value propositions. Given the especially large theft losses that occur in India, massively accelerated ROI is very achievable with the GRID20/20 solution.

Throughout the last year, GRID20/20 has worked to evaluate the India electricity distribution grid, understand its challenges and limitations, and explore pathways to create a helpful solution. Following many costly months to finalize a successful communications path for its devices, GRID20/20 instituted a Proof of Concept deployment of its OptaNODE™ Distribution Transformer Monitoring devices. Although the GRID20/20 team anticipated that its initial form factor would not be ideal for the India market, efforts to experiment within the India grid were pursued. For the purposes of a Proof of Concept (i.e., PoC) evaluation, OptaNODE™ DTM devices were deployed on several distribution transformers in India. For the case of the predominant three-phase environment presented by the India grid, separate devices were attached to each of the phases. This approach allows for isolation of data specific to each phase. Subsequently, data aggregation of phase readings was then performed, thus providing a comprehensive view of each distribution transformer's operating profile. In the case of less frequently occurring single-phase transformers, a single OptaNODE™ device is used to capture the targeted data from each respective transformer asset.

This learning process uncovered several valuable elements of information that will now enable GRID20/20 to perfect its solution for productive use within India. Ongoing evaluations will allow GRID20/20 to effectively modify its hardware offering for India.

It is the ongoing aspiration of GRID20/20 to enter the CPRI test bed to further refine its India-specific offerings. While the PoC experience has revealed many key items, the GRID20/20 team remains focused on providing an invaluable distribution transformer monitoring solution to India. Now is the time to leverage a multitude of smart grid solutions. GRID20/20 provides valuable distribution grid intelligence which will certainly provide a key fundamental step in solving India's very troubling electricity delivery shortfalls. While satisfactorily fulfilling power demand is the end goal for India, the first step to truly arriving at this point will involve the implementation of beneficial distribution optimization practices such as those offered by GRID20/20.

Visit www.grid2020.com to learn more about the unique intellectual properly amassed by GRID20/20 and its meaningful importance to assisting India, and the world's need for advanced grid intelligence.

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