Solutions for Transformer Monitoring

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Transformers are a vital part of the overall smart grid, as well as the deeper transmission and distribution system. Monitoring transformer condition online can prevent outages that are costly to repair and result in a loss of service and devices. Because reliable energy flow is paramount, transformers are absolutely critical, but can be some of the most expensive assets to protect and monitor on the grid.

Transformer monitoring for large power transformers with a capacity greater than 60 MVA is a very familiar concept to utilities who are currently protecting their costly power and distribution transformers. These transformer monitoring systems can cost from $10,000 to $100,000, and when these vital assets fail from weather and tree related outages or equipment failure, consumers are left to suffer through the outages.

Power transformer monitoring in the substation is an established marketplace. Monitoring bushings, temperature, and various gases within the transformer is a daily norm because these costly assets require true asset management. However a new market is forming for transformer monitoring with secondary transformer monitoring, where the transformers located out on the distribution line will be the focus.

Monitoring Today

The newest trend in transformer monitoring is the secondary transformer, where utilities are beginning to monitor pole-mounted, vault and pad mounted transformers. Typically these transformers range from 10 KVA to 5 MVA and measure voltage and current in order to detect load status and temperature. The hardware however, is one key aspect of this market, which varies from vendor to vendor. Additionally, a few secondary transformer monitors measure some form of gas and can detect the changes within the transformer during its life.

Secondary transformer monitors offer utilities further insights to their distribution grid and the condition of their assets. Major benefits include theft detection, outage notification and management, asset management, data for Volt/VAR Control and Volt VAR optimization programs.

Energy theft is a hot topic that utilities are continually facing today. During economic downturns electricity theft greatly increases, and this problem is much greater than one would expect with larger utilities managing thousands of theft cases each month. Electricity theft can cost utilities 1 percent to 3 percent of their revenue, which equates to approximately $6 billion industry wide. Secondary transformer monitoring helps to alleviate this problem by providing utilities with real-time actionable data, allowing them to respond proactively rather than reactively.

Transformer monitoring also provides electric utilities with enhanced outage notification. By monitoring transformers in real time, utilities are able to dispatch line workers out to the problem area without delay, rather than the current situation of waiting for consumers to call and notify the utility of their outage. This inefficiency can greatly increase the downtime for both the customer and the utility. Every minute a utility is not providing power to their customers they are losing revenue; furthermore, the businesses affected by the outage are losing money as well. Outages in the US cost the nation approximately $80 billion annually according to a study conducted by researchers at the Lawrence Berkeley National Laboratory. Accurate monitoring will allow utilities to better serve their customers through faster response times and less downtime, leading to greater overall satisfaction for the customers and the utility.

Protecting utility assets in order to provide the greatest return is a goal of any well managed utility. Optimizing an assets lifespan and transformers are integral, as they are the most numerous and important part of the electric utility infrastructure. Today's utility is faced with an aging infrastructure where the average age of a transformer is 37 years old and has a maximum life expectancy of 40 years, according to research firm Frost and Sullivan. There are approximately 50 to 60 million distribution transformers in US and Canada, and secondary distribution transformers make up a large portion of these utilities assets. Asset management allows utilities to properly maintain and support these aging transformers; however to properly maintain such numerous assets utilities will have to implement transformer monitoring in order to increase reliability, planning and maintenance and anticipate asset replacement. Currently, most Asset management programs require staff to visit some transformers on an annual basis to see if changes have occurred, this antiquated monitoring process is unlikely to really benefit the utility and it inefficiently utilizes their resources.

To progress to a true smart grid, utilities will need to continue on this enlightened path, implementing newer technologies such as the secondary transformer monitor, allowing them access to the information needed to improve distribution reliability and efficiency on the grid. Placing intelligence at the distribution transformer enables additional smart grid applications such as Volt VAR Control (VVC), Volt VAR Optimization (VVO) and Conservation Voltage Reduction (CVR). These various voltage and VAR programs allow utilities to provide more efficient use of power by lowering voltage levels or the voltage profile on the feeder. Transformer monitoring devices can also provide another means of real time data, necessary to run distribution automation programs. The added functionality that transformer monitoring can add to Volt Var programs helps support the business case to monitor these less costly yet abundant assets.

No discussion of secondary monitoring is complete without assessing the available software. There are any number of applications that can be created, and they will be dependant on each utilities needs and the monitoring devices themselves. Loading on transformers is a critical factor to ensure electric utilities are utilizing their assets most efficiently, including

monitoring load based asset management. Proper loading will increase utility efficiency and prolong the life of the transformer. Some utilities may choose to focus on geospatial analysis in order to manage their assets, allowing their workforce to be deployed automatically to problem areas. Other types of software could focus on power quality, theft detection, safety, voltage and VAR management and fault locations. A final key variable of transformers is temperature, where utilities can utilize transformer temperature for their asset management program.

The Future of Monitoring

Moving to a smarter, smart grid is critical for electric utilities, and secondary transformer monitoring provides the the necessary information at the edge of the grid for utilities to make real-time decisions, supporting other smart grid and distribution automation applications.

There are numerous factors that drive these applications, and in the secondary transformer monitoring space there many advantages to implementing such technologies. Transformers are one of the utilities greatest assets and monitoring will help extend the life of these important assets and infrastructure. However planning and overseeing so many transformers is a difficult task without the proper intelligence.

IUS Technologies has recently developed a new transformer technology in the the TM100 which will provide utilities with a variety of information, providing deeper insight into the many assets out on the distribution line. The TM100 allows utilities to monitor True RMS voltage and current, temperature and TCG (Total Combustible Gas). These various measurements supply utilities with a real view of their assets in real time. The built in software presents the status of the load and further information on whether it is normal, abnormal or dangerous. Temperature is additionally categorized to notify when the transformers temperature is normal, abnormal or dangerous. TCG is the sum of concentration of hydrogen, methane, carbon monoxide, ethane, ethylene and acetylene. The TCG level is monitored through four levels including: normal, abnormal, caution and dangerous. TCG notifications will provide utilities with a better view of their assets in the field. Armed with this information, utilities can better monitor their assets and ensure ongoing service with limited service disruption.

Transformer monitoring helps prioritize and schedule proper asset management leading to improved workforce efficiency and reduced labor costs. Reliability, financial efficiency and revenue protection are several key factors in understanding that monitoring is absolutely crucial to the future of the industry and the smart grid.

Transformer monitoring has its benefits but the main support for implementation is other smart grid applications such as Volt VAR Control, Volt VAR optimization and outage management which will drastically increase efficiency. Through these distribution automation smart grid applications, utilities will be more likely to justify the investment in secondary transformer monitoring technology. The adoption of transformer monitoring will be slow at first and will primarily be pilot projects; however, growth in this market will be significant over the next eight to 10 years as utilities move their electric grid from its antiquated past to the smart grid of the future.

IUS Technologies develops products that ease the progress of US utilities toward a true and reliable smart grid through distribution automation. IUS's technologies and Born Smart devices include smart grid sensors, distribution automation, oil degradation and load monitoring systems, power transformers and bushing current transformers. For more information about IUS Technologies visit www.ius-tech.com.

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