TRACEABILITY OF HIGH VOLTAGE POWER MEASUREMENTS IN A DEREGULATED ELECTRIC POWER INDUSTRY

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ABSTRACT The economic impact of uncertainties associated with the measurement of high voltage power measurements is very high. This can easily translate into millions of dollars. Therefore traceability and the acceptable accuracy limits of high voltage power measurements are becoming increasingly more important and critical to utilities and manufacturers, especially in the era of deregulation and free trade. The measurement support provided by the Institute for National Measurement Standards, National Research Council of Canada, to a deregulated electric power industry for obtaining traceability of high voltage power measurements is described.

SUMMARY

The electrical power industry is currently undergoing a period of fundamental change. Internationally there is a trend toward a more competitive, deregulated electricity market, similar to telecommunication and natural gas markets. These changes were initiated in Europe, especially in Britain (1990) and Norway (1991) and have now been expanded to most industrialized countries of the world. The main purpose is to enhance competition by making transmission systems more independent of wholesale market players and thus more accessible to new, smaller energy providers.

Prior to deregulation, the generation, the transmission and the distribution of electric power to a large number of customers were provided by one utility. Traceable measurements must be performed only at the end user's site. No traceable measurement is required between generators and transmission systems nor between transmissions and distribution networks since there is no financial transaction involved.

In a deregulated environment, utility operations are unbundled into separate generation, transmission and local distribution companies. This creates the requirement for revenue metering systems in at least two more points as compared with an integrated single-utility structure. In Canada, the annual sale of electricity is approximately $40 billion Canadian. This means that the sale of electricity is subjected to revenue metering at least three times between generation and end user, so metering will affect at least $120 billion in transactions. A small measurement error of 0.5% would translate to an equivalent impact of $600 million in the transactions.

In trading electricity, there are at least two subjects of importance to the electrical power industry, and its customers and equipment suppliers.

The first is equity in trade. This is affected by the accuracy of the metering of electricity, which requires measurement traceability to national and international standards. Trade in the domestic market dominates here. In a deregulated environment, traceable revenue metering systems are required between generators and transmission systems and between transmission systems and distribution networks, in addition to the ones between distribution networks and end-users. At these two additional points, revenue metering (wholesale revenue metering) occurs under high voltage and high current conditions. For wholesale revenue metering with much larger dollar value transactions, the accuracy requirements of the metering systems would have to be more stringent than the ones between the distribution networks and the end-users.

A second trade subject of importance is access to foreign markets for electrical equipment manufactured domestically that constitutes the main components of the generation and transmission systems of electricity. Such access is very much dependent on the ability of manufacturers to meet the specified requirements of international test standards for electrical equipment. Trade in the foreign market is affected by the establishment of trading blocks and free trade zones, resulting not only in the increasing importance of the recognition of equivalence of measurement standards, but also on the increasing global emphasis in industry on product quality, associated requirements for improved accuracy, and the increasing incidence of contractual requirements for traceability of physical measurements.

Of primary importance in the electrical power industry are the traceability and acceptable accuracy limits of high voltage power measurements, where the dollar values of transactions are high, usually in the billions of dollars every year. High voltage power measurements not only occur in the measurements of power and energy in high voltage transmission lines, but also in loss measurements of power system apparatus to determine the overall efficiency of the electric power and energy transmission systems. Power system apparatus includes large power transformers, high voltage reactors, power capacitor banks, insulator bushings, and power cables. Of all these loss measurements, the most critical for the electrical power industry is the measurement of losses of large power transformers and reactors. There is a penalty, which can be as high as $10,000/kW for every kilowatt of loss exceeding the guaranteed value. This can easily translate into millions of dollars for equipment manufacturers.

The changes that are taking place within the electrical power industry, due to deregulation activities, and the establishment of trading blocks and free trade zones are giving rise to a broad spectrum of new requirements to support and enhance industry's measurement capabilities. The measurement support provided by the Institute for National Measurement Standards, National Research Council of Canada, to a deregulated electric power industry for obtaining traceability of high voltage power measurements will be presented.