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Enabling Transmission & Distribution Utilities to Become More Resilient and Operationally Efficient

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SUMMARY

In today's challenging times Transmission & Distribution utilities across North America are working towards finding more innovative tools to get more resilient in their power delivery. At the same time, aged infrastructure, remote communities, and radial feeders adds more complexity to the grid system. There is growing need to bring more flexibility and innovation to existing pool of resources of the T&D utilities to ensure steady growth, balance in supply and demand, and meeting customer expectations.

This paper describes an innovative set of tools to enable the Transmission and Distribution utilities to become more Resilient and Operationally efficient by providing supplementary power aka "Grid on Demand" as a lever. This concept enables them to keep working on their grid modernization initiatives and maintaining aged infrastructure without negatively impacting grid reliability metrics, at the same time improving grid resiliency and customer satisfaction.

We will discuss an actual project to help the reader understand the concept, a specific case is about a Transmission & Distribution utility in Eastern Canada. The T&D utility had a project that involved installing smart switches on the 44kV sub-transmission line. The challenge they were facing was an inability to work on the live system (hot) to install these switches, instead talking conventionally they had to take an outage to perform this work. This would negatively affect their SAIDI and customer satisfaction metrics. Ideally, the utility did not want to take an outage, as that time of the year they were already trending negative on their annual SAIDI target. However, deferring the installation of these smart switches could affect the grid modernization program, delay capital expenditure and would affect grid resiliency.

This concept of using supplementary generation, enabled the T&D utility to complete the work de-energized while still being able to provide reliable and continuous utility grade power to their downstream customers. This concept also enabled the T&D utility to bundle work, as the system was de-energized, they found other opportunities for improvement, such as replacing an aged insulator and bus sectionalizer on the 25kV DS side. This enabled the utility to maintain reliability while improving capital productivity and thus improving overall grid resiliency and operation efficiency.

In general, the proposed mobile grid solution "Grid on Demand" has several contributing factors to its success, such as engineering capabilities, protection settings, switching plan coordination, services and products. To successfully execute this project, the utility and the supplier worked together to; design and engineer the protection settings and coordination, the switching plans, load requirements, grid synchronization and operation.

The major benefits of this project for T&D utility were saving millions of (CMI) customer minutes of interruptions, completing a project in 9 hours (dead circuit to work on) while the downstream customer had zero power interruptions, bundling of work, saving time and

resources, avoiding taking multiple outages, no recordable SAIFI or SAIDI impact, '0' safety incidents on the project, and resulting to become more resilient and operational efficient.

KEYWORDS

Safety, Resiliency, Reliability, SAIDI, SAIFI, Operational Efficiency, Customer Outage, Customer Satisfaction, Grid Modernization

SITUATION

The "customer", a Transmission and Distribution utility had a project to be completed under their grid modernization initiatives program. They were looking to install smart switches on a 44kV sub-transmission line on a radial feeder. The customer had picked the worst performing feeders to install the switches to improve grid resiliency while completing the capital project. The customer was facing a situation where he could not work "hot" on the lines due to safety protocols, however at the same time they were looking for ways to avoid an outage while preforming this work as they were trending negative on their SAIDI metrics for the year. Taking this outage would further affect their reliability metrics and will impact the customer satisfaction. As part of other challenges, the project time-line was of the concern for them as they were getting closer to the end of their shoulder season. To have the project completed they needed to take an outage, deferring the project to next year could affect the grid resiliency, as well as this would delay their capital spend and their grid modernization initiatives.

CAPABILITIES

The T&D utility needed to perform the work without impacting the reliability metrics, while ensuring the sub-transmission line was de-energized. To do this, they needed to have uninterrupted power provided to their downstream customers from the 25kV DS (Distribution Station). This power needed to be synchronized to the grid during the process of going on to the supplementary generation power and getting on back to the grid with no recordable (less than a minute) interruption to the customers. This 4500 kW, 25kV power needed to be brought on and off the grid without impact to SAIDI and/or SAIFI. They also needed to have the ability to compensate the leading kVARs to balance the power factor for stable operation of the system. The protection settings coordination, reliable uninterrupted power, technical support, project management and site operations were the requirement for supplying the supplementary power to the grid to meet the utility's standard operating protocols.
During this project the T&D utility were not only able to install the smart switches on the dead 44kV circuit, but they were enabled to replace the faulty busbar and insulator at the 25kV distribution station; the details are discussed in the next sections of this paper.

CHALLENGES ADDRESSED DURING THE PROJECT

Some of the challenges during the project planning and execution were:

- The distribution station had hundreds of kilometres of underground cable which was causing capacitance on the system which resulted in leading kVARs in range of 2200kVARs. This shifted power factor into 0.68 leading and could potentially interrupt the power supply if not addressed. The technical team along with the utility team identified this potential issue and designed a way to stabilize power factor throughout the duration of the project. It was then decided by our Technical Support and Engineering team to add an inductive load bank to the system to mitigate this situation.

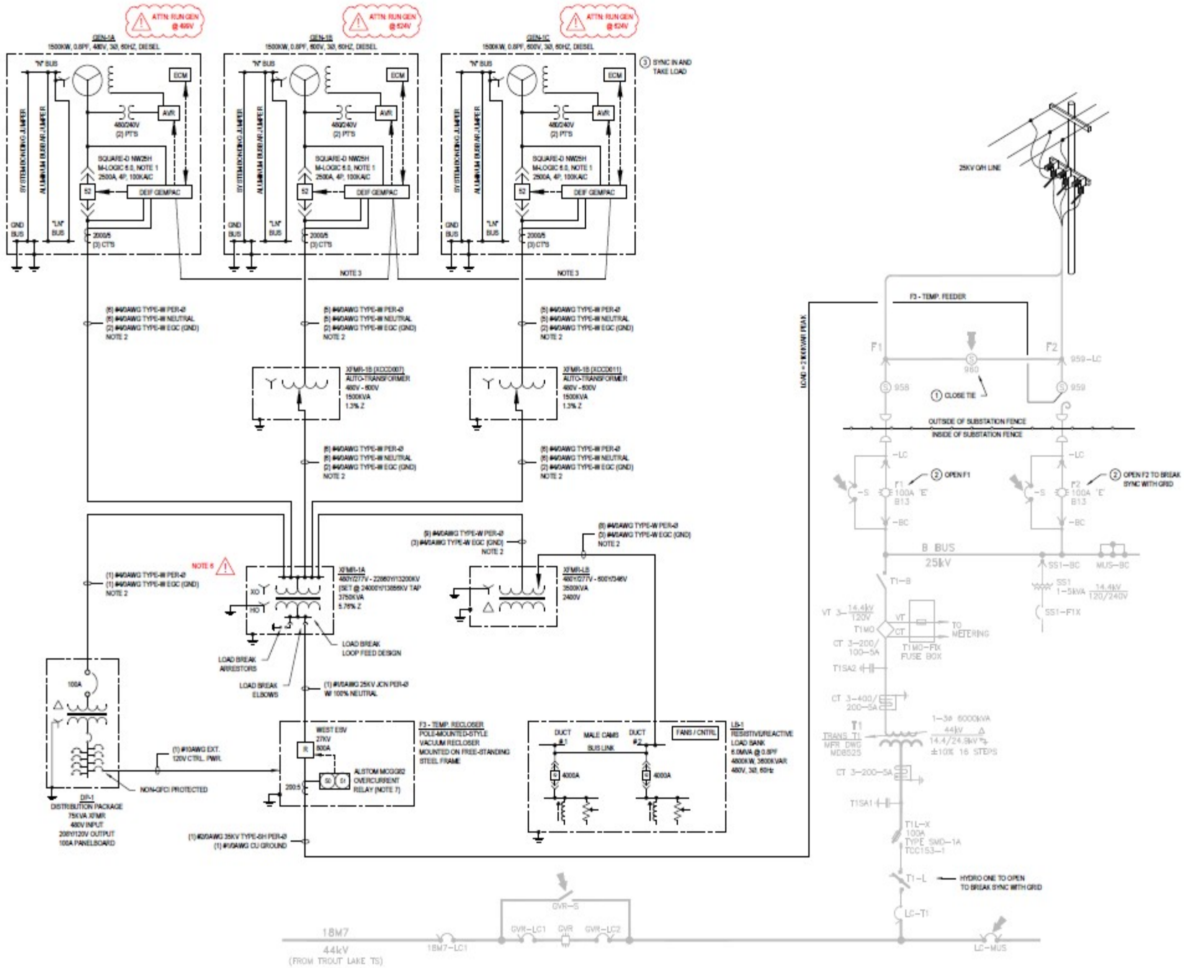
- During the initial site visit the 25kV busbar, within the station was chosen as tie-in point for the supplementary power package. However, during the project kick-off it was realized the busbar itself was unhealthy and was due to be replaced. It was determined by the supplier and the utility that replacing the busbar and insulator at the same time as the line switch installation would both benefit capital productivity and grid reliability.

SOLUTION

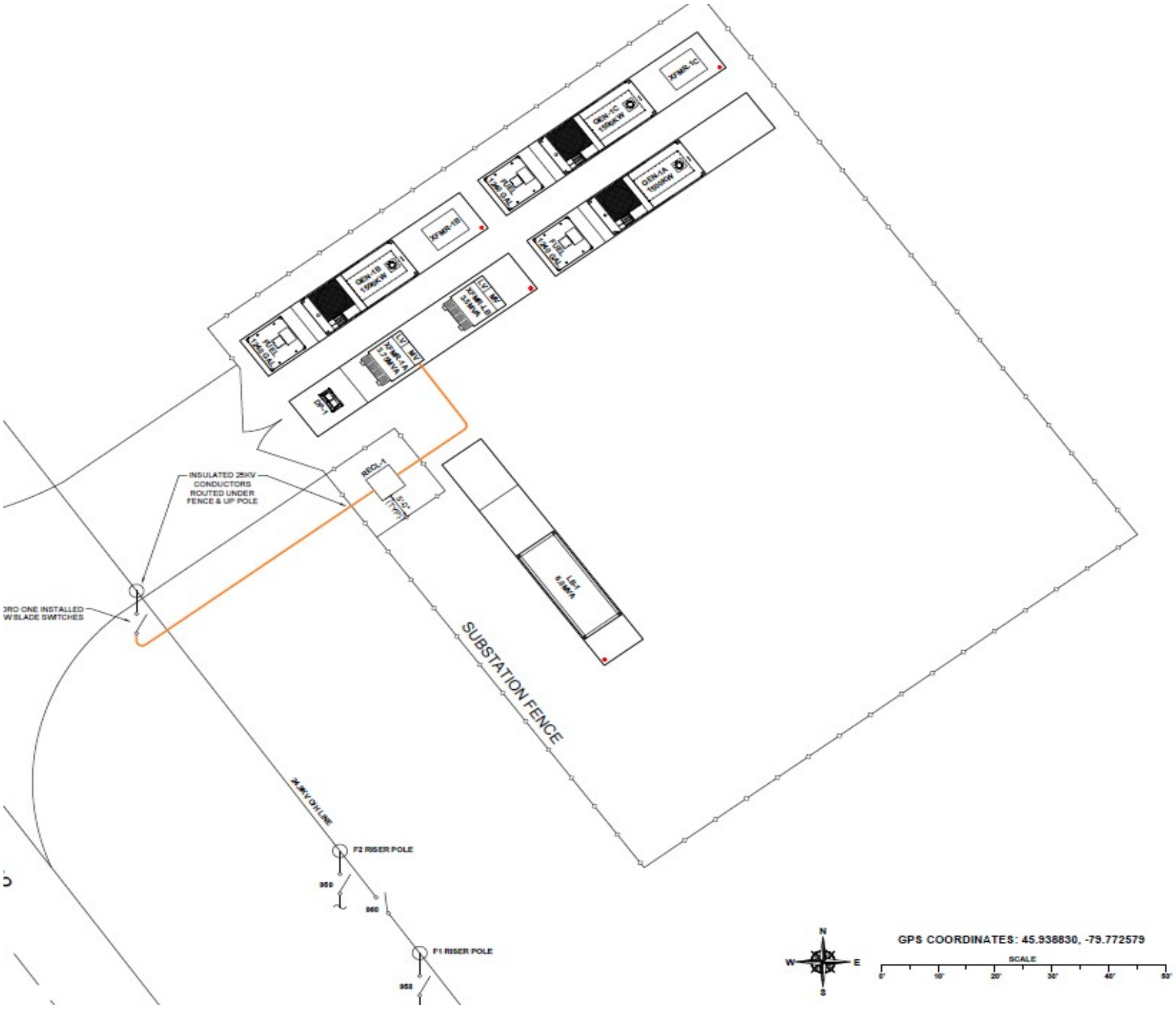
The designed temporary solution for the T&D utility provided 4.5MW reliable utility grade power. This Grid on Demand package was used for 9 hours to serve 2600 customers downstream of that Distribution Station. It included:

- Engineering capabilities
- Protection settings coordination
- Project management
- 3x 1500 kVA diesel generators
- 1x 6000 kVA inductive load bank
- 1x 3750kVA, 25kV power transformer
- 1x 25kV vacuum recloser
- Positioning of the gear inside the DS
- Freight
- Installation, Testing, and Commissioning
- Synchronizing-In with the Grid
- Back on Grid and decommissioning

SINGLE LINE DIAGRAM



SITE FLOOR PLAN



CONCLUSION (MEASURABLE RESULTS)

This project resulted in several benefits, some of the key benefits to the Utility were:

- Ability to save 1.4 Million (CMI) customer minutes of interruption
- Completing grid modernization project with zero customer outages
- Bundling of work, enabling them to save man hours (time) and resources; and at the same time improved capital productivity
- No negative SAIFI or SAIDI impact during project, hence improving the reliability of the grid
- Zero safety incidents on the project
- YOY (year over year) reliability of the circuit improved
- Overall grid resiliency improved due to the work completed, resulting in the utility becoming more operationally efficient; (the OM&A cost for any repair or maintenance will be dropped significantly for this circuit)

We are in discussions with several Transmission and Distribution Utilities in North America on various projects to study the feasibility and potential benefits based on what we have discussed in this paper.

BIBLIOGRAPHY

Not Applicable