

Hydro-Plant Blackstart and Partial System Restoration

Sponsor: Avista

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Abstract

A system black-start is a process that allows portions of the power grid to be brought online after a blackout event, independent of the rest of the grid. The goal of this project is to create a process that will allow two hydropower plant to perform a black-start for the Avista Power Corporation. This was developed by analyzing the system, then using a PLC driven software to create a process that will successfully complete a black-start. In the future, a full re-synchronization of the system to the grid could be attempted using this same process.

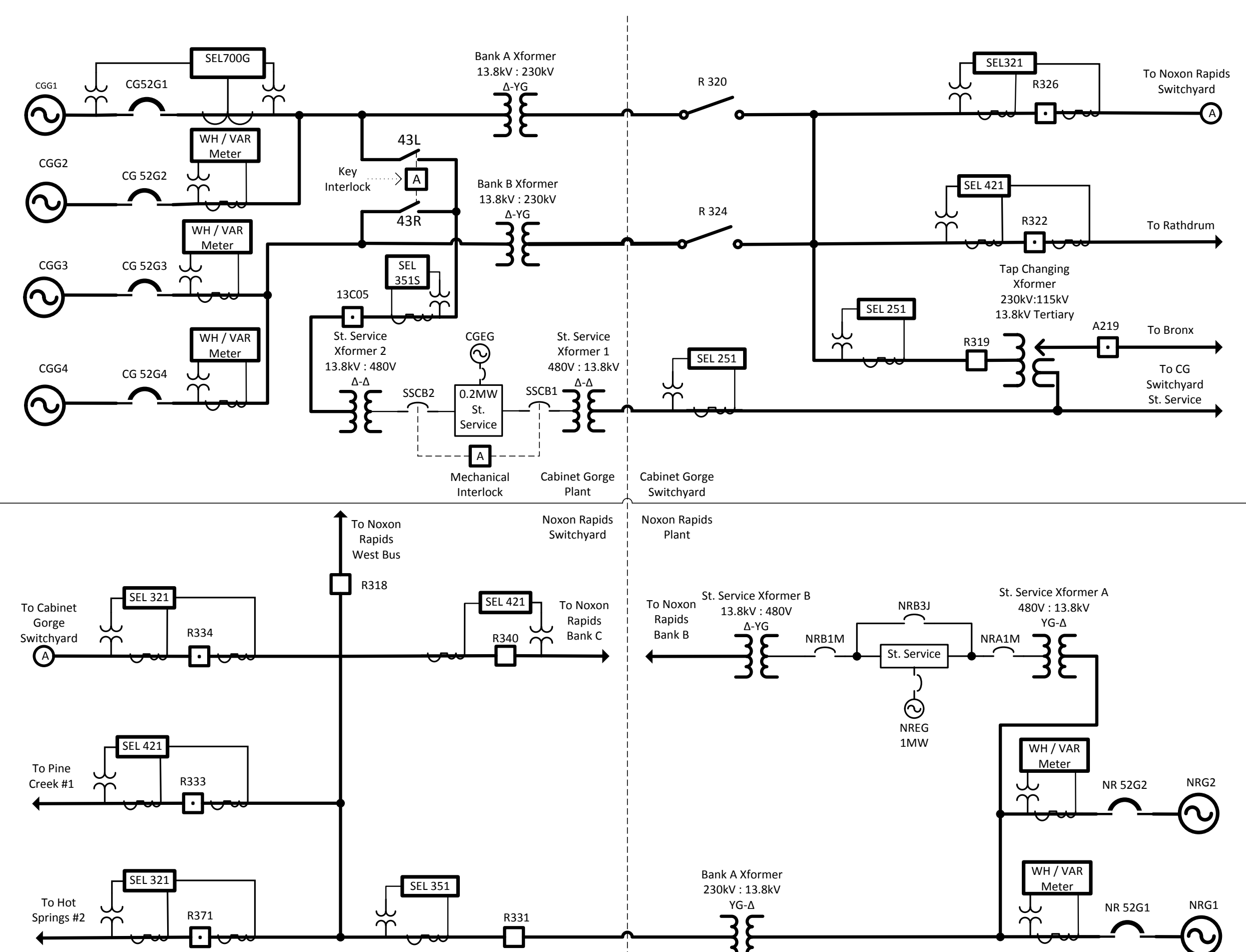
Objective

- Inrush Mitigation
- One-Line
- Sequence of Events (Flowchart)
- PLC Program
- Factory Talk Extension

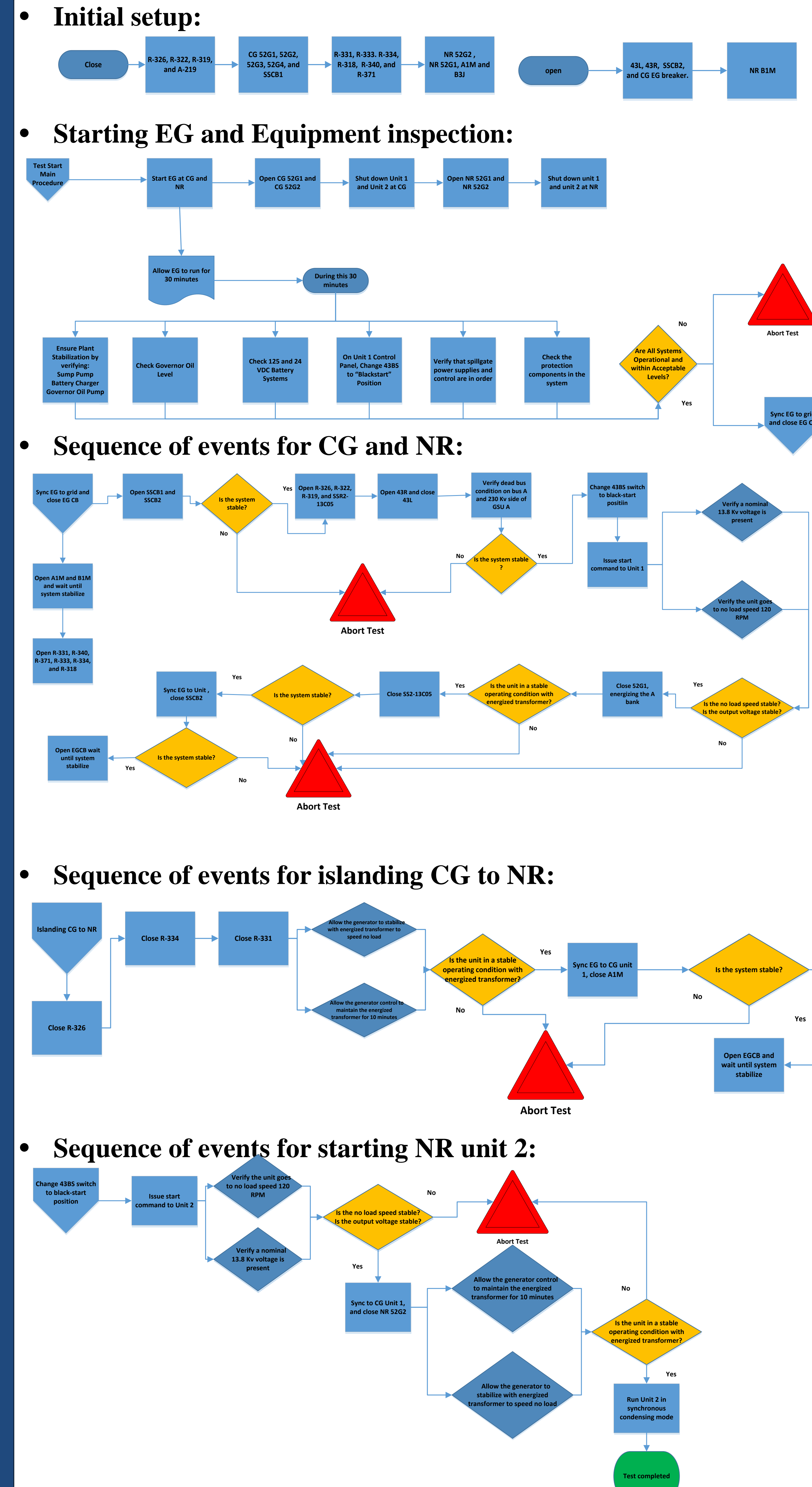
Solution

- Use station service to stabilize system.
- Use Noxon Rapids unit 2 as a synchronous condenser for load management.
- Created flowchart and oneline in Visio for Avista.
- Analyzed entire system in order to model it.
- Created control system using Rockwell Automation RSLogix5000 software.
- Designed HMI in FactoryTalk Software.

One-Line



Flow Chart



Results

- Procedure/flow-chart was not used due to maintenance at Noxon Rapids. It will be used as a baseline when Avista creates their own.
- The new ABB exciter at Cabinet Gorge had a wave error. ABB working with Avista to resolve issue.
- PLC/FactoryTalk program will be used for operator training.
- The one-line will be used for a visualization of components involved for blackstart.

Recommendations

- There are some recommendations to be made for possible future improvements. The first improvement should be to add some extra line monitoring for protection equipment between Cabinet Gorge and Noxon Rapids. There is currently no input from the transmission line into the control room at either plant. This could help with system monitoring during a blackout event. SEL 735G relays could be implemented for this upgrade.
- Another possible upgrade in the future could be to add the ability to condense to Cabinet Gorge unit 2. The addition of synchronous condensing would eliminate the need to synchronize the two separate plants. Having the synchronous condenser available would then allow more power and load to be brought online sequentially, since the condenser would be used for reactive power compensation. Another circuit breaker could be added between the station bus and transformer to eliminate most of the inrush current as well.
- The process, program, and flowchart created by this project could also be used as a training tool in the future. System operators could use the simulation PLC to run through the process that was created. With the simulation running, the operators can physically see what is energized and de-energized at every step of the process, complete with nominal values.

Glossary

- PLC – Programmable Logic Controller
- NR – Noxon Rapids
- HMI – Human Machine Interface
- EG – Emergency Generator
- CG – Cabinet Gorge
- SS – Station Service
- CB – Circuit Breaker

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