Generator Interconnection Request

System Impact Study Report

For: [redacted]

McGuire Units 1 and 2 Uprate

Service Location: Mecklenburg County, North Carolina

Total Output: Additional 80 MW

In-Service Date: 10/24/2012 – 6/30/2013

Prepared By: Daniel Fain, P.E.

Revised Date: 11/10/2011

Table of Contents

1.0 Introduction

Following are the results of the Generation System Impact Study for the installation of an additional 80 MW of generating capacity in Mecklenburg County, NC. This site is located near McGuire Switching Station and has an estimated Commercial Operation Date of 10/24/2012 – 6/30/2013.

2.0 Study Assumptions and Methodology

The power flow cases used in the study were developed from the Duke internal year 2013 and 2015 summer peak cases. The results of Duke's annual screening were used as a baseline to identify the impact of the new generation. To determine the thermal impact on Duke's transmission system, the new generation was modeled as an increase to the generation for the 2 existing units at McGuire Nuclear Station. The economic generation dispatch was also changed by adding the new generation and forcing it on prior to the dispatch of the remaining Duke Balancing Authority Area units. The impacts of changes in the Generator Interconnection Queue were evaluated by creating models with previously queued generators removed. The study cases were re-dispatched, solved and saved for use.

The NRIS thermal study uses the results of Duke Energy Delivery's annual internal screening as a baseline to determine the impact of new generation. The annual internal screening identifies violations of the Duke Energy Power Transmission System Planning Guidelines and this information is used to develop the transmission asset expansion plan. The annual screening provides branch loading for postulated transmission line or transformer contingencies under various generation dispatches. The thermal study results following the inclusion of the new generation were obtained by the same methods, and are therefore comparable to the annual screening. The results are compared to identify significant impacts to the Duke transmission system.

Stability studies are performed using an MMWG dynamics model that has been updated with the appropriate generator and equipment parameters for the new units. The SERC dynamically reduced 2012 summer peak case was used for this study. The case was modified to turn off some units to offset the new generation. NERC Category B, Category C, and Category D faults were evaluated.

Fault studies were not performed for this station because the new generator reactances were slightly higher than the existing reactances. Because the reactances are higher, the fault current will be lower and no negative impacts could exist as a result of the generation changes. The additional power output will not affect the units' fault duty.

Reactive Capability is evaluated by modeling a facility's generators and step-up transformers (GSU's) at various taps and system voltage conditions. The reactive capability of the facility can be affected by many factors including generator capability limits, excitation limits, and bus voltage limits. The evaluation determines whether sufficient reactive support will be available at the Connection Point.

3.0 Thermal Study Results

3.1 NRIS Evaluation

No network upgrades were identified as being attributable to the studied generating facility.

4.0 Stability Study Results

For this analysis, 189 faults were simulated at the McGuire 230 and 500 kV stations on the three base cases to fully analyze NERC TPL Table I.

All NERC TPL defined Category A, B, and C faults were stable. All Category D faults were stable except for the following:

All Category D faults with breaker failure in the McGuire 230 kV switchyard were unstable. McGuire unit 1 and Cowans Ford Hydro went unstable first, followed in some cases by other 230 kV plants in the area. The critical clearing times (CCTs) to achieve stability ranged from 9 to 12.0 cycles across all of these 230 kV faults and all base cases.

Independent pole operation (IPO) was assumed for all 500 kV breakers, and all Category D faults with breaker failure in the McGuire 500 kV switchyard were stable except one. A three-phase fault on GSU 2A with failure of breaker 58 was unstable only in the 2015 case which included the project with Queue ID 40639-01. The CCT was 12.5 cycles - a reduction of just 0.5 cycles.

NERC does not require stability for Category D faults because of their low probability of occurrence. As such, no solutions are required for the unstable Category D faults.

Because instability was seen for some faults, both of the uprated McGuire generators must have out-of-step protection in service whenever operating. No poorly damped oscillations were seen in this study.

Confirmation has been received that both McGuire generators currently have out-of-step protection, therefore the McGuire Nuclear Station should be able to reliably inject its additional 80 MW of net power into the Duke Energy Carolinas electric transmission system without any upgrades.

5.0 Reactive Capability Study Results

With the proposed modifications to the existing generating facility, the level of reactive support supplied by the units has been determined to be acceptable at this time. Evaluation of MVAR flow and voltages in the vicinity of McGuire Switching Station indicates adequate reactive support exists in the region.

Study completed by: _____

Daniel Fain, P.E., Duke Energy

Reviewed by: _____

Henry Ed Ernst, P.E., Duke Energy
Director, Transmission Planning Carolinas