



**System Impact Study
GIP-IR151-SIS-R2**

**Generator Interconnection Request IR151
50 MW Generator
Tufts Cove Generating Plant
Halifax, Nova Scotia**

**Principal Investigator
Hung Huynh, P.Eng.**

**July 25, 2010
Transmission Planning
Nova Scotia Power Inc.**

Executive Summary

As per the Generator Interconnection Procedure (GIP), the System Impact Study is required for Interconnection Request number 151 (IR151) for a pending 50.8 MW synchronous generator with a steam powered turbine at Tufts Cove generating station. IR151 generator will use the exhaust heat from the two existing combustion turbines each rated 50 MW to operate as a 150 MW combined-cycle plant.

Since IR151 generation will be a conventional synchronous generator that can be dispatched and is non-variable, voltage flicker will be a non-issue. IR151 generator is equipped with high speed excitation system hence voltage control will also be a non-issue.

Even though TC4, TC5, and IR151 will share a common node on the 138 kV bus, their combined output is 150 MW, less than the existing largest generator (Point Aconi) in Nova Scotia, hence IR151 should have no impact on operating reserve.

The Power Flow and Stability study in this report assume system normal and single contingencies (NPCC's normal contingencies). For the study of the system starting with a transmission element already out of service (or planned to be out of service) to cater for the next contingency, operation studies will be conducted at that time to identify any system operating limit or restriction.

The increase in short-circuit level due to the addition of IR151 generation does not exceed any short-circuit interrupting capability of the 138 kV or 69 kV circuit breakers at 91H-Tufts Cove substation or any 138 kV circuit breakers at nearby substations. IR151 generator addition will not necessitate any upgrade of short-circuit interrupting capability or thermal rating of circuit breakers in the system.

The 138 kV bus at Tufts Cove will remain non-BPS (non Bulk Power System) provided that the zone 2 times on the 138 kV remote line terminals from Tufts Cove substation are shortened to 200 milliseconds from the existing 350 milliseconds. The breaker back up (BBU) times at the local terminals will also need to be changed appropriately to coordinate with the new zone 2 times.

The dynamic simulation of Nova Scotia islanding shows that IR151 generator remains on line as required and contributes to stabilizing the system frequency.

IR151 generator is capable of providing a power factor of +/-0.95 at the high side of the generating transformer as required in the GIP.

The stability analysis shows that IR151 stays stable and well damped for the contingencies studied.

The load flow analysis identifies contingencies that would cause overload of L-5003, L-5003 switches at 124H-Akerley substation, L-5003 switches at 99H-Farrell St substation, L-5041, L-5049, L-6014, and L-6003. The degree of overload depends on the amount of generation on line at Tufts Cove and Burnside and the system load. The highest level of overload occurs during contingencies when the local generation is at maximum and the system load is at minimum. The contingencies include double circuit tower lines L-6003 and L-6009, double circuit tower lines L-6003 and L-6007, 138 kV breaker failure 91H-605 at Tufts Cove, L-6003, 138 kV/69 kV transformer at Tufts Cove 91H-T11 or 91H-T62, L-5049, L-5041, 69 kV breaker failure 91H-523 at Tufts Cove, L-6014, 138 kV tie breaker 104H-600 at Kempt Road, and 138 kV node for generator 3 and 4 at Burnside.

The details of the overload, the contingencies, and the system conditions are discussed in section 7 “Steady State Power Flow”. The discussion in this section shows that the addition of IR151 generator does not initiate the overload, but just increases the levels of the overload. Since the overload exists for contingencies prior to the addition of IR151, the cost of mitigation is not assigned to IR151 generator interconnection. The cost will be included in NSPI’s capital program. As for the increase of the overload due to IR151 under system contingencies, IR151 generation will be curtailed first. However, since all Tufts Cove generating units are also owned by the same entity, the entity may have a choice of which generator to be curtailed.

After the discussion in section 7 regarding the extreme case (maximum generation at Tufts Cove and Burnside at system light load) versus the practical case (based on historical generation at Tufts Cove and Burnside), only the overload of L-5003, L-5003 switches at 124H-Akerley substation, L-5041, and L-5049 will need resolution.

The following system changes and considerations should be included by NSPI in its transmission capital program:

1. Upgrade L-5003 69 kV switches at 124H-Akerley substation to higher ratings.

Based on historical Tufts Cove and Burnside generation, the overload of L-5003 and its line switches at 99-Farrell St substation for contingencies identified can be managed by the system operator who has 15 minutes to reduce IR151 generation and/or Tufts Cove generation as needed to relieve the overload.

At some future time, if the local generation operates at near maximum during system light load, then further analysis should be undertaken, taking into account the effect of Demand Side Management (DSM), to determine if an SPS or line upgrade will be required.

Also in future, operation studies with one system element already out of service (or planned to be out of service) may identify the need for the SPS or line upgrade or generation restriction for IR151 (TC6) generator and/or Tufts Cove generation.

The cost, benefit, judicious use, and risk of an SPS should be weighed against the line upgrade. All SPSs are subject to NPCC approval.

3. The ratings of L-5049, L-5041, and L-5041 cables should be verified as the line conductors are large (Arbutus 795 ASC) and spans are short and yet their summer rating is just 68 MVA. The 50 degrees C published conductor design temperature may have been a default value instead of actual values. Depending upon the findings, the mitigation will be determined at that time.
4. The zone 2 times on the 138 kV remote line terminals from Tufts Cove substation need to be shortened to 200 milliseconds. The breaker back up (BBU) times at the local terminals will also need to be changed appropriately to coordinate with the new zone 2 times.

There is no cost assigned to IR151 generator interconnection.

It is noted that around 1990, a temporary overload scheme titled “Line L-5041/5003 Intertrip” was installed at Tufts Cove substation. The scheme is now physically there, but disconnected and not in service at this time. The purpose of the scheme was to reduce the overload on L-5041 in the event of maintenance and line fault that leaves L-5041 overloaded. The scheme was designed to trip L-5003 at 99H-Farrell St substation to relieve the overload on L-5041.

The problem with tripping the overloaded L-5003 is that, depending upon the amount of generation at Tufts Cove and Burnside and system load condition, other lines in the vicinity would be overloaded or more severely overloaded if they are already overloaded.

It is recommended that if an SPS is needed, it should be a generation reduction SPS that will reduce Tufts Cove generation to relieve the overload on the affected lines instead of tripping them.