

**Q. Please provide Newfoundland Power’s transmission system, terminal station, substation, subtransmission system, and distribution system design criteria. These criteria should include system contingencies and line and equipment normal and allowed emergency loading limitations. The response should state where Newfoundland Power’s Transmission and Distribution system is not consistent with these criteria (because the criteria may have changed over the years).**

**A. 1. General**

Newfoundland Power (“the Company”) designs the electrical system to ensure that the system provides safe, reliable service to customers on a least cost basis.

Substation, transmission and distribution infrastructure requirements are planned and designed with a focus on operational flexibility and minimizing customer outages through cost effective upgrades and maintenance to the electrical system. The Company’s existing transmission, substation and distribution systems are consistent with this criterion. Further explanation of each system’s design criteria is outlined below.

**2. Transmission**

Newfoundland Power has a total of 103 looped and radial transmission lines throughout its service territory. Looped transmission lines are generally found in more urban centers while radial transmission lines tend to exist in rural areas.<sup>1</sup> The majority of the Company’s transmission system provides full redundancy in the event of a loss of a single transmission line. However, Newfoundland Power does not have a specific policy requiring such redundancy for transmission lines.<sup>2</sup>

The level of redundancy for the transmission system is assessed on an individual basis and considers the level of back-up provided by: (i) local generation; (ii) mobile generation; (iii) and mobile substations. The need to supply customers when extended outages are required for maintenance or upgrade of existing transmission lines is also considered.

Further information relating to Newfoundland Power’s transmission system planning policy, criterion and process is provided in the response to Request for Information PUB-

<sup>1</sup> Looped transmission systems allow for power to be supplied to customers from two different supply points. A looped transmission line corresponds to a substation being fed by two transmission lines. Should an outage occur on one transmission line, service is maintained through an alternate transmission line. Radial transmission systems correspond to a substation being fed by a single transmission line. An outage to a radial transmission line is more likely to cause an extended outage to customers than a looped transmission line.

<sup>2</sup> Newfoundland Power maintains full redundancy for the 4 sections of underground transmission lines currently in operation.

1 NP-155. Information relating to normal and emergency loading limitations for  
2 transmission lines is provided in the response to Request for Information PUB-NP-146.

### 3 **3. Substation**

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6 Newfoundland Power has 130 substations located throughout its service territory. Some  
7 substations provide service to large numbers of customers and include multiple power  
8 transformers and distribution feeders, while others service relatively few customers and  
9 have a single transformer and distribution feeder. To ensure adequate contingencies are  
10 in place in the event of equipment failure the Company's individual substation designs  
11 take these characteristics into account and consider other factors. These include the size  
12 and quantity of transformers required, the number of distribution feeders originating from  
13 the substation, and redundancy of other substation equipment including breakers and  
14 reclosers.

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16 Substation power transformers require contingency planning to ensure customers are not  
17 subjected to extended outages due to equipment failures.<sup>3</sup> Substations with multiple  
18 transformers and with offloading capability to surrounding substations provide a level of  
19 redundancy for power transformers. Where required, Newfoundland Power will deploy  
20 mobile substations to minimize customer outages.<sup>4</sup> Further, the short term overload  
21 capabilities of power transformers will also be utilized to provide backup to adjacent  
22 power transformers.

23  
24 Newfoundland Power designs its substations to provide contingencies for substation  
25 breakers and reclosers. By-pass switches are generally installed in substations to allow  
26 for the replacement of failed breakers and reclosers without customers experiencing  
27 extended outages.

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29 The Company's transformer loading guidelines is taken from American National  
30 Standards Institute ("ANSI") standard C57.92, Guide for Loading Oil-immersed  
31 Distribution and Power Transformers.

32  
33 The Company's normal loading criteria for breakers and reclosers are based on the  
34 equipment ratings at an average ambient temperature of 40°C. If the breaker is operated  
35 at an ambient below 40°C the breaker is capable of handling higher loads. The actual  
36 load the breaker is capable of is a function of the maximum operating temperatures of the  
37 breaker components and the ambient temperature.<sup>5</sup>

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<sup>3</sup> New substation power transformers typically take 12-18 months to procure and deliver to Newfoundland Power.

<sup>4</sup> Newfoundland Power has 4 portable substations ranging in capacity from 10MW to 50MW.

<sup>5</sup> ANSI Standard C37 is used to provide direction on breaker ratings under different ambient temperatures.

#### 4. Distribution

Newfoundland Power has 306 distribution feeders located throughout its service territory.<sup>6</sup> All of the Company's distribution feeders are radial systems and the vast majority of distribution lines are constructed overhead.<sup>7</sup> Where available, distribution feeders can be offloaded onto adjacent feeders. The amount of load that can be offloaded is dependent on the amount of spare capacity available on the adjacent feeders. This will vary by time of year and will depend upon the maximum conductor amperage available given the ambient conditions at that time and other constraints including voltage drop along the feeder.

Newfoundland Power has a limited number of underground primary distribution lines.<sup>8</sup> The Company generally requires sufficient spare capacity in its distribution system to provide full redundancy in the event of an underground cable fault. For main line underground distribution feeders, this capacity is provided by spare underground cables or spare capacity on adjacent feeders. For underground residential distribution, the company maintains full redundancy with a looped underground distribution configuration.<sup>9</sup> Where underground distribution is provided to a single customer, full redundancy is provided at the option of the customer.

Further information relating to Newfoundland Power's distribution system planning policy, criterion and process is provided in the response to Request for Information PUB-NP-157. Information relating to normal and emergency loading limitations for distribution conductor is provided in the response to Request for Information PUB-NP-146.

#### 5. Conclusion

The design of Newfoundland Power's electrical system provides for the safe, reliable delivery of electricity to customers on a least cost basis. Transmission, substation, and distribution systems are designed to provide operational flexibility and to provide contingencies that minimize customer outages. The Company's electrical system design

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<sup>6</sup> Approximately 97% of Newfoundland Power's distribution lines utilize overhead construction.

<sup>7</sup> While many of Newfoundland Power's feeders contain tie points to other feeders on the distributions system, they are not considered by the Company to be looped distribution lines.

<sup>8</sup> Distribution feeders consist of primary lines and secondary lines. Primary lines operate at voltages between 2.4 kV and 25 kV and are used to distribute power from a substation to a step down transformer near the customer's premises. Secondary lines operate at voltages between 120V and 600V and are used to distribute power from the step down transformer to the customer premises.

<sup>9</sup> Newfoundland Power's standard practice for underground residential distribution is to operate a fused open-loop configuration. In this configuration, termination points for the underground loop are fused and energized with an open point typically located in the middle of the loop. In the event of an outage, the fault is isolated and the loop is reconfigured to provide service on both sides of the fault.

1 criteria have contributed to improvements in reliability throughout the Company's service  
2 territory.<sup>10</sup>

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<sup>10</sup> In Newfoundland Power's 2013/2014 General Rate Application, the evidence before the Board was that the reliability of the Company's service was improved from that in 1998.