

1 Q. List the various transmission system studies such as stability, load flow, fault duty  
2 and transmission to subtransmission protection coordination studies, conducted by  
3 Hydro or its consultants and whether these studies are periodic or driven by  
4 changes in the system.

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7 A. Hydro's transmission system includes high voltage electrical equipment with a  
8 voltage rating equal to or greater than 66 kV. Hydro's distribution systems include  
9 electrical equipment with a voltage rating less than or equal to 46 kV. Hydro does  
10 not utilize the term subtransmission when planning or operating the  
11 interconnected systems on the Island or in Labrador.

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13 The following transmission system studies are completed by Hydro's Transmission  
14 Planning group utilizing the Siemens PTI Software package PSS®E:

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- Load Flow Studies

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- Each year Hydro prepares a set of base case load flow models for the  
18 current year and the next four years incorporating the latest load  
19 forecasts and completed system additions or modifications. Both  
20 peak (winter) and light (summer) load cases are prepared. These  
21 cases are used to:

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- Identify the need for additions to the system such as  
23 transformers, lines, voltage support, etc. for inclusion in  
24 Hydro's capital budget and five year plan;

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- Provide the starting point for the analysis of interconnection  
26 requests made by industrial customers or non-utility  
27 generators;

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- 1                   ▪ Provide the starting point for operational studies including  
2                   outage requests and post event simulation; and
- 3                   ▪ Provide the starting point for integration studies for Hydro  
4                   and/or Nalcor generation sources such as Muskrat Falls and  
5                   the Labrador Island Link.
- 6           • Transformer Capacity Studies
- 7               ○ Following the completion of the five year base case load flows Hydro  
8               completes an annual Transformer Monitoring exercise in which the  
9               transformer capacity within its terminal stations is assessed to  
10              ensure there is sufficient transformer capacity to meet the forecast  
11              load over the forecast period.
- 12           • Short Circuit Studies
- 13               ○ Hydro maintains a short circuit model of both the Island and  
14               Labrador Interconnected Transmission Systems. The model is  
15               updated as equipment modifications affecting short circuit levels are  
16               made on the system(s). The model is utilized to provide:
- 17                   ▪ Minimum and maximum short circuit levels for protection  
18                   coordination and review;
- 19                   ▪ Minimum and maximum short circuit levels for motor starting  
20                   calculations and shunt capacitor switching; and
- 21                   ▪ Minimum, maximum and maximum foreseeable short circuit  
22                   levels for equipment specification.
- 23           • Stability Studies
- 24               ○ Hydro maintains stability models of both the Island and Labrador  
25               Interconnected Systems. These models are updated as equipment is  
26               added (i.e., generation) or modified (i.e., exciter or governor

1 replacement). Stability studies are generally equipment addition  
2 driven in nature and are utilized to:

- 3       ▪ Assess the impact of equipment additions (including  
4           interconnection requests) on dynamic response of the system  
5           to transmission line contingencies;
- 6       ▪ Determine critical clearing times for equipment to ensure  
7           stable system response;
- 8       ▪ Determine appropriate settings and limits for excitation and  
9           governor systems;
- 10      ▪ Assess proposed changes to protection philosophies (i.e.,  
11           application of three pole reclosing at 230 kV, out of step  
12           protection); and
- 13      ▪ Post event simulations.

14      • Interconnection Studies

- 15          ○ Hydro completes interconnection studies for interconnection  
16           requests including new sources of generation (i.e., wind farms) and  
17           load (i.e., industrial customers) as requests are received. These  
18           studies include load flow, short circuit and stability analysis as  
19           deemed appropriate for the individual request. Cost estimates for  
20           the technically viable interconnection solutions are prepared. Least  
21           cost life cycle costs analysis utilizing engineering economics  
22           techniques including factors such as capital cost, transmission losses,  
23           incremental maintenance costs and other factors as appropriate to  
24           the project is completed. A least cost interconnection alternative is  
25           provided to the proponent for a decision to proceed with  
26           interconnection.

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1 The Protection, Control and Communications (PC&C) Engineering Department uses  
2 the Aspen OneLiner software package to model the different voltage level systems  
3 operated by Hydro. The Aspen OneLiner package is used to perform relay  
4 coordination. It allows faults to be placed at different locations within the modeled  
5 system and displays the relay responses to the faults. In this way, the operating  
6 times of different relays can be checked to confirm that the proper relay operates  
7 first to minimize the effect of the disturbance. The Aspen OneLiner software is  
8 used when there are changes to the relaying scheme for a transmission line or  
9 distribution system that need to be checked. It is also used to calculate arc flash  
10 results for generating plants. Consultants hired by Hydro to perform relay  
11 coordination studies and arc flash studies also use the Aspen OneLiner software.  
12 This does not apply to Holyrood where a different software package (SKM Power  
13 Tools) was used by the consultant to perform the arc flash study. The arc flash  
14 calculator was not available on Aspen OneLiner when the Holyrood arc flash study  
15 was done.