BC Hydro
Power smart

Inter-office memo

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Date:	May 21st, 2019
To:	Material Classification Facility Team
CC:	Mažana Armstrong, Ali Moshref, Doug Thoreson, Sam Cho, Bob Stewart
Subject:	Electric and Magnetic Field Profile for Material Classification Facility Profile
Memo No.:	T2019-6038

Introduction

BC Hydro's Materials Classification Facility (MCF) at the Surrey Campus is being relocated to south of 88 ave as the new site is more suitable for heavy industrial operations. The new facility will be located on parts of circuits 2L4's and 2L56's Right-Of-Ways (ROWs). Circuits 2L56 and 2L4 are two 230kV circuits originating from Ingledow station, which is located approximately 500m from the facility's new site.

In the vicinity of the substation, the two circuits run in parallel to each other but on different structures. The two lines afterwards run together as double circuits on the same structures. To allow for more space and better accessibility to the new MCF, 2L4's structures 00-03 to 00-06 will be removed and the line will run as a double circuit with 2L56 at an earlier point (at 2L56's 00-02 structure rather than 2L56's 00-04 structure originally). Figure 1 below illustrates these changes mentioned.

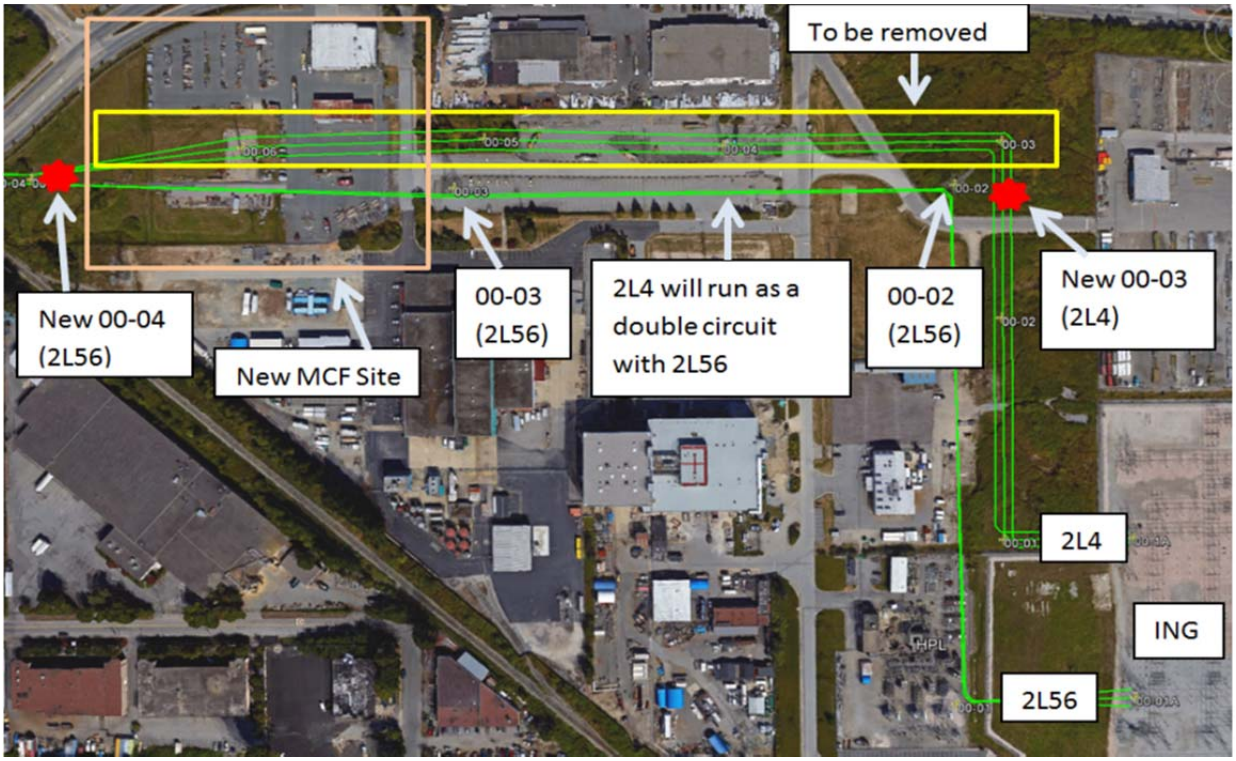

Figure 1: New MCF site location and changes to 2L4 and 2L56

This memo analyzes the Electric and Magnetic Fields (EMF) around the proposed new MCF. It aims to examine whether the EMF levels are safe for the workers and public around the facility after the changes to 2L4's and 2L56's arrangement.

Safety by Design

Safety by Design (SbD) is an application of engineering principles and standards for designing features into new and existing facilities to ensure that they are inherently safe.

This memo applies Safety by Design by ensuring that electric and magnetic fields around the facility does not exceed BC Hydro limits as stated in BC Hydro's ES41K Section 3.3 - "Electric and Magnetic Fields".

Data

The following data is used for the EMF study:

- Conductor Geometry:

  - The MCF facility will be located between 2L56's structures 00-03 and new 00-04. The EMF calculations are analyzed when the conductors are at their maximum sag. The conductors' configuration for both circuits at maximum sag is shown in Figure 2 below.

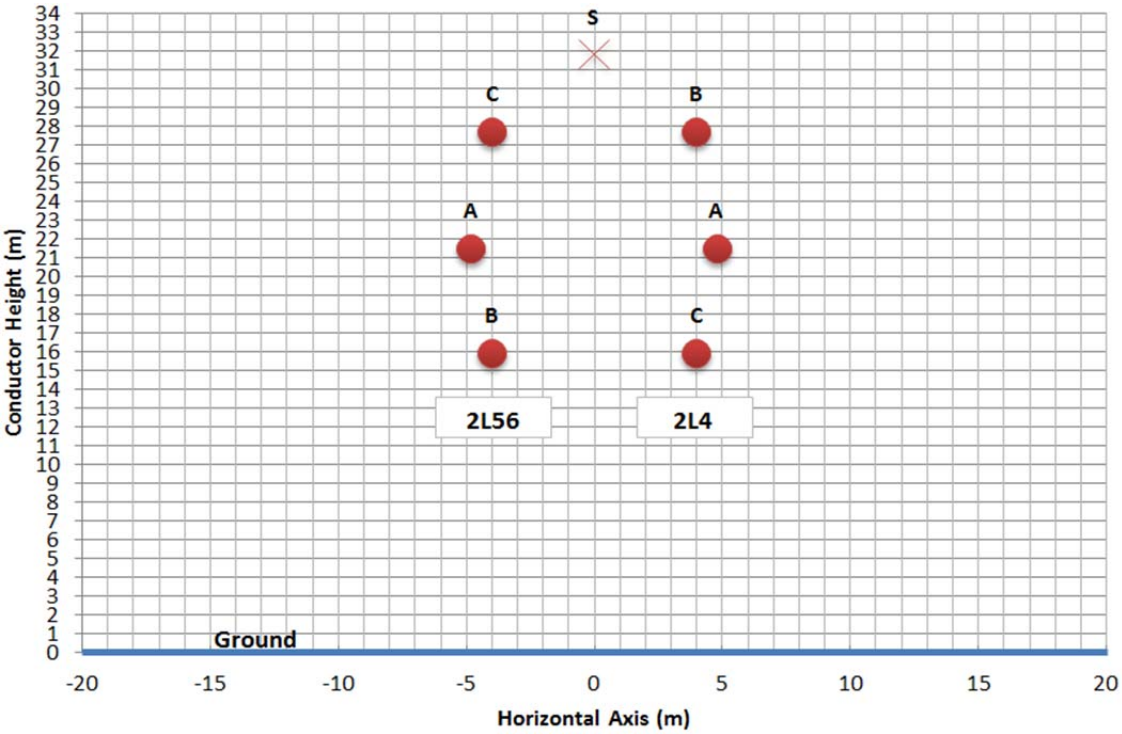

Figure 2: Transverse view of 2L4 and 2L56 at maximum sag around the proposed MCF

  - The conductor size for both circuits is a 2.814 cm diameter Drake single conductor.

- Line Loading:

  - **2L4:** Based on System Operating Order 5T-10 (April 12th, 2019 issue), the maximum steady state rating of 2L4 is 1350 A and is assumed for the induction study. Line currents are assumed to be balanced.

  - **2L56:** Based on System Operating Order 5T-10 (April 12th, 2019 issue), the maximum steady state rating of 2L56 is 1220 A and is assumed for the induction study. Line currents are assumed to be balanced.

Analysis

Transmission Line Electrical Design's in-house tool TLEEF-V3.8 is used to calculate the EMF profiles around the transmission line.

Electric Fields

The electric field profile when both lines are in service is shown below. The maximum field strength is found to be 0.69kV/m.

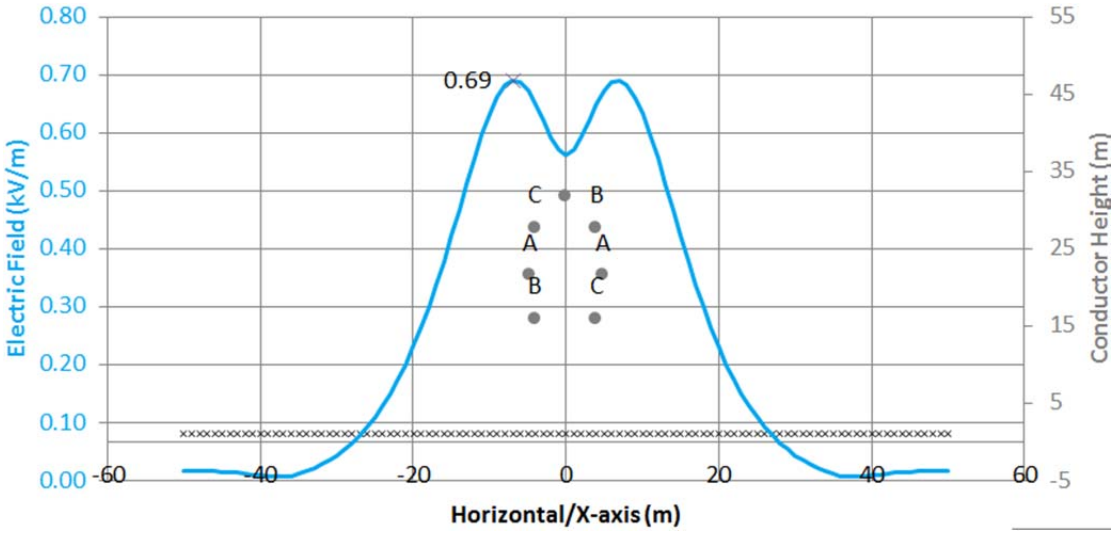

Figure 3: Electric field profile when 2L4 and 2L56 are in service

When one of the lines is not in service, the electric field profile is shown below. 2L4 was chosen to be the one in service since it has a larger load current. The maximum field strength is found to be 1.20kV/m.

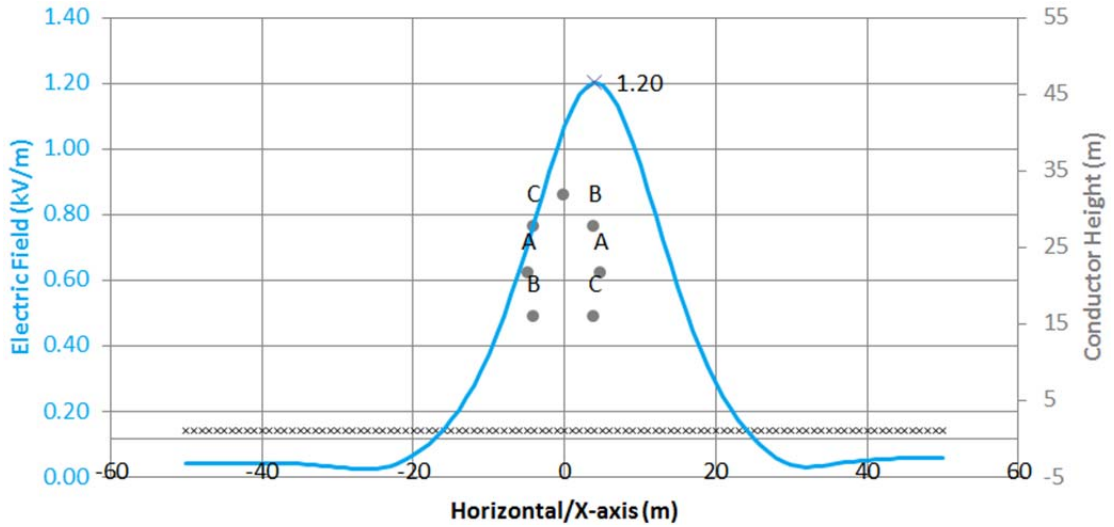

Figure 4: Electric field profile when 2L4 only is in service

The maximum electric field strength in both scenarios is therefore, 1.20kV/m. According to BC Hydro's standard for electric fields (which adopts IEEE's standards for electric field limits), the public's electric field exposure should not exceed 5kV/m [1]. Thus, the electric field generated by the lines is safe for the public and for the MCF workers.

According to BC Hydro's standard for electric fields, the current induced by the lines in objects should be limited to 5mA. For transport trucks that could drive and stop below the transmission lines at the facility, this means that the electric field should not exceed 4.6kV/m [1]. Since 1.20kV/m is the maximum field strength, the electric field generated by the line will therefore not result in hazardous induction currents.

Metallic bins for waste, sorting, and storage will be installed underneath the transmission lines. However, those bins will be smaller than transport trucks. As a result, the current induced in the bins will be smaller than the one induced in trucks. It is therefore safe to assume that the current induced in the bins is also not hazardous.

Magnetic Fields

The magnetic field profile when both lines are in service is shown below. The maximum field strength is found to be 53.8mG.

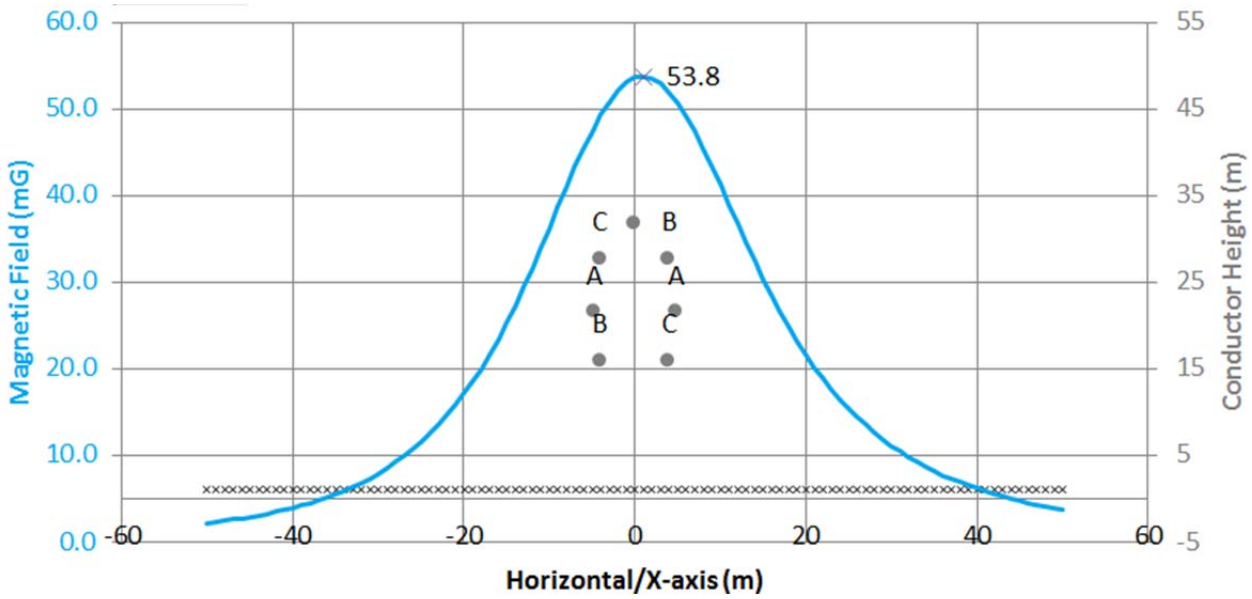

Figure 5: Magnetic field profile when 2L4 and 2L56 are in service

When 2L56 is not in service, the magnetic field profile is shown below. The maximum field strength is found to be 70.2mG.

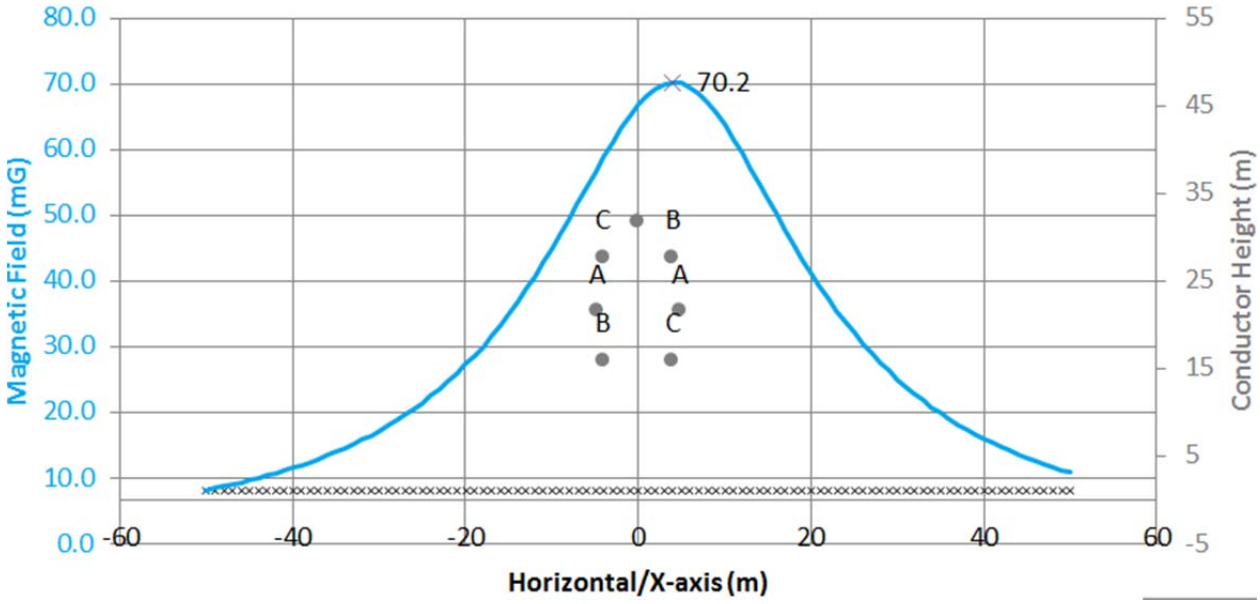

Figure 6: Magnetic field profile when 2L4 only is in service

The maximum magnetic field strength in both scenarios is therefore, 70.2mG. According to BC Hydro's standard for magnetic fields (which adopts IEEE's standards for magnetic field limits), the public's magnetic field exposure should not exceed 2000mG [1]. Therefore, the magnetic field generated by the lines is safe for the public and for the MCF workers.

Future Adjacent Double Circuit Lines

In the future, a new 230kV double circuit will be installed parallel to 2L4 and 2L56 in the vicinity of the MCF. The effects of this future installation on the MCF are also examined. The following has been assumed:

- As with 2L4 and 2L56, the new structures between the MCF are steel structures
- The distances between 2L4 and 2L56's structures' centreline and the new structures' centreline are 20.6m, since this is BC Hydro's minimum circuit to circuit clearance separation for steel structures [2]
- The maximum conductor sag happens at the same position and at the same elevation as 2L4 and 2L56
- The phasing arrangement for the new lines is the same as 2L4 and 2L56, as this is the optimal phasing arrangement to reduce induction levels according to BC Hydro's standard for controlling induction hazards [3]
- The conductors' spacing is the same as 2L4 and 2L56
- The maximum current ratings for the lines is the same as 2L4 and 2L56

The maximum electric and magnetic field produced is found to be when one circuit on each structure is in service while the other is not. Below is the electric and magnetic field profile for this scenario:

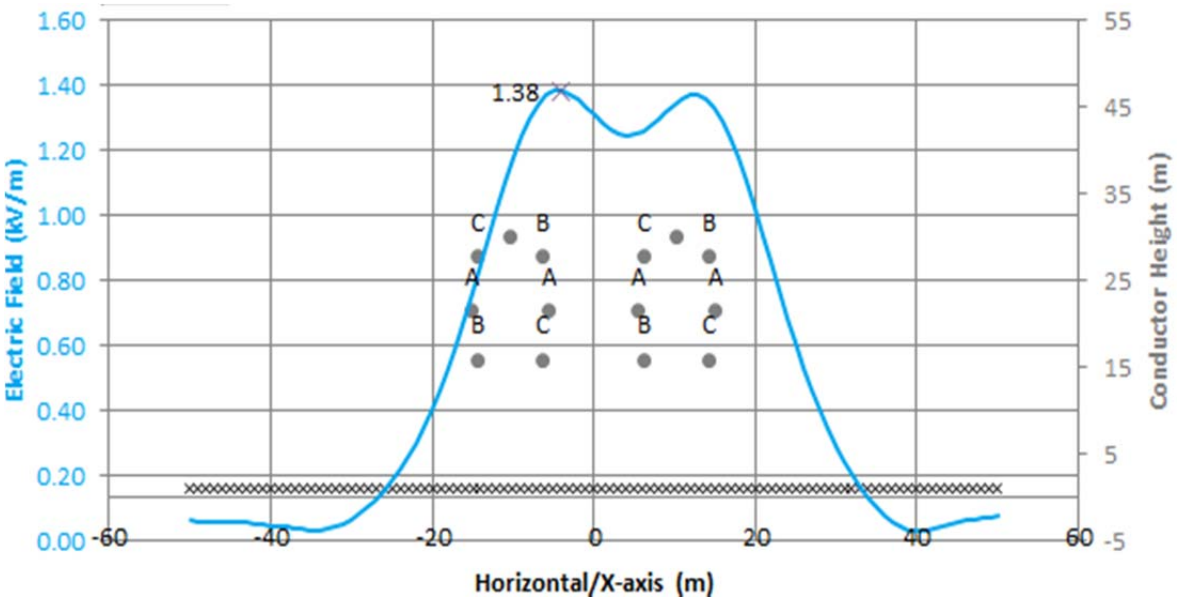

Figure 7: Electric field profile for the two double circuits adjacent to each other with one line only on each structure being in service

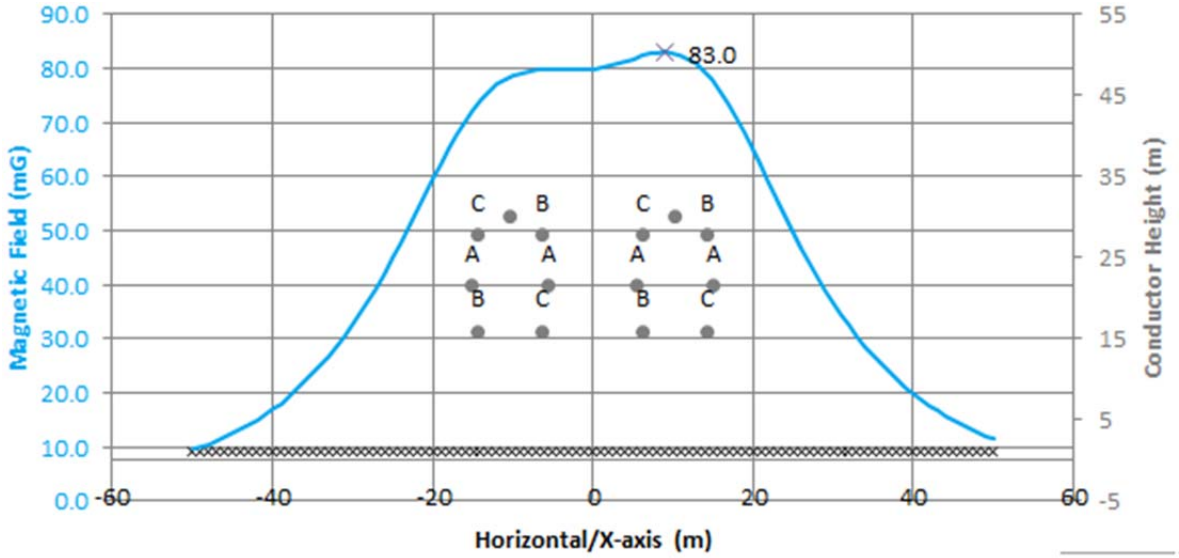

Figure 8: Magnetic field profile for the two double circuits adjacent to each other with one line only on each structure being in service

The maximum electric and magnetic fields are 1.38kV/m and 83.0mg respectively. Both are below the 4.6kV/m and 2000mG mentioned in BC Hydro's standard for EMF limits [1].

Conclusion

Based on the transmission electrical design assessment, there are no EMF issues for the re-configuration of 2L4 to run as a double circuit with 2L56 at an earlier structure. The new MCF will not be exposed to hazardous levels of electric and magnetic fields. This is also the case when a new double circuit will be installed nearby. For induction, a separate study has to be done to ensure that no conductor in the vicinity of 2L4 and 2L56 at the proposed new MCF could be impacted.

References

[1] BC Hydro Engineering Standard ES 41K Section 3.3 R2, "Electric and Magnetic Fields," BC Hydro, Burnaby, 2013.

[2] BC Hydro Engineering Standard ES 41C Section 1 , "Right-of-Way Dimensions for New Overhead Transmission Lines," BC Hydro, Burnaby, 2010.

[3] BC Hydro Engineering Standard ES 41K Section 3.1 R1, "Controlling Induction Hazards," BC Hydro, Burnaby, 2013.

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