Bipole III

Bipole III Transmission Project: A Major Reliability Improvement Initiative

Direct Current Electric and Magnetic Fields

Existing Bipole HVdc Transmission Tower

Manitoba Hydro is proposing to build a new direct current (DC) transmission line, known as Bipole III, to improve system reliability. The new line will link the northern power generating complex on the Lower Nelson River with the delivery system in southern Manitoba.

Two existing DC lines currently carry almost 75% of Hydro's generating capacity within the same corridor and are vulnerable to major outages from severe weather events and forest fires.

This brochure outlines the differences between DC and alternating current (AC) transmission and provides some background information on electric and magnetic fields, including the static fields associated with DC transmission.

What is direct current (DC) and alternating current (AC) transmission?

Electricity is transmitted as current. Current flows from generating stations over transmission lines to substations and then through distribution lines before it reaches our homes and offices. Transmission lines carry either direct current or alternating current:

- Direct current (DC) flows constantly in only one direction (frequency of change or oscillation is 0 Hertz [Hz]).
- Alternating current (AC) changes direction 50 or 60 times per second (frequency of change or oscillation is 50 or 60 Hz).

Why a DC Transmission Line?

Manitoba Hydro's system supplies electricity to its customers as AC power. But, large amounts of power can be more efficiently transmitted over long distances as DC power. DC transmission can significantly reduce the amount of power lost over long distances, when compared to a comparable AC transmission line because in AC systems, the electric field around the conductors and the magnetic field arising as a result of the current flow through the conductors changes direction every cycle.

Existing AC Transmission Line along Perimeter Highway

What are Electric and Magnetic Fields?

Electric and magnetic fields surround any electrical circuit, whether it carries AC or DC power, including appliances, electrical wiring and power lines. Both electric and magnetic fields diminish rapidly as the distance from the source increases. Electric and magnetic fields from DC transmission lines are commonly referred to as static fields because they do not alternate in direction.

What are DC (Static) Electric Fields?

DC or static electric fields are created by the attraction and repulsion of electric charges ("static electricity"). These are measured in volts per meter (V/m) or kilovolts per meter (kV/m). Static electric fields occur naturally. Electric charges in the atmosphere, for example, produce a fairly constant static electric field with an average intensity of 0.15 kV/m. Everyone has experienced static electricity from a comb or brush and 'static cling' on clothing, which can produce static electric fields up to about 100 kV/m. The static electric field associated with the existing Bipoles I and II transmission lines is well within the field levels produced by these natural sources. The proposed Bipole III transmission line is expected to produce fields of similar strengths.

What are DC (Static) Magnetic Fields?

Static magnetic fields are created by a magnet or by the steady flow of electricity (e.g., in appliances using direct current from a battery). These are measured in milligauss (mG). The Earth also has a natural static magnetic field ranging from 300 mG to 600 mG as a result of currents flowing deep within its core. The strength of this field in Manitoba is about 580 mG. It is this field that is used for compass navigation. The static magnetic field level associated with the existing Bipoles I and II is less than the static magnetic field of the Earth in Manitoba. The proposed Bipole III transmission line is expected to produce fields in the same range.

How do electric and magnetic fields differ for AC versus DC transmission?

Electric and magnetic fields from DC lines differ from those associated with AC lines because of the difference in frequency, i.e., oscillation or alternation of current. The fields associated with the operation of a DC line are static, which is the same as having a frequency of zero, and do not induce voltages or currents in conducting materials. Static electric fields from DC transmission lines are typically not perceived as the AC electric fields from higher-voltage AC transmission lines can be. However, in certain weather conditions, both AC and DC transmission lines may produce an electric field associated with electric charges in the air and not just those on the conductors.

Are DC transmission lines similar to AC transmission lines in that some weather conditions can cause audible noise and radio interference?

Yes, these may be noticeable, particularly when crossing underneath an AC or DC transmission line. These occur when the strength of the electric field at points on the conductors' surface exceeds the insulating properties of air and tiny amounts of energy are released. This may be noticeable for AM radio or analog television pictures, but not for FM radio or cable television. Adherence to Canadian and Manitoba electrical codes and standards will minimize such effects.

Has research been conducted on the potential for DC electric and magnetic fields to affect health?

Yes. The research includes epidemiology studies of workers exposed to static (DC) magnetic fields, surveys of persons and animals living near DC lines, animal studies in the laboratory, and studies of cells and tissue in the laboratory. This research has been reviewed by independent scientific panels.

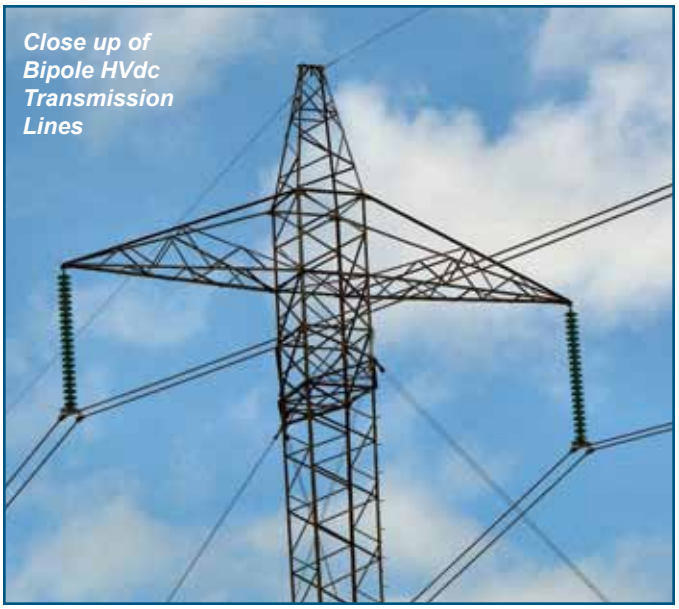
What have scientific panels concluded about the research on DC electric and magnetic fields and human health?

National and international scientific agencies responsible for public health have convened multidisciplinary groups of scientists to evaluate the research and to determine if health effects are associated with exposure to DC electric and magnetic fields. Such groups include the World Health Organization (WHO) in 2006, the National Radiological Protection Board of Great Britain (NRPB) in 2004, and the International Agency for Research on Cancer (IARC) in 2002. With regard to the levels of static fields associated with the proposed DC transmission line and other common sources, these organizations came to the following conclusion:

- There are no known adverse health effects associated with low levels of static electric or magnetic fields such as those associated with DC transmission lines.

Are there any standards or guidelines to limit exposure to DC electric and magnetic fields?

Yes, but these guidelines are designed to prevent effects caused by fields of much higher intensity than those associated with the proposed DC line. For example, guidelines for magnetic fields prevent short-term effects, such as nausea and dizziness that can occur in MRI machines at field levels more than 30,000-fold greater than the field of the Earth and DC transmission lines. Guidelines for static electric fields are designed to minimize static shocks from contact with large ungrounded objects. Guidelines for exposure to static electric and magnetic fields have been published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the International Committee on Electromagnetic Safety (ICES) and the American Conference of Governmental Industrial Hygienists (ACGIH).



Close up of Bipole HVdc Transmission Lines

Do DC electric and magnetic fields affect animals or plants?

Research has not shown that static fields adversely affect plants or the health, behavior, or productivity of animals.

What work has been done to monitor DC electric and magnetic fields for Bipoles I and II?

Bipoles I and II have been operating in Manitoba since the 1970s. The Manitoba HVDC Research Centre, Manitoba Hydro and the National Research Council of Canada conducted a long-term monitoring of the electric fields, magnetic fields, corona loss, ion current density, radio interference, and audible noise of these lines to assess their performance. Manitoba Hydro will use those results together with advanced modeling to describe the electrical environment around the Bipole III Transmission Project. These results and other detailed information about the project will be included in the Environmental Impact Statement.

Summary

While the design and hence the operating characteristics of the proposed Bipole III transmission line are still being developed, these characteristics are likely to be similar to other DC transmission lines in Manitoba.

There are no known health effects associated with static (DC) electric and magnetic fields in the range of levels that would be produced by the proposed Bipole III transmission line.

Bipole I and II Transmission Lines

Where can I find more information?

For information about Bipole I and II, please visit:

http://www.hydro.mb.ca/corporate/facilities/ts_nelson.shtml

For more information on the Bipole III Transmission Project, please visit:

http://www.hydro.mb.ca/projects/bipoleIII/index.shtml

For further information on static and electric magnetic fields, please visit:

World Health Organization: Static electric and magnetic fields - Fact Sheet N°299 (March 2006)

http://www.who.int/mediacentre/factsheets/fs299/en/index.html

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