CHAPTER 15

Electromagnetic Fields

15. ELECTROMAGNETIC FIELDS

Electric and magnetic fields (EMF's) are associated with a wide range of sources and occur both naturally as well as man-made. Naturally occurring EMF's are those associated with lightning or the Earth's magnetic field. Man-made EMF's occur wherever electricity is present, meaning we are constantly exposed to EMF's in our home and work environments.

Wind farms create EMF's from operational electrical equipment, such as transmission lines, substations and the electrical components found within the wind turbines. This equipment has the potential to produce Extremely Low Frequency (ELF) EMF's, that is the current will alternate direction between 30 and 300 times per second, or at 30 to 300 Hertz (Hz).

This chapter focuses on the theoretical health impacts and possible mitigation strategies for ELF electromagnetic fields generated by the operation of a wind farm.

15.1 Existing Situation

There are currently no Australian standards regulating exposure to ELF EMF's. The National Health and Medical Research Council (NHMRC) has issued interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. These guidelines are aimed at preventing immediate health effects resulting from exposure to these fields, and are currently subject to a review by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

The NHMRC recommended exposure limit for members of the public (24 hour exposure) is 1,000 milligauss (mG) for magnetic fields and 5 kilovolts per metre (kV/m) for electric fields. For exposure up to a few hours a day, the guidelines recommend exposure to be limited to 10,000 mG for magnetic fields, and 10 kV/m for electric fields (ARPANSA 2009).

Table 15.1 below provides typical magnetic field measurements and ranges associated with various EMF sources. Electric fields around most equipment/appliances are close to zero due to the shielding that is provided by the equipment itself. According to ARPANSA exposure levels to magnetic fields around the home are in the range of 0.1 to 2.5 mG. For homes near power lines, these levels may be as high as 5 to 10 mG (2009).

Table 15.1 EMF sources and magnetic field strength

Source	Typical measurement (mG)	Range of measurement (mG)
Television	1	0.2 to 2
Refrigerator	2	2 to 5
Kettle	3	2 to 10
Personal computer	5	2 to 20
Electric blanket	20	5 to 30
Hair dryer	25	10 to 70
Distribution power line (under the line)	10	2 to 20
Transmission power line (under the line)	20	10 to 200
Edge of easement	10	2 to 50

Note: Owing to variations in the design of electrical appliances and the loadings on powerlines, the EMF levels may vary. The table above is based on a consistent set of measurements undertaken by power authorities in Australia using similar techniques and protocols to overseas measurements.

Source: Electricity Network Association (2006)

15.2 Potential Impacts

ELF EMF's will be generated once the turbines and electrical infrastructure are energised (commissioned) and during the operation of the wind farm. The final configuration of the proposed Project will determine the profile and intensity of electric and magnetic fields across the Project site.

15.2.1 *Electrical Cables*

The proposed development comprises both under and above ground electric cabling up to 33 kV. Information with respect to the proposed 132 kV double-circuit transmission line connection is provided in **Section 15.5** and summarised **Chapter 3** Project Description, however examples of ELF EMF's from high voltage power lines are provided below to illustrate existing knowledge. The field strength from an electrical cable is dependent on load current(s), distance from the emitting source, relative phasing of circuits and spacing of conductors. Known measurements on the strength of both magnetic and electric fields are provided below:

- Measurements using a gaussmeter from underneath a 220 kV transmission line, resulted in a maximum recorded limit of 7.8 microTesla (µT) (or 78 mG) (Transpower 2009). Typical levels of magnetic field under a 330 kV high voltage transmission line range from 5 to 50 mG at a distance of 30 m from the centre of the easement (ngh environmental 2008). Both of these measurements are in line with the range expected and presented in **Table 15.1**; and
- Similarly, electric field measurements from underneath a 220 kV transmission line, resulted in a maximum recorded limit of 3.2 kV/m (Transpower 2009) with levels of 0.07 kV/m and 0.01 kV/m recorded at 30 m and 60 m from a 115 kV power line (Hafemeister 1996).

These figures are far less than the NHMRC recommended limits for exposure of 1,000 mG and 5 kV/m. As the magnetic and electric fields emitted from the 33 kV cabling is expected to be weaker than those from powerlines discussed above the effects from the proposed 33 kV internal electrical cabling are considered negligible.

However the strength of magnetic and electric fields can also change along a transmission line if there is an unbalanced load of energy within the line or there is line sagging due to excessive heat on the cables. Both of these effects could cause increased recordings directly underneath the transmission line, however the effects are temporary and would not exceed the 24 hour exposure limit from the NHMRC.

15.2.2 *Substation*

Due to the function of a substation and the required components, substations have the highest variation in magnetic fields from 1 mG to 66 mG (recorded at the security fence around the substation) (Health Protection Agency 2004). Note that the recorded magnetic fields are still below the NHMRC limit of 1,000 mG.

15.2.3 *Wind Turbines*

An electromagnetic field is created in the generator and electrical equipment whilst operational. The impact of electromagnetic fields on the surrounding environment is limited by the shielding of the electrical equipment in the turbine structure or small housing unit at the base of the tower and by the height of the generator which is encased 80 to 100 m above the ground. The test results from a 1.65 MW wind turbine in Canada show a measured magnetic field in the front door of the wind turbine of 0.4 mG with typical values at a distance of 10 feet (3 m) from the wind turbine base of 0.04 mG. Furthermore it was noted that at a distance of 25 feet (7.5 m) from a wind turbine, no measurable magnetic field is expected (Windrush Energy 2004). It is anticipated that an increase in generator capacity of up to 3.3 MW would still result in magnetic field measurements below the NHMRC limit of 1,000 mG for the Project.

15.2.4 *Receptors*

There is limited chance of the public being exposed to electric and magnetic fields from the wind farm, since the Project is wholly located on freehold land and the nearest receptor is approximately 800 m from an emitting source.

15.2.5 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a proposal in the context of existing developments and future developments to ensure that any potential environmental impacts are not considered in isolation. As detailed in **Chapter 3** Project Description, and with reference to **Figure 3.3**, the Boco Rock Wind Farm will require a double-circuit 132 kV transmission line to export the power generator by the wind farm to the electricity network. This line will connect the on-site collector substation with a switching substation at the point of connection to the existing network and will be subject to a separate planning assessment. **Figure 3.3** displays the route option corridors initially assessed, the preferred Southern Corridor and the existing electrical infrastructure in the locality.

In addition to the requirement for this new transmission line, Country Energy are in the process of upgrading the existing single-circuit 66 kV power line to the east of the Project to a double-circuit 132/66 kV line. This is expected to be completed before the end of 2010.

Cumulative EMF impacts will be created from the operation of the proposed Project. However as detailed above, in **Sections 15.1** and **15.2**, and the Management and Mitigation measures outlined below it is anticipated that the introduction of the Boco Rock Wind Farm will not have a significant cumulative impact.

15.3 Management and Mitigation

To ensure there is no unnecessary exposure to electromagnetic fields the following mitigation and management measures could include:

- Bury electrical cables where possible to shield electrical fields;
- Place wires together to cause a cancellation between the fields of electrical phases for magnetic fields;

- Place appropriate security around emitting structures (e.g. collector substation); and
- Ensure the public, including tourists, that need to go near emitting structures are accompanied by a trained and qualified staff member.

15.4 Summary

ELF EMF's are generated from operational machinery. The measurements of electromagnetic fields can vary within a wind farm, depending on the placement of equipment such as turbines, substations and internal electrical cables.

The *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields* (NHMRC 1989) places guidelines on exposure to both electric and magnetic fields for the public and construction industry.

The typical strategy for reducing electromagnetic fields is distance from the source. Other strategies also include burying cables and placing cables together to cancel the fields emitted from them.

As most of the wind turbine electrical equipment is encased within the turbine, in housing at the base of the tower or located 80 to 100 m above ground level, the distance and shielding from electromagnetic fields decreases the impact from emitting sources.

Electromagnetic fields can be recorded highest at substations; however, appropriate fencing and remote placement of the substation within the landscape can greatly reduce any expose to electromagnetic fields.

15.5 Proposed Transmission Line

The proposed transmission line will be assessed apart from this EA under Part 5 of the *EP&A Act*. As the proposed transmission line will be designed to conform to the recognised guidelines within Australia and with respect to any additional measures imposed by Country Energy, there will be minimal impacts from electric and magnetic fields.

15.5.1 ***Cumulative Impacts***

The proposed transmission line development will occur in parallel with the planned upgrade to the existing 66 kV network as described in **Chapter 3** Project Description and the Boco Rock Wind Farm. As discussed in **Section 15.2.5** above, the introduction of a double-circuit 132 kV transmission line and switching substation will have a cumulative impact, however with regard to the guidelines presented in this chapter it is anticipated that the introduction of the transmission line will not have a significant cumulative impact. However, if necessary, an assessment will be included in the Review of Environmental Factors for the transmission line.

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