



APPENDIX O EMF / HUMAN HEALTH ASSESSMENT



EMF / Human Health Assessment

The Plains Wind Farm



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Executive Summary

The magnetic field emitted by the proposed electrical power infrastructure for the Plains Wind Farm project (The Project) is estimated to be, in the worst-case scenarios, 2-10 times lower than the safe upper limit for general public exposure, depending on the ultimate design of the conductors assessed.

To meet electric field strength exposure limits, the 330 kV transmission line conductors should be installed more than 12 m above the ground in areas where the general public could walk directly below the transmission lines. The electrical field strength is below exposure limits for all other scenarios.

The predicted electromagnetic field (EMF) strength was calculated using the HIFREQ module in the software package CDEGS. In CDEGS, models of the conductor configurations were built using the following inputs:

- Provided proposed conductor arrangements.
- Underground cable and transmission line tower installation details as per AS 7000 [1] and as per typical industry values.
- Current and voltage magnitude as per design inputs.

A summary of the worst-case measurements is detailed in Table 1.

Table 1: Magnetic field strength results summary

Installation Method	Observation Location	Field Strength (μT)	Pass / Fail
Underground Cable	1.5 m above ground (standard height)	<20	PASS
	1 m above ground (lowest height of impact when standing)	<30	PASS
	Ground level (person lying on the ground)	<100	PASS
Overhead 33 kV Conductors Single Circuit	2.5 m above ground (Max height before breaching AS 2067)	<10	PASS
	1.5 m above ground (standing height)	<10	PASS
Overhead 33 kV Conductors Double Circuit	2.5 m above ground (Max height before breaching AS 2067)	<20	PASS
	1.5 m above ground (standing height)	<10	PASS
Overhead Transmission Line	4 m above ground (person sitting in heavy vehicle)	<20	PASS
	1.5 m above ground (standing height)	<10	PASS

The limit of magnetic field strength to protect human health is determined by the International Commission on Non-Ionising Radiation Protection (ICNIRP) as 200 μT (micro-Tesla), which is higher than the greatest magnetic field strength calculated.

The limit of electric field strength to protect human health is determined by INCIRP as 5 kV/m (kilovolts per metre) for general public and 10 kV/m for occupational personnel. The worst-case scenario of the 330 kV transmission line was assessed.

This study finds the risk to human health due to emitted EMF is negligible when the recommended clearance to the 330 kV transmission line is maintained.

The actual conductor arrangements are likely to differ from this modelled scenario. The difference is assumed to be minimal. The corresponding difference in magnetic field emissions is expected to be marginal and is unlikely to affect the EMF safety compliance performance of the transmission line.

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1 Introduction

1.1 Background

The Plains Wind Farm forms part of the Plains Renewable Energy Park Project is located south of Hay in the Riverina Murray region of New South Wales and situated on Mungadal Station and four neighbouring properties to the east and west of the Cobb Highway.

The Project Area covers approximately 53,894 hectares of land area. The Project proposes up to 188 WTGs generators (WTG) and which have an approximate height of 270 metres above the ground with a combined maximum installed capacity of 1350 MW.

Middleton Group Engineering (MGE) has been engaged by Environmental resource management Australia Pty Ltd (ERM) to undertake an Electromagnetic Field desktop study for inclusion with an Environmental Impact Statement (EIS).

1.2 Purpose

The purpose of this report is to estimate the electric and magnetic fields that will be emitted by the conductors assess the impact on human health.

This is to address the EMF aspect of the "Hazards" element of the Planning Secretary's Environmental Assessment Requirements (SEARs), dated 30/09/2022. An extract of the SEARs which specifies this report requirement is presented below:

an assessment of potential hazards and risks, including electromagnetic fields or the proposed grid connection infrastructure against the International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields.

1.3 Scope

The scope of this study includes:

- Identify and model electromagnetic field emitters to be constructed under the Plains Wind Farm.
- Assess impact of the EMF emitters on human health.

The study bounds are defined as:

- EMF from the proposed 330 kV transmission line.
- EMF from proposed 33 kV overhead wires.
- EMF from proposed underground cables.

The Conductor lines are represented by the area within the red lines in the extract of the project overview in Figure 1.



- Associated Structures
- WTGs
- PWF Project Boundary

0 2.5 5 km

Imagery from ESRI servers. Wind turbine location provided by ERM. ACMA sites sourced from ACMA site location map.

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Figure 1: Project Overview

1.4 Design Inputs

The following information was used to form the basis of the design:

- Proposed conductor arrangements as provided by the Applicant.
- Underground cable and transmission line tower installation details as per AS 7000 [1] and as per typical industry values.
- Current and voltage magnitude as per design inputs provided by Applicant.

2 Definitions

Term	Definition
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
CDEGS	Current Distribution Electromagnetic Fields, Ground and Soil Structure Analysis. A powerful piece of software developed by SES & Technologies Ltd.
EMF	Electro-magnetic field
ICNIRP	International Commission on Non-Ionising Radiation Protection
kV	kiloVolt
Magnetic Flux Density / Magnetic Field Strength	Terms used interchangeably to describe magnetic field
MW	Megawatt
Tesla	A measure of magnetic flux density. One Tesla = Newton / (Amp * metre).

3 References

- [1] Standards Australia, *Overhead line design (AS 7000)*, SAI Global., 2016.
- [2] Australian Radiation Protection and Nuclear Safety Agency, "Radiation Health Series," 2023. [Online]. Available: <https://www.arpansa.gov.au/regulation-and-licensing/regulatory-publications/radiation-health-series>. [Accessed 21 03 2023].
- [3] Australia, Commonwealth of, "Electricity and Health," [Online]. Available: <https://www.arpansa.gov.au/understanding-radiation/radiation-sources/more-radiation-sources/electricity>.
- [4] Energy Network Association, *EMF Management Handbook*, 2016.
- [5] International Commission on Non-Ionizing Radiation Protection, "ICNIRP Guidelines For Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz)," *Health Physics*, vol. 99, pp. 818-836, 2010.
- [6] Standards Australia, *Substations and high voltage installations exceeding 1 kV a.c.*, Sai Global., 2016.

4 Basis

The following parameters have been applied to form the basis of this study.

Electrical Network

1. Electrical installation in line with Australian Standards, in particular: height and configuration of overhead powerlines
2. Underground cables are buried at 800 mm. This is a typical minimum depth, although cables can be as shallow as 750 mm as per AS2067 clause 4.2.9.1.a.
3. All equipment (transformers, switchgear etc.) meets Australian and International Standards for electromagnetic compatibility and therefore does not meaningfully contribute to EMF risk.
4. Current carrying capacity for conductors has not been applied for any modelling.

WTG Parameters

5. Wind Turbine Generator size = 7.2 MW with power factor of 0.9. This equates to 8.0 MVA.
6. WTGs compliant to standards

Scenario Limitations

7. Substations and collector stations excluded. The EMF risk associated with substations/ collector stations impacts occupational personnel and not the general public. EMF risk assessment of substations and collector stations will be undertaken during detailed design.
8. Background EMF on site is considered negligible. Background measurements have not been included in this assessment. However, given the remote location of the site and absence of nearby electrical equipment, the background magnetic field strength along the majority of the route is expected to be negligible, except near the existing Broken Hill Substation.
9. Fault conditions are not modelled in this assessment. A fault event is expected to last no longer than two seconds and is very unlikely to introduce human health risk due to EMF exposure.

5 Methodology

5.1 Assessment Criterion

EMF limits for this study are taken from the International Commission on Non-Ionising Radiation Protection (ICNIRP). The limit is specified below, based on review of the relevant Australian guidelines and health advice.

The advice of the National Health and Medical Research Council (NHMRC) with regards to EMF exposure has been withdrawn. Responsibility for review of the radiation health series publications has been handed to Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) [2]. The EMF exposure guidelines from ARPANSA now explicitly refer to ICNIRP [3].

Furthermore, the Energy Networks Association (ENA) EMF Handbook [4] also refers to ICNIRP for determining the human health limit of magnetic field exposure.

The limit for magnetic and electric field exposure to the general public is specified in the ICNIRP General Public Health Physics publication 99(6):818-836 [5].

The red box highlights in Figure 2 shows the magnetic flux density for the frequencies emitted from the transmission line. The peak field strength from the transmission lines will be at 50Hz. The pass/fail criterion for the general public for this study is 2000 milli Gauss (200 μ Tesla).

Figure 3 shows the electric field strength limits at 50 Hz, which will have the peak field strength from the transmission lines. The pass/fail criterion for the general public will be 5 kV/m.

Table 4. Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values).

Frequency range	E-field strength E (kV m ⁻¹)	Magnetic field strength H (A m ⁻¹)	Magnetic flux density B (T)
1 Hz–8 Hz	5	$3.2 \times 10^4/f^2$	$4 \times 10^{-2}/f^2$
8 Hz–25 Hz	5	$4 \times 10^3/f$	$5 \times 10^{-3}/f$
25 Hz–50 Hz	5	1.6×10^2	2×10^{-4}
50 Hz–400 Hz	$2.5 \times 10^2/f$	1.6×10^2	2×10^{-4}
400 Hz–3 kHz	$2.5 \times 10^2/f$	$6.4 \times 10^4/f$	$8 \times 10^{-2}/f$
3 kHz–10 MHz	8.3×10^{-2}	21	2.7×10^{-5}

Notes:
- f in Hz.
- See separate sections below for advice on non sinusoidal and multiple frequency exposure.
- In the frequency range above 100 kHz, RF specific reference levels need to be considered additionally.

Figure 2: Magnetic field limits for public exposure

TABLE 5-3 ELECTRIC FIELD REFERENCE LEVELS AT 50HZ FOR IEEE AND ICNIRP

	IEEE 2002	ICNIRP 2010
GENERAL PUBLIC		
Exposure	5 kV/m 10kV /m (within right of way)	5 kV/m
OCCUPATIONAL		
Exposure	10 kV/m 20kV /m (within right of way)	10 kV/m

Figure 3: Electric field limits for public exposure

5.2 Assessed Area

The assessed locations are specified in Table 2. All locations are directly underneath the overhead line, or directly above the underground cable(s).

Table 2: Assessment locations

Assessment Location	Scenario
Ground Level	Person lying on the ground
1 m above ground level	Lowest height impact for person standing
1.5 m above ground level	Typical height of impact for person standing
2.5 m above ground level	Person in small tractor Applies to 33 kV overhead transmission line only ¹
4 m above ground level	Person in heavy vehicle (truck, tractor etc.) Applies to 330 kV overhead transmission line only

Note

[1] Any closer than 2.5 m above ground level introduces risk of breaching safe clearance between person/vehicle and live conductor as per AS2067:2016. Refer table 3.1 of AS2067 for safe clearances for operational purposes and maintenance work.

Should the magnetic field and electric field strength at the assessment locations in Table 2 pass the assessment criteria, then the magnetic field and electric field strength at all other areas further away from the electrical installation will also pass. This includes the following:

- Associated houses
- Non-associated houses
- All public locations (such as roads, parks, roadside stops)

This is supported by the modelling which aligns with fundamental theory of electromagnetism which dictates that the magnetic field strength diminishes with distance from the source. See Appendix A for detail.

5.3 CDEGS Model

The SES software package CDEGS was used to model the underground cables and overhead lines. The HIFREQ module was utilised to capture the magnetic and electric field strengths.

5.3.1 Modelled Electrical Installations

The scenarios identified as likely to create the greatest impact are:

Table 3: Modelled scenarios

No.	Conductor Description	Voltage	WTGs Connected	Current in each conductor
1	3 x single core 1000 mm ² cables	33 kV	4	560 A
2	Single circuit overhead lines	33 kV	8	1120 A
3	Double circuit overhead lines	33 kV	16 (8 per circuit)	1120 A
4	Single circuit overhead transmission line	330 kV	66	924 A

Scenarios not modelled will radiate lower magnetic fields due to lower current in conductors (see Appendix A for how lower current results in lower magnetic field). These include:

- Underground cables with fewer than 4 WTGs connected.
- Single circuit overhead 33 kV line with less than 8 WTGs connected.
- Single circuit overhead 330 kV line with less than 66 WTGs connected.

5.3.2 Underground 33 kV Cable Concept Design

The underground cabling which connects WTG will have up to 4 WTGs connected in series. The cables will be single core 1000 mm², installed underground.

The concept design considers the cables will be buried at 800 mm. This is a typical minimum depth, although cables can be as shallow as 750 mm as per AS2067 clause 4.2.9.1.a.

The concept design considers that the cables will be installed in individual conduits, as this is the most likely scenario given the cable size. Furthermore, by spacing the cables apart, the magnetic field will be higher at ground level as the cancellation effect will be diminished. The cable centres are spaced at 400 mm. This considers conduits with 150 mm diameter (typical size for the cables), while the spacing is typical for underground conduits.

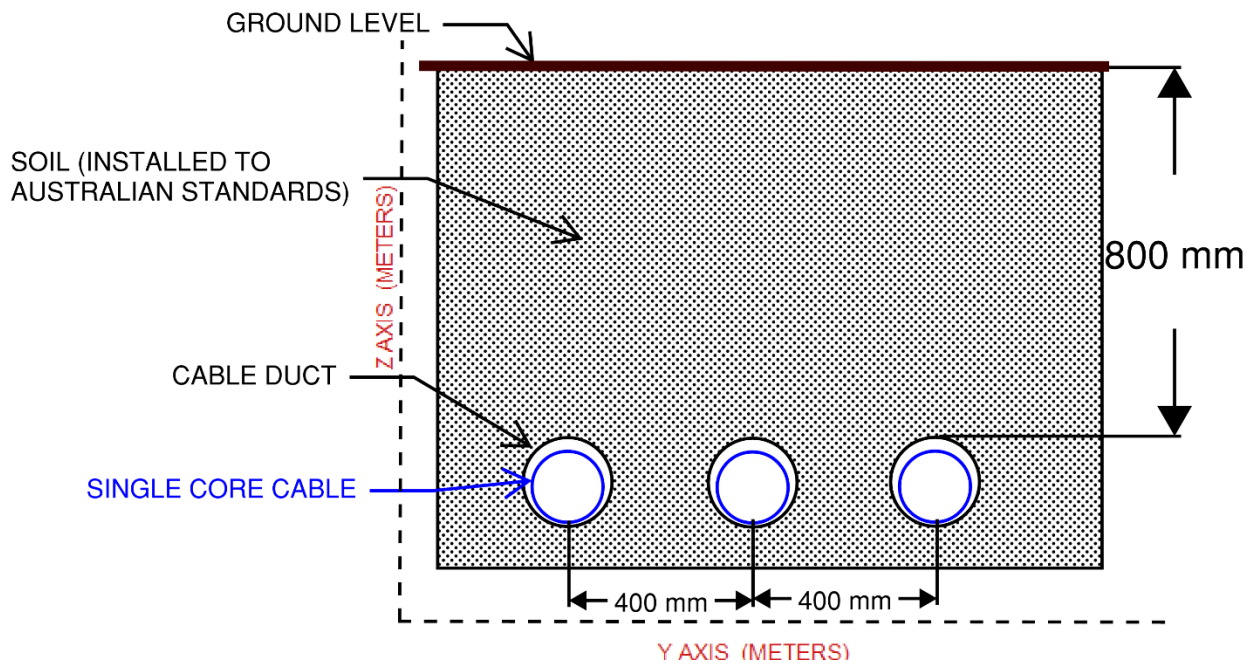


Figure 4: Underground cable installation concept design

5.3.3 Overhead 33 kV line Concept Design

The overhead 33 kV single circuit will carry power for up to 8 WTGs connected in series.

The concept design considers vertically separated conductors. The vertical separation distance considered is 1.2 m (see Appendix B for calculation).

The assessment considers the lowest allowable height above ground level. For this installation, that is 5.5 m [1].

The double circuit will directly duplicate the single circuit design. The conductors will be horizontally spaced by 1.4 m. This study considers matching phase orientation for both circuits. This delivers the worst-case magnetic field strength at ground level.

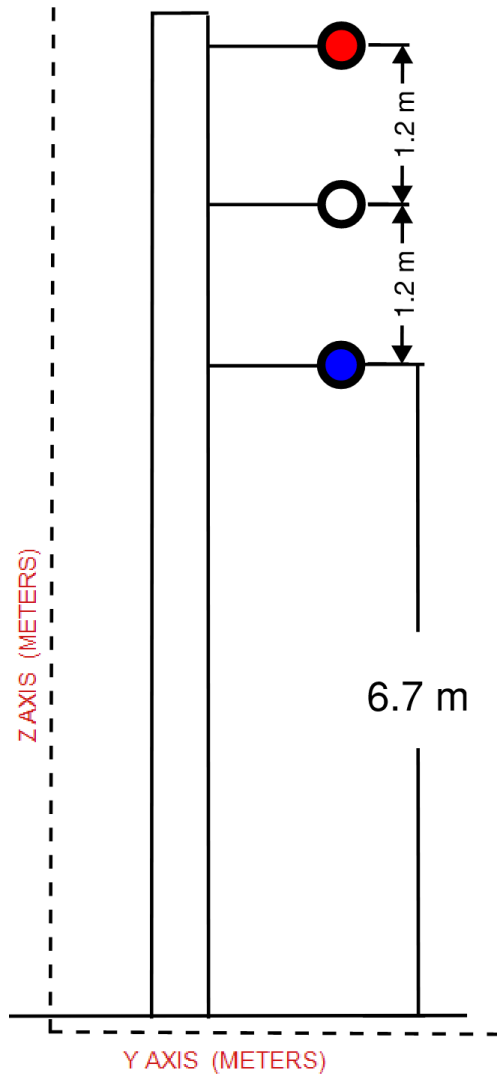


Figure 5: Overhead 33 kV line single circuit design

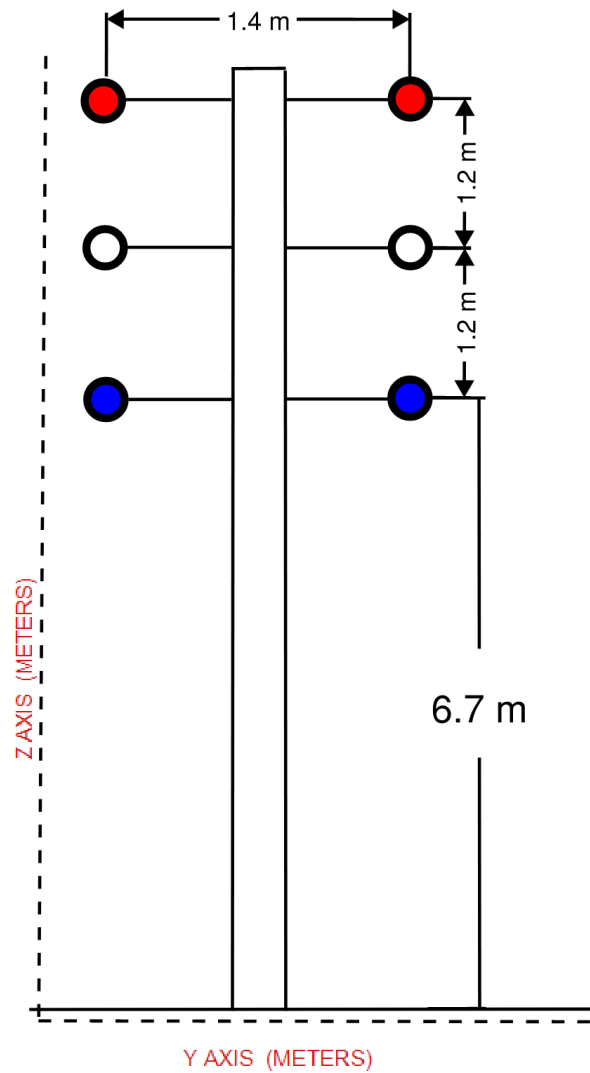


Figure 6: 33 kV Overhead double circuit design

5.3.4 Overhead 330 kV Transmission Line Concept Design

The overhead 330 kV is proposed to be a vertical separated transmission tower that will carry up to 66 wind turbines connected in series. These have been modelled in accordance with AS 7000 [1].

The concept design currently considers three (3) vertically spaced conductors. With a separation distance of 4 m between each conductor.

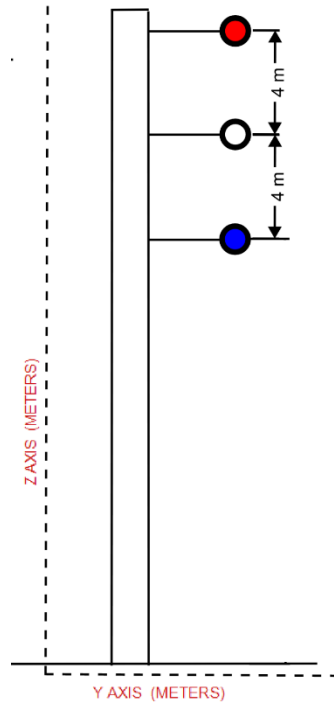


Figure 7: 330 kV transmission tower

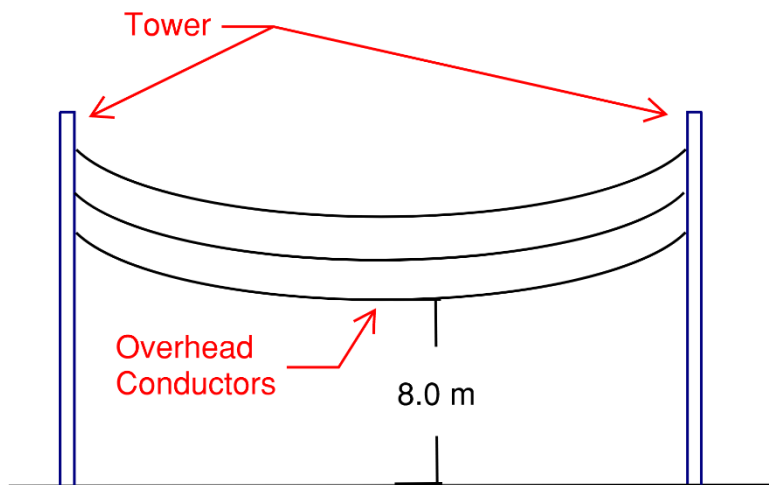


Figure 8: 330 kV transmission lines

6 Results

6.1 Underground Cable

The planned installation for the three (3) 1000 mm² cable circuit installed at an 800 mm depth will carry a maximum of 560 A in each cable. At ground level the magnetic field strength emitted from the cables is less than 100 μ T.

The required current per cable to exceed the 200 μT at ground level is greater than 800 A. This will exceed the current carrying capability of the cable by approximately 30%. The maximum current allowable in 33 kV 1000 mm² copper cables installed in underground ducts is 578 A in underground conduits.

Figure 9 shows the magnetic field strength emitted from the cable in the Y-Z plane. Ground level is marked with a dashed line. Magnetic field strength for a person is usually measured at 1 m.

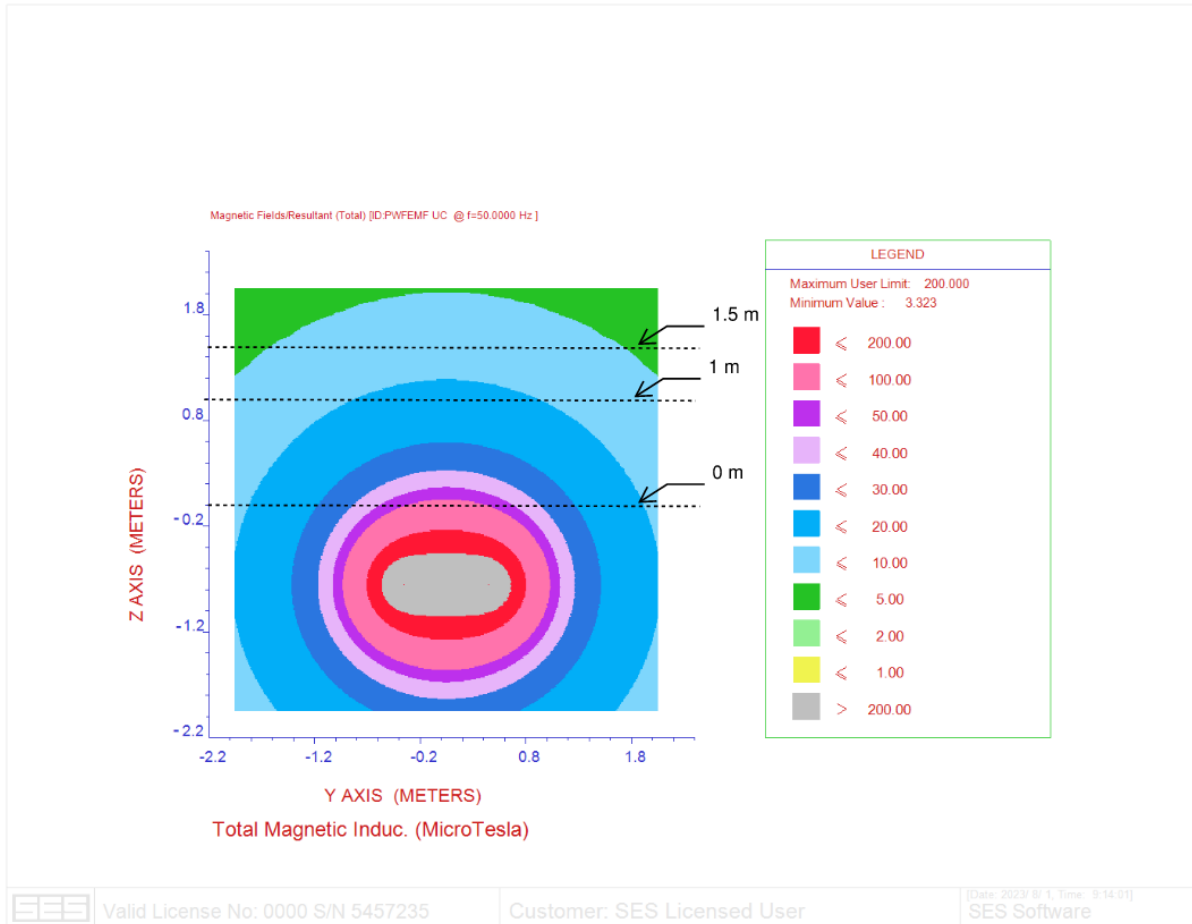


Figure 9: Magnetic field strength from 3x single core cables each carrying 560 A

Figure 11 shows the magnetic field strength emitted from the cable in the Y-Z plane. Ground level is marked by the dashed line.

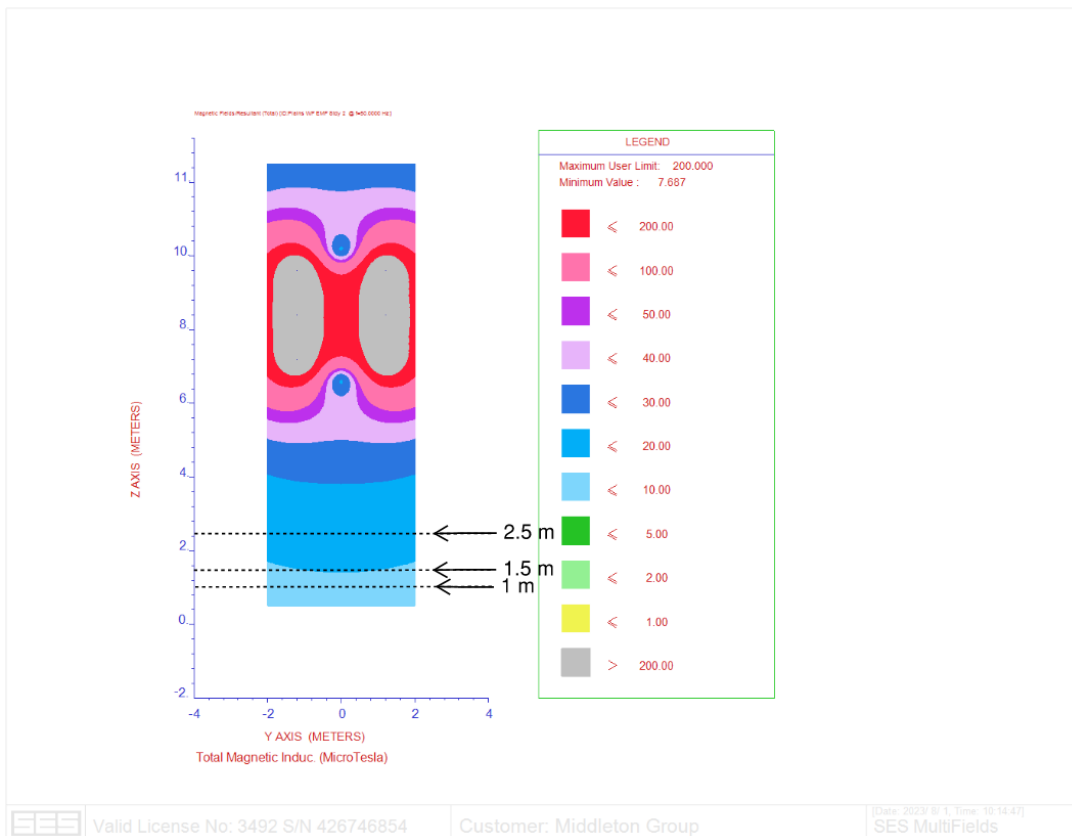


Figure 11: Magnetic field strength from 6x conductors each carrying 1120 A

6.3 330 kV Overhead Transmission Lines

The planned installation for three parallel conductors each carrying 924 A. At 4 m above ground level the magnetic field strength emitted from the conductors is less than 20 μ T. ARPANSA states that the typical value of a magnetic field near transmission lines is between 1-20 μ T [2], which the 330 kV overhead transmission lines currently meet.

To breach the 200 μ T limit at 4 m above ground level, the required current in the conductors must be greater than 2000 A.

Figure 12 shows the magnetic field strength emitted from the cable in the Y-Z plane. Ground level is marked by the dashed line.

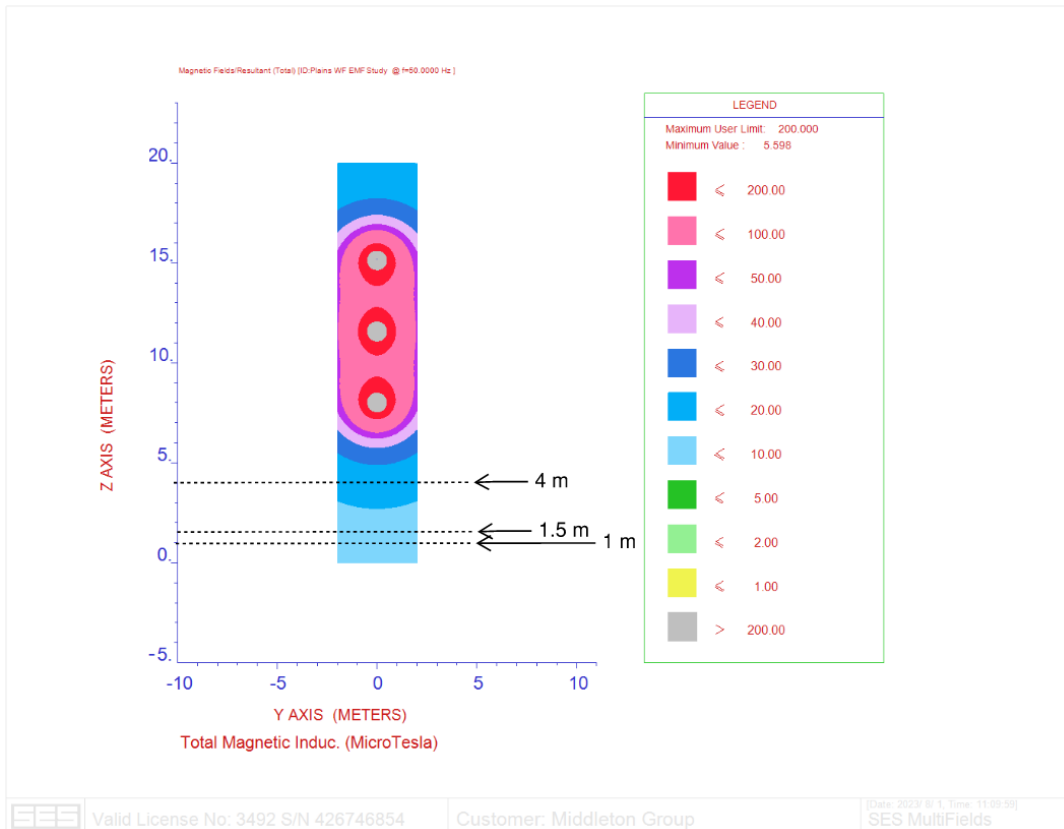


Figure 12: Magnetic field strength from 3x conductors each carrying 924 A

6.4 Electric Field

The electric field assessment is completed for the worst-case scenario only. This is the highest voltage scenario in which a person is directly underneath the 330 kV overhead transmission.

As seen in Figure 13, at 4 m, 1.5 m and 1 m above ground, the electric field strength is above the public exposure limit of 5 kV per metre [4]. At 1.5 m and 1 metre, it is within the occupational exposure limit of 10 kV per metre, however at 4 metres it is above the occupational exposure limit.

When the overhead line is elevated to 12 m above ground level, the electric field strength at 4 m, 1.5 m and 1 m above ground level is less than the public exposure limit of 5 kV per metre. These results can be seen in Figure 14.

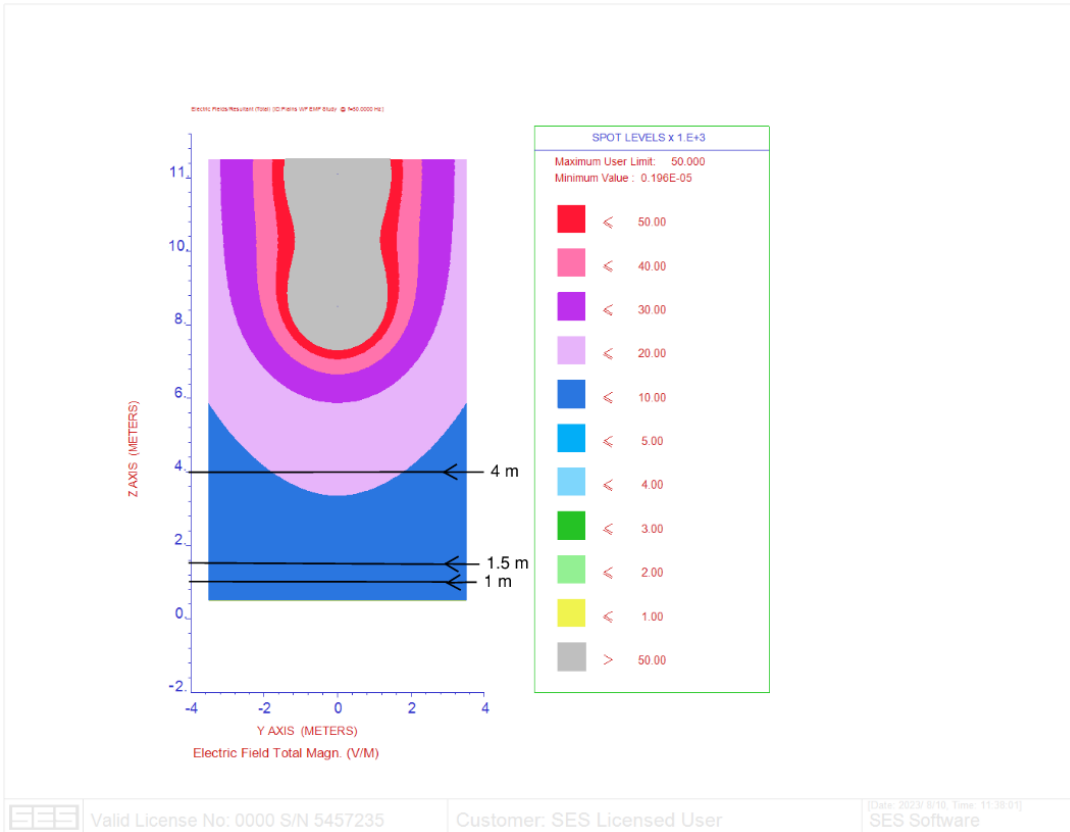


Figure 13: Electric field strength directly below 8 m high 330 kV overhead transmission line

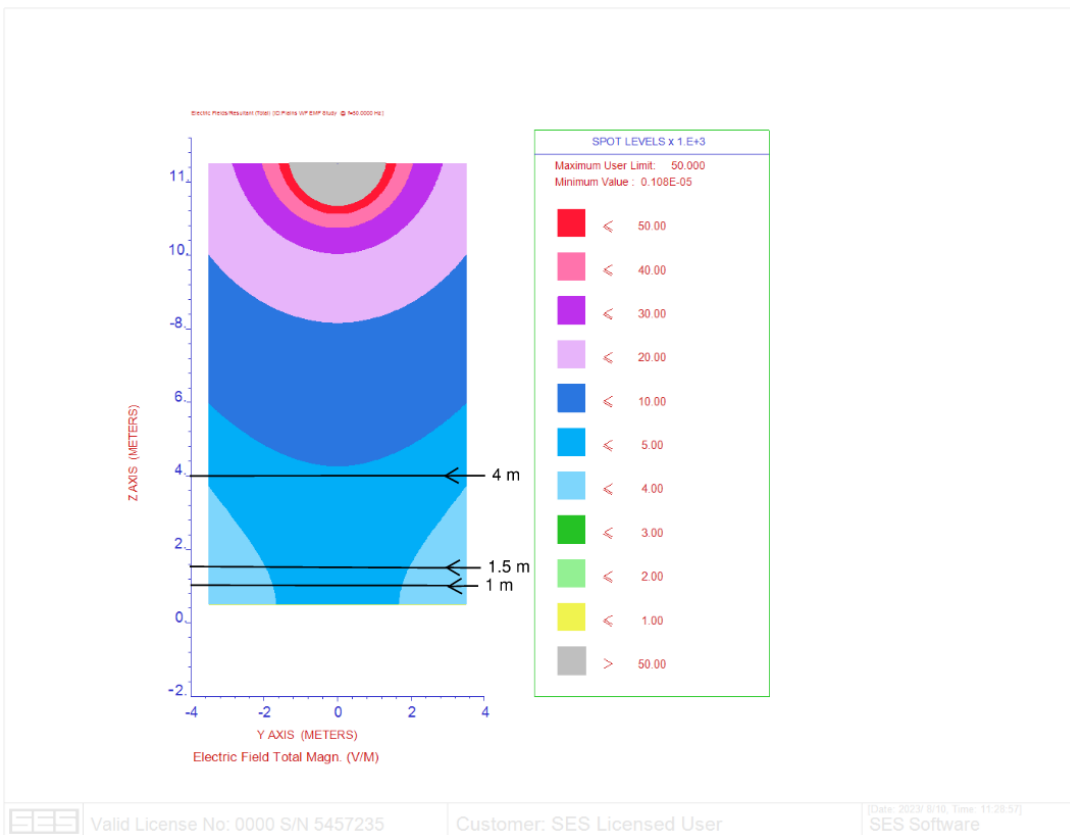


Figure 14: Electric field strength directly below 12 m high 330 kV overhead transmission line

7 Conclusion

The design observations show that for each scenario, that the magnetic field strength should be within INCIRP guidelines at locations where personnel do not risk breaching AS 2067 requirements. Boundary conditions have been provided to enable electric and magnetic fields to comply to INCIRP guidelines at the specified locations.

A summary of the worst-case scenarios can be found in Table 4.

Table 4: Magnetic field strength results summary

Installation Method	Observation Location	Field Strength (μT)	Pass / Fail
Underground Cable	1.5 m above ground (standard height)	<20	PASS
	1 m above ground (lowest height of impact when standing)	<30	PASS
	Ground level (person lying on the ground)	<100	PASS
Overhead 33 kV Conductors Single Circuit	2.5 m above ground (Max height before breaching AS 2067)	<10	PASS
	1.5 m above ground (standing height)	<10	PASS
Overhead 33 kV Conductors Double Circuit	2.5 m above ground (Max height before breaching AS 2067)	<20	PASS
	1.5 m above ground (standing height)	<10	PASS
Overhead Transmission Line	4 m above ground (person sitting in heavy vehicle)	<20	PASS
	1.5 m above ground (standing height)	<10	PASS

The design observations show that, when the 330 kV Transmission line is at a height of 8 metres, it does not meet INCIRP guidelines for general public exposure. However, it meets occupational guidelines for a person standing below the transmission lines. If there are plans to make transmission lines at 8 m above ground level, the risk can be managed by restricting general public access. To meet the INCIRP guidelines for general public exposure, the transmission lines have to be built at a minimum height of 12 metres.

A summary of the worst-case scenarios can be found in Table 5.

Table 5: Electric field strength results summary

Installation Method	Observation Location	Field Strength (kV/m)	Pass / Fail
Overhead Transmission Line 8 m height	4 m above ground (person sitting in heavy vehicle)	<20	FAIL ¹
	1.5 m above ground (standing height)	<10	PASS for occupational

Installation Method	Observation Location	Field Strength (kV/m)	Pass / Fail
Overhead Transmission Line 12 m height	4 m above ground (person sitting in heavy vehicle)	<5	PASS
	1.5 m above ground (standing height)	<5	PASS

Note

[1] Exposure to be restricted for occupational personnel.

Human health assessment

At recommended measurement locations (1-4 m above ground level), the magnetic field strength will be at least 2-10 times lower than the upper safe limit recommended for human exposure.

Applications of these findings

The actual conductor arrangements are likely to differ from this modelled scenario. The difference is likely to be minimal and the corresponding difference in the magnetic field emissions is expected to be negligible. As such the finding of this report will apply for minor design changes.

Appendix A EMF Theory

Overview

A current carrying conductor creates a magnetic field which circulates around the conductor as illustrated.

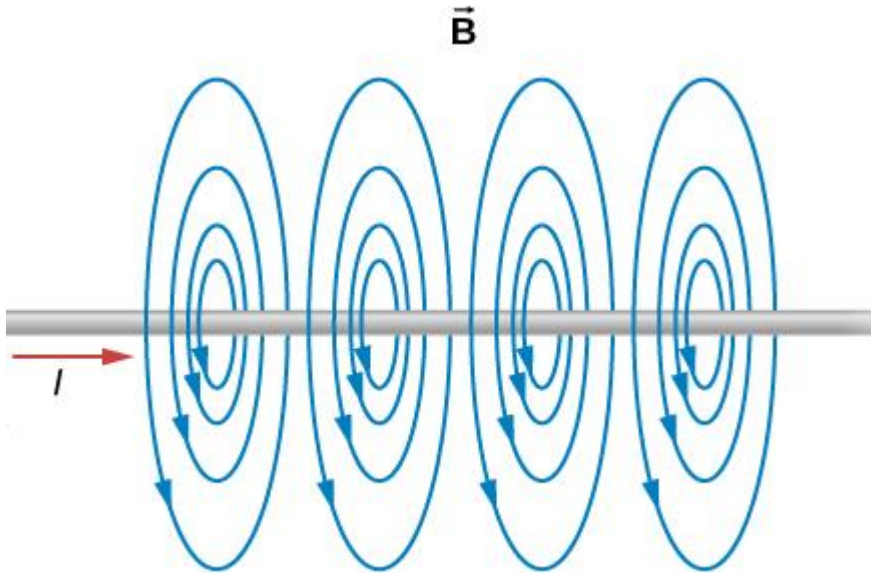


Figure 15: Magnetic field around a conductor

EMF from a single conductor

To calculate the magnetic field strength emitted from a conductor, one must apply the Biot-Savart law.

Application of this law finds that for an infinitely long conductor the field strength due to current I at a distance of R and is given by the formula in. For conductors of enough length, this formula can be used to provide an accurate approximation of the actual field strength.

$$B = \frac{\mu_0 I}{2\pi R}$$

Where:

B = Magnetic field strength in Teslas, where Tesla = $N/(A \cdot m)$

μ_0 = permeability of free space

I = current in conductor

R = distance from conductor in a straight line

This tells us that magnetic field strength is inversely proportional to the distance from the conductor.

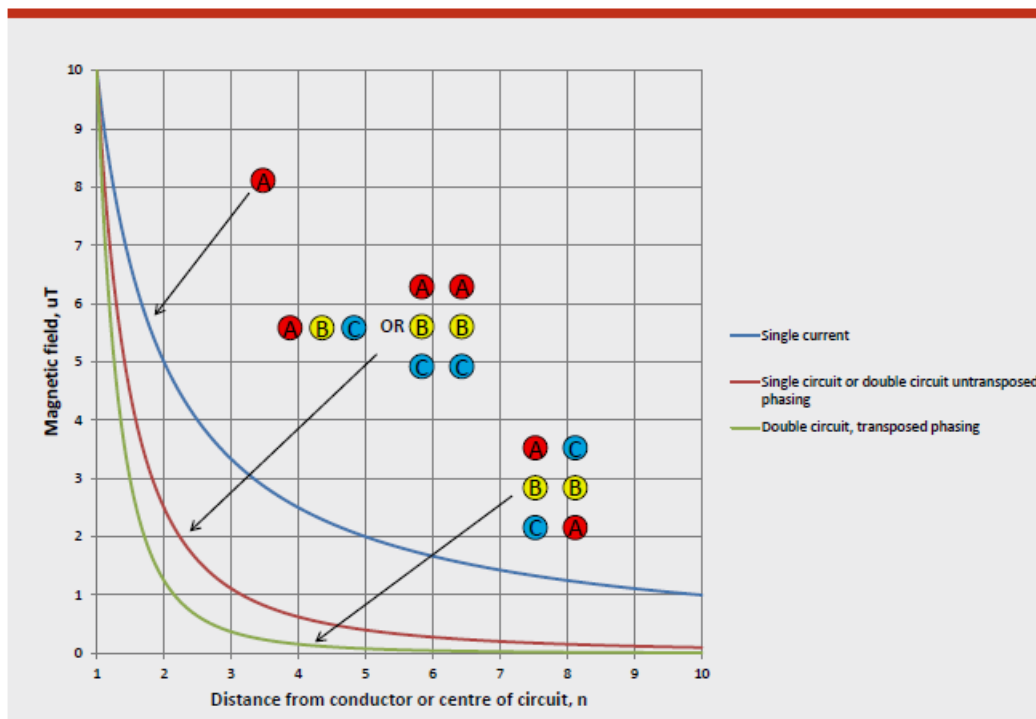
EMF from a three-phase system

The magnetic field at a point will be the vector sum of the fields from each conductor. In a balanced three phase system, the phase angle of the magnetic field from the three conductors will cancel out. However, any three phase system will have a non-zero resultant field strength due to separation between the conductors. That is, at any given location the magnetic field emitted from the three conductors will not be of equal magnitude, therefore not fully cancelling each other out.

Relationship of Field Strength to Distance from Source

As noted above, the magnetic field strength is inversely proportional to the distance from the conductor. However, there is some variability in the field strength reduction with distance from the source where that source is a 3 phase system. The extract from the ENA EMF Handbook below demonstrates this.

FIGURE 3.3 RATE OF DECREASE OF MAGNETIC FIELDS FROM DIFFERENT SOURCES



* Note: Hypothetical examples where magnetic fields are 10uT at 1m from the source.

Appendix B Overhead line concept design

The conductor separation of the transmission line is established in two parts by the following section 3.7.3 of AS 7000-2016.

The first part considers the minimum mid-span conductor separation as per the image and formula given in the following extract:

The mid span conductor separation for a single circuit can be determined using Equation 3.1 and Figure 3.5.

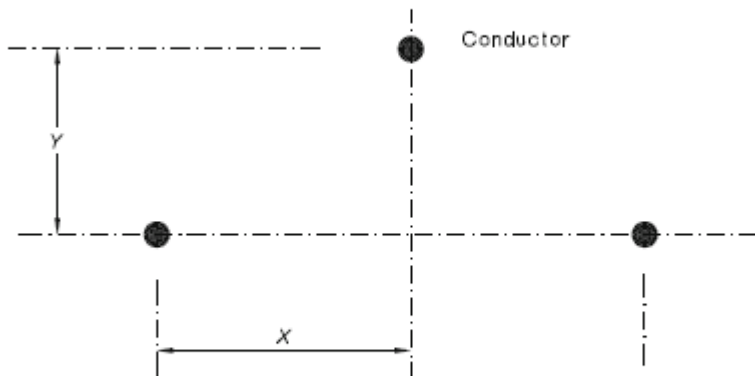


FIGURE 3.5 CONDUCTOR SEPARATION AT MID SPAN (ONE CIRCUIT)

$$\sqrt{X^2 + (1.2Y)^2} \geq \frac{U}{150} + k\sqrt{D+li} \quad \dots 3.1$$

In this, X is the horizontal distance between conductors. For this study, X = 0 as the transmission line concept design assumes that the conductors will be equal height above the ground.

Y is the vertical distance between conductors.

The remaining variables are defined below:

- U = is the r.m.s. vector difference in potential (kV) between the two conductors when each is operating at its nominal voltage. In determining the potential between conductors of different circuits or between an earthwire and an aerial phase conductor, regard shall be paid to any phase differences in the nominal voltages
- k = is a constant, normally equal to 0.4. Where experience has shown that other values are appropriate, these may be applied. See Note 5 to Figure 3.6.
- D = is the greater of the two conductor sags in metres at the centre of an equivalent level span and at a conductor temperature with electrical load (typically 50°C in still air). This may be higher for high temperature conductors
- l = is the length in metres of any free swing suspension insulator associated with either conductor. Zero for pin and post insulators

The second part of establishing conductor separation considers an allowance for wind loading. That is, the conductors may swing in the air. As such, they must be installed with enough separation at the towers that

the mid-span separation requirement described above is not breached. 2 m has been allowed for swinging conductors, based on typical industry application.

The calculation of the above two parts is resolved in Table 6 and Table 8 for 33 kV and 330 kV conductors respectively.

Table 6: 33 kV Overhead Line conductor vertical separation calculation

Variable	Value	Unit	Comment
X	0	m	No horizontal separation
U	57.1578	kV	Derived
k	0.4		As per standard
D	4	m	Typical industry value
li	2.4	m	Typical industry value
Results			
Y (Vertical separation)	1.16	m	
Swinging conductor allowance	2	m	Typical industry value

Table 7: 33 kV Overhead Line conductor horizontal separation calculation

Variable	Value	Unit	Comment
Y	0	m	No horizontal separation
U	57.1578	kV	Derived
k	0.4		As per standard
D	4	m	Typical industry value
li	2.4	m	Typical industry value
Results			
X (horizontal separation)	1.3930	m	
Swinging conductor allowance	2	m	Typical industry value

Table 8: 330 kV Transmission line conductor separation calculation

Variable	Value	Unit	Comment
X	0	m	No horizontal separation
U	571.5767	kV	Derived
k	0.4		As per standard
D	4	m	Typical industry value
li	2.4	m	Typical industry value
Results			

Variable	Value	Unit	Comment
Y (Vertical separation)	4.02	m	
Swinging conductor allowance	2	m	Typical industry value

Appendix C OLEX catalogue

The following is an extract of the Olex-Nexans cable catalogue. The maximum current rating for any 19 / 33 kV single core cable for the proposed installation is shown in red.

Derating factors including depth of burial, proximity of nearby cables, temperature, soil resistivity etc. may reduce this value.

It should be noted that a 1200mm² cable is an upper limit, not commonly installed.

19/33kV Single Core Screened & PVC Sheathed

Copper Conductors, up to 10kA Fault Level

Nominal conductor area mm ²	Nominal conductor diameter mm	Nominal insulation thickness mm	Nominal diameter over insulation mm	Nominal screen area on each core mm ²	Number and nominal diameter of screen wires no/mm	Nominal diameter over wire screen mm	Nominal overall diameter mm	Approx. mass kg/100m	Product code	Max. pulling tension kN	Min. bending radius		Nominal duct diameter	
											During pulling mm	Set in position mm	⊗ mm	⊙ mm
50	8.0	8.0	25.5	48.7	34/1.35	29.8	34.3	170	XNHP19AA001	3.5	620	410	63	100
70	9.6	8.0	27.1	68.7	48/1.35	31.4	36.1	215	XNHP20AA001	4.9	650	430	63	100
95	11.5	8.0	29.0	68.7	48/1.35	33.3	38.0	245	XNHP22AA001	6.7	680	460	65	150
120	13.1	8.0	30.6	68.7	48/1.35	34.9	39.8	280	XNHP23AA001	8.4	720	480	65	150
150	14.5	8.0	32.0	68.7	48/1.35	36.5	41.4	310	XNHP24AA001	11	750	500	65	150
185	16.1	8.0	33.6	68.7	48/1.35	38.1	43.2	345	XNHP25AA001	13	780	520	65	150
240	18.5	8.0	36.0	68.7	48/1.35	40.5	45.9	410	XNHP26AA001	17	830	550	65	150
300	20.7	8.0	38.4	68.7	48/1.35	42.9	48.4	475	XNHP27AA001	21	870	580	80	150
400	23.6	8.0	41.3	68.7	48/1.35	45.8	51.5	575	XNHP28AA001	28	930	620	80	150
500	26.5	8.0	44.2	68.7	48/1.35	48.7	54.9	685	XNHP30AA001	35	990	660	80	200
630	29.9	8.0	47.9	68.7	48/1.35	52.4	58.8	815	XNHP32AA001	44	1060	710	100	200
800	35.9	8.0	54.0	68.7	48/1.35	58.5	65.3	1020	XNHP33AA001	56	1180	780	100	200
1000	40.2	8.0	59.5	68.7	48/1.35	64.0	71.0	1220	XNHP34AA001	70	1280	850	125	200
1200	43.8	8.0	63.5	68.7	48/1.35	68.0	75.2	1420	XNHP50AA001	84	1350	900	125	200

Current Ratings

Nominal conductor area mm ²	Continuous current-carrying capacity, A												Fault current carrying capacity for 1 second		
	In air			In ground			In underground ducts						Cond. kA	Screen kA	
mm ²	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Solid Bond	Cond. kA	Screen kA
50	224	250	210	221	160	208	209	205	187	186	185	174	174	7.15	7.22
70	276	306	259	273	202	251	249	249	223	219	223	216	216	10.0	10.1
95	333	369	315	332	242	297	292	297	265	258	267	258	258	13.6	10.1
120	381	420	361	381	276	335	327	336	296	287	300	292	292	17.1	10.2
150	429	469	407	430	308	372	359	375	327	313	333	325	325	21.4	10.2
185	485	527	463	490	348	414	397	421	362	343	372	366	366	26.4	10.2
240	563	605	542	574	402	471	444	485	408	382	425	420	420	34.3	10.2
300	634	674	616	653	452	521	485	542	446	413	471	469	469	42.9	10.2
400	719	756	706	750	533	579	531	610	492	449	526	547	547	57.2	10.2
500	807	837	803	854	600	637	574	682	539	484	585	611	611	71.5	10.2
630	902	924	911	969	672	697	619	759	576	513	635	680	680	90.0	10.2
800	1012	1026	1036	1103	748	756	664	838	630	552	705	748	748	114	10.2
1000	1160	1131	1219	1300	888	845	713	966	661	578	749	880	880	143	10.2
1200	1252	1204	1337	1426	963	896	745	1043	698	603	801	948	948	171	10.2

Z

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