RESPONSE TO FURTHER INFORMATION REQUEST: SECTION 7.2.1 OF THE SECTION 42A REPORT

Response regarding MF strength in the overhead lines

1. Further information has been requested about the levels of magnetic field for the overhead lines. In particular:

> "*that calculations be provided for both the 220kV and 400kV, to estimate … the actual magnetic field strengths (μT) at the edges of the easement (65m from he centre), assuming:*
>
> - *Normal loading.*
> - *Peak loading*."

2. Magnetic field measurement or calculations are generally performed at 1 m above ground since that is believed to be the average height of vital organs in humans.

3. Mr Khot has produced below graphs for magnetic field values for two scenarios, viz.

(a) peak demand under normal conditions (which equates to the maximum normal current load with both circuits in service for the relevant year of service); and,

(b) normal everyday current load demand (with both circuits in service) which is the average of the current fluctuations that would be expected to occur during an average day in winter. This current is about 76% of the peak demand in the bullet point above.

4. The estimated projected peak current load (also defined as the maximum normal load condition) is expected to only occur:

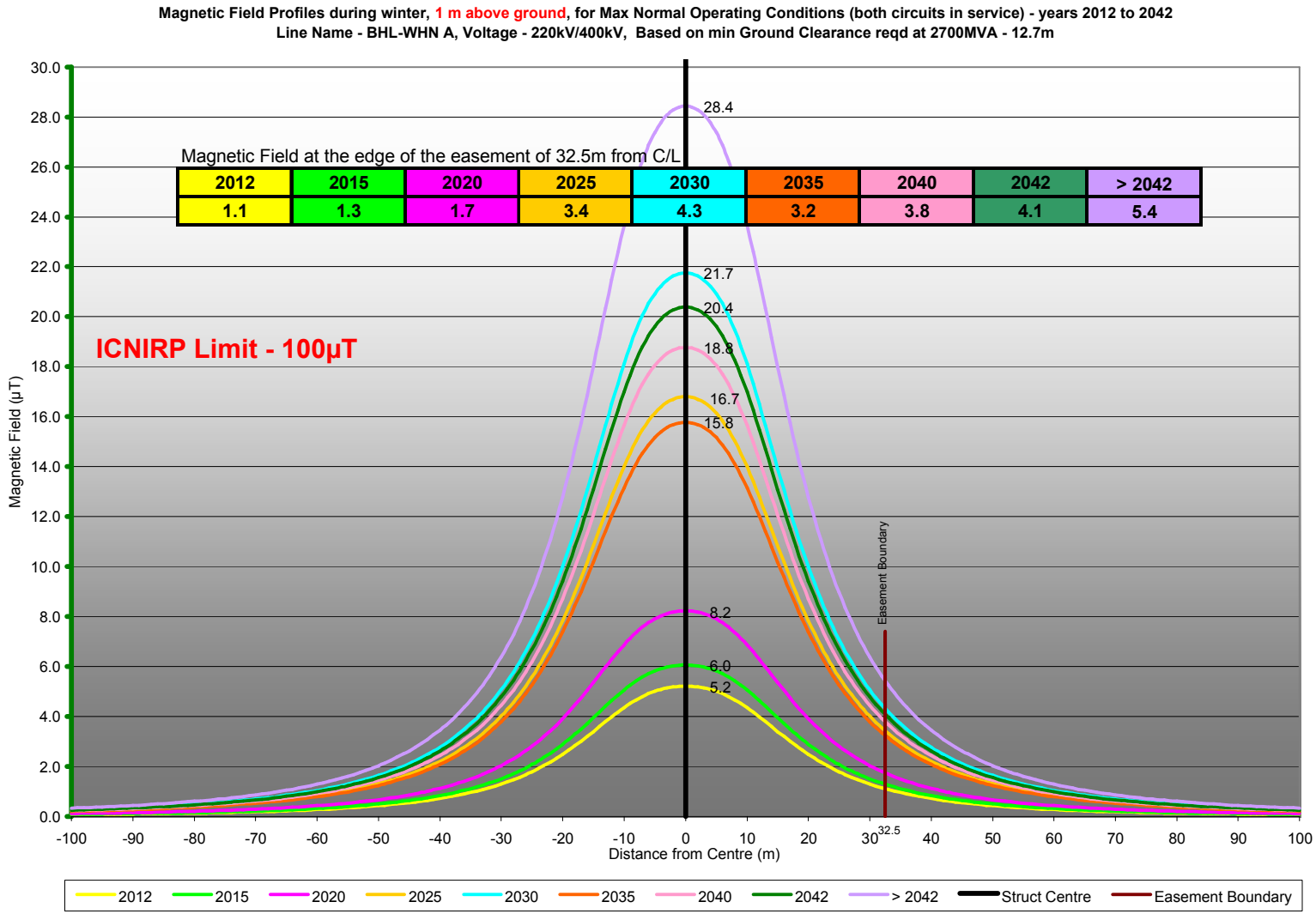
(a) generally during winter;

(b) when high load demand coincides with the highest ambient temperatures, no wind and the highest solar radiation;

(c) possibly only for a few hours, if at all.

5. The graph (**Figure 1**) also shows a table of the progressive increase of field levels at the edge of the easement with increasing annual load demand from year 2012 through to year 2042 and beyond. It can be seen that the magnetic field at the edge of the easement is estimated to increase from 1.1 μT in year 2012 to about 5.4 μT in year 2042 and beyond.

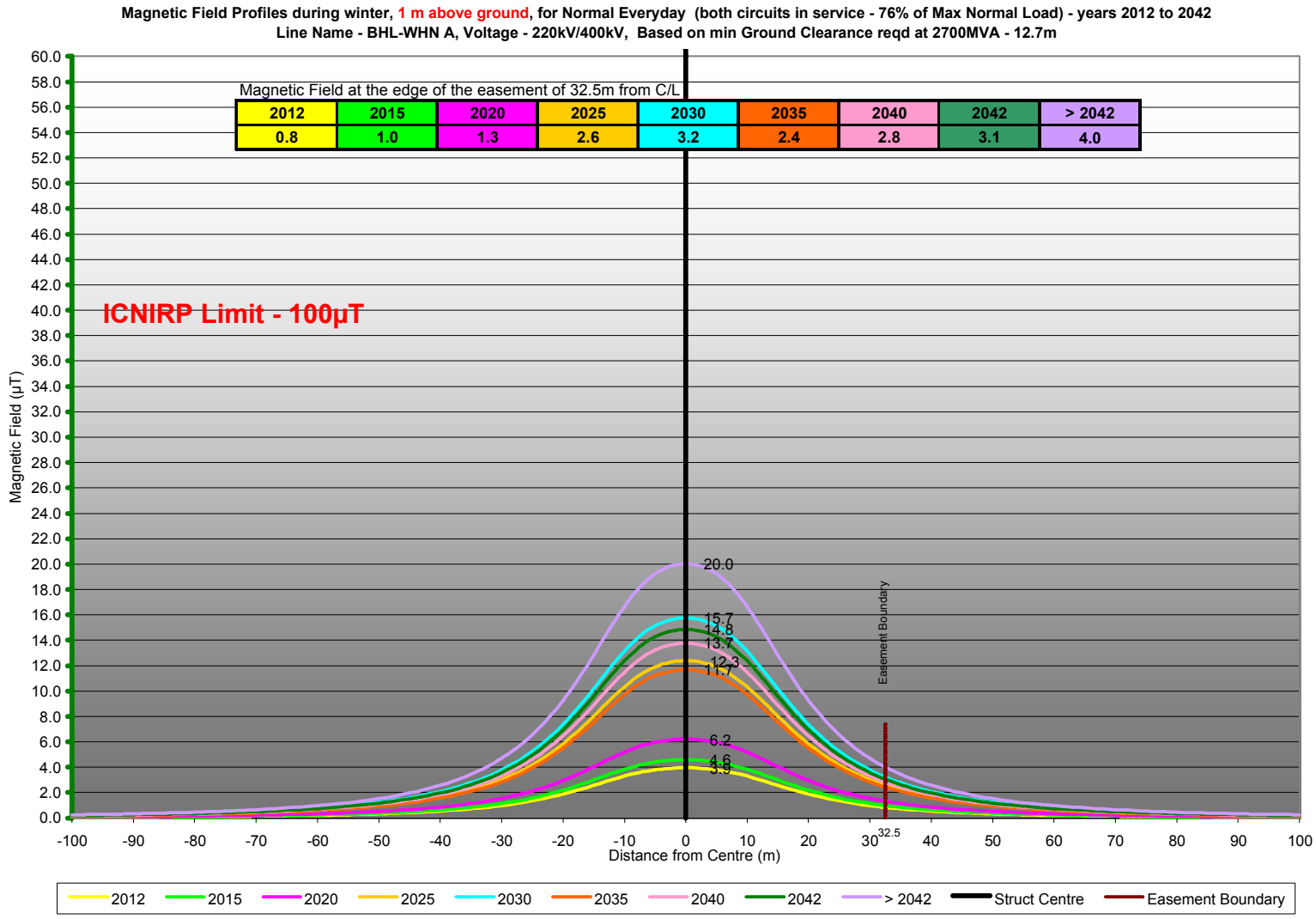
Figure 1 : Peak Normal Conditions



6. Similarly, given below is the graph (**Figure 2**) for **magnetic field levels at the edge of the easement for normal everyday current load demand** (with both circuits in service) which is the average of the current fluctuations that would be expected to occur during a winter month. This everyday average is estimated to be about 76% of the everyday peak current under normal conditions when both circuits are operating. It can be seen that the magnetic field at the edge of the easement is estimated to increase from 0.8 μT in year 2012 to about 4.0 μT in year 2042 and beyond.

7. As can be seen, the magnetic field levels 1m above ground at the edge of the easement of 32.5 m from the centreline reach 5.4 μT and 4.0 μT for the peak normal and everyday normal load conditions respectively **at the end of the analysis period (2042).**

Figure 2: Everyday Normal Conditions



8. The following table summarises the results:

Calculation Location at Easement width of 32.5 m from C/L	Magnetic Field (μT)								
	Peak Normal Load Condition								
	2012	2015	2020	2025	2030	2035	2040	2042	> 2042
1 m above ground	1.1	1.3	1.7	3.4	4.3	3.2	3.8	4.1	**5.4**
	Everyday Normal Load Condition								
	2012	2015	2020	2025	2030	2035	2040	2042	> 2042
1 m above ground	0.8	1.0	1.3	2.6	3.2	2.4	2.8	3.1	**4.0**

9. The evidence of Mr Khot further discusses the magnetic field strengths for the overhead lines.

Further information regarding MF around underground cable routes and substations

10. The section 42A report requests further information on the following:

> "*that calculations be provided for both the 220kV and 400kV, to estimate the following:*
>
> - ***Substations*** *– the magnetic field strengths (μT) at the distance of the closest occupied house to each substation and at the edges of the security fences assuming:*
>
> - *Normal loading.*
> - *Peak loading.*
>
> - ***Underground cables*** *– the magnetic field strengths (μT) at ground level at the distances of the closest occupied houses to the cables (assuming there is no field contributed from other sources) for:*
>
> - *Normal loading.*
> - *Peak loading.*"

11. MF has been studied at ground level, and one metre above ground. Measurement at these locations is common practice, since the human body vital organs are located approximately at one metre above ground.

12. MF studies have been carried out for steady state and peak loading. Fault conditions have not been considered due to their infrequent occurrence and the very short existence (0.12 sec).

Reference levels for MF

13. **THE** National Radiation Laboratory (**NRL**), in conjunction with the Ministry of Health (**MoH**), has published exposure guidelines MF levels in an information brochure. The guidelines published in the NRL brochure are based on guidelines published by the International Commission on Non-Ionizing Radiation Protection **(ICNIRP**). The guidelines give reference levels for protection against adverse

health effects. **Table A** summarises these levels for occupational and public exposure to 50 Hz MF.

Table A The reference levels for MF

Exposure Characteristics	Reference MF Levels	
	(microTesla, μT)	(milliGauss, mG)
Occupational	500	5,000
General public	100	1,000

Magnetic fields

Underground Cables

14. The MF levels were studied in the residential area at the five dwellings closest to the cables, at the property boundaries and directly above the cables near the closest dwellings. The MF levels obtained include no contributions from other sources. **Figure A** illustrates the computer model parameters. Distances A, B and C for each dwelling are shown in **Table B**.

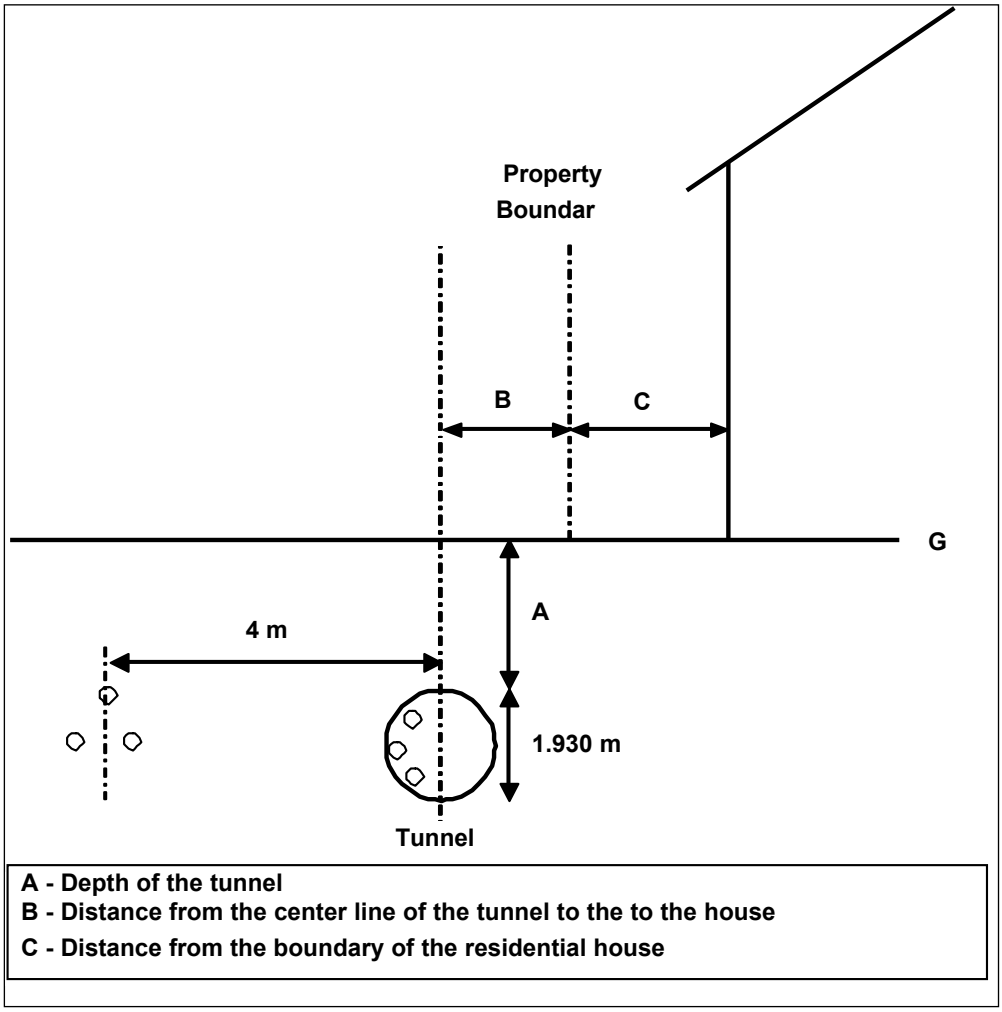


Figure A Illustration of model parameters

Table B The distance of dwellings from the underground cables.

House address	A (m)	B (m)	C (m)
2 Mullroy Place	1.49	2.22	4.50
20 Mullroy Place	2.70	3.15	2.17
27 Dunvegan Rise	2.54	2.04	3.70
185 Kilkenny Drive	2.82	2.67	0.61
98 Moyrus Crescent	1.96	4.58	2.23

15. The MF levels are shown in **Table C**. The results show that the MF levels will not exceed the NRL public exposure guideline level of 100 μT.

Table C MF levels at occupied dwellings close to the BHL – PAK cable route.

House address	MF Above tunnel at GL (μT)		MF at the boundary at GL (μT)		MF at the dwelling at GL (μT)	
	Normal loading	Peak loading	Normal loading	Peak loading	Normal loading	Peak loading
2 Mullroy Place	28	37	15	20	4	5
20 Mullroy Place	13	17	7	9	4	5
27 Dunvegan Rise	15	19	10	13	4	5
185 Kilkenny Drive	12	17	8	10	7	9
98 Moyrus Cresent	21	28	6	8	3	5

Substations

16. **Table D** shows the MF levels at the perimeter fence of each substation and at the closest dwelling. The MF levels will not exceed the NRL reference levels outside the substation boundaries.

17. The MF levels vary along the fence and are significantly higher where the overhead lines enter the substation. The MF levels are summarised in **Table D**.

Table D MF levels around substations

Substation	Loading	MF at the security fence (μT) (under lines /over cables)	MF at the security fence (μT)	MF at the closest dwelling (μT)
WKM	Peak	22	10	< 0.1
	Normal	13	6	< 0.1
WHN (220)	Peak	10	6	< 0.1
	Normal	8	5	< 0.1
WHN (400)	Peak	30	21	< 0.1
	Normal	23	16	< 0.1
BHL (220)	Peak	32	13	< 0.1
	Normal	25	7	< 0.1
BHL (400)	Peak	31	15	< 0.1
	Normal	23	10	< 0.1
PAK	Peak	57	13	< 0.1
	Normal	43	9	< 0.1

18. Mr Mitton's evidence further discusses magnetic field strengths around substations and underground cables.