Appendix H - Electric and Magnetic Fields Supplement

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Based on epidemiological studies, there is concern about the potential for adverse health effects from exposure to electric and magnetic Fields (EMF) as the result of residing near high voltage transmission lines (HVTLs). Extremely low-frequency (ELF) - EMF that is emitted from HVTLs does not have the energy to ionize molecules or to heat them; however, they are fields of energy and thus have the potential to produce effects.

In the 1970s, epidemiological studies indicated a possible association between childhood leukemia and EMF levels. Since then, various types of research, including animal studies, epidemiological studies, clinical studies and cellular studies, have been conducted to examine the potential health effects of EMF. Scientific panels and commissions have reviewed and studied this research data. These studies have been conducted by, among others, the National Institute of Environmental Health Sciences (NIEHS), the World Health Organization (WHO), the International Agency for Research on Cancer (IARC), the Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR) and the Minnesota State Interagency Working Group (MSIWG). In general, these studies concur that:

- Based on epidemiological studies, there is a weak association between childhood leukemia and EMF exposure. There is however no consistent association between EMF exposure and other diseases in children or adults.
- Laboratory, animal, and cellular studies fail to show a cause and effect relationship between disease and EMF exposure at common EMF levels. A biological mechanism for how EMFs might cause disease has not been established.

Because a cause and effect relationship cannot be established, yet a weak association between childhood leukemia and EMF exposure has been shown: 1) the potential health effects of EMF are uncertain; 2) no methodology for estimating health effects based on EMF exposure exists; 3) further study of the potential health effects of EMF is needed; and 4) a precautionary approach, including regulations and guidelines, is needed in designing and using all electrical devices.

Researchers continue to study potential health effects related to ELF-EMF and potential causal mechanisms. The following sections provide brief summaries from scientific panels and commissions that have examined the potential health impacts of ELF-EMF.

National Institute of Environmental Health Sciences

In 1992, the U.S. Congress authorized the Electric and Magnetic Fields Research and Public Information Dissemination Program (EMF-RAPID program). Congress instructed NIEHS and the U.S. Department of Energy to direct and manage a program of research and analysis aimed at providing scientific evidence to clarify the potential for health risk from exposure to ELF-EMF. The program provided the following conclusions to Congress (Reference H1):

- "The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak.
- Epidemiological studies have serious limitations in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF-EMF at environmental levels and changes in biological function or disease status. The lack of consistent positive findings in animal or mechanistic studies weakens the belief that this association (the epidemiological association between ELF-EMF and childhood leukemia) is actually due to ELF-EMFs but it cannot completely discount the epidemiological findings.
- The NIEHS concludes that ELF-EMF exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on education both the public and regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer outcomes provide sufficient evidence of a risk to currently warrant concern."

In 2002, the EMF-RAPID program published a detailed question and answer pamphlet summarizing research on ELF-EMF and potential health effects. The pamphlet is available at: http://www.niehs.nih.gov/health/materials/electric_and_magnetic_fields_associated_with_the_use_of_electric_power_questions_and_answers_english_508.pdf

World Health Organization

In 1996, the WHO established the International EMF Project to study the potential health impacts of EMF. The project develops and disseminates information on EMF and public health. In 2007, the WHO issued an environmental health monograph on ELF-EMF (Reference H2). The monograph concluded:

- "Scientific evidence suggesting that everyday, chronic low-intensity (above 0.3-0.4 µT; 3-4 mG) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increase risk for childhood leukemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.
- A number of other diseases have been investigated for the possible association with ELF magnetic field exposures. These include cancers in children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications and neurological disease. The scientific evidence supporting a linkage between ELF magnetic fields and any of these diseases is much weaker than for childhood leukemia and in some cases (for example, for cardiovascular disease or breast cancer) the evidence is sufficient to give confidence that magnetic fields do not cause the disease.
- The use of precautionary approaches is warranted. However, electric power brings obvious health, social and economic benefits and precautionary approaches should not compromise these benefits. Furthermore, given both weakness of the evidence for a link between exposure to ELF magnetic fields and childhood leukemia and the limited impacted on public health if there is a link, the benefits of exposure reduction on health are unclear. Thus, the costs of precautionary measures should be very low. The costs of implementing exposure reductions would vary from one country to another, making it very difficult to provide general recommendation for balancing the costs against the potential risk from ELF fields."

International Agency for Research on Cancer

Since 1969, the IARC has been evaluating the carcinogenic risks of chemicals and other agents, such as viruses and radiation. In 2001, the IARC convened a working group of scientists to evaluate possible carcinogenic risks to humans from exposure to EMF (Reference H3). These scientists concluded that ELF magnetic fields are possibly carcinogenic to humans (a "Group 2B carcinogen"). Group 2B carcinogens are agents for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals. The working group concluded:

- "Since the first report suggesting an association between residential ELF electric and magnetic fields and childhood leukemia was published in 1979, dozens of increasingly sophisticated studies have examined this association. In addition, there have been numerous comprehensive review, meta-analyses and two recent pooled analyses. In one pooled analysis…no excess risk was seen for exposure to ELF magnetic fields below 0.4 µT and a twofold excess risk was seen for exposure above 0.4 µT. [In the other study] a relative risk of 1.7 for exposure above 0.3 µT was reported.
- No consistent relationship has been seen in studies of childhood brain tumors or cancers at other sites and residential ELF electric and magnetic fields.
- While a number of studies are available, reliable data on adult cancer and residential exposure to ELF electric and magnetic fields, including the use of appliances, are sparse and methodologically limited…. Although there have been considerable number of reports, a consistent association between residential exposure and adult leukemia and brain cancer has not been established."

Scientific Committee on Emerging and Newly Identified Health Risks

The SCENIHR serves as an advisory committee to the European Commission. At the request of the Commission, the SCENIHR reviewed possible adverse health impacts due to EMF. In 2007, the committee concluded (Reference H4):

- "The previous conclusion (by a prior advisory committee, the Scientific Committee on Toxicity, Ecotoxicity and the Environment, CSTEE) that ELF magnetic fields are possibly carcinogenic, chiefly based on occurrence of childhood leukemia, is still valid. For breast cancer and cardiovascular disease, recent research has indicated that an association is unlikely. For neurodegenerative diseases and brain tumors, the link to ELF fields remains uncertain."

In 2009, the committee updated its prior opinion after reviewing new studies of ELF-EMF (Reference H5) and concluded:

- "The new information available is not sufficient to changes the conclusions of the 2007 opinion. The few new epidemiological and animal studies that have addressed ELF exposure and cancer do not change the previous assessment that ELF magnetic fields are a possible carcinogen and might contribute to an increase in childhood leukemia. At present, in vitro studies did not provide a mechanistic explanation of this epidemiological finding.
- New epidemiological studies indicate a possible increase in Alzheimer's disease arising from exposure to ELF. Further epidemiological and laboratory investigations of this observation are needed."

Minnesota State Interagency Working Group

In 2002, the MSIWG on EMF issues was formed to examine the potential health impacts of EMF and to provide science-based information to policy makers in Minnesota. Working group members included representatives from the Department of Commerce, Department of Health, Pollution Control Agency, Public Utilities Commission and Environmental Quality Board. The working group issued a white paper entitled "A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options" (Reference H6). The white paper concluded:

- "Some epidemiological results do show a weak but consistent association between childhood leukemia and increasing exposure to EMF... However, epidemiological studies alone are considered insufficient for concluding that a cause and effect relationship exists and the association must be supported by data from laboratory studies. Existing laboratory studies have not substantiated this relationship... nor have scientists been able to understand the biological mechanism of how EMF could cause adverse effects. In addition, epidemiological studies of various other diseases, in both children and adults, have failed to show any consistent pattern of harm from EMF.
- The Minnesota Department of Health concludes that the current body of evidence is insufficient to establish a cause and effect relationship between EMF and adverse health effects. However, as with many other environmental health issues, the possibility of a health risk from EMF cannot be dismissed. Construction of new generation and transmission facilities to meet increasing electrical needs in the state is likely to increase exposure to EMF and public concern regarding potential adverse health effects.
- Based on its review, the Work Group believes the most appropriate public health policy is to take a prudent avoidance approach to regulating EMF. Based upon this approach, policy recommendations of the Work Group include:
  - Apply low-cost EMF mitigation options in electric infrastructure construction projects;
  - Encourage conservation;
  - Encourage distributed generation;
  - Continue to monitor EMF research;
  - Encourage utilities to work with customers on household EMF issues; and
  - Provide public education on EMF issues."

References

H1. National Institute of Environmental Health Sciences, 1999. NIEHS Report on Health Effects from Exposure to Power-line Frequency Electric and Magnetic Fields. NIH Publication No. 99-4493

H2. World Health Organization, 2007. Environmental Health Criteria 238 (2007): Extremely Low Frequency (ELF) Fields. ISBN 978-92-4-157238-5

H3. International Agency for Research on Cancer, 2002. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Volume 80. Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields. Summary of Data Reported and Evaluation

H4. Scientific Committee on Emerging and Newly Identified Health Risks, 2007. Possible Effects of Electromagnetic Fields (EMF) on Human Health. Accessed February 2014 at: http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_007.pdf

H5. Scientific Committee on Emerging and Newly Identified Health Risks, 2009. Health Effects of Exposure to EMF. Accessed February 2014 at: http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_022.pdf

H6. The Minnesota State Interagency Working Group on EMF Issues, 2002. A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options. Accessed February 2014 at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId=%7B474587DD-E5C5-4A6E-95BC-7BC805CE4975%7D&documentTitle=20101-45731-07

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ITC Midwest LLC • 444 Cedar Street, Suite 1020 • St. Paul, MN 55101

December 30, 2013

Raymond Kirsch
Minnesota Department of Commerce
Suite 500
85 Seventh Place East
St. Paul, MN 55101

Re: In the Matter of the Application of ITC Midwest LLC for a Route Permit for the Minnesota – Iowa 345 kV Transmission Line Project in Jackson, Martin, and Faribault Counties
MPUC Docket No. ET6675/TL-12-1337
EIS Development – Fifth Response

Dear Mr. Kirsch:

I write to provide supplemental information to our First and Second Responses to your emails requesting additional information from ITC Midwest LLC ("ITCM") for the Environmental Impact Statement for the Minnesota-Iowa 345 kV Project. Attached are updated versions of Tables 7, 8, and 9 from the Route Permit Application to reflect the updated structure configurations.

You also requested that magnetic fields be estimated for a higher loading scenario. We developed a model to reflect the generation additions that will be enabled by the Project and MVP #3 to calculate these magnetic fields. These calculations are based on 2,000 MW of new generation additions in southwest Minnesota and other assumptions which load the 345 kV system to the point where a single contingency would overload other facilities. Loading above this level could not occur without additional facility additions.

This scenario is just one of many possible future scenarios. The resultant calculations for this scenario are shown on a new table, labeled 9A, which is also attached.

Thank you for your questions and for providing us time to gather the requested information. Please contact me if you have any further questions.

Sincerely,

David B. Grover

Table 7. Estimated Electric Fields (kV/m) Update 12/30/2013

Structure Type	Maximum Conductor Voltage	Distance to Proposed Centerline												
		-300′	-200′	-100′	-75′	-50′	-25′	0′	25′	50′	75′	100′	200′	300′
Single Pole Davit Arm 345 kV/ 161 kV	362.25 kV/ 169.05 kV	0.04	0.09	0.30	0.58	1.60	4.28	3.35	0.74	0.35	0.20	0.13	0.04	0.02
Single Pole Davit Arm 345 kV/ 161 kV at Initial 345 kV/69 kV Operation	362.25 kV/ 72.45 kV	0.05	0.10	0.31	0.58	1.65	4.48	3.90	1.00	0.13	0.09	0.10	0.06	0.04
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service	362.25 kV	0.07	0.14	0.31	0.54	1.63	4.57	4.22	1.35	0.27	0.21	0.23	0.12	0.07
Single Pole Davit Arm Low Profile 345 kV/161 kV	362.25 kV/ 169.05 kV	0.03	0.09	0.83	2.00	4.36	3.55	2.46	0.27	0.92	0.51	0.21	0.03	0.02
Single Pole Davit Arm Low Profile 345 kV/161 kV with only 345 kV circuit	362.25 kV	0.05	0.11	0.82	1.97	4.34	3.66	3.32	1.68	0.89	0.57	0.39	0.13	0.06
Single Pole Braced Post 161 kV/ 161 kV	169.05 kV/ 169.05 kV	0.00	0.01	0.03	0.02	0.12	0.96	1.38	0.96	0.12	0.02	0.03	0.01	0.00
Single Pole Braced Post 161 kV/161 kV with 161 kV/69 kV Initial Operation	169.05 kV 72.45 kV	0.01	0.02	0.06	0.05	0.12	1.14	1.61	0.20	0.05	0.03	0.02	0.01	0.01
Single Pole Braced Post 161 kV	169.05 kV	0.01	0.03	0.12	0.22	0.45	0.92	1.96	1.35	0.37	0.19	0.12	0.03	0.01
Single Pole Davit Arm 345 kV/161 kV/ 161 kV	362.25 kV/ 169.05 kV/ 169.05 kV	0.07	0.11	0.09	0.29	1.11	2.95	0.66	2.32	0.67	0.23	0.15	0.09	0.06

Structure Type	Maximum Conductor Voltage	Distance to Proposed Centerline												
		-300′	-200′	-100′	-75′	-50′	-25′	0′	25′	50′	75′	100′	200′	300′
Single Pole Davit Arm 345 kV/161 kV with 69kV Underbuild at Initial 345kV with 69kV Underbuild Operation	362.25 kV/ 169.05 kV/ 72.45 kV	0.10	0.19	0.18	0.17	1.21	3.06	2.08	1.10	0.40	0.12	0.24	0.16	0.10
Two Pole H-Frame 345 kV/161 kV	362.25 kV/ 169.05 kV	0.09	0.23	1.75	3.97	5.25	1.49	4.59	2.40	1.84	1.29	0.64	0.15	0.07
Two Pole H-Frame 345 kV Parallel with Existing Two Pole H-Frame 161 kV	362.25 kV Parallel 169.05 kV	0.06	0.21	2.31	4.68	3.84	2.72	3.52	1.02	1.51	1.37	0.71	0.08	0.02
Existing Single Pole Davit Arm 161 kV/161 kV Parallel With Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service	169.05 kV/ 169.05 kV Parallel 362.25 kV	0.08	0.16	0.56	1.64	4.55	3.97	0.85	1.24	1.42	0.14	0.14	0.10	0.06
Single Pole Braced Post 161 kV at 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation	72.45 kV Parallel 72.45 kV/ 169.05 kV	0.01	0.03	0.35	0.74	0.51	0.14	0.08	0.08	0.22	1.61	1.14	0.05	0.02

Structure Type	Maximum Conductor Voltage	Distance to Proposed Centerline												
		-300′	-200′	-100′	-75′	-50′	-25′	0′	25′	50′	75′	100′	200′	300′
Single Pole Braced Post 161 kV/161 kV at 161 kV/ 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation Parallel with Single Pole Braced Post 161 kV at 69 kV Initial Operation	169.05 kV/ 72.45 kV Parallel 72.45 kV/ 169.05 kV Parallel 72.45 kV	0.06	0.11	0.04	0.08	0.10	0.22	1.60	1.15	0.18	0.20	0.44	0.37	0.05
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service Parallel with Single Pole Davit Arm 345 kV/ 161 kV	362.25 kV Parallel 362.25 kV/ 169.05 kV	0.10	0.30	4.27	1.43	0.32	0.05	0.24	0.63	1.83	4.98	5.29	0.08	0.08

Table 8. Estimated Magnetic Fields in 2017 (mG) Update 12/30/2013

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Davit Arm 345 kV/161 kV	Peak	215/20	0.9	1.8	6.0	9.3	15.2	23.3	21.7	12.9	7.5	4.8	3.3	1.2	0.6
	Average	144/13	0.6	1.2	4.0	6.2	10.2	15.6	14.5	8.6	5.0	3.2	2.2	0.8	0.4
Single Pole Davit Arm 345 kV/161 kV at Initial 345 kV/69 kV Operation	Peak	215/75	0.7	1.5	5.1	8.1	13.7	21.5	20.6	11.7	5.8	3.3	2.2	0.8	0.5
	Average	144/50	0.5	1.0	3.4	5.5	9.2	14.4	13.8	7.8	3.9	2.2	1.5	0.5	0.3
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit	Peak	215	0.9	1.9	6.3	9.7	15.8	23.9	22.2	13.8	8.4	5.5	3.8	1.3	0.7
	Average	144	0.6	1.3	4.2	6.5	10.6	16.0	14.9	9.2	5.6	3.7	2.5	0.9	0.5
Single Pole Davit Arm Low Profile 345 kV/161 kV	Peak	215/29	0.9	1.8	7.0	12.0	21.8	28.6	21.2	10.6	5.0	3.2	2.3	0.7	0.4
	Average	144/19	0.6	1.2	4.7	8.1	14.6	19.2	14.2	7.1	3.4	2.2	1.5	0.5	0.2
Single Pole Davit Arm Low Profile 345 kV/161 kV with only 345 kV circuit	Peak	215	0.9	1.9	7.3	12.5	22.6	29.8	22.3	12.5	7.1	4.3	2.8	0.9	0.4
	Average	144	0.6	1.3	4.9	8.4	15.1	19.9	14.9	8.4	4.7	2.9	1.9	0.6	0.3
Single Pole Braced Post 161 kV/161 kV	Peak	55/68	0.0	0.1	0.2	0.4	0.9	3.3	8.2	4.9	1.9	0.9	0.5	0.1	0.1
	Average	37/46	0.0	0.0	0.1	0.2	0.6	2.2	5.5	3.3	1.3	0.6	0.3	0.1	0.0
Single Pole Braced Post 161 kV/161 kV with 161 kV/69 kV Initial Operation	Peak	55/191	0.3	0.5	1.6	2.4	4.1	9.3	24.2	18.3	8.2	4.2	2.5	0.6	0.3
	Average	37/128	0.2	0.3	1.0	1.6	2.8	6.2	16.2	12.3	5.5	2.8	1.6	0.4	0.2
Single Pole Braced Post 161 kV	Peak	94	0.2	0.4	1.2	2.0	3.7	7.9	14.6	9.6	4.2	2.2	1.3	0.3	0.1
	Average	63	0.1	0.2	0.8	1.3	2.5	5.3	9.8	6.4	2.8	1.4	0.9	0.2	0.1
Single Pole Davit Arm 345 kV/161 kV/161 kV	Peak	215/29/20	0.7	1.5	4.1	5.6	8.0	11.3	9.3	5.1	3.3	3.0	2.5	1.0	0.5
	Average	144/19/13	0.5	1.0	2.7	3.7	5.3	7.5	6.2	3.4	2.3	2.0	1.6	0.7	0.4

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Davit Arm 345 kV/161 kV with 69kV Underbuild at Initial 345kV with 69kV Underbuild Operation	Peak	215/0/109	0.7	1.7	5.9	9.1	14.8	23.6	33.9	30.0	10.1	4.8	3.2	1.1	0.6
	Average	144/0/73	0.5	1.1	4.0	6.1	9.9	15.8	22.7	20.1	6.8	3.2	2.2	0.8	0.4
Two Pole H-Frame 345 kV/161 kV	Peak	215/211	1.3	3.1	13.4	23.3	35.0	34.3	23.5	17.6	25.2	19.4	12.0	2.9	1.3
	Average	144/141	0.9	2.1	9.0	15.6	23.4	23.0	15.8	11.8	16.8	13.0	8.0	2.0	0.9
Two Pole H-Frame 345 kV Parallel with Existing Two Pole H-Frame 161 kV	Peak	215 Parallel 211	1.2	2.8	14.4	26.5	37.5	33.2	13.9	19.4	27.2	20.2	12.1	2.9	1.3
	Average	144 Parallel 141	0.8	1.9	9.7	17.8	25.1	22.3	9.3	13.0	18.2	13.5	8.1	1.9	0.9
Existing Single Pole Davit Arm 161 kV/161 kV Parallel With Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service	Peak	29/20 Parallel 215	1.0	2.3	9.6	15.6	23.7	22.1	13.4	4.3	6.4	4.7	3.2	1.1	0.6
	Average	19/13 Parallel 144	0.7	1.5	6.4	10.4	15.9	14.8	9.0	3.0	4.3	3.1	2.1	0.7	0.4
Single Pole Braced Post 161 kV at 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation	Peak	110 Parallel 191/120	0.3	0.9	9.0	17.1	12.1	6.0	4.6	7.0	15.8	22.6	7.3	0.4	0.2
	Average	74 Parallel 128/80	0.2	0.6	6.0	11.5	8.1	4.0	3.1	4.7	10.6	15.1	4.9	0.3	0.1

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Braced Post 161 kV/161 kV at 161 kV/ 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation Parallel with Single Pole Braced Post 161 kV at 69 kV Initial Operation	Peak	88/110 Parallel 191/120 Parallel 55	0.2	1.3	4.4	4.1	6.8	15.2	21.9	7.9	2.8	1.8	2.4	2.6	0.4
	Average	59/74 Parallel 128/80 Parallel 37	0.1	0.9	2.9	2.7	4.6	10.2	14.7	5.3	1.9	1.2	1.6	1.7	0.3
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service Parallel with Single Pole Davit Arm 345 kV/ 161 kV	Peak	215 Parallel 85/68	1.9	6.3	22.0	13.4	8.0	4.9	3.0	1.7	2.4	6.3	8.7	0.9	0.5
	Average	144 Parallel 57/46	1.3	4.2	14.7	9.0	5.3	3.3	2.0	1.1	1.6	4.2	5.9	0.6	0.3

Table 9. Estimated Magnetic Fields in 2023 (mG) Update 12/30/2013

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Davit Arm 345 kV/161 kV	Peak	310/20	1.3	2.6	8.7	13.6	22.2	33.8	31.5	18.9	11.2	7.2	5.0	1.8	0.9
	Average	208/13	0.8	1.7	5.9	9.1	14.9	22.7	21.1	12.7	7.5	4.8	3.3	1.2	0.6
Single Pole Davit Arm 345 kV/161 kV at Initial 345 kV/69 kV Operation	Peak	310/92	1.1	2.2	7.6	12.1	20.1	31.5	29.9	17.0	8.8	5.1	3.4	1.3	0.7
	Average	208/62	0.7	1.5	5.1	8.1	13.5	21.2	20.1	11.4	5.9	3.4	2.3	0.9	0.5
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit	Peak	310	1.3	2.7	9.0	14.0	22.7	34.5	32.1	19.9	12.1	7.9	5.4	1.9	1.0
	Average	208	0.9	1.8	6.1	9.4	15.3	23.1	21.5	13.3	8.1	5.3	3.6	1.3	0.7
Single Pole Davit Arm Low Profile 345 kV/161 kV	Peak	310/48	1.2	2.6	10.0	17.3	31.3	41.0	30.3	14.9	6.9	4.4	3.1	1.1	0.5
	Average	208/32	0.8	1.7	6.7	11.6	21.0	27.6	20.4	10.0	4.6	3.0	2.1	0.7	0.3
Single Pole Davit Arm Low Profile 345 kV/161 kV with only 345 kV circuit	Peak	310	1.3	2.7	10.5	18.0	32.6	42.9	32.2	18.1	10.2	6.2	4.1	1.2	0.6
	Average	208	0.9	1.8	7.0	12.1	21.9	28.8	21.6	12.1	6.9	4.2	2.7	0.8	0.4
Single Pole Braced Post 161 kV/161 kV	Peak	132/84	0.2	0.3	1.2	2.1	4.3	10.3	15.3	5.3	1.6	0.8	0.5	0.2	0.1
	Average	88/56	0.1	0.2	0.8	1.4	2.9	6.8	10.2	3.5	1.1	0.5	0.4	0.2	0.1
Single Pole Braced Post 161 kV/161 kV with 161 kV/69 kV Initial Operation	Peak	132/56	0.2	0.4	1.5	2.6	5.2	11.7	15.7	5.5	2.3	1.3	0.9	0.3	0.2
	Average	88/38	0.1	0.3	1.0	1.7	3.4	7.7	10.5	3.6	1.5	0.9	0.6	0.2	0.1
Single Pole Braced Post 161 kV	Peak	132	0.2	0.5	1.7	2.8	5.2	11.1	20.4	13.5	5.9	3.0	1.8	0.5	0.2
	Average	88	0.2	0.3	1.2	1.9	3.5	7.4	13.6	9.0	2.9	2.0	1.2	0.3	0.1
Single Pole Davit Arm 345 kV/161 kV/161 kV	Peak	310/48/20	1.0	2.2	6.0	8.3	12.0	17.3	13.7	7.9	5.6	4.7	3.8	1.6	0.8
	Average	208/32/13	0.7	1.5	4.1	5.6	8.0	11.6	9.2	5.3	3.8	3.2	2.5	1.1	0.5

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Davit Arm 345 kV/161 kV with 69kV Underbuild at Initial 345kV with 69kV Underbuild Operation	Peak	310/0/118	1.0	2.3	8.3	12.7	20.4	31.9	43.0	36.1	12.8	6.8	4.7	1.7	0.8
	Average	208/0/79	0.7	1.6	5.6	8.5	13.7	21.4	28.8	24.2	8.6	4.6	3.1	1.1	0.5
Two Pole H-Frame 345 kV/161 kV	Peak	310/258	1.8	4.3	18.9	33.1	50.2	50.0	35.3	22.4	31.6	24.8	15.6	3.9	1.7
	Average	208/173	1.2	2.9	12.7	22.2	33.7	33.6	23.7	15.0	21.2	16.6	10.4	2.6	1.1
Two Pole H-Frame 345 kV Parallel with Existing Two Pole H-Frame 161 kV	Peak	310 Parallel 258	1.6	3.9	20.4	37.8	54.2	49.2	22.2	22.4	33.4	25.4	15.4	3.7	1.7
	Average	208 Parallel 173	1.1	2.6	13.7	25.4	36.4	33.0	14.9	15.0	22.4	17.0	10.3	2.5	1.1
Existing Single Pole Davit Arm 161 kV/161 kV Parallel With Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service	Peak	48/20 Parallel 310	1.5	3.4	13.9	22.6	34.1	31.3	18.2	6.5	10.5	7.4	5.0	1.7	0.9
	Average	32/13 Parallel 208	1.0	2.3	9.3	15.2	22.9	21.0	12.2	4.4	7.0	5.0	3.3	1.1	0.6
Single Pole Braced Post 161 kV at 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation	Peak	99 Parallel 177/128	0.3	0.8	8.1	15.3	10.8	5.3	4.0	6.0	13.9	21.0	7.4	0.3	0.2
	Average	66 Parallel 119/86	0.2	0.5	5.4	10.2	7.2	3.5	2.7	4.0	9.4	14.1	5.0	0.2	0.1

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Braced Post 161 kV/161 kV at 161 kV/ 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation Parallel with Single Pole Braced Post 161 kV at 69 kV Initial Operation	Peak	128/99 Parallel 177/128 Parallel 132	0.6	3.7	2.7	2.9	5.3	12.7	20.5	8.8	3.8	3.3	5.3	6.0	0.9
	Average	86/66 Parallel 119/86 Parallel 88	0.4	2.5	1.8	1.9	3.6	8.5	13.8	5.9	2.5	2.2	3.6	4.0	0.6
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service Parallel with Single Pole Davit Arm 345 kV/ 161 kV	Peak	310 Parallel 130/84	2.3	8.4	33.6	21.9	14.3	10.7	9.7	11.1	15.2	20.9	19.4	3.6	0.8
	Average	208 Parallel 87/56	1.5	5.6	22.6	14.7	9.6	7.2	6.5	7.4	10.2	14.0	13.0	2.4	0.6

Table 9A. Estimated Magnetic Fields Maximum (mG)

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Davit Arm 345 kV/161 kV	Peak	975/132	3.8	7.7	26.4	41.1	67.7	104.1	97.2	56.8	32.1	20.2	14.0	5.1	2.7
	Average	653/88	2.5	5.2	17.7	27.6	45.4	69.7	65.1	38.0	21.5	13.6	9.4	3.4	1.8
Single Pole Davit Arm 345 kV/161 kV at Initial 345 kV/69 kV Operation	Peak	975/92	3.9	8.0	27.0	42.0	68.9	105.4	98.3	58.8	34.2	21.8	15.0	5.3	2.8
	Average	653/62	2.6	5.3	18.1	28.1	46.1	70.6	65.8	39.4	22.9	14.6	10.0	3.6	1.9
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit	Peak	975	4.1	8.4	28.4	43.9	71.5	108.4	100.8	62.5	38.1	24.7	17.1	5.9	3.1
	Average	653	2.7	5.7	19.0	29.4	47.9	72.6	67.5	41.9	25.5	16.6	11.4	4.0	2.1
Single Pole Davit Arm Low Profile 345 kV/161 kV	Peak	975/190	3.8	8.0	31.2	53.6	97.3	127.7	94.2	45.1	19.5	12.8	9.3	3.2	1.6
	Average	653/127	2.5	5.4	20.9	35.9	65.2	85.5	63.1	30.2	13.0	8.6	6.3	2.2	1.1
Single Pole Davit Arm Low Profile 345 kV/161 kV with only 345 kV circuit	Peak	975	4.0	8.5	33.0	56.6	102.5	134.9	101.1	56.8	32.1	19.6	12.9	3.8	1.8
	Average	653	2.7	5.7	22.1	37.9	68.7	90.4	67.7	38.1	21.5	13.1	8.6	2.6	1.2
Single Pole Braced Post 161 kV/161 kV	Peak	390/126	0.7	1.4	5.1	8.6	16.7	36.9	48.5	18.3	8.4	5.0	3.3	1.2	0.7
	Average	261/84	0.5	1.0	3.4	5.8	11.2	24.7	32.4	12.2	5.6	3.3	2.2	0.8	0.5
Single Pole Braced Post 161 kV/161 kV with 161 kV/69 kV Initial Operation	Peak	390/79	0.8	1.6	5.6	9.4	18.1	39.2	51.0	21.6	10.4	6.1	4.0	1.3	0.7
	Average	261/53	0.5	1.1	3.8	6.3	12.1	26.2	34.1	14.5	7.0	4.1	2.7	0.9	0.5
Single Pole Braced Post 161 kV	Peak	390	0.7	1.4	5.1	8.3	15.4	32.8	60.4	39.8	17.4	8.9	5.2	1.3	0.6
	Average	261	0.5	1.0	3.4	5.6	10.3	22.0	40.4	26.6	11.7	6.0	3.5	0.9	0.4
Single Pole Davit Arm 345 kV/161 kV/161 kV	Peak	975/190/132	3.2	6.8	19.3	26.8	39.3	60.6	49.7	24.8	12.7	12.7	10.7	4.7	2.4
	Average	653/127/88	2.1	4.5	12.9	17.9	26.7	40.6	33.2	16.6	8.5	8.5	7.2	3.2	1.6

Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Davit Arm 345 kV/161 kV with 69kV Underbuild at Initial 345kV with 69kV Underbuild Operation	Peak	975/0/118	3.1	7.1	24.4	37.0	58.3	86.7	97.5	71.1	34.6	22.2	15.6	5.4	2.6
	Average	653/0/79	2.1	4.7	16.3	24.8	39.1	58.1	65.3	47.6	23.1	14.9	10.5	3.6	1.7
Two Pole H-Frame 345 kV/161 kV	Peak	975/496	5.1	12.2	56.4	100.9	157.0	161.7	122.7	61.4	69.5	56.7	36.8	9.8	4.4
	Average	653/332	3.4	8.2	37.8	67.6	105.1	108.3	82.2	41.1	46.6	38.0	24.6	6.5	2.9
Two Pole H-Frame 345 kV Parallel with Existing Two Pole H-Frame 161 kV	Peak	975 Parallel 496	4.7	11.5	61.6	116.1	171.5	163.8	89.3	41.7	66.6	54.5	34.3	8.8	4.0
	Average	653 Parallel 332	3.1	7.7	41.2	77.8	114.9	109.7	59.8	27.9	44.6	36.5	23.0	5.9	2.7
Existing Single Pole Davit Arm 161 kV/161 kV Parallel With Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service	Peak	190/132 Parallel 975	4.6	10.5	43.3	70.5	107.0	99.8	60.3	12.5	32.8	23.2	15.4	5.1	2.6
	Average	127/88 Parallel 653	3.1	7.0	29.0	47.3	71.7	66.9	40.4	8.4	21.9	15.6	10.3	3.4	1.8
Single Pole Braced Post 161 kV at 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation	Peak	99 Parallel 236/141	0.3	0.8	8.0	15.4	11.3	5.9	5.2	8.6	19.7	27.9	9.0	0.6	0.3
	Average	66 Parallel 158/94	0.2	0.5	5.3	10.3	7.5	3.9	3.5	5.8	13.2	18.7	6.0	0.4	0.2

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Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline (feet)												
			-300	-200	-100	-75	-50	-25	0	25	50	75	100	200	300
Single Pole Braced Post 161 kV/161 kV at 161 kV/ 69 kV Initial Operation Parallel with Single Pole Braced Post 161 kV/161 kV at 69 kV/ 161 kV Initial Operation Parallel with Single Pole Braced Post 161 kV at 69 kV Initial Operation	Peak	370/99 Parallel 236/141 Parallel 390	2.7	16.7	7.9	5.2	6.5	15.7	26.9	12.9	7.7	8.9	15.3	18.0	2.7
	Average	248/66 Parallel 158/94 Parallel 261	1.8	11.2	5.3	3.5	4.4	10.5	18.0	8.7	5.1	6.0	10.3	12.1	1.8
Single Pole Davit Arm 345 kV/161 kV with only one 345 kV circuit in service Parallel with Single Pole Davit Arm 345 kV/ 161 kV	Peak	975 Parallel 761/126	6.7	25.7	107.9	71.6	48.5	38.3	37.9	47.3	69.4	99.0	88.4	13.9	3.9
	Average	653 Parallel 510/84	4.5	17.2	72.2	47.9	32.5	25.7	25.4	31.7	46.5	66.4	59.3	9.3	2.6

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