Exponent
17000 Science Drive
Suite 200
Bowie, MD 20715

telephone 301-291-2500
facsimile 301-291-2599
www.exponent.com

February 22, 2010

Mr. Michael Doyle
Environmental Planning Group
247 South 500 East
Salt Lake City, UT 84102

Re: Mona - Oquirrh Transmission Line Project
Submissions to Tooele County Planning Commission

Dear Mr. Doyle:

We have evaluated the material submitted to the Tooele County Planning Commission expressing concerns regarding the siting of the above-referenced line. The material raised health concerns based largely on testimony provided by Dr. David Carpenter at a hearing for an unrelated transmission line project in another state (Attachment #7 of citizen packet submitted on February 3, 2010).

In short, Dr. Carpenter's opinion is that there is "strong" evidence that exposure to magnetic-field levels greater than 4 milligauss (mG) is associated with an increased risk of childhood leukemia (p. 4), and that the public health impact of magnetic fields from power lines is "significant" (p. 10). He also opines that it is "likely" that magnetic fields cause adult cancer (p. 13) and there is "strong" evidence in support of a relationship with neurodegenerative diseases (p. 13). Dr. Carpenter, therefore, recommends that long-term residential exposures above 2 mG and, more important, above 4 mG should be avoided when routing power lines. Dr. Carpenter also recommends that lines be routed away from schools and child care facilities.

Dr. Carpenter's opinions, which he presents as based on the scientific research, are strikingly different from the conclusions and recommendations of the scientific agencies that have reviewed the same body of research. These scientific agencies include the US National Institute of Environmental Health Sciences (NIEHS), the World Health Organization (WHO), the International Commission for Non-Ionizing Radiation Protection (ICNIRP), the International Agency for Research on Cancer (IARC), the Health Council of the Netherlands (HCN), the SSI of the Swedish Radiation Protection Authority, and the Health Protection Agency (HPA) of Great Britain.[1] These reviews represent the consensus of multidisciplinary expert panels that have carefully reviewed the research in its entirety. Dr. Carpenter's opinions are inconsistent with the scientific consensus of these seven international and national scientific agencies because he did not employ a systematic weight-of-evidence approach, whereby all studies are

[1] Each of these scientific agencies maintains an internet site where their reviews and conclusions are available to the public. The public should focus on the material provided on these websites, rather than the material and opinions provided on advocacy websites such as Community & Environmental Defense Services (CEDS).

systematically reviewed and weighted to provide a balanced assessment of the evidence in support of an adverse effect. While all of these agencies have recognized that there is consistent evidence of a weak statistical *association* between childhood leukemia and magnetic field exposure greater than 3-4 mG, they have agreed that the evidence is too limited to conclude that there is a causal relationship; scientific agencies have recommended further research to clarify this topic, but have concluded that the existing research does not justify exposure reductions at 3-4 mG.

In summary, Dr. Carpenter's analysis is flawed because, among other things, he selects studies out of a vast database to support his opinion, fails to note limitations in study design that affect the significance of any statistical findings or conclusions, and misunderstands the nature and role of animal model systems. A careful evaluation of the cumulative body of epidemiologic and experimental research to understand the evidence that each study provides in the context of its strengths and weaknesses is the hallmark of a valid risk assessment. A few, brief examples of each of these points are discussed below to demonstrate why Dr. Carpenter's opinions diverge from the consensus of scientific agencies.

- *Selecting outdated studies out of a broad database to support an opinion leads to bias, or error, in conclusions.*
  In testimony submitted to the Tooele County Planning Commission, Dr. Carpenter cites Peplonska et al. (2007) as finding an "increased risk of breast cancer in women occupationally exposed to elevated magnetic fields" (p.13). Dr. Carpenter makes no mention of the nature or limitations of this study, the results of studies with much better methods (e.g., Johanssen et al. [2007]), or the cumulative weight in support of a relationship between magnetic fields and breast cancer. It is inappropriate to cite the results of a single epidemiology study or a select group of studies as providing authoritative or definitive evidence because of the many limitations associated with any single epidemiology study. Dr. Carpenter's citation of this single study, which has numerous limitations given its case-control design and reliance on job titles for exposure assessment, does not reflect the growing consensus of scientific agencies that there is not a relationship between magnetic fields and breast cancer (WHO, 2007). In fact, the conclusion of the WHO report was "[t]he scientific evidence supporting a linkage between ELF magnetic fields and … breast cancer) . . . is sufficient to give confidence that magnetic fields do not cause the disease." (p. 12).

- *Flawed conclusions arise from a failure to consider limitations in a study's design that could affect the weight of a study's statistical findings on the overall risk assessment.*
  Dr. Carpenter cited Draper et al. (2005) to support his opinion that there is a dose-response relationship between magnetic fields and childhood leukemia and Lowenthal et al. (2007) to support his opinion that there is evidence of an increased susceptibility among younger persons to magnetic fields. These studies used distance from power lines as a surrogate for magnetic-field exposure, rather than taking actual measurements or calculations of residential magnetic field levels. Distance from power lines has been shown to be an unreliable predictor of actual magnetic field levels in the home (e.g., Maslanyj et al., 2009). As a result, any observed association with distance, even in an otherwise well-designed study like Draper et al. (2005), could be the result of bias or a relationship confused by another factor linked with distance (e.g., traffic density or socioeconomic status). Dr. Carpenter does not address this limitation appropriately, or any other strengths or weaknesses of these or other selected studies he cites. Furthermore, he demonstrates a limited understanding of a dose-response relationship by citing Foliart et al. (2006) and Svendsen et al. (2007) on pg. 8, and a failure to recognize the nuances of exposure misclassification in his discussion on pg. 11.

Dr. Carpenter also states, "Yang et al. (2008) found that children who live within 100 meters of a power line or transformer and have a certain gene (the XRCC! Ex9 + 16A allele of a DNA repair 20 gene) have an increased risk 4.31 times greater (over 400 percent increase) of developing leukemia than children with the same exposure that did not have this gene." His interpretation of this limited study is scientifically inaccurate. The study only enrolled children with leukemia and, therefore, can offer no conclusions regarding risk or causation. The authors reported that, out of five alleles of a gene that currently have no known link to childhood leukemia, one was more likely to be found in children who lived within 100 meters of an electrical installation, compared to children living greater than 100 meters away. The results of this study provide researchers with a topic for further study, at best, but provide no evidence that magnetic fields enhance the risk of childhood leukemia. The evaluation of the Yang study by the Health Council of the Netherlands was that "Due to the restrictions stated above, no conclusion on a causal relationship can be drawn from this single study on the relationship between residing in the vicinity of powerlines and Alzheimer's disease: it is not possible to pronounce upon the question of whether this elevated risk is also related to the exposure to the low-frequency magnetic fields generated by the powerlines." (HCN, 2009). The conclusion of the European Union's Scientific Committee on Newly Identified Health Risks was "There are too many weaknesses in this study to allow any conclusions to be drawn" (p.39, SCENIHR, 2009).

A valid risk assessment is largely based on a thorough, unbiased and careful evaluation of epidemiologic studies; Dr. Carpenter's testimony does not display any of these features.

- *Dr. Carpenter misunderstands the nature and role of animal model systems in the risk assessment process.*
  It is standard scientific procedure to conduct studies on laboratory animals to determine whether exposure to a specific agent leads to the development of cancer (USEPA, 2005). This approach is important because all known human carcinogens cause cancer in laboratory animals. Although Dr. Carpenter believes that no adequate animal model system is available for childhood leukemia, the EPA states that an agent may or may not produce cancer at the same site in animals and in humans (i.e., site concordance).[2]

  Thus, the results of experiments in all types of animal models are relevant to evaluating carcinogenicity.

  The research database on magnetic fields includes several large, long-term studies of laboratory animals conducted according to good laboratory practices in research laboratories worldwide (e.g., Mandeville et al., 1997; Boorman et al., 1999a,b; McCormick et al., 1999). Several studies were conducted in animals with a particular genetic susceptibility to developing leukemia or lymphoma (Harris et al., 1998; McCormick et al., 1998; Sommer and Lerchel, 2004; Chung et al., 2009), including a recent study which tested a new animal model for acute lymphoblastic leukemia, the most common type of leukemia in children (Bernard et al., 2008). These studies do

[2] EPA's *Guidelines for Carcinogen Risk Assessment* states: "Moreover, the absence of tumors in well-conducted, long-term animal studies in at least two species provides reasonable assurance that an agent may not be a carcinogenic concern for humans… agents observed to produce tumors in both humans and animals have produced tumors either at the same site (e.g., vinyl chloride) or different sites (e.g., benzene) (NRC, 1994). Hence, site concordance is not always assumed between animals and humans." (p. 2-22, USEPA 2005)

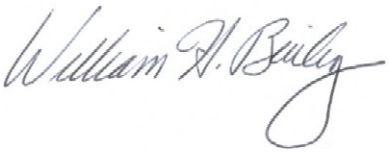
not show consistent evidence that magnetic fields can cause or enhance the development of cancer, including leukemia or lymphoma.

Dr. Carpenter notes in his qualifications that he served as the co-editor of the BioInitiative Report (www.bioinitiative.org). This report was written and posted online by an *ad hoc* group of individuals that does not represent any well-established regulatory agency or scientific authority; the report was a compilation of chapters written by separate authors, rather than a weight-of- evidence review. Numerous scientific agencies have reviewed and commented on the report, including the Health Council of the Netherlands (2008), the Australian Centre for Radiofrequency Bioeffects Research (2008), and the EMF-NET Steering Committee of the European Commission (2007). These agencies have not changed their opinion regarding EMF and health because as they explain the conclusions of the BioInitiative report were not based on standard scientific methods, as discussed above.

In conclusion, Dr. Carpenter's testimony and the opinions that he has offered in material such as the BioInitiative Report are inconsistent with the conclusions of scientific agencies, which have reviewed the literature using standard scientific methods. The public should look to the conclusions of these agencies, which have organized panels of multidisciplinary experts to review the research. These agencies have not recommended exposure reductions at 3-4 mG, as Dr. Carpenter suggested, because the research is not strong enough to justify this action.

Given that you have determined that the closest home to the proposed route for the Mona - Oquirrh line is approximately 960 feet from the right of way, the proposed line would contribute virtually no magnetic field exposure to the surrounding homes. Furthermore, no schools, child care facilities, or other locations where children may congregate are located near the proposed route. Thus, regardless of the validity of Dr. Carpenter's opinions on the relationship between magnetic fields and cancer, his recommendations would be met by this project.

Sincerely,



William H. Bailey, Ph.D.
Principal Scientist
Center for Exposure Assessment &
Dose Reconstruction

References

Australian Centre for Radiofrequency Bioeffects Research (ACRBR). ACRBR Position Statement on BioInitiative Report. December 18, 2008. http://www.acrbr.org.au/FAQ/ACRBR%20Bioinitiative%20Report%2018%20Dec%202008.pdf.

Bernard N, Alberdi AJ, Tanguy ML, Brugere H, Helissey P, Hubert C, Gendrey N, Guillosson JJ, Nafziger J. Assessing the potential Leukemogenic effects of 50 Hz and their harmonics using an animal leukemia model. Journal of Radiation Research, 49:565-577, 2008.

Boorman GA, Anderson LE, Morris JE, Sasser LB, Mann PC, Grumbein SL, Hailey JR, McNally A, Sills RC, Haseman JK. Effects of 26-week magnetic field exposure in a DMBA initiation-promotion mammary glands model in Sprague-Dawley rats. Carcinogenesis 20:899-904, 1999a.

Boorman GA, McCormick DL, Findlay JC, Hailey JR, Gauger JR, Johnson TR, Kovatch RM, Sills RC, Haseman JK. Chronic toxicity/oncogenicity evaluation of 60 Hz (power frequency) magnetic fields in F344/N rats. Toxicologic Pathology 27:267-78, 1999b.

Chung M-K, Yu W-J, Kim Y-B, Myung S-H. Lack of a co-promotion effect at 60 Hz circularly polarized magnetic fields on spontaneous development of lymphoma in AKR mice. Bioelectromagnetics 31:130-139, 2009.

Draper G, Vincent T, Kroll ME, Swanson J. Childhood cancer in relation to distance from high voltage power lines in England and Wales: a case-control study. BMJ 330:1290, 2005.

European Commission (EC) EMF-NET Coordination Action – The Steering Committee. Comments on the BioInitiative Working Group Report (BioInitiative Report). EC FP6, October 30, 2007. http://www.izmf.de/download/archiv/EMF-Net-Bioinitiative-608.pdf.

Foliart DE, Pollock BH, Mezei G, Iriye R, Silva JM, Ebi KL, Kheifets L, Link MP, Kavet R. Magnetic field exposure and long-term survival among children with leukaemia. Br J Cancer 94:161-164, 2006.

Harris AW, Basten A, Gebski V, Noonan D, Finnie J, Bath ML, Bangay MJ, Repacholi MH. A test of lymphoma induction by long-term exposure of E mu-Pim1 transgenic mice to 50 Hz magnetic fields. Radiat Res, 149:300-307, 1998.

Health Council of the Netherlands (HCN). BioInitiative Report. U-5601/EvR/iv/673-L1 Publication nr 2008/17E. September 2008. http://www.gezondheidsraad.nl/en/publications/bioinitiative-report-0#a-downloads

Health Council of the Netherlands (HCN). Advisory letter Power lines and Alzheimer's disease. U-5150/EvR/sl/673-D2 Publication no. 2009/05E. March 2009.

International Commission on Non-Ionizing Radiation. ICNIRP Statement – Use of the ICNIRP EMF Guidelines. March 31, 1999. http://www.icnirp.org/documents/Use.htm.

Johansen C, Raaschou-Nielsen O, Olsen JH, Schuez J. Risk for leukaemia and brain and breast cancer among Danish utility workers: A second follow-up. Occup Environ Med 64:782-4, Epub 2007 May 1.

Lowenthal RM, Tuck DM, Bray IC. Residential exposure to electric power transmission lines and risk of lymphoproliferative and myeloproliferative disorders: a case-control study. Internal Med J 37:614-9, 2007.

Mandeville R, Franco E, Sidrac-Ghali S, Paris-Nadon L, Rocheleau N, Mercier G, Desy M, Gaboury L. Evaluation of the potential carcinogenicity of 60 Hz linear sinusoidal continuous-wave magnetic fields in Fisher F344 rats. FASEB Journal. 11:1127-1136, 1997

Maslanyj M, Simpson J, Roman E, Schüz J. Power frequency magnetic fields and risk of childhood leukaemia: Misclassification of exposure from the use of the distance from power line' exposure surrogate. Bioelectromagnetics 30:183-188, 2009

McCormick DL, Ryan BM, Findlay JC, Gauger JR, Johnson TR, Morrissey RL, Boorman GA. Exposure to 60 Hz magnetic field and risk of lymphoma in PIM transgenic and TSG-p53 (p53 knockout) mice. Carcinogenesis. 19:1649-1653, 1998

McCormick DL, Boorman GA, Findlay JC, Hailey JR, Johnson TR, Gauger JR, Pletcher JM, Sills RC, Haseman JK. Chronic toxicity/oncogenicity evaluation of 60 Hz (power frequency) magnetic fields in B6C3F1 mice. Toxicol Pathol 27:279-85, 1999.

Peplonska B, Stewart P, Szeszenia-Dabrowska N, Rusiecki J, Garcia-Closas M, Lissowska J, Bardin-Mikolajczak A, Zatonski W, Gromiec J, Brzeznicki S, Brinton LA, Blair A. Occupation and breast cancer risk in Polish women: a population-based case-control study. Am J Ind Med 50:97-111, 2007.

Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR). Health Effects of Exposure to EMF. January 19, 2009. p. 39.
http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_022.pdf

Sommer AM and Lerchl A. The risk of lymphoma in AKR/J mice does not rise with chronic exposure to 50 Hz magnetic fields (1 microT and 100 microT). Radiat Res 162:194-200, 2004.

Svendsen AL, Weihkopf T, Kaatsch P, Schuz J. Exposure to magnetic fields and survival after diagnosis of childhood leukemia: a German cohort study. Cancer Epidemiol Biomarkers Prev 16:1167-71, 2007.

US Environmental Protection Agency (USEPA). Guidelines for Carcinogen Risk Assessment (2005). U.S. Environmental Protection Agency, Washington, DC, EPA/630/P-03/001F, 2005.

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

Yang Y, Jin X, Yan C, Tian Y, Tang J, Shen X. Case-only of interactions between DNA repair genes (hMLH1, APEX1, MGMT, XRCC1 and XPD) and low-frequency electromagnetic fields in childhood acute leukemia. Leukemia & Lymphoma 49: 2344-2350, 2008.