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August 4, 2022

Commercial Energy Consumers Association of British Columbia
c/o Owen Bird Law Corporation
P.O. Box 49130
Three Bentall Centre
2900 – 595 Burrard Street
Vancouver, BC V7X 1J5

Attention: Mr. Christopher P. Weafer

Dear Mr. Weafer:

Re: FortisBC Energy Inc. (FEI)

Project No. 1599211

Application for a Certificate of Public Convenience and Necessity (CPCN) for Approval of the Advanced Metering Infrastructure (AMI) Project (Application)

Response to the Commercial Energy Consumers Association of British Columbia (CEC) Information Request (IR) No. 3 on Rebuttal Evidence

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On May 5, 2021, FEI filed the Application referenced above. In accordance with the regulatory timetable as amended in British Columbia Utilities Commission Order G-206-22 for the review of the Application, FEI respectfully submits the attached response to CEC IR No. 3 on Rebuttal Evidence.

For convenience and efficiency, FEI has occasionally provided an internet address for referenced reports instead of attaching lengthy documents to its IR responses. FEI intends for the referenced documents to form part of its IR responses and the evidentiary record in this proceeding.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Diane Roy

Attachments

cc (email only): Commission Secretary
Registered Parties

1. Reference: Exhibit B-26, FEI Rebuttal Evidence, Q2

Q2: On page 2 of Appendix A to Exhibit C7-12-1, Mr. Karow states:

> **The Sensus Sonix IQ contains a lithium battery which Sensus warns can explode if heated to 212 degrees Fahrenheit. Gas and exploding batteries are a highly lethal combination. CORE is concerned that in British Columbia interior areas, if the meter is in the sun and exposed to excessive heat, it is not unlikely that temperature extremes could result in lithium batteries exploding.**

In response to BCUC IR No. 1.2 on CORE's Evidence, asking for evidence regarding the potential for the meter temperature to reach 212 degrees Fahrenheit, Mr. Karow provides a link to a news article dated June 29, 2021 regarding record setting temperatures in Lytton, BC of 49.5 degrees Celsius.

How do you respond to these statements?

A2: FEI's proposed advanced meter is powered by a lithium thionyl chloride battery. This battery is encased in a gel-filled container, ensuring oxygen cannot reach the battery thereby eliminating risk of ignition. The meters are designed, tested, and certified to meet Canadian Standards Association requirements.

This battery technology has been used safely by gas utilities across North America for over 30 years, including in many existing FEI gas meters and other field devices.[1]

This type of battery (not, as referenced in Exhibit C7-12-1,Tadiran, which is a name brand) is used extensively in measurement equipment. FEI has more than 10,000 devices that have been in operation for the last 20 years that use a combination of integral (non-changeable) and field changeable batteries. FEI has not had batteries in its own measurement equipment fail in an unsafe manner in that time.

1.1 Please confirm that FEI has received no indication from Sensus that FEI's proposed use of the Sensus products in the interior of BC represents any kind of hazard.

Response:

FEI has discussed the environmental conditions present in different areas in BC with Sensus and Sensus has confirmed that the battery will safely operate in all of them.

1.2 Please confirm that this type of battery 'in use by utilities across North America' have been exposed to peak temperatures in these jurisdictions similar to and/or higher than the Lytton BC 49.5 degrees Celsius temperatures without undue risk

of "explosion", which is therefore a sensationalist claim without substantive evidence to support it.

Response:

FEI confirms it is aware of utilities using devices containing lithium thionyl chloride batteries in jurisdictions (e.g., Arizona) that reach and exceed the temperatures experienced in Lytton, BC during the June 2021 heat dome event. Further, FEI is unaware of any explosions occurring resulting from exposure to these extreme temperatures (that are still far below the typical lithium thionyl chloride battery's rated maximum operating temperature of +85 degrees C).

2. Reference: Exhibit B-26, FEI Rebuttal Evidence, Q3

Q3: On page 2 of Appendix A to Exhibit C7-12-1, Mr. Karow states:

> **CORE members are concerned with the AMI Project's use of Tadiran batteries. CORE is of the view that the use of Tadiran batteries poses safety issues. Further, FEI has provided no evidence that the battery has been certified as "intrinsically safe" so that it can be worked on in the presence of a possible methane atmosphere. CORE members are concerned that FEI has not produced evidence of a peer reviewed safety report. Additionally, CORE is concerned that fires may be sparked if the gas measured by the AMI Meters is not turned off during a battery replacement. [Underlining added.]**

CEC IR1 5.3 on CORE's Evidence asks CORE to elaborate on the circumstances that an AMI meter would not be turned off during battery replacement and how often a battery replacement could be expected to occur. In response, CORE notes that these technical matters are outside its scope of knowledge and then goes on to state that an analog meter has a 30-40 year lifespan.

How do you respond to these statements?

A3: The Sonix IQ advanced meters are extensively tested by the manufacturer and by FEI and must be certified under CSA 12.22 no. 213 and ANSI/ISA 12.12.01 for intrinsic safety. In order to validate the safety of the Sonix IQ meter design, Sensus has had the device certified as intrinsically safe for Class I, II, III, Division 2, Group D, F, G, T4 in accordance with ANSI/IAS 16 12.12.01/CSA C22.2 No 213 *Nonincendive Electrical Equipment for Use in Class I and II, Division 17 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*. This means the meters are designed and tested to ensure they will not ignite a fire, even in hazardous areas where flammable gases are present.[2]

With respect to CORE's claim that advanced meter batteries "will be worked on in the presence of a possible methane atmosphere", FEI can confirm this will never happen. The advanced meter batteries are hermetically sealed so they cannot be replaced in the field. In the unlikely event an advanced meter battery were to fail while in service, FEI will always replace the advanced meter because these meters are not field serviceable.

Knowing the advanced meter battery cannot be replaced in the field also addresses CORE's unwarranted concern that "fires may be sparked if the gas measured by the AMI Meters is not turned off during a battery replacement".

Finally, with respect to CORE's suggestion that the diaphragm meter has a 30-40 year lifespan, FEI confirms that its diaphragm meters have an average service life of 18 years,

in accordance with its 2017 Depreciation Study filed as part of FEI's 2020-2024 Multi-Year Ratemaking Plan (2020-24 MRP).[3]

2.1 Please discuss FEI's procedures to identify and respond to hazardous situations where flammable gases are present.

Response:

FEI personnel use portable gas detectors to confirm the presence of methane or other hydrocarbons. If natural gas is present but remains at a safe level, FEI personnel will investigate the source of the leak and if the leak is on FEI's system, FEI personnel will complete the required repairs.

If the natural gas levels are unsafe, FEI will evacuate the immediate area, move to a safe remote location and shut off the gas upstream of the leak. Once the escaping gas has dissipated and the area is safe, FEI will conduct any necessary repairs to fix the leak.

FEI typically does not repair customer gas houselines (piping downstream of the meter) and instead will either inform the customer a repair is required or, if the situation is unsafe, shut off the gas to the appliance or premises and inform the customer to contact a gas contractor to address the unsafe situation.

1 **3. Reference: Exhibit B-26, FEI Rebuttal Evidence, Q4**

FEI always follows the requirements of GSR section 53(2). At present, to meet the requirements of GSR section 53(2)(b), FEI never opens the meter set valve after the valve has been closed during a service visit without also performing a dial check.[5]

The AMI Project does not change FEI's responsibility to meet GSR section 53(2)(b), which again requires FEI not to turn the gas back on to a premises unless the appliances are immediately relit or are turned off. As stated in FEI's IR responses in this proceeding and in its response to RCIA IR1 8.15 in the TLSE Application process, the AMI remote reconnect process has not been finalized, but the possible steps under consideration are:

- FEI gains verbal confirmation from the customer that all appliance feed valves have been positioned in the off position;
- FEI then remotely opens the internal valve within the advanced meter;
- The advanced meter would monitor for any gas flow for the next three minutes;
- If gas flow is detected by the advanced meter during this three-minute dial check, the meter would automatically close its internal valve and send a signal back to the FEI employee, indicating the situation is not safe to perform the appliance relight(s).

  At this step in the process, the potential of a leaking gas safety valve or a gas cooktop that was left 'on' would be quickly identified and the advanced meter's firmware would automatically stop the remote reconnect process by closing its internal valve.

- If the advanced meter does not detect gas flow during these three minutes, then the remote dial check has confirmed it is safe to relight the appliance(s) and the

2 _____

FEI employee will inform the customer they can proceed and relight their appliance(s).

- FEI could offer the customer the option of having a qualified person remotely support (via a video link) the customer during the relight, or, if necessary, an FEI Customer Service Technician could provide onsite support.

As has been outlined in this response, today FEI meets the requirements of GSR section 53(2)(b) by performing a dial check immediately after manually opening the meter set valve. With the implementation of AMI, FEI will continue to meet its responsibilities under section 53(2) of the GSR by having the advanced meter perform a dial check and automatically close its internal valve if an unexpected flow occurs as a result of a defective gas safety valve or a gas cooktop (or similar appliance) being left in the 'on' position.

3.1 Please confirm that an FEI employee could be supervising the remote reconnection, and could have contact with the customer at all times during the course of the remote reconnection.

Response:

As cited in the preamble, FEI has not finalized the remote reconnect process; however, the process would allow for a FEI representative to be in continuous contact with the customer during the remote reconnect process.

4. Reference: Exhibit B-26, FEI Rebuttal Evidence, Q7

> A7: The analysis of a wired AMI solution was provided in FBC's responses to information requests in its 2012 application for a CPCN for its AMI Project. Although FBC's AMI project was for the installation of electric AMI meters, the challenges and costs associated with a wired AMI meter option are similar and relevant to FEI's AMI Project. In response to the Citizens for Safe Technology (CSTS)'s IR1 12.5 in that proceeding, FBC set out a cost analysis for fibre optic alternatives. While the cost analysis is limited to FBC's service territory, the considerations are relevant to FEI. While fibre infrastructure is often already in place throughout urban areas "to the curb" or "to the neighbourhood", it is likely that a small length of fibre cable to the customer's gas meter is still needed. FEI would be required to enter into agreements for leasing this existing fibre network.
>
> In more rural areas, it has been cost prohibitive to extend fibre networks, and this option likely does not exist for FEI's rural customers.[8] FEI would be required to build fibre in order to access those meters.
>
> All of the above also assumes that a feasible wired AMI gas meter option even exists, which is not the case. The example put forward by Mr. Karow is not a feasible option for FEI for a number of reasons. As shown in the meter specifications on the webpage provided by Mr. Karow, the Willfar ZG-D-Y Wired Smart Gas Meter has a working life of only 10 years, and a temperature rating of -10 to 40 degrees Celsius. Most importantly,

4.1 Would a wired alternative be subject to outages in the event of an electrical service disruption?

4.1.1 If yes, please provide the impacts of a disruption to the electrical service to FEI's meters, if any.

Response:

As detailed in the response to BCUC IR3 3.1, a wired gas AMI solution is not a possible option for this Application. However, in a hypothetical situation where a battery-operated gas meter communicated to the utility over a wired network, all communications capabilities would be disrupted in the event of a power outage to the communications network. This includes read interrogations, remote valve operations, and communication of real-time alarms. The battery in the meter would allow it to continue to register consumption, and automatic local actuation of the valve for potential safety incidents would continue to operate. Consumption readings could still be retrieved once power and communications capabilities were restored.

5. Reference: Exhibit B-26, FEI Rebuttal Evidence, Q11

> **Q11: In its response to CEC IR1 2.1, CORE refers to testimony of Dr. James McNamee of Health Canada in a case in the Quebec courts, *White c. Chateauguay*. CORE says that Dr. McNamee "acknowledged ... that there are studies which indicate the existence of non-thermal effects of radio frequencies."**
>
> **Is FEI familiar with the testimony of Dr. McNamee that CORE is referring to and is CORE's description of this testimony consistent with FEI's understanding of it?**
>
> A11: Yes, FEI is familiar with the testimony of Dr. McNamee that CORE refers to in its IR response. A transcript of Dr. McNamee's testimony from a hearing in the Quebec Superior Court on February 18, 2013 was filed with the BCUC as Exhibit B-46[9] in FBC's prior application for approval of electric AMI meters. The BCUC quoted in full the passage from Dr. McNamee's testimony that CORE paraphrases in Decision and Order C-7-13, at p. 111:
>
> > Q. And do I understand that, even though there is out there some studies regarding non-thermal effects for our frequency, the position of Health Canada is that none of these studies, because it's what it's saying in Safety Code 6, is relevant and there's no change?
> >
> > A.: We recognize that there are a large number of studies assessing virtually every health endpoint there is. There are a large number that show an adverse effect here, an adverse effect there. So, I'm not denying that there are studies showing effects, no question. There are also a large number of studies that don't show effects, and generally, a much larger number of studies, in many cases much more thorough and much more well-conducted. (Exhibit B-46, pp. 69-70)
> >
> > [Underlining added.]

5.1 Please confirm that FEI would not install meters if it considered them to be unsafe or not compliant with relevant safety standards.

Response:

Confirmed.

5.2 Please confirm that there is no evidence of which FEI is aware suggesting that a significant change to Safety Code 6 is imminent due to the existence of non-thermal effects from radio-frequencies.

Response:

FEI is not aware of any proposal by Health Canada to change Safety Code 6 for any reason. FEI consulted with Exponent in providing this response

6. Reference: Exhibit B-26, Exponent Rebuttal Evidence, Q2

> Many of the published articles listed by Ms. Friesen are outside the scope of the Exponent RF Health Report, in that they are *in vivo* studies of biological and health outcomes other than cancer. *In vivo* studies of non-cancer outcomes were not covered in the report, which notes that all studies relevant to such outcomes have been reviewed by scientific and health organizations and that the overall conclusions of these organizations remain consistent. Specifically, the scientific evidence does not confirm that exposure to RF fields below scientifically-based exposure guidelines cause or contribute to the development of any adverse health effects, including chronic diseases and other health conditions. In addition, several of the documents listed by Ms. Friesen are review articles, not primary research articles. Review articles were intentionally excluded from the Exponent RF Health Report, as is common in systematic literature reviews, because they do not report on new, original data, and are subject to gaps in the literature and the biases of the author or authors.[1]

6.1 Please explain why 'in vivo studies of non-cancer outcomes' was determined to be outside the scope of the Exponent RF Health Report.

Response:

The following response has been provided by Exponent.

The purpose of the Exponent RF Health report was to assess the impact of epidemiologic and experimental research published after the most recent comprehensive review was completed (SCENIHR, 2015) on the current scientific consensus regarding adverse effects of relatively low levels of RF energy, including cancer, other chronic diseases, and non-specific symptoms. The Exponent RF Health report included summaries of individual studies of cancer and non-specific symptoms because these outcomes have been the focus of much of the recent research on RF fields and have also received much attention by the general public.

In vivo studies of carcinogenesis were included in the section on cancer research because doing so aligns with the International Agency for Research on Cancer's (IARC) process of evaluating both epidemiologic studies of human populations and experimental studies of laboratory animals (*in vivo*) and isolated cells and tissues (*in vitro*) when assessing the potential for carcinogenicity. For the Exponent RF Health report, *in vitro* studies were not included because they are of lesser relevance at the current stage of research on RF and health.[1] Further, since IARC's classification of RF as *possibly carcinogenic* was based on *limited* evidence in both human epidemiologic and

[1] *"Genotoxicity assays in experimental animals are usually applied after in vitro studies to see if a positive effect seen in vitro could be ascertained in vivo. They can also be used to check the correctness of negative results obtained in vitro, especially if it is suspected that in vitro conditions may not have been able to detect the activity, e.g. due to a lack of a crucial metabolic route. In vivo results are considered to have more relevance than in vitro results in the overall assessment of a genotoxic hazard"* SCENIHR (2012).

in vivo animal studies, it is important to review recent research of both study types to assess any potential impact on the conclusions reached by IARC and other agencies.

For non-cancer diseases, the results of the studies identified in the table in the response to CEC IR3 7.1 are consistent with previous research over many years that targeted areas for biological research without providing sufficient evidence for a causal association with RF exposure, as noted in SCENIHR (2015) and other recent reviews, and thus have no immediate health implications. Therefore, it was not necessary for the Exponent RF Health report to review this research in detail. The Exponent RF Health report, under *"Other health conditions studied,"* states that, *"[t]he overall conclusions of these review panels remain consistent, that the scientific evidence does not confirm that exposure to RF fields below scientifically-based exposure guidelines cause or contribute to the development of any adverse health effects, including chronic diseases and other health conditions…* (p. 117)"

7. Reference: Exhibit B-26, Exponent Rebuttal Evidence, Q2

Table 1. Reasons for exclusion from the Exponent RF Health Report

Reason for exclusion in Exponent RF Health Report	Friesen Group 1. Primary Research specifically on 900 MHz exposures (n=21)	Friesen Group 2. Primary/original – RF radiation but not specifically on 900 MHz (n=2)	Friesen Group 3. Comments and articles about the NTP animal studies (n=1)	Friesen Group 4. Reviews and comments – except on NTP studies (n=25)
Not primary, peer-reviewed epidemiologic or experimental research			1	20
Outside the scope of the report (*in vivo* studies of non-cancer outcomes; *in vitro* studies; studies not relevant to human exposures)	19	1		1
Did not study the association between RF fields and a health outcome	1			1
Not isolated RF exposure	1	1		1

[1] Two additional articles identified by Ms. Friesen that were not included in the Exponent report (Rodrigues et al., 20210; Shih et al. 2020) do not provide sufficient evidence to alter the conclusions of the health and scientific organizations that have reviewed the literature on RF and health; that is, that the evidence does not confirm that RF fields below scientifically-based exposure guidelines cause or contribute to the development of cancer, or other chronic diseases, in adults or children.

7.1 Of the 19 studies identified in column 1, row 2, please break down the number of reports that were 'in vivo studies of non-cancer outcomes', and those that are 'studies not relevant to human exposure'.

Response:

The following response has been provided by Exponent.

Of the 19 studies identified in Exhibit B-26, Table 1, column 1, row 2, Exponent Rebuttal Evidence, Q2: 2 were *in vitro* studies, 16 were *in vivo* studies of non-cancer outcomes, and 2 were studies not directly relevant to human exposure (e.g., exposure to ticks, onions). Refer to the table below for the list of studies within in each category.

Article number in Friesen report	Article Citation	Reason for Exclusion from Exponent RF Health Report
1.9	Grasso, R., Pellitteri, R., Caravella, S. A., Musumeci, F., Raciti, G., Scordino, A., … Campisi, A. (2020). Dynamic changes in cytoskeleton proteins of olfactory ensheathing cells induced by radiofrequency electromagnetic fields. The Journal of Experimental Biology, 223(Pt 5), jeb217190.	*in vitro*
1.19	Szymański, Ł., Sobiczewska, E., Cios, A., Szymanski, P., Ciepielak, M., & Stankiewicz, W. (2020). Immunotropic effects in cultured human blood mononuclear cells exposed to a 900 MHz pulsemodulated microwave field. Journal of Radiation Research, 61(1), 27–33.	*in vitro*
1.1	Azimzadeh, M., & Jelodar, G. (2020a). Prenatal and early postnatal exposure to radiofrequency waves (900 MHz) adversely affects passive avoidance learning and memory. Toxicology and Industrial Health, 36(12), 1024–1030.	*in vivo* study of non-cancer outcome
1.2	Azimzadeh, M., & Jelodar, G. (2020b). The protective effect of vitamin supplementation (E and E + C) on passive avoidance learning and memory during exposure to 900 MHz RFW emitted from BTS. Toxicology and Industrial Health, 36(2), 93–98.	*in vivo* study of non-cancer outcome
1.3	Azimzadeh, M., & Jelodar, G. (2020c). Trace elements homeostasis in brain exposed to 900 MHz RFW emitted from a BTS-antenna model and the protective role of vitamin E. Journal of Animal Physiology and Animal Nutrition, 104(5), 1568–1574.	*in vivo* study of non-cancer outcome
1.5	Borzoueisileh, S., Shabestani Monfared, A., Ghorbani, H., Mortazavi, S. M. J., Zabihi, E., Pouramir, M., … Niksirat, F. (2020). Combined Effects of Radiofrequency Electromagnetic Fields and X-Ray in Renal Tissue and Function. Research and Reports in Urology, 12, 527–532.	*in vivo* study of non-cancer outcome; not isolated RF exposure
1.6	Bosquillon de Jenlis, A., Del Vecchio, F., Delanaud, S., Bach, V., & Pelletier, A. (2020). Effects of coexposure to 900 MHz radiofrequency electromagnetic fields and high-level noise on sleep, weight, and food intake parameters in juvenile rats. Environmental Pollution (Barking, Essex: 1987), 256, 113461.	*in vivo* study of non-cancer outcome
1.7	Er, H., Basaranlar, G., Ozen, S., Demir, N., Kantar, D., Yargicoglu, P., & Derin, N. (2020). The effects of acute and chronic exposure to 900 MHz radiofrequency radiation on auditory brainstem response in adult rats. Electromagnetic Biology and Medicine, 39(4), 374–386.	*in vivo* study of non-cancer outcome
1.10	Haghani M, Pouladvand V, Mortazavi S M J, Razavinasab M, Bayat M, & Shabani M. (2020). Exposure to Electromagnetic Field during Gestation Adversely Affects the Electrophysiological Properties of Purkinje Cells in Rat Offspring. Journal of Biomedical Physics & Engineering, 10(4), 433–440.	*in vivo* study of non-cancer outcome
1.11	Keleş, A. İ. (2020). Morphological changes in the vertebrae and central canal of rat pups born after exposure to the electromagnetic field of pregnant rats. Acta Histochemica, 122(8), 151652.	*in vivo* study of non-cancer outcome
1.13	Mai, T. C., Delanaud, S., Bach, V., Braun, A., Pelletier, A., & de Seze, R. (2020). Effect of non-thermal radiofrequency on body temperature in mice. Scientific Reports, 10(1), 5724.	*in vivo* study of non-cancer outcome
1.14	Ren DD, Lu XX, Zhong W, Ma HR, Chen JW, & Sun LJ. (2020). [Guilingji Capsules reduce 900 MHz cellphone electromagnetic radiation-induced testicular oxidative damage and downregulate Prdx2 protein expression in the rat testis]. Zhonghua Nan Ke Xue, 26(10), 926–933.	*in vivo* study of non-cancer outcome
1.18	Shokri, M., Shamsaei, M. E., Malekshah, A. K., & Amiri, F. T. (2020). The protective effect of melatonin on radiofrequency electromagnetic fields of mobile phone-induced testicular damage in an experimental mouse model. Andrologia, 52(11), e13834.	*in vivo* study of non-cancer outcome

Article number in Friesen report	Article Citation	Reason for Exclusion from Exponent RF Health Report
1.20	Tafakori, S., Farrokhi, A., Shalchyan, V., & Daliri, M. R. (2020). Investigating the impact of mobile range electromagnetic radiation on the medial prefrontal cortex of the rat during working memory. Behavioural Brain Research, 391, 112703.	*in vivo* study of non-cancer outcome
1.21	Yahyazadeh, A., & Altunkaynak, B. Z. (2020a). Effect of Luteolin on Biochemical, Immunohistochemical, and Morphometrical Changes in Rat Spinal Cord following Exposure to a 900 MHz Electromagnetic Field. Biomedical and Environmental Sciences: BES, 33(8), 593–602.	*in vivo* study of non-cancer outcome
1.22	Yahyazadeh, A., & Altunkaynak, B. Z. (2020b). Neuroprotective efficacy of luteolin on a 900-MHz electromagnetic field-induced cerebellar alteration in adult male rat. Brain Research, 1744, 146919.	*in vivo* study of non-cancer outcome
1.23	Yahyazadeh, A., Altunkaynak, B. Z., & Kaplan, S. (2020). Biochemical, immunohistochemical and morphometrical investigation of the effect of thymoquinone on the rat testis following exposure to a 900-MHz electromagnetic field. Acta Histochemica, 122(1), 151467.	*in vivo* study of non-cancer outcome
1.24	Yang, M.-L., Hong, S.-Y., Huang, H.-H., Lyu, G.-R., & Wang, L.-X. (2020). [The effects of prenatal radiation of mobile phones on white matter in cerebellum of rat offspring]. Zhongguo Ying Yong Sheng Li Xue Za Zhi = Zhongguo Yingyong Shenglixue Zazhi = Chinese Journal of Applied Physiology, 36(1), 77–81.	*in vivo* study of non-cancer outcome
1.8	Frątczak, M., Vargová, B., Tryjanowski, P., Majláth, I., Jerzak, L., Kurimský, J., … Majláthová, V. (2020). Infected Ixodes ricinus ticks are attracted by electromagnetic radiation of 900 MHz. Ticks and Tick-Borne Diseases, 11(4), 101416.	not directly relevant to human exposure
1.12	Kumar, A., Kaur, S., Chandel, S., Singh, H. P., Batish, D. R., & Kohli, R. K. (2020). Comparative cyto- and genotoxicity of 900 MHz and 1800 MHz electromagnetic field radiations in root meristems of Allium cepa. Ecotoxicology and Environmental Safety, 188, 109786.	not directly relevant to human exposure

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8. Reference: Exhibit B-26, Exponent Rebuttal Evidence, Q4

> Q4: Scientists from Leiden University and the National Institute for Public Health and the Environment in the Netherlands published a systematic review of more than 113 peer-reviewed studies and existing reviews on the potential ecological effects of RF/microwave electromagnetic fields in the range of 10 MHz to 3.6 Gigahertz (GHz). Their main conclusion was that "No clear dose-effect relationship could be discerned" (Cucurachi et al., 2012, p. 116). These reviewers commented further:
>
> > Considering the relevant remark of Beers (1989) 'a long list of reports of positive results yielded by inadequate experiments may appear impressive in a review and yet mean little.' No clear relationships, in fact, could be found between dosage and effects because of a wide variety of exposure strengths, durations, conditions, frequencies, time between exposures, assessment methods, measurement systems, replications efforts, and adequate dosimetry ...
> >
> > The plotting of the size of the ecologically relevant effects in relationship to the dose conditions applied did not seem to define a trend. Thus, the result of the graphical meta-analysis leads to no definitive conclusions about whether the effects are real, not real, or can be found only under certain conditions. The plotting of the size of the ecologically relevant effects in relationship to the dose conditions applied did not seem to define a trend (p. 137).

8.1 Please explain how the 'dosages' being examined for ecological effects might quantitatively relate to the emissions from a smart meter, wifi, computer terminals, microwave ovens, cellular phones, cellular towers, and other common environmental emission contributors.

Response:

The following response has been provided by Exponent.

The cited review article (Cucurachi et al., 2012) states:

> Fig. 1 presents a plot of the effect with the relative measured power density, from studies [of birds] with a significant effect (see Table 2 for details on the studies). It is not possible to define a clear dose–effect relationship, but also at low values of power density strong effects of RF-EMF are found (p. 122).

Fig. 1 in the review article presents the reported power density and the percent difference in some effect observed in an exposed group of birds relative to a control group of birds with lower or no exposure. The differences between groups of birds (interpreted as evidence for some effect) was reported for only 16 of the 25 studies that met the reviewers' criteria for inclusion. The figure legend explains that *"[d]ata is [sic] reported for studies from which information could be extracted."* At low values of power density (< 1 mW/cm^2), 5 of the 16 studies reported larger effects than all

but 1 of the other studies for which exposures were reported to be above 1 mW/cm^2, which is consistent with the reviewers' description quoted above. The exposures in those five studies would be within the range of power densities from a wide variety of radiofrequency sources common in residences or the outside environment. Similar results were presented for studies of insects in Fig. 2 and for studies of vertebrate animals in Fig. 3. However, as the reviewers point out, these selected data *"leads to no definite conclusions*," and to the extent that the overall trend can be described as showing an inverse trend between the magnitude of the effects reported and power density exposure, it is counter to the general toxicological maxim that higher exposures are more likely to have effects than lower exposures. Overall, these data provide no support for CORE's position. The analyses of dose response data from the studies reviewed by Cucurachi et al. (2012) have no clear relevance to emissions from the sources listed in CEC IR3 8.1, because the data provide no support for the hypothesis that the level of exposure to RF explains the biological differences observed.

9. Reference: Exhibit B-26, Exponent Rebuttal Evidence, Q12 and Q15

A12: No. Dr. Héroux's removal of the sources to which he objects is arbitrary, unfounded, and unsupported by any scientific evidence. The implication from his artificial removal of sources is that the *only* source in British Columbia that provides a "valid" comparison to the FEI system is a cell phone base station 28 km away (e.g., Fig. 9d on page 23).

Notwithstanding any of the above, it is interesting to note that even according to Dr. Héroux's estimate, a single cell phone base station within 28 km would expose residents to over 10 times more RF energy than a Sonix IQ gas meter indoors (Fig. 9d, p. 23). It is also interesting to note that according to Dr. Héroux's assessment, even if a person spent their entire day indoors 1 m away from the Sonix IQ gas meter, it would meet the EUROPAEM "Daytime limits." If persons were concerned about the exposure from the Sonix IQ gas meter, they may be able to spend less than 100% of their time close to the Sonix IQ gas meter, and instead spend the majority of their time 3 m or more away from the gas meter. At a distance of 3 m or more, the exposure of the Sonix IQ gas meter indoors would be below even the "Sensitive limits" of EUROPAEM.

A15: No. First, each Sonix IQ gas meter is configured to transmit every 4 hours on a pseudo-random schedule of ±20% of the transmission period (see the Exponent RF Technology Report, p. 16), meaning that the likelihood of two meters transmitting at the same time is very low (the purpose of the pseudo-random transmission schedule is precisely to prevent potential transmission interference of two meters transmitting at the same time). Second, even if there were a bank of 100 meters, the total daily transmission time from the combined 100 meters would be approximately 34 seconds, which would result in a tiny fraction of the SC 6 limit (see the Exponent RF Technology Report, Table B-2). Third, as described by Equation 1 of the Exponent RF Technology Report (p. 21), the strength of the RF transmission from a gas meter decreases very rapidly with distance so only the gas meters immediately adjacent to a person would be meaningful in an exposure assessment because the contribution of those even a few meters away would be negligible in comparison.

As noted by the FCC, "… Irrespective of duty cycle, based on the practical separation distance and the need for orderly communications among several devices, even multiple units or 'banks' of meters in the same location will be compliant with the public exposure limits" (Knapp, 2010). In essence, the RF from smart meters would comply with RF exposure limits, even if held against the body or clustered together at one location.

9.1 Please confirm that cell phone base stations can be reasonably considered to be transmitting virtually all of the time.

Response:

The following response has been provided by Exponent.

For the purposes of an exposure assessment, this is confirmed

9.2 Did FEI take into account the very small proportion of time spent transmitting when calculating the exposure at a distance of 1 meter and 3 meters? Please explain.

Response:

The following response has been provided by Exponent.

Yes. The Exponent RF Technology report describes the typical duty cycle of all FEI end points (including the Sonix IQ gas meter) in Table 3 (pg. 20) and provides additional potential exposure scenarios in Appendix B to the Exponent RF Technology report in Tables B-1 and B-2 (pg. B-1 to B-3). The proportion of the time each day in which FEI end points transmit is 0.00039 percent (about 0.34 seconds per day).

10. Reference: Exhibit B-26, Exponent Rebuttal Evidence, Q13

> **Q13: In section 4 of his report (Appendix B to Exhibit C7-12-1), on page 38, Dr. Héroux comments on the "densification of the RF Environment" (i.e., the proposed increase in the number and distribution of RF sources associated with the AMI Project). Does he present a scientific basis for these comments?**
>
> A13: No. Dr. Héroux's complaint conflates the number of sources with the extent of exposure to RF fields. The very small areas around the Sonic IQ gas meters where RF signals are greatest in aggregate are very much smaller than the area exposed to RF fields by even a single radio station in British Columbia (e.g., as discussed in the Exponent RF Technology Report, pp. 28-29). The average RF power density indoors from the CBUT-DT broadcast station at a distance of approximately 340 kilometers is the same as the indoor exposure from the Sonix IQ gas meter. So, the number of sources is not a good proxy for RF exposure .

10.1 Please provide approximate quantification for the size for the 'very much smaller' areas where RF signals are greatest in aggregate from the Sonic IQ gas meters.

Response:

The following response has been provided by Exponent.

As described in the Exponent RF Technology report (pp. 28-29), the average RF power density indoors from the CBUT-DT broadcast station at a distance of 340 km is approximately 1.1×10^{-7} W/m^2 (0.0000042% of the SC6 limit at 900 MHz). This is the distance at which average power density of the CBUT-DT broadcast station (indoors) is the same as the average power density from a Sonix IQ gas meter at a distance of 1 m indoors. Indoor exposure is therefore considered below.

Since both the Sonix IQ gas meter and the CBUT-DT broadcast station transmit preferentially approximately over only half of a hemisphere (preferentially south rather than north for the CBUT-DT broadcast station and preferentially away from a home rather than toward the home for a Sonix IQ gas meter), it is appropriate to calculate the area of a half circle of radius 340,000 m (for the CBUT-DT) and a half circle of radius 1 m (for the Sonix IQ gas meter) to compare the relative areas over which the average exposure exceeds 1.1×10^{-7} W/m^2 (0.0000042% of the SC6 limit at 900 MHz).

The area of a half-circle of radius 340,000 m is approximately 1.2×10^{11} m^2. The area of a half-circle of radius 1 m is approximately 1.6 m^2. It would take more than 115 billion Sonix IQ gas meters in aggregate to cover an equivalent area of the CBUT-DT broadcast station over which the average exposure from the two sources exceeds 1.1×10^{-7} W/m^2 (0.0000042% of the SC6 limit at 900 MHz).

10.2 Please provide approximate quantification for the size of the area exposed to RF fields by a single radio station.

Response:

Please refer to the response to CEC IR3 10.1.

11. Reference: Exhibit B-26, Exponent Rebuttal Evidence, Q18

> A18: No, Dr. Miller's statement is in fact highly inconsistent with the current scientific consensus on RF and human health. In the time since the International Agency for Research on Cancer (IARC) classified radiofrequency fields as a Group 2B carcinogen in 2011, a number of prominent regulatory, scientific, and health organizations have reviewed the research on RF exposure and health (AGNIR, 2012; HCN, 2013, 2014, 2016; IARC, 2013; WHO, 2014, RSC, 2014; SCENIHR, 2015; SSM, 2016, 2018, 2019, 2020, 2021; ICNIRP, 2020; FDA, 2020). These organizations have all independently reached the same conclusion regarding RF exposure and health—that the evidence does not confirm that RF fields below scientifically-based exposure guidelines (e.g., the ICNIRP guidelines) cause or contribute to the development of cancer, or other chronic diseases, in adults or children.

11.1 Is there any indication that the IARC will soon reclassify radiofrequency fields such that they are no longer considered to be potential 2B carcinogens but something potentially more dangerous?

Response:

To FEI and Exponent's knowledge, IARC has not announced the convening of a Task Group to review and update its monograph "Non-ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields Volume 102" (2013).

12. Reference: Exhibit B-26, Exponent Rebuttal Evidence, Q26

Q26: Dr. Havas also provides conclusions that the Earth does not emit continuous RFR (p. 71) and that human beings do not emit RFR (p. 74). Additionally, in her video evidence, filed as Exhibit C7-12, Dr. Havas shows herself conducting certain tests with an RF meter, and she suggests that her results demonstrate that Earth and humans do not emit RF radiation.

What is your response to this evidence?

A26: When making measurements, it is important to carefully evaluate the capabilities of the instrumentation selected. In this case Dr. Havas is using the wrong tool for the job. The manual for the measurement device used by Dr. Havas specifies that the device is not capable of measuring the vast majority of RF/microwave energy (3 kHz–300 GHz) from either a human or from the Earth.[10] Other instrumentation, such as that cited by Meng et al. (2017), is required to measure the extremely low levels of RF/microwave energy from humans or the Earth.

12.1 Please identify the devices cited by Meng et al. that would be the correct instrumentation/measurement device for Dr. Havas to conduct her experiment.

Response:

The following response has been provided by Exponent.

A microwave radiometer can be used to detect low levels RF/microwave energy from humans and the Earth. For example, the radiometer employed in the study by Meng et al. was *"radiometer PMMW-10-0001 manufactured by Farran Technology Ltd"*. Meng et al. (2017) states, *"[t]he radiometer consists of a millimeter wave low noise amplifier (LNA) cascade unit, a detector unit, and a video amplifier unit."* Furthermore, other microwave energy focusing elements and waveguiding components were needed to direct the energy toward the microwave radiometer, as noted by Meng et al. (2017): *"[m]illimeter waves from the target is [sic] reflected by the circular smooth metal reflector to the focusing antenna and focused in the feed. A Cassegrain antenna with 300 mm aperture size is selected as the focusing antenna. The focused signal is transmitted to the W band millimeter wave radiometer at the back of the focusing antenna through wave guide [sic]."*

12.1.1 Are such devices generally known and readily available?

Response:

The following response has been provided by Exponent.

This type of device for the detection of passive millimeter wave (PMMW) is generally known by properly trained microwave engineers. The microwave radiometer, key to the detection of the low blackbody radiation in the RF/microwave range, which has now found important security and surveillance applications, was invented and reported by physicist R. H. Dicke at Massachusetts Institute of Technology in 1946.[2] It is now described and taught in typical microwave engineering textbooks, including *Microwave Engineering* by Pozar.[3] They are readily available in the industry for engineers to develop their microwave detection/ imaging system. The particular radiometer used in this experiment is detailed on the Farran Website.[4] Expertise in microwave engineering is required to properly operate such detectors in conjunction with the appropriate focusing and waveguiding elements due to the low signal level of the RF/microwave energy from the blackbody.

12.2 To FEI's or Exponent's knowledge, is Dr. Havas an expert or accredited in the measurement of RFR?

Response:

FEI notes that Dr. Havas' Curriculum Vitae, filed as Appendix E.1.3 of Exhibit C7-11, does not indicate that Dr. Havas has relevant practical experience or accreditation for the measurement of RFR.

The following response has been provided by Exponent.

To Exponent's knowledge, Dr. Havas is not an expert or accredited in the measurement of RFR.

[2] Dicke RH. The measurement of thermal radiation at microwave frequencies. Review of Scientific Instruments 17, 268 , 1946.
[3] Pozar DM. Microwave Engineering. 4th edition. Hoboken, NJ: Wiley, 2011.
[4] https://farran.com/wp-content/uploads/2020/12/PMMW-10-0001.pdf.