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July 2nd, 2012

Mr. Andy Kaps
Project Manager
Sauna Works / Clearlight Infrared Saunas
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Subject: AC ELF EMF EMC Magnetic Field Testing for a Sauna Heater

Dear Mr. Kaps,

VitaTech Electromagnetics was commissioned by Sauna Works to perform comprehensive AC ELF EMF EMC (electromagnetic compatibility) testing for a 600-watt sauna heater at our office in Virginia. VitaTech operated the heater under normal electrical load and its regular "ON/OFF" settings to identify the peak magnetic field emission level emitted from the heater per full-compliance testing. In addition to the normal magnetic field testing at the common power frequency of 60 Hz, VitaTech measured the AC ELF magnetic field emanating from the 600-watt sauna heater from 12 Hz to 50 kHz as spot readings to ensure low-level magnetic flux density levels at the harmonic frequencies as well. The site survey was performed from 2:30pm to 4:00pm on Thursday, June 28th, 2012 and from 12:30pm to 2:00pm on Friday, June 29th, 2012.

AC ELF Electromagnetic Interference (EMI)

Electromagnetic induction occurs when time-varying AC magnetic fields couple with any conductive object including wires, electronic equipment and people, thereby inducing circulating currents and voltages. In unshielded (susceptible) electronic equipment (computer monitors, video projectors, computers, televisions, LANs, diagnostic instruments, magnetic media, etc.) and signal cables (audio, video, telephone, data), electromagnetic induction generates electromagnetic interference (EMI), which is manifested as visible screen jitter in displays, hum in analog telephone/audio equipment, lost sync in video equipment and data errors in magnetic media or digital signal cables.

Magnetic flux density susceptibility can be specified in one on three terms: Brms, Bpeak-to-peak (p-p) and Bpeak (p) according to Equation 1 below:

$$\text{Equation 1:} \quad Brms = \frac{Bp-p}{2\sqrt{2}} = \frac{Bp}{\sqrt{2}}$$

The objective of the AC ELF EMF testing services performed for the 600-watt heater was to identify the peak magnetic flux density levels emanating from the sauna heater under its normal "ON" setting and compare the recorded data with both current federal/state/industry standards and VitaTech Electromagnetics' recommendation for long-term human health exposure.

It should be noted that all recorded magnetic flux density level within this report is presented in units of milligauss, RMS (BRMS, Bx, By, Bz).

AC ELF Magnetic Flux Density Site Assessments & Conclusions

VitaTech recorded timed, mapped, and spot-reading AC ELF magnetic flux density levels as a set of data plots to ascertain the magnetic field emission profile of the 600-watt Sauna Heater with the 600-watt Sauna Works sauna heater plugged into a typical 120-volt electrical outlet. It should be noted that due to the nature of the testing, a push-button was used to record spot-reading measurements with the FieldStar1000 gaussmeter collecting data at 60 Hz and a single-axis MEDA 8532 gaussmeter used to collect data from 12 Hz to 50 kHz. Lastly, it should also be noted that all AC magnetic flux density levels were recorded in units of milligauss RMS (root-means-square), and it is important to distinguish between the resultant magnetic field measurements recorded by the FieldStar 1000 three-axis gaussmeter and the directional-component magnetic field measurements recorded by the MEDA 8532 single-axis gaussmeter. A detailed assessment of the recorded magnetic flux density data is presented as a series of graphics, Figure #1 through Figure #3, and within the body of this report below.

Figure #1 600W Heater AC ELF Data, presents the magnetic flux density levels recorded directly atop the Sauna Works 600-watt sauna heater panel as a timed plot during typical operational modes. This plot was recorded to identify/measure the peak magnetic field levels from the center of the heater panel (and location where the electrical connection was fastened to the sauna heater itself) and to identify the magnetic field emission profile of the heater under typical operation. As shown by Figure #1, the peak magnetic flux density level recorded atop the energized sauna heater panel was 1.96 mG, which was recorded at the location as identified on Diagram #2.

As shown by Diagram #1, the magnetic field recorded atop the sauna heater (with the electrical source placed on the floor) was 0.0 mG with the heater OFF, between 0.12 mG to 0.20 mG in the exact center of the panel after turning the heater ON, between 0.2 mG and 1.5 mG around the center area of the panel after 3 minutes of duration, with the peak magnetic flux density level recorded from the panel at 1.96 mG. The table below summarizes the ramp-up AC ELF EMF magnetic field test:

Event	Recorded Magnetic Flux Density Levels	Time during Plot of Event
Heater OFF	0.0 mG	0s – 30s
Heater Ramp-Up	0.12 mG – 0.20 mG	30s – 3:30m
Heater ON	0.2 mG – 1.5 mG	3:30m-4:30m
Peak	1.96 mG	4:30m-5m

Table #1 – Magnetic Flux Density Levels recorded during Timed Plot

Figure #2, 600W Heater AC ELF Data, presents the magnetic flux density levels recorded above the 600-watt Sauna Works heater as a series of contour plots at different elevations to establish the emission profile of the source and the relative magnetic field decay rate. Similar to the timed plot, these plots were recorded to identify/measure the peak magnetic field levels from the entire heater panel under typical operation.

Diagram #1 presents the magnetic flux density levels recorded directly above the Sauna Works heater panel with the unit plugged into a standard electrical outlet. At a separation distance of ~0 feet, an average magnetic flux density level of 0.58 mG was recorded.

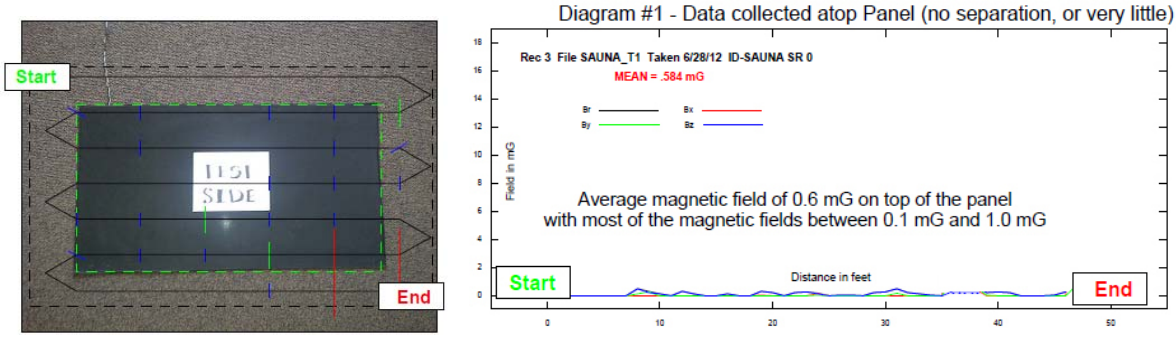


Diagram #2 presents the magnetic flux density levels recorded above the Sauna Works heater panel at an elevation of 1-foot with the unit plugged into a standard electrical outlet. At a separation distance of 1 foot, a peak magnetic flux density level of 0.04 mG was recorded from the heater panel, with an average magnetic field of <0.01 mG.

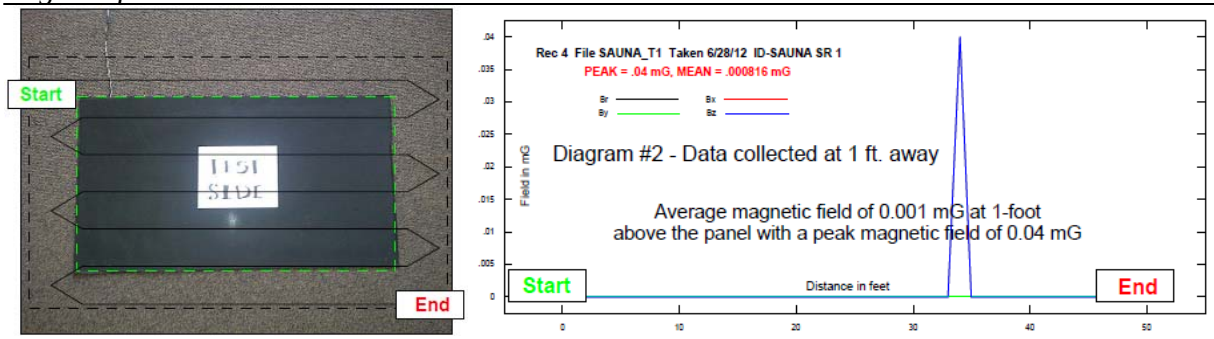
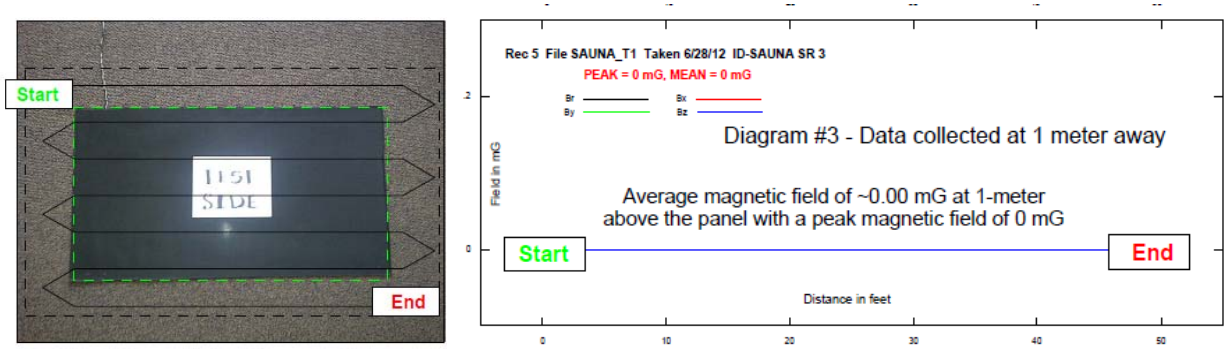


Diagram #3 presents the magnetic flux density levels recorded above the Sauna Works heater panel at an elevation of 1-meter with the unit plugged into a standard electrical outlet. At a separation distance of 1 meter, a peak magnetic flux density level of 0.0 mG was recorded from the heater panel, with an average magnetic field of 0.0 mG.



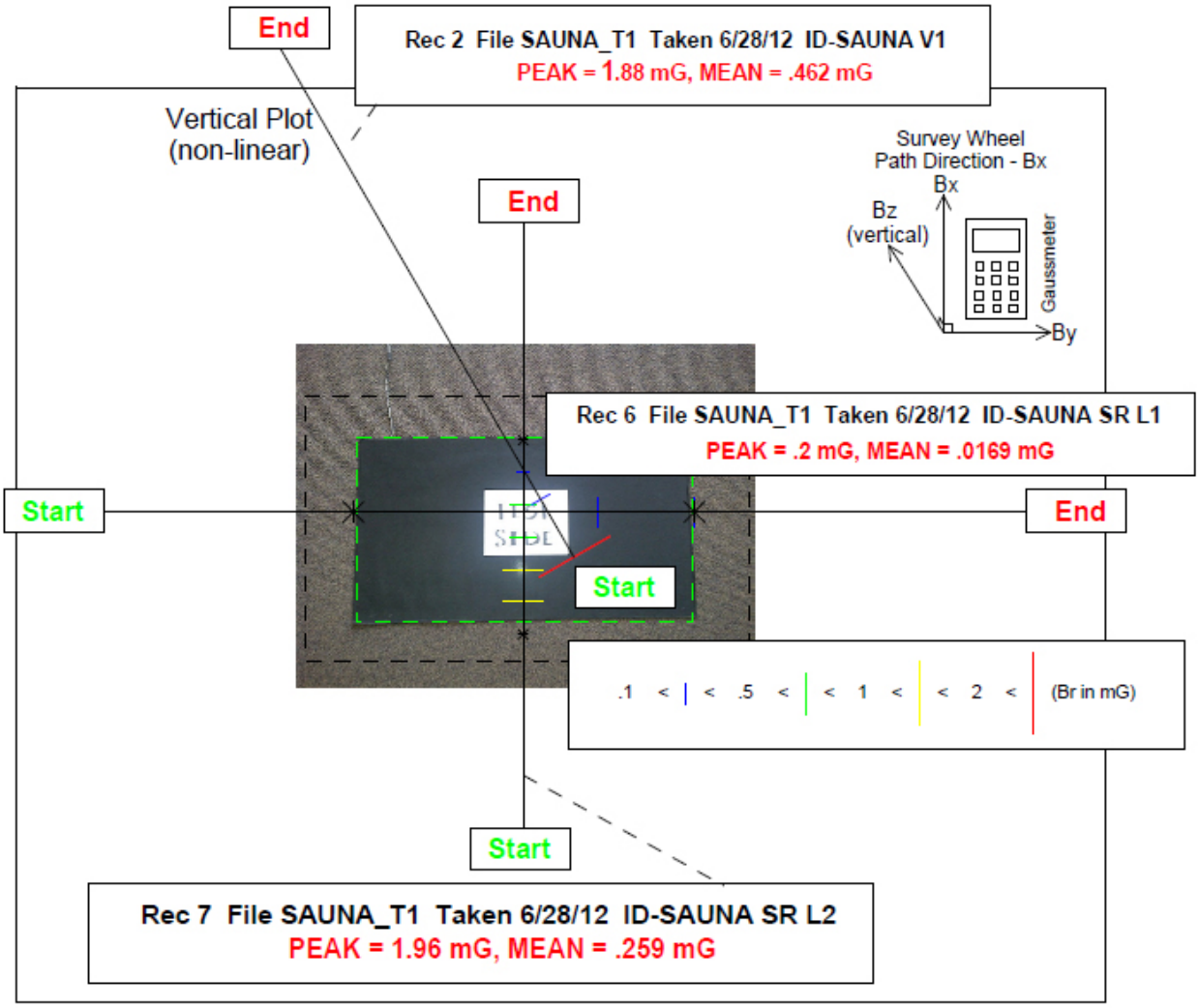
As shown by Figure #2, the magnetic field decay rate from the Sauna Works 600-watt sauna heater is excellent, with magnetic field levels recorded at 1-foot separation distance at 0.04 mG and less (smallest resolution of instrument used for measurements).

Figure #3, 600W Heater AC ELF Data, presents the magnetic flux density levels recorded above/around the 600-watt Sauna Works heater as a series of lateral and vertical plots across the heater panel and from the center to establish the emission profile of the source and the relative magnetic field decay rate. Similar to the contour plots, these plots were recorded to identify/measure the peak magnetic field levels from the entire heater panel under typical operation.

As shown by Figure #3, there were three lateral/vertical plots recorded to establish the lateral decay rate, including two (2) lateral plots recorded at floor level (directly atop the panel) and a third lateral plot conducted as a vertical originating from the center of the panel (floor level) and continuing to 10 feet in elevation.

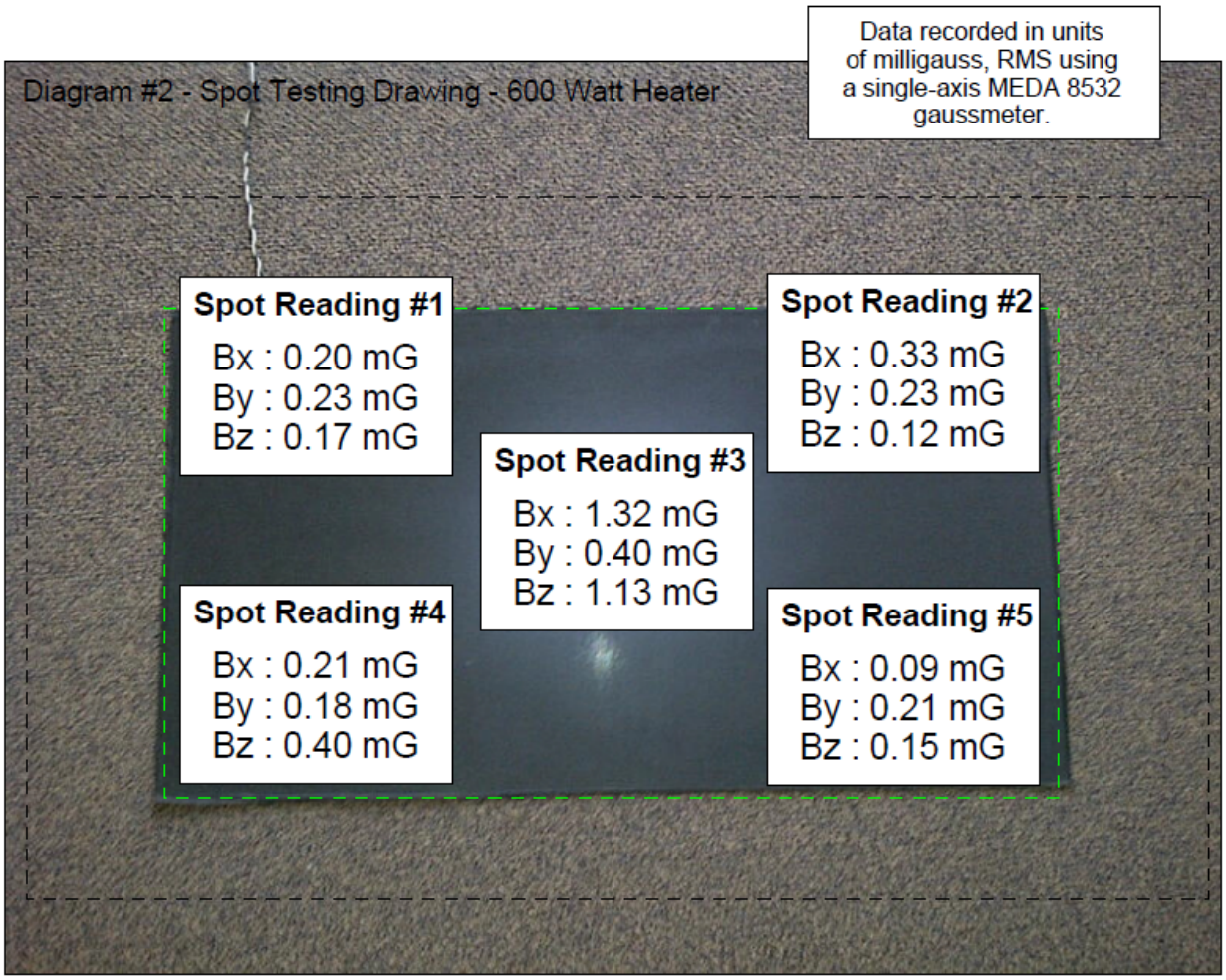
The pair of lateral plots recorded peak magnetic field levels of 0.2 mG and 1.96 mG with averages of 0.02 mG and 0.26 mG, respectively. However, the vertical plot recorded a peak magnetic flux density level of 1.88 mG at floor level with an

average magnetic field of 0.46 mG. Please see the diagram below for the lateral/vertical plot paths, as recorded during the Heater EMF EMC assessment:



Spot-Reading, 600W Heater Wideband AC ELF Data, presents the magnetic flux density levels recorded directly above the 600-watt Sauna Works heater as a series of spot reading measurements using the single-axis MEDA 8532 gaussmeter, which records magnetic flux density levels from a frequency range between 12 Hz and 50 kHz. It should be noted that the single-axis measurements were recorded to ensure low-level magnetic field levels on the harmonic frequency ranges emitting from the 600-watt Sauna Works heater panel.

It should be noted that the measurements were recorded as the directional component magnetic field levels in units of milligauss, RMS, and were taken directly above the heater panel (<3in. away). The calculated RMS magnetic field levels at each location are presented in the table below the diagram atop the next page:



Spot Reading Location	Bx Component in mG, RMS	By Component in mG, RMS	Bz Component in mG, RMS	Calculated Br Resultant, mG RMS
Location #1	0.20 mG	0.23 mG	0.17 mG	0.35 mG
Location #2	0.33 mG	0.23 mG	0.12 mG	0.42 mG
Location #3	1.32 mG	0.40 mG	1.13 mG	1.78 mG
Location #4	0.21 mG	0.18 mG	0.40 mG	0.49 mG
Location #5	0.09 mG	0.21 mG	0.15 mG	0.27 mG
Peak Field in mG	1.32 mG	0.40 mG	1.13 mG	1.78 mG

Table #2 – 12 Hz – 50 kHz Magnetic Flux Density Levels recorded as Spot Readings

Conclusions

The peak magnetic flux density level recorded from the center of the 600-watt sauna heater panel itself during the AC ELF EMF testing was 1.96 mG (during the timed

test), which complies with the long-term human health exposure threshold/recommendation of 10 mG.

As the magnetic field decay rate away from the 600-watt Sauna Works heater is also excellent, VitaTech can strongly recommend the heater panel as an acceptable sauna device with regard to our typical human health exposure recommendations.

AC ELF Test Instruments

MEDA 8532 Single-Axis Gaussmeter

VitaTech recorded the AC LF-ELF magnetic flux density data using a single-axis gaussmeter oriented in each axis. The MEDA 8532 gaussmeter has a resolution of 0.01 mG and a frequency response of 12 Hz to 50 kHz. After collection of the 12 Hz to 50 kHz magnetic field data, the measurements were then converted to true RMS magnetic flux density (milligauss) readings of each axis (Bx, By, Bz) and then to the resultant *Rrms* (root-means-square) vector according to the following formula:

$$R_{rms} = \sqrt{Bx^2 + By^2 + Bz^2}$$

FieldStar 1000 Gaussmeter - AC ELF Magnetic Flux Density

VitaTech recorded the AC ELF magnetic flux density data using a FieldStar 1000 gaussmeter with a NIST traceable calibration certificate manufactured by Dexsil Corporation. The FieldStar 1000 has a resolution of 0.04 mG in the 0 - 10 mG range, 1% full-scale accuracy to 1000 mG and a frequency response of 60 Hz (55 - 65 Hz @ 3dB). Three orthogonal powdered-iron core coils are oriented to reduce interference to less than 0.25% over the full dynamic range. The three coils are arranged inside the unit holding horizontal with the display forward: Bx horizontal coil points forward, By horizontal coil points to the right side, and Bz vertical coil points upward. The microprocessor instantly converts the magnetic field to true RMS magnetic flux density (milligauss) readings of each axis (Bx, By, Bz) and simultaneously calculates the resultant R_{rms} (root-means-square) vector according to the following formula:

$$R_{rms} = \sqrt{Bx^2 + By^2 + Bz^2}$$

When collecting contour path data, a nonmetallic survey wheel is attached to the FieldStar 1000 gaussmeter and the unit is programmed to record mapped magnetic flux density data at selected (1-ft., 5-ft., 10-ft. etc.) intervals. The FieldStar 1000 is exactly 39.37 inches (1 meter) above the ground with the survey wheel attached. Along each path the distance is logged by the survey wheel and the relative direction (turns) entered on the keyboard. Up to 22,000 spot, mapped and timed data points can be stored, each containing three components (Bx, By & Bz), event markers and turn information. After completing the path surveys, magnetic flux density data is uploaded and processed. All plots display a title, time/date stamp, ID path number, and the following statistical data (in milligauss) defined below:

Peak - maximum magnetic field (flux) value measured in group.
Mean - arithmetic average of all magnetic field (flux) values collected.

The following is a quick description of the Hatch, Profile and 3-D Contour plots presented in the figures of this report:

Hatch Plot - data is represented by four difference hatch marks (1 mG, 5 mG, 10 mG and 25 mG thresholds) based on width and color as a function of distance along the survey path that shows 90 and 45 degree turns. Note: the site drawing and all Hatch Plots were scaled in feet to verify actual recorded distances and correct survey locations.

Profile Plot - data shows each recorded component (Bx, By, Bz) axis and the resultant (Br) levels as a function of distance: Bx (red) is the horizontal component parallel to the survey path, By (green) is the horizontal component normal (perpendicular) to the survey path, and Bz (blue) is the vertical component with the computed Br resultant RMS (root-means-square) summation of the three components.

AC ELF EMF Health Issues
VitaTech defines AC ELF magnetic flux density emissions according to six orders of magnitude from *low, elevated, high, very high, extremely high* to *potentially hazardous:*

First order of magnitude 1- to 9.9-mG as *low,*
Second order of magnitude 10- to 99-mG as *elevated,*
Third order of magnitude 100- to 999-mG as *high,*
Fourth order of magnitude 1000- to 9,999 mG (1 - 9.9 Gauss) as *very high*,
Fifth order 10,000- to 99,999-mG (10 - 99.9 Gauss) as *extremely high.*
Sixth order 100,000- to 999,999-mG (100 - 999.9 Gauss) as *potentially hazardous.*

Warning: at AC ELF magnetic flux density levels exceeding 50 Gauss (10 mA/m^2 induced current density threshold used by WHO, ACGHI, CENELEC, DIN/VDE, NRPG & NCRP), the human body experiences physiological and / or neurological responses because of induced currents within body tissues, organs and neurons. The actual biological effect depends on the magnitude, polarization, proximity and exposure time to *extremely high and potentially hazardous* magnetic field sources. Finally, information about *AC ELF EMF Health Issues* and VitaTech's 10 mG (1 µT) recommended long-term human exposure limit are discussed in the next section.

AC ELF Magnetic Field Health Issues, Standards & Guidelines
Currently, there are no Federal standards for AC ELF electric and magnetic field levels. The National Energy Policy Act of 1992 authorized the Secretary of the Department of Energy (DOE) to establish a five-year, $65 million EMF Research and Public Information Dissemination (RAPID) Program to ascertain the affects of ELF EMF on human health, develop magnetic field mitigation technologies, and

provide information to the public. In May 1999, the NIEHS Director Kenneth Olden, Ph.D. delivered his final report, *Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields*, to Congress that stated the following in the Cover Letter and Executive Summary below:

> *The scientific evidence suggesting that ELF-EMF exposures pose any health risk is weak. The strongest evidence for health effects comes from associations observed in human populations with two forms of cancer: childhood leukemia and* ***chronic lymphocytic leukemia in occupationally exposed adults... The NIEHS concludes that ELF-EMI exposure cannot be recognized at this time as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard.***

U.S. & International Organizational AC ELF EMF Standards

The International Commission on Non-Ionizing Radiation Protection (IRPA/INIRC) have established 833 mG maximum human exposure limit over 24 hours for the general public and 4,167 mG for occupational workers. Whereas The American Conference of Governmental Industrial Hygienists (ACGIH) recommends a 10,000 mG (10 Gauss) exposure limit over 24 hours for occupational workers, but specifies 1,000 mG (1 Gauss) as a maximum exposure for workers with cardiac pacemakers.

New York State Public Service Commission AC ELF EMF Standards

Effective September 1990, the State of New York Public Service Commission (PSC) "began a process looking toward the adoption of an interim magnetic field standard for future major electric transmission facilities". The Commission concludes that a prudent approach should be taken that will avoid unnecessary increases in existing levels of magnetic field exposure. Therefore, future transmission circuits shall be designed, constructed and operated such that magnetic fields at the edges of their rights-of-way will not exceed 200 mG when the circuit phase currents are equal to the winter-normal conductor rating. They also established an electric field strength interim standard of 1.6 kV/m electric transmission facilities.

IARC June 2002 Report

In June 2002, the International Agency for Research on Cancer (IARC) issued a 400+ page report formally classifying extremely low frequency magnetic fields as ***possibly carcinogenic to humans*** based on studies of EMF and childhood leukemia. **This is the first time that a recognized public health organization has formally classified EMF as a possible cause of human cancer**. IARC found that, while selection bias in the childhood leukemia studies could not be ruled out, pooled analyses of data from a number of well-conducted studies show a fairly consistent statistical association between childhood leukemia and power-frequency residential magnetic fields above 4 milliGauss (mG), with an approximately two-fold increase in risk that is unlikely to be due to chance.

IARC is a branch of the World Health Organization. The IARC classification of EMF was made by a panel of scientists from the U.S. National Institute of Environmental

Health Sciences, the U.S. Environmental Protection Agency, the U.K. National Radiological Protection Board, the California Department of Health Services, EPRI, and other institutions around the world.

Switzerland's February 2000 AC ELF Standard

The Swiss Bundersrat in February 2000 set by law an emission control limit of 10 mG from overhead and underground transmission lines, substations, transformer vaults and all electrical power sources.

VitaTech's & NCRP Draft Recommended 10 mG Standard

Section 8.4.1.3 option 3 in the National Council of Radiation Protection and Measurements (NCRP) draft report published in the July/August 1995 issue of *Microwave News* (visit the Microwave News Homepage <www.microwavenews.com> for the entire draft report) recommended the following on the next page:

> ***8.4.1.3 Option 3:*** *An exposure guideline of 1 μT (10 mG) and 100 V/m: A considerable body of observations has documented bioeffects of fields at these strengths across the gamut from isolated cells to animals, and in man. Although the majority of these reported effects do not fall directly in the category of hazards, many may be regarded as potentially hazardous. Since epidemiological studies point to increased cancer risks at even lower levels, a case can be made for recommending 1 μT (10 mG) and 100 V/m as levels not to be exceeded in prolonged human exposures. Most homes and occupational environments are within these values, but it would be prudent to assume that higher levels may constitute a health risk. In the short term, a safety guideline set at this level would have significant consequences, particularly in occupational settings and close to high voltage transmission and distribution systems, but it is unlikely to disrupt the present pattern of electricity usage. These levels may be exceeded in homes close to transmission lines, distribution lines and transformer substations, in some occupational environments, and for users of devices that operate close to the body, such as hair dryers and electric blankets. From a different perspective, adoption of such a guideline would serve a dual purpose: first, as a vehicle for public instruction on potential health hazards of existing systems that generate fields above these levels, as a basis for "prudent avoidance"; and second, as a point of departure in planning for acceptable field levels in future developments in housing, schooling, and the workplace, and in transportation systems, both public and private, that will be increasingly dependent on electric propulsion.*

This completes the *600-Watt Sauna Works sauna heater ELF EMF EMC Testing Assessment*

The contents of this report are intended for the exclusive use of Sauna Works and their subsidiaries.

Please call if you have any further questions.
Best regards,

Greg Slonka – EMF Technician/Project Manager/Simulation Programmer
VitaTech Electromagnetics (540) 286-1984

Enclosures: Figures #1 - #3 (total of five graphics)

600W Heater AC ELF Data
EMF/EMC Magnetic Field Testing
Magnetic Flux Density Levels Recorded as Lateral Plots

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