AC Magnetic Field
Survey Report

of

Literature Building - 3000
University of California San Diego

for

University of California San Diego
La Jolla, California

Report Date: February 15, 2010
FMS Ref: 2010-1082
NOTICE

All materials contained in this report are protected by copyright and may not be used by others. All content herein, including but not limited to text, graphics, and other intellectual property, cannot be reproduced except by permission of Field Management Services Corp. and provided that copyright notice appear in all copies and that both the copyright notice and permission notice appear in supporting documentation. Documentation contained in this report may not be reproduced, distributed, published, entered into a database, displayed, modified, used to create derivative works, transmitted, or exploited for distribution to others without the expressed written consent of Field Management Services Corp.

Field Management Services Corp. has expressly prepared this report for the party noted as “Client”. Field Management Services Corp. shall be indemnified and held harmless from any losses, damages and costs with respect to the unauthorized use of any information contained in this report. Field Management Services Corp. is only responsible for the content of this report and reference to any other service or information source does not imply an endorsement by Field Management Services Corp.
Table of Contents

BACKGROUND: .................................................................................................................. 2

ELF OR AC MAGNETIC FIELD CHARACTERISTICS: .................................................. 2

UNITS OF MEASURE: ..................................................................................................... 4

SURVEY MEASUREMENT EQUIPMENT: ...................................................................... 4

MEASUREMENT PROCEDURES: .................................................................................... 5

TEMPORAL VARIATIONS: ............................................................................................... 6

MEASUREMENT OBSERVATIONS: ................................................................................... 7

Attachments

  I. Measurement Floor Plans
DATE: February 15, 2010

FMS REF: 2010-1082

CLIENT: University of California San Diego
9500 Gilman Drive
La Jolla, California 92093

ATTN: Grant Silva
Health Physicist

PROPERTY: Literature Building - 3000
University of California San Diego
La Jolla, California

PROJECT: AC Magnetic Field Survey

SCOPE: The scope of this project involved measurement of the magnitude and vector direction of power frequency magnetic fields.

Submitted by:
FIELD MANAGEMENT SERVICES
BACKGROUND:

This report documents results of an AC 60 Hz magnetic field survey authorized by the University of California San Diego (UCSD) and conducted by Field Management Services (FMS) of the “Literature Building – 3000” located on the UCSD Campus in La Jolla, California. This survey which involved spot measurements of AC magnetic fields at random locations on all four floors of the building was authorized pursuant to terms of UCSD Purchase Order 10304480 dated January 7, 2010. On January 13 and February 10, 2010, an FMS technical representative visited the UCSD site and conducted detailed measurements of AC magnetic fields present in the areas of interest.

To inform the reader, the following general information is provided regarding AC magnetic fields.

ELF OR AC MAGNETIC FIELD CHARACTERISTICS:

ELF or AC magnetic fields are naturally emitted by current-carrying electrical conductors and devices. The AC magnetic field strength emitted by electrical circuits is directly proportional to the magnitude of electrical current. However, multiple conductor cables carrying balanced currents have a low net emission, a consequence of the natural cancellation of magnetic fields created by currents traveling in opposite directions (or with different phase angles) in adjacent conductors. Rigid metallic conduit generally provides good magnetic field reduction, provided that the feed and return currents are equal, in single-phase circuits, and if all of the currents (both feed and return) are present, in multi-phase circuits.

If electrical current from a circuit returns via an alternate path, then magnetic field levels emitted from such a circuit can increase significantly. This condition usually occurs if neutral circuits are “cross connected” or illicit connections are made between a neutral and ground in a building’s electrical distribution system. This is often referred to as “stray”, “ground” or “net-current” conditions.
AC magnetic fields decrease naturally in intensity as function of distance \((d)\) from the source. The rate of decrease however, can vary dramatically depending on the source. For example, magnetic fields from motors, transformers, etc. decrease very quickly \((1/d^3)\) while circuits in a typical multi-conductor circuit decay slower \((1/d^2)\). Magnetic fields from “stray” current on water pipes, building steel, etc. tend to decay much slower \((1/d)\). Simply increasing the distance from the source(s) of an area with elevated magnetic field strengths can often reduce magnetic fields to an acceptable level.

Unlike electric fields that are relatively easily shielded by common materials used in commercial construction, magnetic fields are capable of penetrating all but a very few, specially manufactured and installed materials. AC magnetic fields will pass undiminished through earth, concrete and most metals, including lead. The actual AC magnetic field strengths encountered within a given commercial building typically range from under 0.2 mG in open areas to several hundred near electrical equipment.

As previously mentioned AC magnetic fields at relatively low levels are capable of producing interference patterns on computer monitors and have been shown to otherwise interfere with electronic equipment. Available technical literature on the subject indicates that computer monitor interference patterns will occur at background AC magnetic field strengths of approximately 5-10 mG and in certain circumstances in environments as low as 3 mG. State of the art “flat screen” LCD computer monitors and processors utilized in today’s applications are generally immune to interference threats from AC magnetic fields.

The possible effects of AC magnetic fields on human health have been extensively studied. FMS, by virtue of this report, makes no attempt to attribute value to either side of the question regarding risk to human health nor, for the purposes of health or safety, does the company assign value to any particular magnetic field level. The US Department of Energy RAPID Program WEB site \(\text{www.niehs.nih.gov/emfrapid}\) and the World Health Organization \(\text{www.who.int/peh-emf}\) are excellent sources for comprehensive information on the EMF health issue.
UNITS OF MEASURE:

Magnetic flux densities (B) are reported using units of gauss (G). However, it is usually more convenient to report magnetic field levels using milligauss (mG) which is equal to one-thousandth of a gauss (i.e., 1 mG = 0.001 G). Some technical reports also use the unit Tesla (T) or microtesla (µT); (1 µT = 0.000001 T) for magnetic flux densities. The conversion between these two units is 1 mG = 0.1µT and 1 µT = 10 mG.

SURVEY MEASUREMENT EQUIPMENT:

To record AC magnetic field values, the following equipment was utilized:

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Serial No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauss Meter</td>
<td>Dexsil</td>
<td>Fieldstar 1000</td>
<td>31400324</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Magnum 310</td>
<td>9870535</td>
</tr>
</tbody>
</table>

AC magnetic field measurements were taken using a Dexsil Fieldstar 1000 Gauss meter and a Dexsil Magnum 310 Gauss meter. The meters take readings in three orthogonal planes and calculate the resultant field (square root of the sum of the squares) for the measurement point in space. The Field Star 1000 and Magnum 310 are computer-controlled, three-axis, AC magnetic field exposure meters. Each of the three-axis sensors measures the magnetic field and the on-board computer calculates a resultant field value. The resultant is comparable to a maximum field value and is calculated as the square root of the sum of the squares for all three orthogonal axes \( Br = \sqrt{Bx^2 + By^2 + Bz^2} \). All magnetic field measurements in this report are the RMS (root mean square) values.

The Dexsil Magnum 310 and Fieldstar 1000 meters were used to take spot measurements at selected locations on all four floors of the Literature Building.
The Field Star 1000 meter also contains an internal sampling mode wherein measurement values can be stored at intervals of 1 second or any number of minutes between 1–15. For this study, the meter was set to record timed data at the rate of 1 sample per second in a First Floor Conference Room study site. At the conclusion of the measurement session, a file name was created, which describes the conditions of the test location, and the data uploaded to a laptop computer that is equipped with interface software.

**MEASUREMENT PROCEDURES:**


- As shown on attached figures, magnetic field spot measurements were first taken throughout each floor of the Literature Building including hallways and areas adjacent to the Literature Building’s electrical & elevator equipment rooms at a constant height of one meter above floor level. At the request of UCSD representatives, spot magnetic field measurements were also taken on a random basis, in occupied offices on each floor.

- Detailed spot measurements were taken in areas immediately adjacent to the First Floor electrical and elevator equipment rooms and in areas adjacent to the electrical rooms on Floors 2, 3 & 4. Attached enlarged floor plans of these areas provide a more detailed view of magnetic field conditions adjacent to the electrical facilities.

- Note that two sets of AC magnetic field spot measurements were taken in areas immediately adjacent to each floor’s electrical room; one set with the two hydraulic elevators not in use and a second set of measurements with the elevators in operation.
• A supplemental set of detailed AC magnetic field measurements were taken in a First Floor Conference Room No. 155 utilizing an “x” & “y” grid of equal four foot spacing. Spot measurement values were recorded at each grid intersection point at one meter from the floor surface.

• To determine to what extent if any, AC magnetic field conditions in the First Floor Conference Room No. 155 may momentarily increase when the nearby elevators are operating, timed magnetic field measurements were taken at a study location as shown on an attached diagram. Timed measurements utilizing a 1 second sample rate were taken for a twenty minute period without the elevators operating and then for an additional ten minute period with each of the two elevators operating in varying lifting and descending sequences to emulate a “busy” elevator operation conditions.

TEMPORAL VARIATIONS:

AC magnetic field spot readings taken during magnetic field surveys are accurate only for the specific point in time that they were taken. Magnetic field strengths emanating from electrical equipment such as is adjacent to the measured areas of the Literature Building, will vary with the electric (current) load.

It was noted during the January 13 and February 10, 2010 survey visits, that the Literature Building appeared to be at a reasonable level of occupancy and typical of normal day-to-day operations. It is the observation of FMS based on prior experience and observation that it is possible that magnetic field conditions at other times of the year in the Literature Building may be somewhat higher or lower and will vary in relation with the amount activity in the building and ambient external conditions.
MEASUREMENT OBSERVATIONS:

The following observations are offered after a review by FMS of the data from the January 13 and February 10, 2010 AC magnetic field survey visits to the UCSD Literature Building in areas of interest:

- AC magnetic field levels throughout all occupied areas of the Literature Building, generally were well below 1 mG with many areas near “0” mG.

- As can readily be seen from the attached measurement floor plans for each level of the Literature Building, the only areas with modestly elevated AC magnetic field levels present were areas adjacent to the central core of the building on each level, which is the location of elevators and electrical rooms. The measurement data demonstrates that magnetic fields from the central core electrical equipment on each floor generally decay at the anticipated $1/d^2$ rate associated with typical electrical circuits. This suggests that net-current circuit conditions, if present, are negligible.

- The measurement data confirms that relatively short duration increases in electrical loading in the MS-3 main distribution panel caused by cycling of the elevator hydraulic pumps, causes a like short duration but very minimal increase in the AC magnetic field environment in areas immediately adjacent to the Ground Floor electrical room. Similarly on Floors 2, 3 & 4, increases in AC magnetic field levels in areas immediately adjacent to the elevator core and electrical rooms with the elevators operating, were negligible.

- Detailed “grid” measurements taken in Conference Room No. 155 were generally < 0.1 mG with the exception of a small area in the northwest corner which is adjacent to a small telecom equipment room. An examination of the telecom room revealed the presence of a small electrical breaker panel which explains the source of very modestly elevated AC magnetic field levels in the corner of the conference room.
Data from the 30 minute time study of AC magnetic field levels in a selected location of Conference Room No. 155 are presented in the attached plot of field values vs time. While it is interesting to note that field levels during the study period, momentarily (several seconds) increased periodically every 5 minutes or so, likely due to cycling of some device such as a refrigerator, etc, it appears as anticipated, that operation of the nearby elevators had no noticeable effect on field levels when compared to the period of time when the elevators were not in operation.

The detailed grid spot measurements recorded in Conference Room No. 155 failed to confirm the presence of a buried electrical feed circuit which was suspected to transverse an area of the Conference Room. Further investigation by University’s facility maintenance confirmed that the feed circuit did not run beneath the Conference Room, but rather, beneath the main building entrance.

In sum, the measurement data indicates that AC magnetic field levels in very limited areas of the Literature Building ground floor immediately adjacent to the ground floor electrical room and in the immediate region of a buried, under slab feed conduit in the building's entrance hallway, are modestly higher than the background magnetic field; a consequence of close adjacency to electrical circuits. AC magnetic field levels measured outside these areas were generally consistent with ambient AC magnetic field levels typically present in office buildings.
University of California, San Diego
Literature Building - 3000

AC (60 Hz) Magnetic Field Survey
January 13, 2010 - 2:15 PM

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG

Confirmed path of 480-277 V
Buried feed from MS-2
AC (60 Hz) Magnetic Field Survey
January 13, 2010 - 3:55 PM

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG
Values in Blue - Elevators Being Exercised
First Floor

University of California, San Diego
Literature Building - 3000

AC (60 Hz) Magnetic Field Survey
January 10, 2010 - 3:15 PM

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG

Field Management Services Corp.
New York - Los Angeles
FIRST FLOOR
(Conference Room)

University of California, San Diego
Literature Building - 3000

AC (60 Hz) Magnetic Field Survey - Timed Measurements
February 10, 2010 - 3:40 PM

AC (60 Hz) Magnetic Field - One Second Sample Rate
At +1 Meter from Floor, Resultant Value in mG

Elevators Running
Elevators Not Running

Conference Room Time Study Point
(See "First Floor Conference Room Diagram for Study Location")
University of California, San Diego
Literature Building - 3000

AC (60 Hz) Magnetic Field Survey
January 13, 2010 - 4:05 PM

SECOND FLOOR

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG
AC (60 Hz) Magnetic Field Survey
January 13, 2010 - 4:15 PM

SECOND FLOOR
(Electrical & Elevator Room)

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG
Values in Blue - Elevators Being Exercised
AC (60 Hz) Magnetic Field Survey
January 13, 2010 - 2:21PM

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG
AC (60 Hz) Magnetic Field Survey

January 13, 2010 -2:40 PM

THIRD FLOOR
(Electrical & Elevator Room)

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG

Values in Blue - Elevators Being Exercised
AC (60 Hz) Magnetic Field Survey
January 13, 2010 - 3:10 PM

AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG
AC (60 Hz) Magnetic Field Levels
Spot Measurements @ +1 Meter from Floor, Resultant Value in mG

Values in Blue - Elevators Being Exercised