

June 20, 2008

In Confidence

Chancellor Marye Ann Fox

Reference: Literature Building

Dear Chancellor Fox,

Thanks to you, leadership of the Department of Literature, and of the Department of Environment, Health and Safety (EHS) for the opportunity that I have been given to comment on incidence of cancer in people who work in the Literature Building, and to analyze the pattern of incidence.

This letter summarizes my opinion of the situation in the Literature Building, and provides my recommendations for prudent public health action to minimize any possible contribution of the physical exposure characteristics of Literature Building to risk of future cancer cases. This letter should assure you, Department of Literature leadership, EHS leadership, and the majority of workers in the building that, in general, carcinogenic exposures associated with the Literature Building appeared to be no greater, by traditional definitions of such exposures, than those normally encountered while working on a modern research university campus.

However the investigation revealed some aspects of the physical plant of the Literature Building that should be scheduled for remediation, based on the public health principle of prudent avoidance of close-range exposure to high electrical current configurations (1-2).

Prudent avoidance has become the principal rationale in recent years for minimizing human exposure to high electric current configurations. This concept was developed because some epidemiological studies and laboratory investigations have reported the existence of risks related to proximity of certain high-current electrical configurations, even when readings of the electromagnetic magnetic fields, generally measured in units of milliGauss or microTesla, are observed that have previously been considered as low.

Prudent avoidance is a special case of the precautionary principle that is applied when the scientific findings are suggestive of potential for harm, but when there is still uncertainty. It is a special case of the more general concept that is almost always better to risk making an error in the direction of worker safety, than in the direction of no action when there is a possible increase in risk associated with an exposure.

## **METHODS**

Cases were reported through the Department of Literature, based mainly on self reports. Although microscopic and other medical records were not available for confirmation, major cancers are usually reported accurately in a population such that of workers in the Literature Building. A previous study in southern California that compared self-reports of

cancer with medical records found that examination of supporting medical records did not generally result in substantial changes from self-reported diagnoses. In particular, reports of cancer site and type were in agreement with medical records in 93% of individuals with cancer in that investigation (3).

Most of the self-reports of the apparent cluster in the Literature Building included details such as stage, subtype, or other indicators of the probable validity of the report. It is unlikely that the breast cancers that were reported were secondary to primary cancers in other organs. Although metastases to the breast from cancers elsewhere are possible, the breast is not a common site of metastasis of unidentified malignancies from other organs, except in very advanced, highly disseminated cases of cancer that are typically diagnosed later in life than the ages encountered in an employed population. Therefore it is unlikely that self-reported breast cancer cases in this population arose in tissues other than the breast.

A total of nine cases of breast cancer are known by the Department of Literature in women who worked in the Literature Building during 1991-present. Of these, eight were diagnosed during 2000-2006, and are the principal focus this letter. The approximate dates of first diagnosis of women with breast cancers during the period of primary interest in this report (2000-2008) were in 2000 (two cases), 2002, 2005, 2006 (two cases), 2007, and one case who was diagnosed after 2000, but with some uncertainty regarding the exact year. The first two cases in the 2000-2008 range, who were diagnosed during 2000, have died; one individual in 2002, and the other in 2005. Both

had inflammatory breast cancer, which is a particularly fatal form of breast cancer, and had deaths attributable to it.

Reports to the Department of Literature from individuals working in the Literature Building also included one case each of ovarian cancer (who was diagnosed in 1997, and who died in 1999), carcinoma of the adrenal cortex (diagnosed in 2006), adenoid cystic carcinoma of the salivary gland (diagnosed in 2000), and metastatic cervical cancer (diagnosed in 2005, and who died in 2006). There were also three workers in the Literature Building who reported large uterine (two workers) or ovarian (one worker) masses that were nonmalignant according to microscopic examination. The ovarian tumor was diagnosed recently in an individual who had been diagnosed with breast cancer within the past 12 months.

All cases are of considerable interest in surveillance for cancer, and all require consideration as part of comprehensive overall evaluation of an apparent cancer cluster. The most salient feature of this apparent cluster was a possibility of a greater than expected aggregation of breast cancer cases within the Literature Building. For brevity, all later mentions in this letter of this apparent cancer cluster will refer to it simply as the cluster, with an understanding that the adjective “apparent” is implied.

A possible role of some structural or environmental characteristic of the Literature Building in all cancers and the reported benign tumors was considered as part of this investigation. Of the reported malignancies, breast cancer had the largest number of

cases. Since it was the largest category, breast cancer was chosen for closer scrutiny with regard to age and year of diagnosis, and location of work within the building. A specific case definition supporting a focus on breast cancer was adopted for further, more detailed analysis (see below). This was done for breast cancer because there was not sufficient incidence of cancer in any other single anatomic category.

Case definition. The case definition of breast cancer was adopted for purposes of this investigation was: any case of breast cancer known or reported to the Department of Literature with a first diagnosis of the malignancy during 2000-2008. Working location within the literature building and age were the principal variables that were analyzed. Inclusion of other sociodemographic and reproductive variables could have added useful detail, but these were not available on all cases. The sociodemographic variable and reproductive details that were available did not suggest that personal characteristics caused the cluster, although they may well have played a role in it.

Genetics was not a major factor in this analysis, since all but two of the cases were unrelated, to the best of our knowledge. Although there is some familial aggregation of breast cancer, and a few genetic polymorphisms that increase risk, such as BRCA1 and BRCA2, it has been determined that 9 out of 10 cases of breast cancer are sporadic and not of primarily genetic origin. While some polymorphisms may markedly increase risk of breast cancer, these polymorphisms are not common enough in population to account for more than 10-15% of incidence of the disease, according to the preponderance of

current estimates based on studies of concordance of incidence in identical compared to fraternal twins.

The ages of the eight breast cancer cases in the Literature Building cluster were 35, 43, 47, 56, 58, 60, 60, and 62 years. The mean age at diagnosis was 53 years and the median was 56 years. This is younger than the median age of diagnosis (60 years) for breast cancer in the US population (4). The younger mean and median age of onset of the cases in the Literature Building is suggestive of an effect of surveillance of a working population. Women at the high end of the age distribution of breast cancer generally were not included due to their retirement before diagnosis of breast cancer. One woman who was diagnosed with breast cancer in 1991 at age 55 years was excluded from further analyses due to her diagnosis date being substantially earlier than diagnosis dates of the other cases, and because her primary work area was mainly at another on-campus site, in the Scripps Institution of Oceanography.

Apparent cancer clusters may occur by chance alone. It is usually hard to accurately estimate the probability that a cancer cluster might have occurred solely due to chance, since historical data on individuals are usually incomplete or unavailable. Also, once events have occurred, statements about probability of their occurrence may not be logical. However, the probability that a cluster was due to chance can be roughly estimated as a screening tool for apparent cancer clusters. It can help in deciding whether an apparent cluster could be accounted for solely on the basis of chance, or whether there possibly

might be a greater aggregation of cases than would be expected solely on the basis of chance.

One rough approximation for this purpose involves estimation of expected cumulative incidence compared to observed cumulative incidence. Results from the California Cancer Registry indicate that approximately 2.5% of California women aged 50 years will develop invasive breast cancer during the next 10 years of their lives (5). Although the number and ages of all women who worked in the Literature Building during 2000-2008 is not precisely known, data that are available at this time suggest the average (approximately steady-state) population size of female workers in the Literature Building was approximately 130 women, and that the majority were age 35 years or older, with a probable median age of 45 years.

Assuming this median age and approximately this average steady-state population size, the expected cumulative incidence of invasive breast cancer during 2000-present would be roughly 2% of women, or two cases. This compares with the eight cases of invasive breast cancer that were reported during this period. If the women in the steady-state population had a mean age younger than 45 years, the expected number would be lower. For example, if the steady state mean age were 40 years, the expected number would be 1.4% of women, or 1.6 cases; if it were 30 years, it would be 0.4% of women, or 0.5 cases.

A very approximate estimate of the relative risk associated with working in the Literature Building is  $8/2 = 4$ , or an estimated relative risk of four, compared to the expected incidence in the general California female population. The Poisson  $p$ -value for the comparison of observed to expected incidence is 0.003. In other words, there are 3 chances in 1,000, or 1 chance in 333, that the cluster was due to chance alone. If the median age of the working population was 40 years, rather than the assumed 45 years, the ratio of observed to expected cases would be  $8/1.6 = 5$  cases, for an estimated relative risk of 5.0, and probability of the cluster being due solely to chance would be approximately 0.0003 or 1 chance in 3,333. Using this approximate method of estimation, the observed incidence of invasive breast cancer in the Literature Building was about 4-5 times the expected incidence in the California general population. On the other hand, if the median age were 50 years, the estimated relative risk would be 2, which would be associated with a  $p$ -value of 0.018, or an approximately 1 in 50 chance that the cluster was a product of chance alone. Estimated relative risks in the range that was observed suggest that the cluster was worthy of closer epidemiological scrutiny. While such calculations may be regarded as helping to diminish the likelihood that chance alone may have produced an apparent cluster, spatial aggregation could, of course, be due to any factor that could increase risk of breast cancer and was unevenly distributed with respect to geographic location.

As a sensitivity analysis, the estimated relative risk was calculated under various assumptions regarding the ethnicity of the women working in the Literature Building, and that analysis determined that the observed incidence would be statistically significantly



above the expected background level, regardless of reasonable assumptions about the ethnic distribution of the workers (6).

Mold and toxins. A few workers in the building mentioned that there had been several episodes of flooding in the building, with the largest amount of flooding on the first floor. These appear to have involved various types of plumbing failures. Following the flooding, some occupants reported that they perceived an odor that they associated with growth of mold and fungi. Also, clearly visible growth of fungi was observed on ceiling tiles in two locations. Since toxins produced by some molds may be carcinogenic, samples were collected of dust and spores on surfaces in several offices and in the ducts that supply air to occupants of the building.

The samples were analyzed by an independent mycology laboratory. Most of the molds that were present in the sample were the reasonably common molds of inhabited structures, such as Penicillium, which is common under moist conditions, particularly when suitable substrates supporting proliferation are present, such as cellulosic ceiling tiles. However, there also was some geographically-limited detection of a black filamentous fungus, Stachybothrys, which is associated with buildings that have been characterized as causing respiratory or other symptomatology. Stachybothrys is capable of secretion of respiratory irritants and Satratoxin G, which has been implicated in loss of sensory neurons in the olfactory epithelium and a mild neutrophilic encephalitis in mice, but it has not been related to breast cancer or other neoplasms.

The limited areas of fungal growth that were seen had a concentric circular growth pattern suggesting that dripping water from pipes that run above the ceiling tiles was a factor. An EHS staff member (Sarah Woodard) examined ceiling tiles in many of the rooms, and reported that few had evidence of fungal contamination. An inspection to identify any remaining plumbing leaks above the ceiling tiles in all rooms with any plumbing obscured by the acoustic ceiling tile should be performed, in an effort to prevent leakages that could lead to renewed growth of fungi or other microorganisms.

Some areas of the Literature Building are air conditioned. These include classrooms and assembly areas, and some offices. Assembly areas have higher than usual heating loads due to occupancy. Air conditioning of the remainder of the building would tend to reduce the conditions supporting growth of molds and fungi, since it would provide lower relative humidity. Whatever decision may be reached on this, a detailed internal inspection and, if there is buildup of dust and sediment, thorough cleaning of the duct system should be performed. Visual examination in a few locations revealed a moderate degree of accumulation of sedimented dust in portions of the duct system that could be readily seen, suggesting that cleaning of the duct system should be performed.

Domestic Water. As standard precautionary strategy, investigation of the water supply was performed. The domestic water comes mainly from the Torrey Pines Reservoir, but may at times be connected to other reservoirs operated by the City of San Diego.

Chemical analyses from an independent analytical laboratory found no evidence of heavy metal contamination, and microbiological analysis by an independent laboratory found no

evidence of microbiological contamination of the building's water supply. It did not appear likely that domestic water in the Literature Building was a major contributor to the cluster.

Chemicals such as radioactive isotopes, hydrocarbon solvents, alkylating agents and promoters. Chemicals such as radioactive isotopes and other potential carcinogens are in use in virtually all research university campuses, as an essential part of a university's mission to conduct chemical and biomedical research.

As expected, no laboratories were in operation in the Literature Building. Therefore, exposure of the occupants to various chemical carcinogens that may be used in at times in some laboratories did not appear to be an issue in this building. While it is possible that release of such chemicals could occur from buildings in the area, this is regarded as unlikely due to distance and dilution. While sporadic release of minor amounts of chemicals used in experiments or medical examinations is possible on any major university campus, the amounts are generally small, and rapid aerial dilution (such as by wind) is likely to make these relatively minor factors in risk of cancer incidence on campus.

No substantial odor issues were identified. These were considered since unusual odors may occasionally lead to recognition of unsuspected chemical exposures. This is true even though many toxic or hazardous compounds are inherently odorless. The only odor that was noted was a very minimal odor of hydraulic fluid or lubricating oil in the

elevator machinery room, as would be expected near any powerful motor-compressor system that requires lubrication. There is a history of a leak of hydraulic fluid from an elevator compressor tank that extended to one or more offices adjacent to the elevator machinery room on the first floor, reportedly within the past two years. It was reported that this leak was repaired and cleaned up promptly, and it is not considered a factor in the cluster. At times, painting contractors have applied paint on interior walls whose odor that was reported as reminiscent of hydrocarbon solvents was a concern to some occupants, and forced them from the building. Odor-related air contaminant appear unlikely to be an issue with respect to this cluster.

Apart from these minor topics, exposure of the residents of the Literature Building to available markers of chemical carcinogens does not appear, at present, to be greater than would be encountered in a typical office building, and would be less than in mixed-use buildings that include laboratories and offices.

High electric current configurations. Some epidemiological and laboratory studies have linked exposure to residential levels of electromagnetic fields (7-8) from high electrical current configurations, such as distribution lines supplying several residences with electricity, or step-down electric power transformers, to breast or other cancers, although the literature on this association is mixed (9). Occupational EMF exposures larger than those generally identified in the Literature Building have been associated with a small to moderate increase in risk of breast cancer (7-8) in some but not all (9) studies. Although the US does not have a national standard for power-frequency EMF exposure, the

Swedish Confederation of Professional Employees (TCO) has defined a worker exposure standard of no more than 2.0 milliGauss as the de facto standard for EMF (10).

Existing epidemiological studies of the influence of physical proximity to high-current configurations on risk of breast cancer, combined with the TCO standard prohibiting continuing exposure of > 2.0 milliGauss (10), suggested further scrutiny of the electrical characteristics of the building.

The Literature Building was constructed without a basement. This omission is not rare, nor is it unique on campus, but it is a slightly unusual configuration for large, multi-story office buildings. Multi-story office buildings usually have elevators, and, if they are hydraulic, the basements typically house the compressor motors that produce hydraulic pressure for the elevators, and step-down transformers that convert the supplied electrical current to the 115, 208 and/or 230/270 volt current supplied to power switching panels, circuit breaker panels, and contactors. The electrical current supplied to the Literature Building originates at a step-down transformer in an adjacent structure in the same complex. The voltage supplied to the Literature Building is 480 volts, 3 phase, and enters through an underground conduit a few feet south of the main (west) entrance. It passes through a main power switch in room 122, a small (38 square foot) electrical room located off the hallway of the first floor, east wing of the Literature Building.

The hydraulic elevator compressor motors in the Literature Building are each rated at 30 horsepower. This horsepower rating corresponds to 22,000 watts each. They are

specified as being operable on 230/480 volts. These motors are regarded as actually developing the rated approximately 30 horsepower, since this amount of power is needed to rapidly compress the hydraulic fluid that propels the drive cylinder and cars to higher floors with a full load of passengers.

The florescent lighting operates on 270 volts and the tubes are in undiffused fixtures. The lighting, office equipment, heating ventilation, and air conditioning fans (HVAC) fans, and other electrical equipment in the Literature Building are operated using power from three step-down transformers located near the elevators in the building (TR-3A, TR-3B and XFMR T3) with primary voltages of 480 volts. These are located in rooms near the intersection of the three wings. The original construction included transformers TR 3-A and TR 3-B, which are rated at 112.5 Kw each. The third transformer, XFMR T3, is rated at 25 kW, and was added due to (or in anticipation of) overload of the original circuits by a new computer server, reportedly 1.5-2 years ago.

The total rated wattage of these transformers is therefore 250 Kw. When the hydraulic elevators are both operating in the “up” phase, they contribute another 22 Kw each, for a total rated power of 294 kW.

The total rated power of this circuit corresponds to the peak electric current supplied to 123-134 typical single-family residences (assuming 2.2-2.4 kW is consumed per residence). Since electrical equipment usually is not used at full rated power, the flow of

current could be considerably smaller. Further measurements could more precisely determine the typical current usage on a typical work day.

When hydraulic elevator motors are energized to compress hydraulic fluid, the electrical power drawn by the motor increases instantaneously by a factor of about five. About one year ago, an older technology, relay operated, compressor motor starting device was replaced with newer technology, solid-state starting equipment. The current still surges during each startup of each compressor, but reportedly less excessively than it did about a year ago. Momentary current surges greater than the rated 294 kW probably occur regularly whenever the elevator motors are energized. This was observed to occur about every 15-60 seconds during the work day, with the higher frequency corresponding to the daily beginning and end of classes. At times, both hydraulic elevator compressor motors are energized at the same time.

Since conduits were not equipped with ammeters, rated amperages were used as a proxy for potential actual amperages, which may be somewhat lower. However the current surges demanded for starting the hydraulic compressor motors are typically allowed to exceed conductor or fuse/circuit breaker current ratings for very brief periods. Such circuits are often used in elevator power supplies. So-called slow-blow fuses, and possibly some circuit breakers, may allow momentary current peaks that exceed longer-term current norms. Such momentary surges in current are likely to be underestimated or missed entirely by typical environmental electromagnetic field monitoring instruments,

since many of these instruments integrate inputs over time, in order to stabilize the display.

The survey revealed that the entire 294 kW rated electric current supply for the building passes through or near a single small electrical room (room 122) on the first floor. This electrical room, and the adjacent elevator equipment (room 121), are within a few feet of a breast cancer incidence centroid that was obtained by a rough spatial analysis of the locations of the cases. This is the approximate point on the first floor of the building around which the known breast cancer cases were roughly evenly distributed. Centroids are used in cluster investigations to help isolate the most probable geographic location of potential risk factors, but they also depend heavily on the geographic distribution of the population. If there is no risk factor present, the centroid of the cluster will be approximately the same as the population centroid.

The approximate location of the centroid of breast cancer incidence was 30 feet from the Literature Building's population centroid. The centroid of the Literature Building population is in a public-use area approximately 30 feet south of the centroids of the breast cancer cases. Aggregation of cases around a particular source of exposure is often considered a hallmark of a point-source exposure, and it is often used to identify a role of a point source, or some correlate of it, in etiology.

Based solely on visual inspection, the known breast cancer cases appeared to be somewhat more closely clustered around their centroid than would be expected on the



basis of chance or population density alone. This rough visual assessment could be confirmed by application of Monte Carlo methods, but such statistical simulation is generally beyond the scope of disease surveillance investigations.

Electrical equipment room 122 is located about 18 feet from a first-floor office where one of the breast cancer cases worked, 30 feet from another, and 72 feet from another.

The elevator compressor motors in the adjacent room (room 121), were 28, 30, and 64 feet distant from these three cases. There was one other case on the first floor, whose office was 60 feet from the high-current electrical room. (One other case worked on the 2<sup>nd</sup> floor, 36 feet from the electrical conduit riser from room 122, and three cases worked on the 4<sup>th</sup> floor, one 55 feet and two 62 feet from the electrical riser from room 122).

(One case of breast cancer was excluded due to onset before the cluster period. She worked 25% time in a room about 18 feet from the electrical room on the first floor, in the same room as another case of breast cancer who was included in the overall cluster analysis.)

Milligaussmeter. Typical residential milligaussmeter readings are in the range of 0.2 mGauss, although they are often considerably higher in offices and other occupational settings. Readings were taken in the full-current configuration in the Literature Building using a Monitor Industries research milligaussmeter that was calibrated during the period of observation in the laboratory of the co-discoverer of the association between electromagnetic fields and cancer, including breast cancer, Edward Leeper, of Boulder

CO. Mr. Leeper kindly provided useful advice regarding the characteristics of different types of measurement instrumentation and approaches to evaluation of this cluster.

Readings in the hallway outside the first floor electrical room of the Literature Building revealed that the electromagnetic field (EMF) were usually about 1 mGauss when the elevators were not energized. However the EMF rose abruptly to 2.5 mGauss or higher momentarily whenever the elevator motors started. This was a momentary rise to above the lower limit of the TCO (presumably sustained) exposure standard of no more than 2.0 milliGauss (0.2 microTesla).

Leeper and the co-discoverer of the EMF-breast cancer association, Nancy Wertheimer, who also provided input to this analysis, expressed opinions regarding this apparent cluster that exposure even to such seemingly low doses (momentary 2.5 mGauss) could have an impact, albeit perhaps modest, on risk of breast cancer. Both investigators indicated that they believed that application of the TCO 2.0 mGauss standard would be appropriate with regard to minimizing incidence of breast cancer.

New epidemiological studies have tended to support the concept that exposure to rather small intensities of power-frequency EMF are capable of contributing to the risk of breast cancer (2). Some of the extra risk might be in frequencies beyond the range of detection by typical milliGaussmeters. It is perhaps for this reason that, in previous studies, distance from the source of the EMF to the point of human exposure was considerably

more closely related to risk of breast cancer than were milliGaussmeter readings using the available instrumentation.

Previous epidemiological studies have proposed that certain high-current configurations are associated with higher cancer incidence (7). Such configurations in residential neighborhoods typically serve 6-8 residences, and are rated at 40-60 kW. The current passing through the mechanical and elevator equipment rooms of the Literature Building, if used at rated levels, could be equivalent to that in use in 123-134 typical residences. However, electrical equipment is usually operated below its rated power.

Perhaps of most immediate relevance for the Literature Building are recent in-vitro studies that have found that moderate exposures to EMF interferes with the action of tamoxifen against preventing recurrence of breast cancer (10). One of the EMF dosages used in the experiments (2 milliGauss) was similar to that in the high-current configuration on the first floor near Room 122, although it was regarded as the study background (i.e., unshielded) exposure. According to the authors “ ... at 0.2 microTesla [2 milliGauss] the dose-response curve of tamoxifen was shifted to higher concentrations” (10). The meaning of this statement is that a larger amount of tamoxifen was needed to produce the same amount of in vitro inhibition of growth of breast cancer cells as was achieved in shielded (0 milliGauss) condition. Tamoxifen is commonly used to prevent recurrence of estrogen-positive breast cancer, and may have been prescribed to

one of more breast cancer cases who occupied or occupy areas near the first floor high-current configuration.

Prudent avoidance. The issue of the etiological role of EMF in breast cancer is still not resolved with final scientific certainty, despite decades of research. However, the lack of such certainty should not be a reason to avoid taking moderate measures to minimize needless exposure of workers to power frequency EMF. This is the concept of prudent avoidance, which was characterized in a report of the US Office of Technology Assessment (OTA) as:

. . . looking systematically for strategies which can keep people out of 60 Hz fields arising from all sources but only adopt those which look to be "prudent" investments given their cost and our current level of scientific understanding about possible risks (11).

The OTA report suggests that reasonable measures should be taken to minimize human exposure to power-line EMF, pending further research (11).

Summary:

Offices in the Literature Building appeared to be, in general, safe with regard to chemical or microbiological carcinogenic exposures at the time of investigation. Most people who work in the Literature Building can be reassured with respect to these concerns.

Despite the apparent overall safety of most of the Literature Building, there is a possibility of a mild to modest increase in risk of breast cancer associated with very small area of the first floor building in very close proximity to the electrical and elevator equipment rooms (rooms 121-122). A high-current configuration in these rooms may expose people working extremely close to them to a previously non-suspicious level of surges in EMF. Such an EMF exposure is not prohibited by any known US national exposure standard, although it is similar to the lower limit of 2.0 mGauss of the Swedish TCO standard for presumably sustained EMF exposure, such as for video displays and computers (9). This exposure is unlikely to be a principal cause of breast cancer that has been diagnosed in people who have worked in this small area, however some possibility exists that it could have contributed modestly to risk. Importantly, such exposure could interfere with treatment using tamoxifen, based on tissue culture research (10).

Concerns regarding growth of mold and fungus in some rooms of the building should be addressed by Facilities Maintenance personnel by careful cleaning procedures, taking appropriate precautions to avoid aerosolization of the mold and fungus and respiratory exposure. The cleaning work should be performed by appropriately trained personnel. The data reviewed to date suggests that mold and fungus was probably not a factor in this apparent cluster.

This review has several recommendations, respectfully listed below for consideration by you and staff.

Recommendations:

1. It would be desirable to inform people who work in the Literature Building of the existence of a laboratory study showing an association between low-intensity electromagnetic fields and tamoxifen resistance, to assist in their own decision-making. It would be valuable to ascertain if any worker in any high-current configuration area room is taking tamoxifen. If an individual who is assigned to rooms 123, 124, 133, or 134, or who spends time in room 118, a copy room near the elevator equipment room, reports that she is taking tamoxifen, and volunteers to move, I would recommend transfer of the individual to a low-current area where the same work can be performed. Most offices in the Literature Building are located away from the core electrical and elevator equipment rooms 121-122, and are in low-current configuration areas. Their EMF levels are similar to residential or typical nonautomated office levels.
2. Vacate rooms 123, 124, 133, and 134, if the occupants concur that such action would be desirable from their personal perspective. Convert these (and room 118, which is directly north of the elevator equipment room) to uses where visits are made only sporadically, for brief periods, such as storage of equipment or inactive files.
3. Seek help from electrical engineering and facilities engineering technical staff or consultants who could evaluate various technical electrical methods that have been

developed to reduce EMF from high-current configurations, such as that in rooms 121-122. Rerouting of conductors and installation of solid-state electrical controls may be feasible approaches to reduction of EMF. Input from a technical specialist in power line frequency electromagnetic silencing would be advisable, to evaluate methods that could reduce EMF radiation near electrical motors, switches, conduits and transformers. These might include temporary measures, such as temporarily replacing obsolete or worn switch panels and contactors that emit relatively large amounts of EMF in Room 122. This information is based on milligaussmeter readings taken 18 inches from the working surface of these devices in Room 122 and the other electrical rooms in the building. Modern solid-state devices emit substantially less EMF for a particular flow of electric current, and reduce the generation of harmonics that may carry their own risks.

4. Invite participation by campus architectural-engineering staff regarding the feasibility of replacing the existing hydraulic elevators and their high-current demand compressor system on the first floor with modern low-EMF traction elevators, possibly driven by traction motors located elsewhere with less current demand. If used, such low-EMF traction elevator motors might be located on a new structure rising approximately 20 feet above the existing roof level (i.e., at the same height as the existing roof ventilation equipment), if architecturally feasible.

5. Add a provision to campus construction guidelines a prohibition against placing high-current configurations in proximity to offices or other occupied spaces. Prohibit new hydraulic elevator installations in preference to traction elevator installations whenever

possible, unless the compressors are distant from usual work areas. If hydraulic elevators are used, require that plans include a basement of sufficient height and size to allow the hydraulic compressor motors to be installed a considerable distance from workers, or another architectural arrangement that keep compressors distant from usual work areas.

6. Consider adopting a campus standard for proximity to high current configurations in offices and other occupied spaces. (Occasional variations from the guidelines may be required in laboratories or industrial environments, where spacing may be impractical.)

7. Provide a reasonable additional level of financial support to the Department of Environment, Health and Safety specifically to purchase more modern, multi-frequency power frequency EMF measurement equipment than is presently available to them for measuring the characteristics of high-current configurations. Such equipment should be capable of detection of the distribution of the radiated energy from electric power circuits into harmonics, and of detection of the brief or instantaneous overcurrent pulses, which occur when large motors are started. Such equipment would generally provide a graphic display similar to a high-precision oscilloscope operating in the frequency domain. This may require training of personnel in use of the appropriate EMF monitoring tools.

Thanks for inviting me to perform this surveillance review. It had many limitations, some of which are stated in this letter, but some conclusions and recommendations have been possible, drawing on the concept of prudent avoidance.



Successfully preventing breast cancer one of the greatest challenges faced by science, with benefits to humanity that will one day rank with achievements in exploration of space. While exposure to high-current configurations in general appears to play a small role in the etiology of this potentially catastrophic disease, it appears to play a role in some cases. The situation in the Literature Building and appropriate action in response to it, with a strategy of prudent avoidance while the scientific research continues, could be a step in helping, on a small scale, to minimize risk one of the most challenging and devastating diseases being addressed by the scientific community.

#### ACKNOWLEDGEMENTS

Many people assisted in inspections and evaluations of the Literature Building. All of deserve special attention for their understanding of the scientific basis of this investigation , and for their devotion to goals of the investigation.

Particular thanks and credit are due to Mrs. Lucinda Rubio-Barrick, former Management Service Officer of the Department of Literature. Mrs. Rubio-Barrick provided sustained, meticulous help with all demographic and case-finding aspects of the investigation. She provided institutional memory for the Department of Literature on a wide range of topics, from human resources to environmental events. She was readily available at all times

for questions that arose during the investigation, and answered them knowledgeably. Her devoted, untiring efforts in facilitating this investigation were of truly major value.

Considerable help, information, and coordination of data collection was provided by Daphne Thaug, leader of the ongoing EHS investigation. She was assisted in performing industrial hygiene investigations by Sarah Woodard of EHS.

Valuable assistance with three-dimensional analysis and rendering of the Literature Building and the locations of electrical rooms and centroids of breast cancer cluster cases was provided by computing and analysis specialist Mr. Hamid Al-Asin. The author is grateful to Mr. Al-Asin for execution of three-dimensional structural- epidemiological analyses.

Welcome help was provided by members of the Facilities Maintenance department, including Mr. Mike Griffin, of electrical shop management, and Mr. Phil Oliveri, elevator engineering specialist and supervisor. Their knowledge of campus electrical circuitry and elevator engineering was extensive and very helpful

Referral to relevant architectural drawings and help with inspection of the building ventilation system was provided by Mr. Tod Ferguson, Hazardous Materials Business Plan Manager, EHS. Graphics access assistance was provided by Mr. Alex Lanchares of EHS. The author is grateful for their help.

Thanks also to Jim Turman of the San Diego Gas and Electric Company for his knowledge and very helpful assistance in preliminary exploration of power-frequency electromagnetic fields.

Thanks are also due to the UCSD Heating, Ventilation and Air Conditioning (HVAC) department, whose members provided architectural renderings of the HVAC system that assisted this surveillance review. Special appreciation is owed to several workers in the Literature Building who vacated their offices temporarily while measurements were taken, and patiently allowed the work to go forward.

Each of these helpful people and their respective departments, supervisors, and organizations provided valuable technical assistance in this surveillance evaluation, although they are not responsible for its conclusions. Other individuals in Environment, Health and Science, in the Literature Building and members of the Facilities Management staff who helped with this work, but are not individually named here, should also be recognized for their time and interest devoted to this investigation.

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calculation would be of substantial help to this evaluation, since the only purpose of the calculations was to decide whether the apparent cluster was worthy of further consideration, and such a decision was made. A sensitivity analysis that assumed all members of the population were non-Hispanic white did not substantially modify this conclusion.

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10. Although the U.S. has not set standards for electromagnetic field exposures, the Swedish Confederation of Professional (Telecommunications) Employees (TCO) has developed and disseminated limits for maximum human exposure to magnetic fields from computer equipment, such as video display terminals (VDTs). According to TCO, EMF exposure should not exceed 2.0 mGauss (0.2 microTesla) at a normal working distance from electronic equipment, such as a VDT or computer, in the range from 5 Hz to 2 kHz.

The TCO limit has become a de facto standard in electronic equipment manufacturing and testing for EMF safety, although it has not been determined whether momentary exposures, such as surges rising momentarily to 2.5 mGauss, would have the same expected effect as sustained exposures that are usually assumed with electronic equipment such as video display terminals. The TCO limit for exposure to 4 kHz-200 kHz EMF is 0.25 mGauss, but this range is above the electric power frequency range of 60-300 Hz, including harmonics potentially produced by fast switching. URL:

[http://www.tcodevelopment.se/tcodevelopment1200/Datorer/TCO99/99\\_CRT\\_report\\_1\\_ed\\_2\\_2.pdf](http://www.tcodevelopment.se/tcodevelopment1200/Datorer/TCO99/99_CRT_report_1_ed_2_2.pdf) See also <http://www.niehs.nih.gov/health/scied/documents/emf2002.pdf>

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