AGENDA

Lake Park Town Commission
Town of Lake Park, Florida
Special Call Commission Meeting
Monday, March 21, 2016, 6:00 PM,
Lake Park Town Hall
535 Park Avenue

James DuBois	**—**	**Mayor**
Kimberly Glas-Castro	**—**	**Vice-Mayor**
Erin T. Flaherty	**—**	**Commissioner**
Michael O'Rourke	**—**	**Commissioner**
Kathleen Rapoza	**—**	**Commissioner**
Anne Lynch	**—**	**Commissioner-Elect**
John O. D'Agostino	**—**	**Town Manager**
Thomas J. Baird, Esq.	**—**	**Town Attorney**
Vivian Mendez, CMC	**—**	**Town Clerk**

PLEASE TAKE NOTICE AND BE ADVISED, that if any interested person desires to appeal any decision of the Town Commission, with respect to any matter considered at this meeting, such interested person will need a record of the proceedings, and for such purpose, may need to ensure that a verbatim record of the proceedings is made, which record includes the testimony and evidence upon which the appeal is to be based. ***Persons with disabilities requiring accommodations in order to participate in the meeting should contact the Town Clerk's office by calling 881-3311 at least 48 hours in advance to request accommodations.***

A. CALL TO ORDER/ROLL CALL

B. PLEDGE OF ALLEGIANCE

C. RESOLUTION(S) - ACCEPTING ELECTION RESULTS

1. RESOLUTION No. 13-03-16 Accepting the Certified Results of the Municipal Election **Tab 1**

A RESOLUTION OF THE TOWN COMMISSION OF THE TOWN OF LAKE PARK, FLORIDA, CERTIFYING THE RESULTS OF THE MUNICIPAL ELECTION HELD ON MARCH 15, 2016 FOR FOUR (4) COMMISSIONERS.

D. SWEARING IN CEREMONY:

2. Swearing in Ceremony for Commissioners Conducted by the Town Clerk **Tab 2**

E. 3. SELECTING A VICE-MAYOR: Tab 3

F. RESOLUTION:

4. Resolution No. 14-03-16 Designation of Signatories for Town Bank Accounts Tab 4

G. PUBLIC COMMENT:

This time is provided for addressing items that do not appear on the Agenda. Please complete a comment card and provide it to the Town Clerk so speakers may be announced. Please remember comments are limited to a TOTAL of three minutes.

H. QUASI-JUDICIAL HEARING(S):

******************OPEN PUBLIC HEARING ********************

5. Site Plan Application for a Proposed 125-foot Stealth "Yard Arm" Telecommunications Tower at the Lake Park Harbor Marina Tab 5

A. Staff Report
B. Public Comments
C. Commission Deliberation

*********** CLOSE PUBLIC HEARINGS*************

I. TOWN ATTORNEY, TOWN MANAGER, COMMISSIONER COMMENTS:

J. ADJOURNMENT:

Next Scheduled Regular Commission Meeting will be held on Wednesday, April 6, 2016

PUBLIC COMMENTS AND

ASSOCIATED DOCUMENTATION

Nadia DiTommaso

From: Kim Glas-Castro
Sent: Tuesday, September 15, 2015 7:47 PM
To: Nadia DiTommaso
Subject: Fwd: Lake Park Marina Cell Tower

For site plan file

Kim Glas-Castro
Vice Mayor
Town of Lake Park

Sent from my iPad

Begin forwarded message:

> **From:** Curtis Lyman <curtlyman@gmail.com>
> **Date:** September 15, 2015 at 1:08:20 PM EDT
> **To:** kglas-castro@lakeparkflorida.gov
> **Subject: Lake Park Marina Cell Tower**
>
> Dear Vice Mayor,
>
> I recently purchased a residential unit in 301 Lake Shore Drive, Lake Park.
>
> I am excited about becoming a Lake Park resident.
>
> I am, however, most distressed that the Lake Park municipal government is considering allowing the installation of a cellular telephone tower in the Marina which adjoins our property.
>
> I want to weigh in with my objections to the project:
>
> 1) The safety of the tower is unknown. As you are aware, there are a number of studies which indicate that people living in close proximity to these installations may be at higher risk for fatal diseases, including cancers. If there is even a scintilla of a doubt in this regard, I believe that prudent representation of your constituency would dictate allowing the tower in another location.
>
> 2) The Marina area is unique and picturesque. It is every bit a beautiful as the Marina del Rey area on the west coast, or the SanDiego harbor. You will not find cellular towers in either of those locations. Why sully this unique parcel of property with this installation?
>
> 3) The placement of this tower in the Marina will result in lower neighboring property values as well as higher property turnover rates. It would seem to me that the most important goal of the municipal government would be to encourage project which promote higher property values, off which your ad valorem taxes are computed. As well, stability of the population leads to further growth in the Town. This tower project does neither and I suspect that the economic impact from the lease of the land for the tower is far outweighted by the potential damage the tower can

do, physically, to the residents of the Town and/or to the tax base if properties are sold at below market values.

It is my hope that the Town will allow the placement of the tower, but in a location other than that which is one of the most picturesque in the Town.

Respectfully,

Curtis L. Lyman

From: Kim Glas-Castro
Sent: Friday, January 29, 2016 6:48 AM
To: Nadia DiTommaso
Subject: Fwd: Tower?

Resident comment and my response for the file

Kim Glas-Castro
Vice Mayor
Town of Lake Park

Sent from my iPad

Begin forwarded message:

> **From:** Kim Glas-Castro <kglas-castro@lakeparkflorida.gov>
> **Date:** January 25, 2016 at 9:42:54 PM EST
> **To:** Jeff Blakely <jeff@blakelyla.com>
> **Subject: Re: Tower?**
>
> Hello!
> You are correct on all points. We were duped by the former Manager!
> A lease option was put on the agenda in April, 2014 for Commission approval (without notice to neighbors). I was under the impression that it would still require Conditional Use and Site Plan review/approval, during which we could ensure that it is compatible with the surrounding uses and redevelopment plans for the area. I am now told that it is a permitted use and we have little criteria for the review process. I am very annoyed, to say the least.
> I can share my thoughts with you, but prefer not to put them in an email.
> -Kim
>
> Kim Glas-Castro
> Vice Mayor
> Town of Lake Park
>
> Sent from my iPad
>
> > On Jan 25, 2016, at 1:13 PM, Jeff Blakely <jeff@blakelyla.com> wrote:
> >
> > Hi James and Kim,
> >
> > Violet brought home a flyer regarding a proposed Cell Tower at the Marina yesterday and I thought it might be the normal hysteria generated by certain factions without being in possession of all of the facts.

I spoke with Nadia this morning and she confirmed that indeed a private company negotiated a lease (I have to assume that the Town Commission was aware of this?) for this tower with the former Town Manager. The question I have is, was there a proposed location

attached to this lease? And further, and more seriously, how could a lease for a proposed structure of this nature be entered into and approved without prior Planning and Zoning review, and / or Town Commission approval. Knowing of the sensitivity of the areas residents to development of any kind this seems completely baffling. Did the Town Manager think that no one would notice an approximately 120' cell tower being constructed in the neighborhood? Has no one anticipated the consequences (political and otherwise) of such an undertaking?

I am told that the tower was sold on the income stream it would generate. But, at what cost to the lake front, property values, desirability for future development, and just plan being a blight on one of the Town's amenity's.

Another thorny issue is the proposed leasee's ability to litigate should the final agreement not be approved and based upon an assertion of the Town's not having bargained in good faith.

Tell me I'm missing something here.

Jeff

From: Kim Glas-Castro
Sent: Saturday, February 06, 2016 8:43 PM
To: Nadia DiTommaso
Subject: Fwd: Stealth Tower in Lake Park

For file

Kim Glas-Castro
Vice Mayor
Town of Lake Park

Sent from my iPad

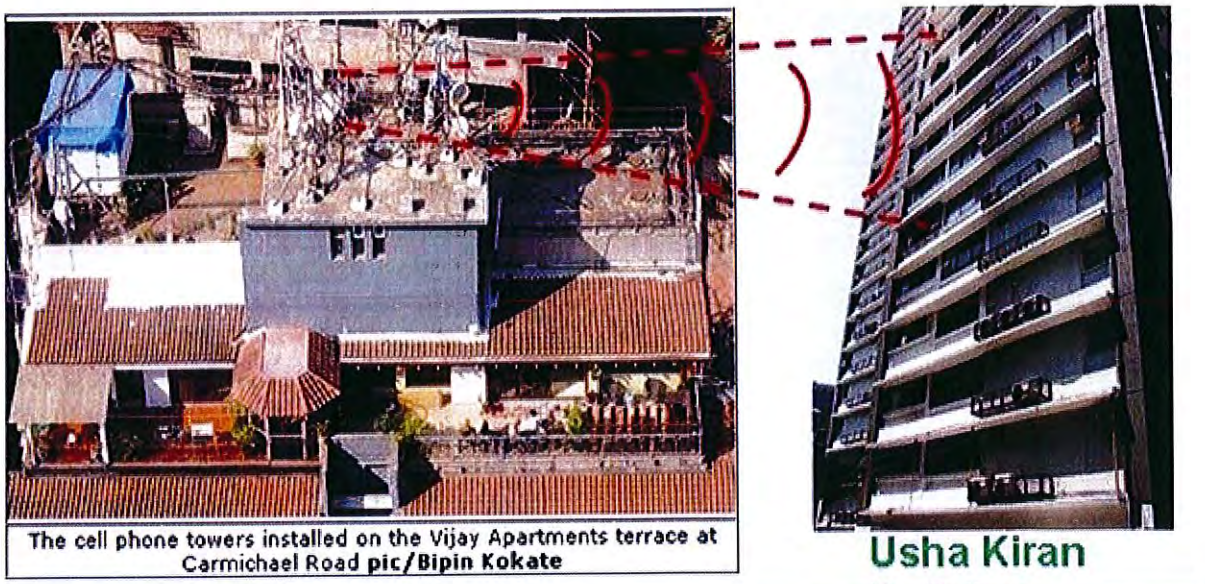
Begin forwarded message:

> **From:** "Sharon Hayek" <ladyhayek@comcast.net>
> **Date:** February 6, 2016 at 6:09:27 PM EST
> **To:** <kglas-castro@lakeparkflorida.gov>
> **Subject: Stealth Tower in Lake Park**
>
> Good morning Kimberly,
>
> I have been following the news regarding the installation of a stealth cell tower near the marina. Most of what I have been seeing is about aesthetics and revenue. Has ANYBODY taken into account the residents in Lake Park? We seem to be in an area that doesn't have good cell signals.
> My mom has lived in Lake Park for 40 years, and I've been with her for the past 10 years here in Lake Park. We have to keep a landline phone because the signal is so non-existent that we are unable to use a cell phone on our property.
>
> Just as some citizens don't want to live near a cell tower, some of us citizens need cell phone service within our own homes here. We have seen many things over the years that have ruined the original beauty of Lake park, such as parking meters in our once beautiful park, and the existence of dangerous half-way houses in our neighborhoods. Also, those buildings that sit totally vacant for years on Park Avenue. Surely, having a decent cell phone signal in one's own home cannot be too detrimental to the town of Lake Park.
>
> Thanks for reading my letter.
>
> Sharon Hayek

From: Claudia Wendel <claudiajwendel@gmail.com>
Sent: Monday, February 29, 2016 6:09 PM
To: James Dubois; Kim Glas-Castro; Erin Flaherty; Michael O'Rourke; Kathleen Rapoza; John D'Agostino; Nadia DiTommaso

Subject: REVISED/UPDATED EMAIL-(PHOTO ATTACHED)-Effects of DIRECT Mobile Tower Radiation and Cases reported worldwide

CASE STUDY Usha Kiran Building, Worli, Mumbai



The cell phone towers installed on the Vijay Apartments terrace at Carmichael Road pic/Bipin Kokate

Six cancer cases in consecutive floors (5th, 6th, 7th, 8th and 10th) directly facing and at similar height as the mobile phone towers of four telecom companies placed on the roof of opposite building.

Dear Mayor Dubois, Vice-Mayor Castro, Commissioner Flaherty, Commissioner O'Rourke, Commissioner Rapoza, Mr. D'Agostino and Ms. Di Tommaso:

The proposed Lake Park Cell Tower Installation will put you and your fellow citizens at risk of physical harm. Please read.
THIS IS IMPORTANT.

Please click on the two blue links below to view the slide show and the December 2010 article.

http://www.slideshare.net/nehakumar01/cell-tower-radiation-btua-neha29jan11good?related

http://www.slideshare.net/nehakumar01/cell-tower-radiation-report-2010-sent-to-dot-india?related=3

FAA guidelines do not take into consideration a cell phone tower antennae located immediately adjacent to and shooting radiation directly into residential windows.

Thank you for your time and consideration.

Most sincerely,
Claudia Wendel

RECEIVED

MAR 8 2016

Town Clerk's Office
TOWN OF LAKE PARK

Richard Harvey

3/8/2016

Mayor James DuBois
535 Park Avenue
Lake Park, FL 33403

Alternatives to the Cell Tower

Lake Park Commission Voting March 21, 2016

Dear Mayor DuBois:

You physically cringe and turn away from anyone concerned with the construction of a 120-foot cell tower in the Jewel of Lake Park – the marina. The town does not support this. Your own zoning board has denied the application as a public nuisance incongruent with the Town of Lake Park. Cell towers are far more powerful and dangerous than when the law was written by the cell phone providers in 1996. Most of the world recognizes – cellular towers have a "massive health implications for anyone in the path of the signal." Many countries and communities are ordering their removal.

I have leukemia and I moved to Lake Park for the quiet and fresh air from our waterfront condo. We are on the 8th floor only 384 feet from the proposed tower. The electromagnetic radiation transmitters aren't 120 feet above us … they are going to be almost in my living room. You and your fellow commissioners are going to kill me … and if my leukemia relapses because of this tower … I'm going to share my pain with you all. There are many elderly and infirmed residences here. I've included several articles for your review. You can no longer claim ignorance of these dangers. Many other communities are fighting and winning against these cell towers. In California recently a community rejected the applications solely for health concerns.

If you approve this tower … it is my understanding that they may expand the physical structures and equipment without further approval. It won't be long before this is even a bigger burden on the marina, community and the expanded "Kill Zone" radiation from MUCH STRONGER emitting equipment.

The new 5G technology is already coming. This is going to outdate your equipment and you will not receive the revenue they promised. Communities like Los Angeles and Worthington are now using "Small Cells" that are placed on existing light and telephone poles. Please have your city manager call T-Mobile, Verizon and AT&T – you could save the community and earn additional revenue we so desperately need.

The proposed cell tower is a natural lighting rod. Can you really believe that these lightening strikes will be transferred into the ground? Our marina is surrounded and often submerged in high tides … Imagine

the danger to residents and damage to all the high cost electronic equipment in the boats and neighboring buildings. We will hold you and the Commission responsible for our losses.

Please REJECT the cell tower application. If you don't ... the 5 condominiums on the waterfront will unite and fight against you. We can help you improve Lake Park ... if you help us. If you vote to approve this cell tower our substantial block of influential residents will oppose you.

Most sincerely,

Richard Harvey

cc:

Erin Flaherty -Commissioner
Kimberly Glas-Castro – Vice-Mayor
Michael O'Rourke – Commissioner
Kathleen Raposa – Commissioner
Ashleigh Waters, WPTV Channel 5, 1100 Banyan Blvd, West Palm Beach, FL 33401
Susanne Boyd, CBS 12, 1100 Fairfield Drive, West Palm Beach, FL 33407
Tiffany Kenney, WPBT-TV, 3970 RCA Blvd #7007, Palm Beach Gardens, FL 33410

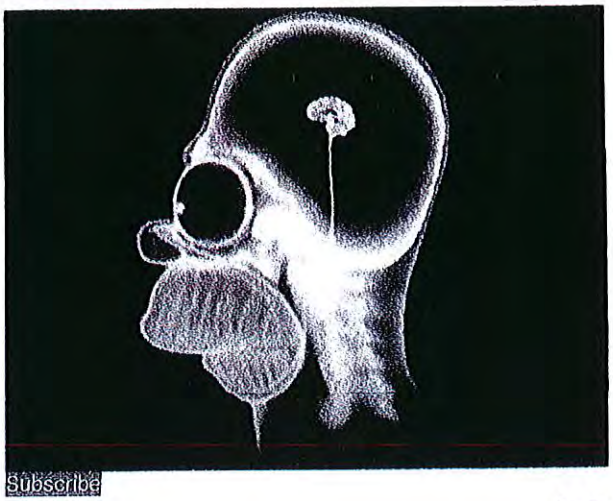
301 Lake Shore Drive #807
Lake Park, Florid 33403
(561) 425-5680

http://mybroadband.co.za/news/cellular/42425-4g-health-warning-report-slated.html

4G health warning report slated

Well known media expert slates report on LTE health warnings' questions credentials of 'alarmist' organization

By **Rudolph Muller** - January 30, 2012 **12 Comments**



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130

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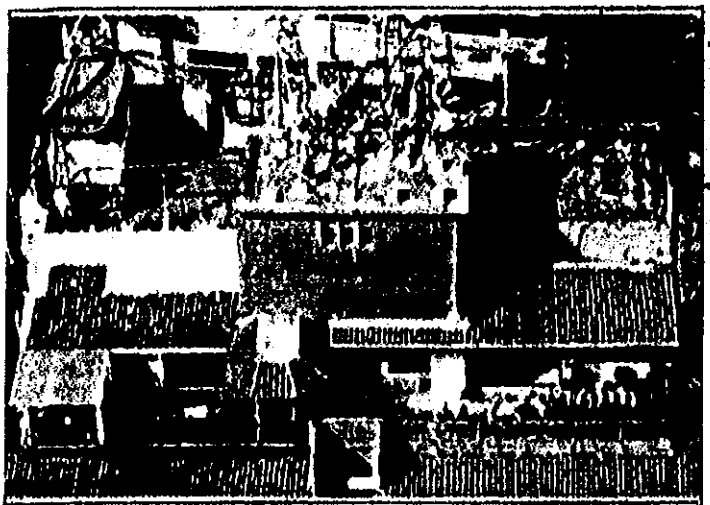
Wits University media studies head professor Anton Harber slated the latest Saturday Star front page article (**article here**) which sent out a warning about the potential adverse health effects of LTEnetworks (**Harber's blog post**).

The article entitled "Scorched tree poser for cellphone giant" focused on concerns that 4G [actually LTE which is 3.9G] tower radiation may cause health damage to humans and the environment.

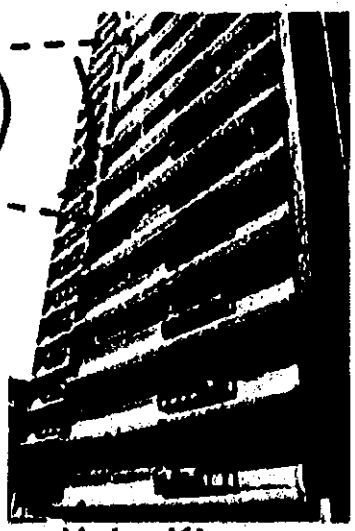
Well known electromagnetic radiation activist Tracey-Lee Dorny is quoted in the article saying that the rollout of 4G [LTE] cellular towers can have 'massive health implications for anyone in the path of the signal'.

JAN 3, 2010

CASE STUDY | Usha Kiran Building, Worli, Mumbai



The cell phone towers installed on the Vijay Apartments terrace at Carmichael Road pic/Bipin Kokate



Usha Kiran Building

Six cancer cases in consecutive floors (5th, 6th, 7th, 8th and 10th) directly facing and at similar height as the mobile phone towers of four telecom companies placed on the roof of opposite building.

http://www.slideshare.net/nehakumar01/cell-tower-radiation-report-2010-report-sent-to-dot-india?related=3

http://www.slideshare.net/nehakumar01/cell-tower-radiation-btua-neha29jan11good?related

From **The Times** - 22 April 2007

by Daniel Foggo

Cancer clusters at phone masts

http://bioenergy.timleitch.net.nz/mast_dangers/cancer_clusters_uk.htm

SEVEN clusters of cancer and other serious illnesses have been discovered around mobile phone masts, raising concerns over the technology's potential impact on health.

Studies of the sites show high incidences of cancer, brain haemorrhages and high blood pressure within a radius of 400 yards of mobile phone masts.

One of the studies, in Warwickshire, showed a cluster of 31 cancers around a single street. A quarter of the 30 staff at a special school within sight of the 90ft high mast have developed tumours since 2000, while another quarter have suffered significant health problems.

The mast is being pulled down by the mobile phone after the presentation of the evidenceoperator O2 by local protesters. While rejecting any links to ill-health, O2 admitted the decision was "clearly rare and unusual".

Phone masts have provoked protests throughout Britain with thousands of people objecting each week to planning applications. There are about 47,000 masts in the UK.

Dr John Walker, a scientist who compiled the cluster studies with the help of local campaigners in Devon, Lincolnshire, Staffordshire and the West Midlands, said he was convinced they showed a potential link between the angle of the beam of radiation emitted from the masts' antennae and illnesses discovered in local populations.

"Masts should be moved away from conurbations and schools and the power turned down," he said.

Some scientists already believe such a link exists and studies in other European countries suggest a rise in cancers close to masts. In 2005 Sir William Stewart, chairman of the Health Protection Agency, said he found four such studies to be of concern but that the health risk remained unproven.

Selected "HAVE YOUR SAY" comments On-Line to Times On-Line

As a state worker for the state of Calif. U.S.A. , I have been diagnosed with RF exposure after visiting my wife at a fire lookout (for the state of Calif.), we both have been diagnosed as well as around 20 other people who lived or worked at the same location. Damage to the cerebral area diagnosed by a liscensed doctor. The only common factor for some of us was the tower area. I came down with cancer. The state denies we are sick.

Ben Garcia, Bieber, California, U.S.A.

10 out of 40 houses in my road have had people with cancer,we live very near to a large amount of phone masts which have not needed planning permission as they have been put on top of council owned highrise flats.These flats are for elderly people who would not raise suspition when cancer occurs.The people in the houses with cancer ,some of whom died young are more noticeable,my own daughter had Hodgkins Lynphoma when she was 19,at the same time a friend who lived next door but one died aged 48 of the same cancer ,could anyone tell me what the odds of this happening would be?

Sue Mathie, Wirral, Mersyside, England
Cancer induced by microwaves: A recent swiss study (The Schwarzenburg Shut-down Study) has shown that people exposed to microwaves with values from 0,2 V/m to 4V/m have an average of a 80% loss of melatonin, an hormone believed to regulate cancer risks. Swiss & European limits are 50 to 60 V/m outdoor!

D. Ficher, Bern, Switzerland
We have a mast right in front of our house. My husband has prostate cancer at the early age of 45, and two of my neighbours have tumours, their father and husband died of prostate cancer.

MAS, Brighton
I am interested to note that high blood pressure is included in the list of illnesses. Having taken to using Broadband via Wi-Fi some six months ago with the Hub sitting about five feet away from me, I find now that I too have slightly high blood pressure for the first time in my life. There is probably a false correlation between these two circumstances, but one does wonder if any studies, such as those mentioned in this article, have been carried out on the effects on health of wireless transmission in the home.

Michael Laughton, London

COMPARE '16 ANNUITY RATES
2016 Rates from A+ Rated Companies. Increase Monthly Income up to 30%!

Verizon booster 'small cells' explained, approved at council meeting

By Gordy Moore on Jan 12, 2016 at 7:51 p.m.

WORTHINGTON – The Worthington City Council on Monday night learned about a new type of cellular communications technology that will now be installed in Worthington after being approved by an unanimous vote.

The council unanimously approved a licensing agreement with Alltel Communication (referred to as Verizon) to install cell phone signal booster devices officially called "small cells" on two streetlights in Worthington – one on Ray Drive near McDonald's, one just off the U.S. 59/Minnesota 60 roundabout.

The purpose of the small cells, Mayor Mike Kuhle explained, is to boost Verizon's signal at targeted high-traffic areas and take some of the burden off main cell towers around Worthington. A Verizon representative present at the meeting said that after the small cells are installed, Worthington Verizon customers can expect faster data speeds when using apps and other features that require the use of cellular data.

The two cellular boosters that will be installed – the small cells – function like mini-booster antennas and are currently being rolled out across the country by major wireless carriers like Verizon and AT&T. The pace of installation has accelerated in the past couple of years, with networks looking to speed service as much as possible. The cells are installed in high-traffic areas – 400 were put into service in downtown San Francisco last year, according to Gigaom.com – and are a major part of cell companies' future network plans.

Beck, a Verizon representative and the city's legal representative in this contract, explained that the city will be paid $1,500 per pole for the initial cost. Verizon will pay for the cost of the two heavier-duty poles that the small cells will require, and Beck said the project should not be a financial burden or obligation for the city.

The city will enter into a 10-year contract it could choose to not renew if it wished, but Beck advised that it would not be reasonable for anything other than a public purpose to terminate it. Beck also explained that under federal and state telecommunication laws, the city is legally obligated to be non-discriminatory should another cellular provider come in and ask to negotiate with the city for a similar license agreement.

TRENDING

1. Section 3A South boys basketball final: MCC wins a thriller in OT
2. Five arrested during drug bust
3. Firefighters called for fire in Iona
4. Class of 2016: Juston Bents ramps up his senior year with a variety of experiences
5. Escaped patient steals vehicle

more ⟩

LATEST

Section 3A South boys basketball final: MCC wins a thriller in OT

Minnesota State Class AA wrestling: Pwae brothers into semifinals

Minnesota State Class A wrestling: Hieronimus in a good spot

Section 3AA girls basketball: T-M-B bounces Windom Area in second half

Class of 2016: Juston Bents ramps up his senior year with a variety of experiences

more ⟩

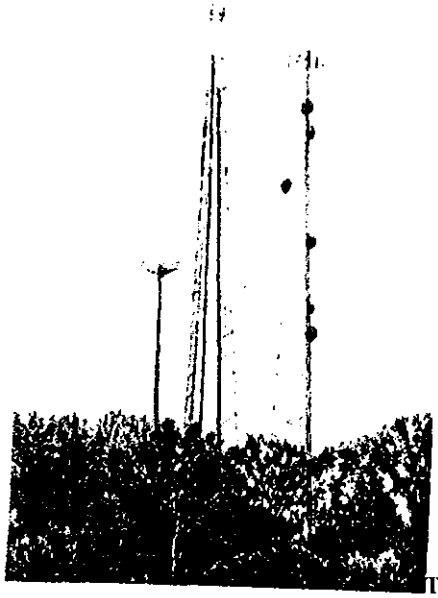
This Week's Circulars

TAP FOR CIRCULAR
MATTRESS FIRM

TAP FOR CIRCULAR
Walmart

TAP FOR CIRCULAR

TAP FOR CIRCULAR



To: Town Commission

We want to take this opportunity to express our disappointment in the manner in which the town has pursued a solution to its telecommunications issues. There has been a long history of tower advocates attempting to convince the town that a tower was the only feasible solution for Longboat. We have heard the tower advocates discrediting DAS as being a science fair project and only useful for indoor or stadium deployment and not practical for Longboat Key.

Fortunately the Commission saw the folly in relying on information from "someone who was trying to sell us something" and instead authorized a study by TE Connectivity. The study stated that large cell phone towers providing coverage over 2 or more miles will not be able to provide coverage to all areas. This led to a discussion of heterogeneous networks (HetNet) which incorporate various forms of Small Cell technology including residential Femtocells, Picocells, Metrocells , and Microcells. Finally the study ended with a discussion of DAS as an available more flexible solution and suggested steps to be pursued to deploy a DAS system. That was 14 months ago. Today, as we were advised, the communications industry is now trending toward the use of heterogeneous networks to solve telecommunications issues. HetNet (a combination of DAS and small cell solutions) is being used to fill the gaps. Yet, despite this accurate advanced outlook from our independent industry expert, Longboat Key is still talking about cell towers.

If the study produced any result it provided undeniable authority that DAS was a feasible solution and in fact would produce more areas of perfect coverage with less environmental impact to the island. This was contrary to all the information received to that date from the tower advocates. Nevertheless, Longboat Key is not just talking about cell towers it is changing its comp plan and zoning codes to make it easier to put up a cell tower. At the 6/3 meeting the Commission eliminated the hierarchy language and the statement that towers were the least preferred solution from the comp plan amendment. This language had been developed by staff based on previous Commission input. The elimination of this language was totally unexpected as was the discussion that followed which put carrier cost as a factor in determining a telecommunications solution. This will produce only one result – a tower. This is a complete change in direction that was established at the 10/15/2012 workshop and all the more reason to have had this meeting when residents were on the key. This flip flopping is the reason for the discussion on telecommunications at the 6/17 Commission workshop. At this point even the Amazing Kreskin wouldn't be able to predict where the Commission is going.

Since the final report was issued by TE Connectivity there has been a steady attempt to discredit it. An extremely vocal resident has repeatedly spread misinformation about the study. The tower builders have shown DAS installations at their very worst to prompt some in government to suggest a tower is a more aesthetically pleasing solution than a DAS installation. To date the only clear direction given the town manager was by implication to approach the providers to determine what they needed in the way of code modifications to place a tower on town property. To that end the town manager contacted Tom Giacomo, a Verizon employee, who has appeared on behalf of a tower builder at various town meetings. When we asked the town manager if DAS was part of the conversation, his reply was no. In short, nothing has been done to find an alternative to a tower.

Any time a new area is suggested or even rumored to be a location for a tower, people in the potentially affected area oppose it. This has been the pattern since 2009 and will continue to be so. In case you're not getting the message, no one wants a cell tower where they live and most people don't want one where they work. There is no place on Longboat for a cell tower.

What's the answer? In our opinion the town manager should be given specific direction to reach out to the providers to specifically determine if they have any interest in participating in a neutral host DAS or Small Cell system. In reaching out, the manager should call the DAS/Small Cell representatives of the carriers not the tower people. AT&T for one has been very aggressive in deploying HetNet solutions to solve its network gaps. (Please download the attachment)

In the event there is no response from the carriers, the manager should seek authorization to contact a DAS provider (a real DAS provider, not a tower builder trying to discredit DAS) to determine how a DAS/Small Cell system might be subsidized to make it competitive to a tower. At the very least,

LPGI & Affiliates
'The Lightning Protection Experts'

962 Coronado Drive
Sedalia, CO 80135
(303) 688-5800
Fax (303) 688-5551
www.lpi-expert.com
www.lightning-protection-institute.com

March 3, 2016

Ms. Nadia DiTommaso
Town Hall, 535 Park Avenue
Lake Park, Florida 33403

RE: RG TOWER SITE AT LAKE PARK MARINA, 105 LAKE SHORE DRIVE, LAKE PARK, FL 33403

Dear Ms. Nadia DiTommaso,

This proposed RG Tower will significantly increase the incidences of lightning strikes to the Lake Park Marina, because tall objects, particularly a 125 foot tower, naturally will attract lightning. Thus, this tower will increase the chances of more lightning strikes to this entire area. A more menacing problem will be that lightning strikes to a tower results in a Ground Potential Rise (GPR) that will radiate out from the base of the tower.

This rise in earth voltage of many thousands of volts has the potential to damage equipment in buildings, both power and communication wires, metallic pipes in the earth, electrical shock between two differently grounded pieces of equipment, the electrical connections at the boat dock, a danger to people in a swimming pool or on the dock, animals or people near the tower fence, etc. The fact that this area is prone to a high water level or flooding may make a Lightning Induced Ground Potential Rise (GPR) more severe.

The distance from a tower that may offer a margin of safety is difficult to quantify, because of many variables such as; magnitude of strike, soil resistivity, tower system grounding, and moisture in the soil, other nearby grounded structures, water pipes, sewer mains, etc. Properly grounded towers from

- https://www.californialandusedevelopmentlaw.com/2015/01/26/u-s-supreme-court-tells-

U.S. Supreme Court Tells Cities to Explain a Cell Tower Denial in Timely Fashion, Even if in a Separate Document

By James McTarnaghan on January 26, 2015Posted in Planning and Zoning

The tension between demand for high-quality, ubiquitous cell phone service and opposition to cell towers in residential neighborhoods has resulted in significant disputes between wireless carriers and municipalities over siting of such towers. Typically, the fight begins and ends at a city council. Recently, however, one such dispute resulted in a U.S. Supreme Court decision, *T-Mobile South, LLC v. City of Roswell, Georgia,* **No. 13-975, Jan. 14, 2015, which delved into procedural issues associated with denial of proposed cell towers and provided guidance to municipalities as to how and when such denials must be explained.**

T-Mobile proposed to construct a cell tower (disguised as a 108-foot tall pine tree, as required by local ordinance) on a vacant residential property. As is often the case, there was substantial neighborhood opposition to the new tower based on concerns that it was not needed, that the technology was outdated, and that it was aesthetically incompatible with the neighborhood. The application was discussed at a public meeting and ultimately rejected by the City Council. After the meeting, the City sent a notice of the denial to T-Mobile but without any written explanation. Minutes of the Council meeting were published 26 days later, shortly before the deadline to file suit challenging the denial.

Approval or rejection of cell phone towers is addressed in the federal Telecommunications Act of 1996. In that Act, Congress delegated to the local governments the power to consider cell tower applications and required that a denial of an application "be in writing and supported by substantial evidence contained in a written record." T-Mobile argued that the denial, while in writing, did not contain any explanation and, as such, could not be supported by substantial evidence. The City argued that T-Mobile representatives were present at the public meeting and thus knew the reasons. On top of that, they claimed, the release of the meeting minutes 26 days later (and four days before a petition for judicial review was due) satisfied the Act's requirement of a written explanation. The Eleventh Circuit upheld Roswell's denial, and the Supreme Court granted certiorari to resolve a conflict between the circuits.

With a surprising degree of dissension on a seemingly simple issue, the Court addressed conflicting views in the Courts of Appeal and ultimately determined that a City need not include the rationale for its denial of a cell tower application in the denial document itself, provided it states those reasons with sufficient clarity in some other written record issued essentially contemporaneously with the denial. The Court did not set a precise time limit between the denial and the statement of reasons, but concluded that the 26-day delay between the notice of denial and release of the detailed minutes in this case did not satisfy the "essentially- contemporaneous" standard. It reasoned that a near-contemporaneous statement of reasons was necessary because suit must be filed within 30 days, and the record must reflect the stated rationale in order to enable judicial review. Justice Sotomayor, who delivered the majority opinion, criticized Chief Justice Robert's dissenting view, under which the locality would have been allowed to withhold its explanation for denial until after the lawsuit is filed. The majority opinion, in a sharply worded footnote, observed that such a practice would lead to *post hoc* rationalization by the public agency in its defense of its action. Ultimately, the Court remanded the case for further proceedings, and the City of Roswell may well deny the application again, but this time in a letter with some explanation. The Court was painstaking in its refusal to even consider whether the denial was actually based on "substantial evidence," leaving to another day the question of whether a locality can deny a cell tower application based primarily on NIMBY concerns. The Court also offered little guidance on what sort of written record is needed to pass procedural muster. It acknowledged that "a locality may rely on detailed meeting minutes as it did here," but suggested that "the local government may be better served by including a separate statement containing its reasons."

http://www.celltowerdangers.org/defeated-cell-towers.html

Defeated Cell Towers

A contentious plan to build an Optus mobile phone base station on top of a Mt Hawthorn shopping centre was rejected by the Town of Vincent last week... (Read More)

Cell phone tower voted down at Wilmette park... (Read More)

Controversial cell tower proposal dropped; debate continues... (Read More)

U.S. Antenna permit denied on health grounds...'Please disable Wi-Fi on Laguna Beach School Campuses'... (Read More)

Park Ridge has disconnected T-Mobile's plans to erect an 80-foot cellular antenna pole in Northeast Park... (Read More)

Thanks, Ocean City, for saying no to cell tower...Letter to the Editor, shore News Today (Read More)

Virginia community that contacted GOACT successfully opposed cell tower near municipal pool. (Read More)

Cell tower proposal near a historic site defeated by a coordinated letter writing campaign of local citizens and environmental organizations. (Read More)

State Supreme Court judge denies cell tower proposal due to the towns local zoning laws. (Read More)

Plan to bring a cell tower to Condon Park was soundly defeated at Town Meeting after opponents argued the structure could pose unacceptable health risks for children.. (Read More)

Schaumburg trustees voted 5-0 Tuesday night to reject a proposal by T-Mobile to construct cellular towers near two schools.. (Read More)

Alliance of Neighbors of Walt Whitman High School...the Whitman community is notorious for such opposition ever since it defeated a cell tower proposal at Pyle Middle School in 2005. (Read More)

Cell tower stopped by the Citizens Against the Cell Tower in Holualoa. The individual who was going to allow the tower on his property decided he did not want all his neighbors against him, and he did not want to be responsible for any possible long term health effects. (Read More)

The Hempstead Town Board will holds a public hearing on new cell tower regulations meant in part to keep the wireless equipment away from homes and schools. (Read More)

More towns fight cell towers - increasing evidence of adverse health effects. (Read More)

LAUSD Calls for Increased Setbacks, Advance Notification on Locations Near Schools. (Read More)

Douglas County Planning and Zoning meeting denied permits to T-Mobile for two separate tower locations: ...The tower would be 'an eyesore' and would drive down property values. (Read More)

Fred Camillo, a state representative from Greenwich, is absolutely right about passing a law that would govern where cell phone towers can and can't go. (Read More)

Union Township's zoning Board of Adjustment Wednesday unanimously denied T-Mobile's application to build a cell tower near a residential neighborhood... (Read More)

The Building Commission denied the Grace Point Church's request to build the 151 foot tall tower. (Read More)

Milton Planning Commissiondenied three applications for cell towers. Residents who live near the proposed sites came out in force to object to the 150 ft tall monopoles as both too big and too close to their homes... (Read More)

Fort Dodge City Council says no to vacating Elmhurst Court, throwing cell tower plan into question, after nine people told them the 150-foot-tall tower would ruin the beauty of the neighborhood and drive down their property values. (Read More)

Cell tower request to build near Huntington Beach's Harbour View Elementary School was denied, but now a legal battle erupts. (Read More)

Port St. Lucie rejects cell tower proposal. "There is no benefit here for the city," said Vice Mayor Jack Kelly. "Residents don't want it."
(Read More)

Group opposes cell tower placement, upset by the size of the tower, its location near the town center and its proximity to populations of elderly residents and the affordable housing complex. (Read More)

Council nixes controversial cell tower, as more than 1,400 residents have protested having a cell tower in what is largely a residential area. (http://www.reporternewspapers.net/2010/07/14/council-nixes-controversial-cell-tower/)

Normandy Park rejects controversial cell tower. The tower would have violated the zoning laws in the area, with the tower being taller than the allowed 40 feet. (Read More)

Community
MAR 09 2015
Development

To: Nadia DiTommaso

Fax: 561-881-3323

From: Claudia Wendel

Date: March 9, 2016

Dear Ms. DiTommaso:

Would you please include the following 4 pages in the March 21, 2016 Cell Tower Agenda Packet.

Thanks very much.

Respectfully submitted,
Claudia Wendel

NO SWEETWATER TOWER

HELP US BLOCK A CELL PHONE TOWER AT SWEETWATER BAPTIST CHURCH

- An Unwelcome Neighbor
- Health Worries
- Safety Concerns
- We're Not Alone
- Who to Contact

SAFETY CONCERNS

LIGHTNING MAGNET – The NASA web site confirms that "scientists have known for a long time that towers attract more lightning than the undisturbed ground nearby."

It cited a 1998 case of a Murfreesboro, N.C., family. After a 138-foot water tower was erected on property near its farmhouse, the family – who had never experienced a lightning strike in 10 years – had five separate discharges near their house in a five-month period, killing two trees, triggering a fire in electrical equipment, destroying telephone wiring and damaging electrical fixtures.

The lightning threat is of particular concern here in Florida, with twice as many deaths and injuries due to lightning than any other state. Two-thirds of lightning strikes occur between noon and 4 p.m., a crucial time

when students are dropped off at the bus stop and preschoolers are picked up by their parents. SUNDAY is the deadliest day for lightning strikes, an irony, given that the Sweetwater tower will be housed on church property. Read complete article here.

Blog at WordPress.com. The Newsworthy Theme.

According to L.G. Byerley III from Lightning Protection Technology and W.A. Brooks, R.C. Noggle, and K.L Cummins from Global Atmospherics, Inc., the growth of towers in the United States has increased the amount of lightning strikes in certain areas. Such towers include cellular telephone and wireless communications, radio, microwave repeater, VHF communications and water towers. Read complete article here.

* **ELECTRICAL SURGES –** In a recent case in Tuscon, Arizona, Byerley, an expert on lightning, concluded that a 60-foot tower proposed at a church there "will be about **four times more likely to be struck by lightning** than a 30-foot flagpole at the same location. Strong electromagnetic effects will accompany all lightning strikes to this tower and these effects will not be mitigated in any way by the tower or the ground electrode configuration of the tower."

The effects of the lightning "may cause electrical overstress of electrical equipment used by the church as well as equipment used by the nearest neighbors of the church," he wrote. **"From a lightning safety standpoint, people should not be situated near an energized lightning conductor."** Read his April 2013 report here.

* **FIRE –** A Sanford cell phone tower caught fire Aug. 21, forcing road closures and evacuations of nearby businesses, and triggering fears by firefighters that the leaning 125-foot tower might collapse. Read more here. Similar fires have occurred nationwide, including a monopole fire in May Middletown Township, N.J. at a cell tower near a high school. Numerous cell tower fires have been captured on video and have been posted to YouTube under "cell tower fire." See burning Massachusetts tower topple.

Follow

FALL HAZARD – Municipalities in New Jersey, Pennsylvania and elsewhere have specified "fall zones" surrounding cell phone towers in order to protect neighbors from falling debris associated with a tower failure, with good reason. A tower industry website, Wireless Estimator, has chronicled numerous instances in which cell phone towers have caught fire, buckled or collapsed, including a Sprint/Nextel tower that broke off at its base in California in May 2007. See photo here. A monopole tower buckled in St. Louis with recorded wind speeds of less than 50 mph, leaving the top third dangling by transmission cables.

The top section of a 100-foot cell phone tower shaped like a cross snapped off at the Horizon Baptist Church in Palm Beach June 6, 2013 during severe weather related to Tropical Storm Andrea, sending a large fragment, 30 to 40-feet long, into the air. It landed in a retention area, narrowly avoiding serious damage to the church. Read more here.

During the deadly May 2011 tornado in Joplin, Missouri, at least 17 cell phone towers toppled in a single day, according to Missouri Gov. Jay Nixon's office. Scroll down to read story here.

Tarpon Towers LLC representatives said the tower planned at First Baptist Sweetwater could withstand winds of up to 130 mph, however, wind speeds of 147 were documented far inland during Hurricane Charley, and during Hurricane Andrew, winds speeds surpassing 175 mph were recorded.

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[redacted] CRACT [redacted]

[redacted]

Cell Towers Increase Lightning Strikes [redacted]

CELL TOWERS INCREASE CHANCE OF LIGHTNING STRIKES

CELL TOWER'S AND LIGHTNING STRIKES

By Jane Celltower

If there is a tall object nearby, move from the area (at least 2 meters - 7 feet), when you know lightning is close by. Standing near tall isolated objects, such as cell towers, makes you vulnerable to secondary discharges. L.G. Byerley III, lightning Protection Technology and W.A. Brooks, R.C. Noggle, and K.L. Cummins from Global Atmospherics, Inc, states the growth of towers in the United States has increased the amount of lightning strikes in certain areas. SpaceRef Interactive reports, "This includes Cell Towers, wireless communications, radio, microwave repeater, VHF communications and waters towers."

Scientists state, towers attract more lightning than the undistrubed land. A North Carolina family never had a problem with lighting untill a 138 foot tower was erected near Murfreesboro, N.C., on a one acre plot of open farm land. Once the tower siting took place, 5 separate discharges near the house occurred over a period of 5 years, causing the deaths of two trees, a fire in electrical equipment, and complete destruction of all phone wiring, and damage to electrical fixtures. This is not an isolated case, as any tall object such as a cell tower, "will" attract lightning. News Source: spacescience.spaceref.com

http://spacescience.spaceref.com • reports in yet another article titled: "Human Voltage - What happens when people and lightning converge" provides the following expert advice, "Isolated trees, telephone booths, and open structures like gazebos or porches make poor lightning shelters. If there is a tall object nearby, move as far away as possible - at least 2 meters (7 ft.). Standing next to tall isolated objects like poles or towers makes you vulnerable to secondary discharges coming off those objects. According to L.G. Byerley III from Lightning Protection Technology and W.A. Brooks, R.C. Noggle, and K.L. Cummins from Global Atmospherics, Inc., the growth of towers in the United States has increased the amount of lightning strikes in certain areas. Such towers include cellular telephone and wireless communications, radio, microwave repeater, VHF communications and water towers." This Space Science article gave credit and thanks to Dr. John M. Horack, and NASA for creating the resource which SpaceRef. now archives.

In an article titled: Lightning: The Under-rated Weather Hazard, By William P. Roeder, 45 WS/SYR Patrick Air Force Base, Florida, provided by the "National Lightning Safety Institute" (NLSI), we learn:

MYTH:
Cars are safe because the rubber tires insulate them from the ground.
TRUTH:
Cars are safe because of their metal shell.

Step 4: If you can't get to proper lightning shelter, at least avoid the most dangerous locations and activities.

- Avoid higher elevations
- Avoid wide-open areas, including sports fields and beaches
- Avoid tall isolated objects like trees, poles, and light posts.
- Avoid water-related activities: boating, swimming (includes indoor pools), and fishing.
- Avoid golfing.
- Avoid open vehicles like open farm tractors, open construction vehicles, riding lawnmowers, and golf carts (even with roofs)
- Avoid unprotected open buildings like picnic pavilions, rain shelters, and bus stops
- Avoid metal fences and metal bleachers.

DO NOT GO UNDER TREES TO KEEP DRY DURING THUNDERSTORMS!

Step 5: The Lightning Crouch: Use this only as a last, desperate measure!! If you've made several bad decisions and are outside far away from proper shelter when lightning threatens, proceed to the safest location. Get off the higher elevations, get out of the open fields, get away from tall isolated objects, and get away from water.

Jane Celltower reports and confirms, "Tall Isolated Objects - Like Poles and Cell Phone Towers?" In an

From: Claudia Wendel <ccwendel@bigplanet.com>
Sent: Wednesday, March 09, 2016 3:33 PM
To: Nadia DiTommaso
Cc: Claudia Heisler Wendel
Subject: For the March 21, 2016 Agenda Packet-CELL TOWER
Attachments: Marina; ATT00001.htm

Dear Nadia,

Please print out (from the following seven links) the specific pages and include them in the March 21, 2016 Agenda Packet.
I would also like you to include this email in the agenda.
Thank you very much.

Respectfully submitted,
Claudia Wendel

Decrease in Property Value:
The following links address address the public's concern when a cell tower base is erected in a residential area. The data references a distance of one city block. In our situation, the cell tower base is within 300 feet of our windows.

The overwhelming majority of respondents (94%) reported that cell towers and antennas in a neighborhood or on a building would impact interest in a property and the price they would be willing to pay for it. And 79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antenna.

The results of the sales analysis showed prices of properties were reduced by around 21% after a cell phone base station was built in the neighborhood."

So, if we assume that the average condo unit in our building has a current market value of $200,000 and there is a decrease of 20% (which is $40,000) and multiply that by 84 residences, the decrease in property value for our building alone would total $3.3 Million.
And if we multiply that $3.3 Million total property value by a 2.7% tax rate, there would be a loss of tax revenue of $90,720 for our building alone.
And in our complex, we have 3 other buildings. So that would total a tax revenue loss of $362,880 each year for our area alone. That doesn't take into account other buildings to the west and south of the marina.
That $362,880 tax revenue loss per year economically makes not sense, when the guaranteed cell tower tax revenue is only $36,000 per year.
It would also thwart the revitalization of the US 1 Corridor.

The following is a view showing how close 300 feet actually appears.

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BIOLOGICAL EFFECTS OF CELL TOWER RADIATION

Neha Kumar

Wilcom Technologies Pvt. Ltd.

wilcom.neha@gmail.com

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OUTLINE OF PRESENTATION

Common Health problems

Effect on Brain, DNA, Ear, Eye

Risk to Children and Pregnant Women

Epidemiological Studies Worldwide

Cases Reported

Conclusions

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Most common complaints:

- Sleep disruption
- Headache
- Concentration
- Forgetful memory
- Depression
- Fatigue
- Dizziness
- Palpitations of the heart
- Visual disorders
- Cardiovascular problems
- Buzzing in the head
- Altered reflexes

Many of these are related to changes in the electrical activity of the brain

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Blood Brain Barrier

Selectively lets nutrients pass through from the blood to the brain, but keeps toxic substances out.

Leif Salford *et al* 1988

Albumin - protein component of blood;does not normally cross BBB

- Albumin in brain tissue - Damaged blood vessels & lost brain protection
- Neuron - Grouped & shrunken with loss of internal cell structures.

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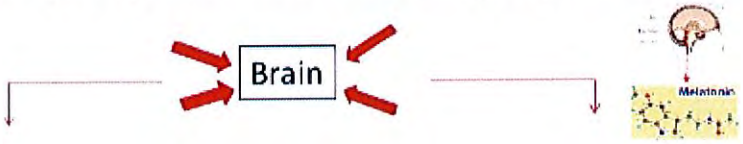
Neurodegenerative Diseases: Alzheimer's , Motor neuron, Parkinson's disease

- 4 times incidence of Alzheimer's disease *(Hakansson et al 2003)*
- 3 times amyotrophic lateral sclerosis (ALS) *(Savitz et al1998)*



Cells concerning learning, memory, movement damaged

(Salford et al 2003)

↓Melatonin production (Protects from brain damage)

(Burch 1999a ,Wood et al 1998)

Alzheimer's , Parkinson's disease

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DNA Damage

Prof. Henry Lai
University of Washington

Single and double strand breaks observed in DNA from microwave exposure at levels below the current FCC exposure standard.

1995, Diem *et al. 2005*

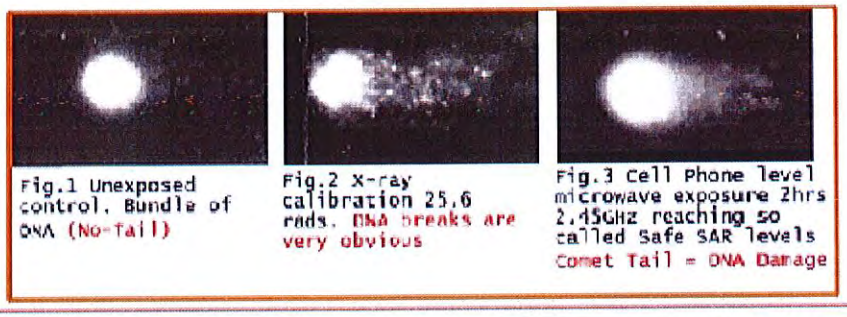

Fig.1 Unexposed control. Bundle of DNA (No-Tail)

Fig.2 X-ray calibration 25.6 rads. DNA breaks are very obvious

Fig.3 Cell Phone level microwave exposure 2hrs 2.45GHz reaching so called Safe SAR levels

Comet Tail = DNA Damage

When Damage to DNA > Rate of DNA repaired, there is the possibility of retaining mutations and initiating cancer

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Effect on Heat Shock Proteins (HSP's)

Normal Cell
(Human/ Animal)

Over-expression of (HSPs)
Inhibit natural programmed cell death (apoptosis)

cells that should have 'committed suicide' *continue to live.*

Normal Cell

Cancer Cell

Consistent with the 2-3-fold ↑in incidence of a rare forms of cancer

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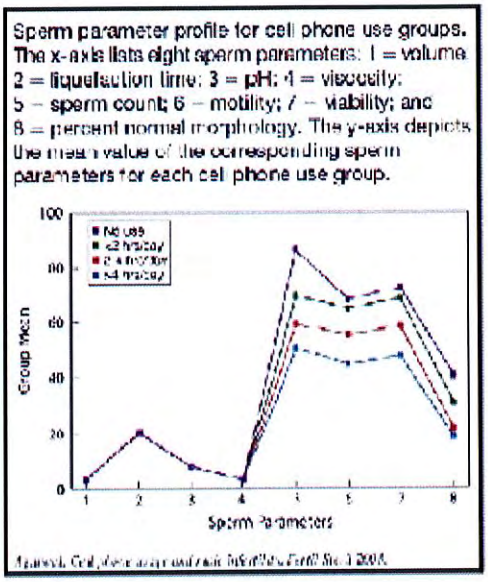
Irreversible infertility

Continuous exposure ⟹ 30% sperm decrease in intensive mobile users, in addition to damage of sperms



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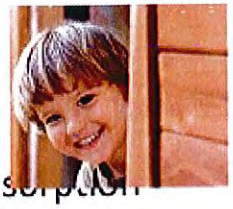
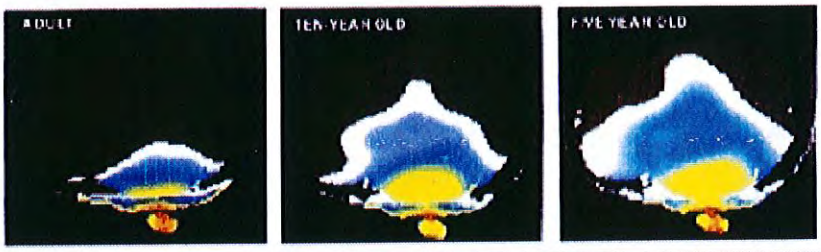


Risk to Children

Children are more vulnerable as:

- Skulls are smaller & thinner - ↑'s radiation absorption
- ↑rate of Cell division - more susceptible to genetic damage
- Myelin sheath not developed - Electrical brain-wave activity
- Immune system not well developed -less effective against fighting cancer growth



RF penetration in the skull of an adult (25%), 10 year (50%) and a 5 year old (75%).

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Risk to Pregnant Women

- A pregnant woman and the fetus both are vulnerable as RF radiations can pass placental barrier & continuously react with the developing embryo and increasing cells.

- Use of cell phone during pregnancy can lead to greater likelihood for behavioural problems in their children. It is believed that the eggs, which form the embryo can be affected and the damage will become apparent after the child reaches puberty. (Divan et al., 2008).

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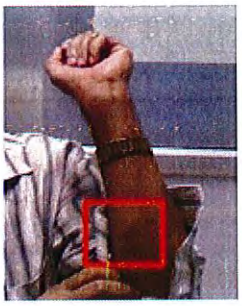
Effect on Skin

✓Rashes /sores – redness of skin
✓crawling, biting and stinging sensations
✓granules, threads or black speck-like materials on or beneath the skin.

❑Alters protein expression in endothelial cell lines and affect skin structure,(↑ed *transtyretin* protein conc.)
❑↑ed Mast cells – explains itch, pain, edema and erythema
❑May enhance development of skin tumours.



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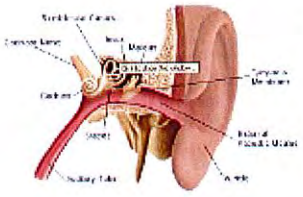
Tinnitus and Ear Damage



Tinnitus or "Ringxiety"- sensation of cell phone ring – in millions of cell phone users. People with severe tinnitus may have trouble hearing, working or even sleeping.

Warm sensation/pain > tinnitus > irreversible hearing loss

- Damage the delicate workings of the inner ear.
- Patients,18-25 yrs of age - damaged hair cells by RFR from phones. Hearing problems occur because these cells do not regenerate

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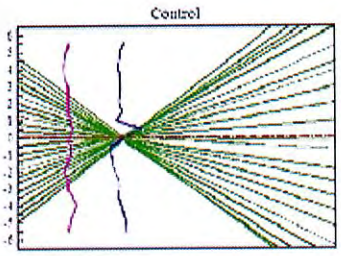
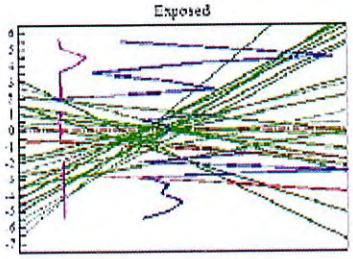
Effect on Eye/ Uveal Melanoma



Good quality lens



Ability to focus the laser beam at the various locations is altered.

Prolonged exposure to microwave radiation can lead to macroscopic and microscopic damage to the lens and part of this damage does not heal and accumulates with time.

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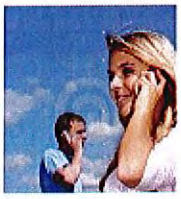
Melatonin Reduction

Powerful antioxidant, antidepressant and immune system enhancer that regulates circadian rhythm.



Prolonged RF exposure from cell phones/ cell sites ➡ **↓Melatonin production**

(Burch 1997, 2002, Graham C 2000)

- arthritis
- ↑cancer
- miscarriage
- increased eye stress
- renal impairment
- ↑ DNA damage
- chronic fatigue, depression
- ↑ childhood leukemia
- sleep disturbance
- cardiac, reproductive and neurological diseases

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Increase in Cancer risk

Prof. Lennart Hardell
Dept. of Oncology
University Hospital
Orebro, Sweden

❑ Mobile phone use >10 years doubles risk of brain cancer. Risk is highest for ipsilateral (on the same side of the head where the instrument is held) exposure

❑Cell phone use also increases risk of glioma, acoustic neuroma, salivary gland tumors , uveal melanoma, facial nerve tumors, skin, blood, testicular and breast cancer

❑**Children and teenagers**, before age of 20 - **Five times** more likely to get **brain cancer** if they use cell phones.

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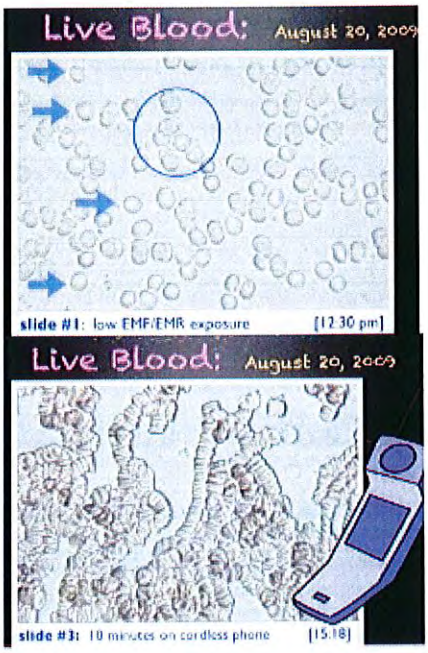
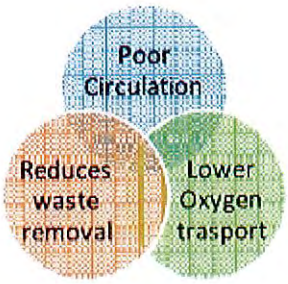
Live Blood Cells and Electrosmog



Dr. Magda Havas
Trent University, Canada

Consequences



Epidemiological studies- Cell Phone Antennas

Studies in France, Israel, Germany, Spain, the Netherlands, Egypt and Austria all document adverse health effects below the FCC guideline.

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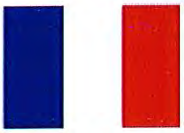
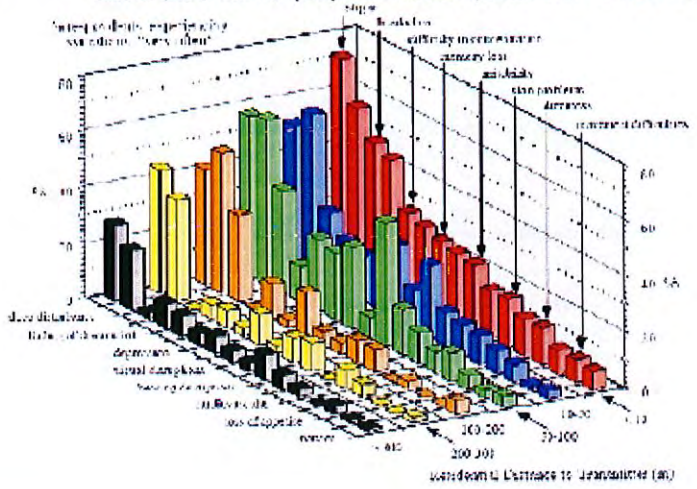
FRANCE



FRANCE

- Incidents increased with proximity to towers
- Women had more symptoms
- Based on symptoms experiences: Cellular phone base stations should not be sited closer than 300 m to populations. (*Santini R 2002*)



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ISRAEL

ISRAEL

Netanya, Irus – Medical Records (Wolf R *et. al* 2004)

- **Four fold increased** incidence of cancer within 350m after long term exposure to a phone mast compared with the general population of Israel.
- **10- fold** increase specifically among women

Table 1. Cancer cases in area A

Name	Age	Sex	Origin[1]	Smoking	Cancer Type	Measured power density in $\mu w/cm^2$
Henda	52	f	ash	No	Ovary ca stage 1	$0.3\mu w/cm^2$
Edna	42	f	sph	No	Breast ca in situ	$0.4\mu w/cm^2$
Tama	54	f	ash	No	Breast ca	$0.5\mu w/cm^2$
Neli	67	f	ash	Yes	Breast ca	$0.4\mu w/cm^2$
Galit	24	f	ash	No	Hodgkins	$0.5\mu w/cm^2$
Miriam	61	f	sph	No	Lung ca	$0.3\mu w/cm^2$
Masal	37	f	sph	No	Osteoid osteoma	$0.4\mu w/cm^2$
Max	78	m	ash	No	Hypernephroma	$0.3\mu w/cm^2$

[1] Origin: ash - Ashkenazien Jews sph - Spharadic Jews

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GERMANY

GERMANY

Naila: (Eger H 2004, 2009)

- **3-fold increase** in new malignancies within 400m from a mast after five years exposure
- Breast Cancer topped the list.
- Cancers of the prostate, pancreas, bowel, skin melanoma, lung and blood cancer increased.

Berlin - Head of cancer registry, 2006

- **7 fold increase** in breast cancer

SWEDEN

SWEDEN

- **250,000 Swedes are** electro hypersensitive out of a population of 9,000,000.
- One of the first countries where mobile technology was introduced (approx. 15 years ago).

(Munich, Germany)

CASE STUDY

- **Symptoms:** Dizziness, difficulty to sleep, BP increase, high pitched sounds in the ear (Tinnitus), joint pains, nausea, heart palpitations, short term memory loss etc. Doctors could not offer any cure.
- Countryside - symptoms vanish and re-emerge after coming home.
- Sleeps in car in the underground garage or in a nearby wood.
- **9% of German population Electrosensitive**
- 50% of the Germans have sleeping problems, children have sicknesses only known by elderly people in earlier generations, but any context with microwave radiation is officially denied.
- Applying pensions as young as forty years old.
- This is a global problem and **it is high time that people awake to this danger to life."**

SPAIN

SPAIN

- Strongest five associations within 50 to 150 m: Depressive tendency, fatigue, sleeping disorder, difficulty in concentration and cardiovascular problems. (Oberfeld 2004)
- Among 350 inhabitants of Pérez, Malaga – 43 cancer cases, 35 have resulted in death.

UK

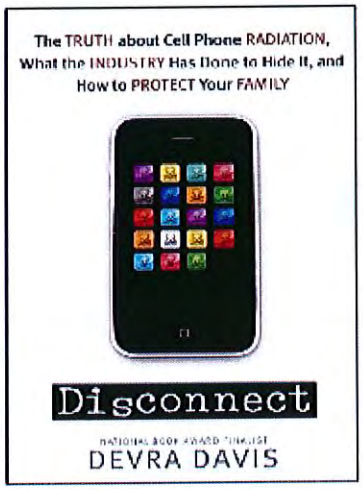
UK

- Warwickshire - 31 cancer patients on a single street within sight of 90 ft high mast developed brain tumours since 2000.

WISHAW T, UK-Mobile mast
After 7 years the story unfolds (2001)

Eileen O'Connor
Director, Radiation Research Trust
2001 - Diagnosed with breast cancer

- Five ladies developed breast cancer
- One case of prostate cancer
- One bladder cancer
- One lung cancer
- Three cases of pre-cancer cervical cells
- One motor neurone disease, also had spinal tumour
- People have developed benign lumps
- Electro-sensitivity
- Three cases of severe skin rashes
- Many villagers suffering with sleep problems, headaches, dizziness and low immune system problems.
- Horse with blood problems, continuous treatment needed by the vet.



Disconnect: The Truth About Cell Phone Radiation, What the Industry Has Done to Hide It, and How to Protect Your Family
By: Devra Davis

The book presents a range of recent and long-suppressed research demonstrating the national emergency we now face. It highlights on DNA damage, breakdown in brain's defenses, reduced sperm count, increasing memory loss, the risk of cancer and neurological diseases such as Alzheimer's, and even autism and vulnerability to children

Cases in India:

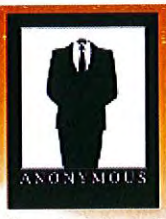
Increased cancer cases with proximity to Towers

Within 91 m from a mobile tower

Name of deceased	Year of death	Cause of death	Age at time of death
Radhabai Sathe	2005	Breast cancer	66
Deshpande	2006	Oesophagus cancer	48
Shubhangee Deshpande	2007	Rectum cancer	66
Pujaree	2008	Cancer	46
Gawai	2008	Breast cancer	52
Shah	2009	Cancer	48
Vidyadhar Dev	2009	Liver cancer	52
Ransube	2009	Throat cancer	73
Archana Malvadkar	2009	Spinal cord cancer	17

Source: L B Deshpande, who studied the deaths in his Solapur locality since two towers were installed four years ago

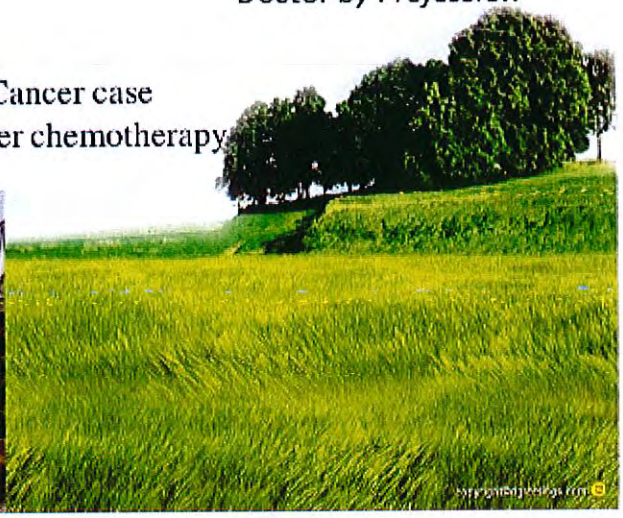
Cases in India:



Nine cancer cases in the same locality, all diagnosed in a row.

- 5 - Breast Cancer cases
- 1 - Ovarian Cancer case
- 1 - Blood Cancer case
- 1 - Inguinal Lymph Node Cancer case
- 1 - unknown – relapsed after chemotherapy

(Andheri, Mumbai)
Doctor by Profession



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- Until now, man has been absorbing the harmful, unseen EM radiations without even being aware of it, but now, with rapid advent in technology this RF Radiation pollution has started having ill effects on human health and health of animals.

- Hence, there is an urgent need to take precautionary steps.

- Example, when a glass is filled with water, it holds up to a certain level, but once it reaches the rim, it starts spilling. Similarly, our bodies can also absorb radiation up to a certain limit.

CONCLUSIONS

- Several health problems have been reported worldwide due to cell phones and cell towers much below the FCC and ICNIRP guidelines.
- Many countries have realized this and have adopted 1/100 to 1/1000th of these values
- Precautions must be taken and use of mobile phones should restricted to emergency especially for children and pregnant women.
- Better radiation norms should be adopted.

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REPORT

ON

CELL TOWER RADIATION

Submitted To

Secretary, DOT, Delhi

Prepared By

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December 2010

CELL TOWER RADIATION REPORT

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1. Advantages and disadvantages of cell phone technology

Cell phone technology has revolutionized the telecommunication scenario in India. Due to its several advantages, cell phone technology has grown exponentially in the last decade. Currently, there are more than 50 crore cell phone users and nearly 4.4 lakh cell phone towers to meet the communication demand. The numbers of cell phones and cell towers are increasing without giving due respect to its disadvantages. All over the world, people have been debating about associated health risk due to radiation from cell phone and cell tower. Radiation effects are divided into thermal and non-thermal effects. Thermal effects are similar to that of cooking in the microwave oven. Non-thermal effects are not well defined but it has been reported that non-thermal effects are 3 to 4 times more harmful than thermal effects.

A cell phone transmits 1 to 2 Watt of power in the frequency range of 824 - 849 MHz (CDMA), 890 - 915 MHz (GSM900) and 1710 – 1780 MHz (GSM1800). A cell phone has a SAR (Specific Absorption Rate) rating. In USA, SAR limit for cell phones is 1.6W/Kg which is actually for 6 minutes per day usage. It has a safety margin of 3 to 4, so a person should not use cell phone for more than 18 to 24 minutes per day. This information is not commonly known to the people in India, so crores of people use cell phones for more than an hour per day without realizing its associated health hazards.

Cell tower antennas transmit in the frequency range of 869 - 894 MHz (CDMA), 935 - 960 MHz (GSM900) and 1810 – 1880 MHz (GSM1800). Also, 3G has been deployed in a few cities, in which base station antenna transmits in the frequency range of 2110 – 2170 MHz. Mobile phone operators divide a region in large number of cells, and each cell is divided into number of sectors. The base stations are normally configured to transmit different signals into each of these sectors. In general, there may be three sectors with equal angular coverage of 120 degrees in the horizontal direction as this is a convenient way to divide a hexagonal cell. If number of users is distributed unevenly in the surrounding area, then the sectors may be uneven. These base stations are normally connected to directional antennas that are mounted on the roofs of buildings or on free-standing masts. The antennas may have electrical or mechanical down-tilt, so that the signals are directed towards ground level.

A base station and its transmitting power are designed in such a way that mobile phone should be able to transmit and receive enough signal for proper communication up to a few kilometers. Majority of these towers are mounted near the residential and office buildings to provide good mobile phone coverage to the users. These cell towers transmit radiation 24x7, so people living within 10's of meters from the tower will receive 10,000 to 10,000,000 times stronger signal than required for mobile communication. In India, crores of people reside within these high radiation zones.

2. Radiation from the cell tower

A GSM900 base station antenna transmits in the frequency range of 935 - 960 MHz. This frequency band of 25 MHz is divided into twenty sub-bands of 1.2 MHz, which are allocated to various operators. There may be several carrier frequencies (1 to 5) allotted to one operator with upper limit of 6.2 MHz bandwidth. Each carrier frequency may transmit 10 to 20W of power. So,

one operator may transmit 50 to 100W of power and there may be 3-4 operators on the same roof top or tower, thereby total transmitted power may be 200 to 400W. In addition, directional antennas are used, which typically may have a gain of around 17 dB (numeric value is 50), so effectively, several KW of power may be transmitted in the main beam direction.

2.1 Radiated power density from the cell tower

Power density P_d at a distance R is given by

$$P_d = \left(\frac{P_t \times G_t}{4\pi R^2} \right) \quad \text{Watt/m}^2$$

where, P_t = Transmitter power in Watts
G_t = Gain of transmitting antenna
R = Distance from the antenna in meters

For P_t = 20 W, G_t = 17 dB = 50, P_d for various values of R is given in Table 1.

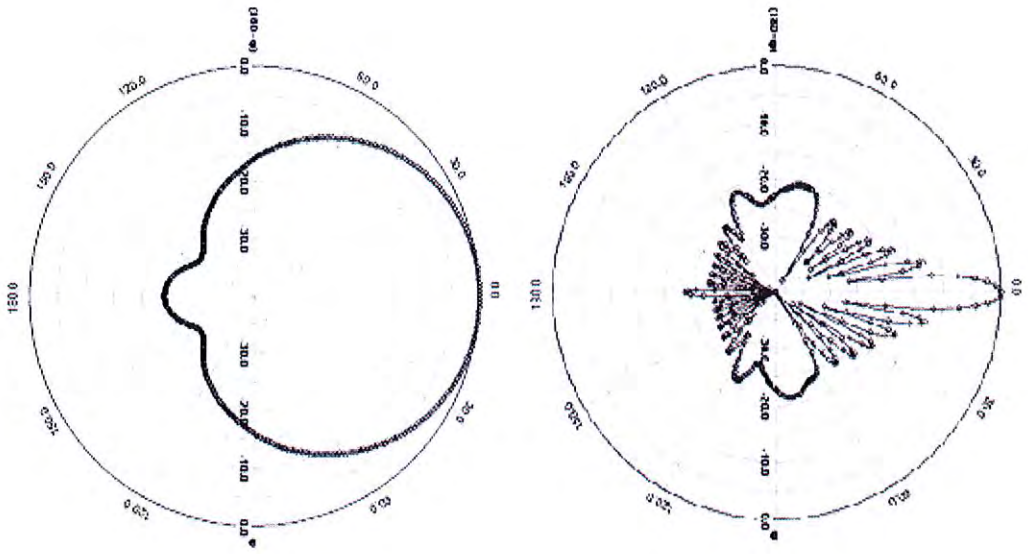
Table 1 – Power density at various distances from the transmitting tower

Distance R (m)	Power density P_d in W/m^2	Power density P_d in μW/m^2
1	79.6	79,600,000
3	8.84	8,840,000
5	3.18	3,180,000
10	0.796	796,000
50	0.0318	31,800
100	0.008	7,960
500	0.000318	318

The power density values given in Table 1 are for a single carrier and a single operator. If multiple carriers are being used and multiple operators are present on the same roof top or tower, then the above values will increase manifold. However, radiation density will be much lower in the direction away from the main beam. One should know actual radiation pattern of the antenna (which unfortunately is not made public) to calculate exact radiation density at a point.

2.2 Radiation pattern of the antenna

The simulated radiation pattern of GSM900 antenna of approximately 17 dB gain at 950 MHz of size 2400 mm x 30 mm is shown in Fig. 1. Radiation pattern of the antenna is shown in two planes – horizontal and vertical. There is one main lobe and several side lobes. For the main lobe, half-power beam-width (HPBW – defined as angular range over which maximum power decreases to half of its value) in the horizontal direction is 65 degrees and HPBW in the vertical direction is 6 degrees. There are several side lobes, whose maximum levels are about -13 to -20 dB below the main level.



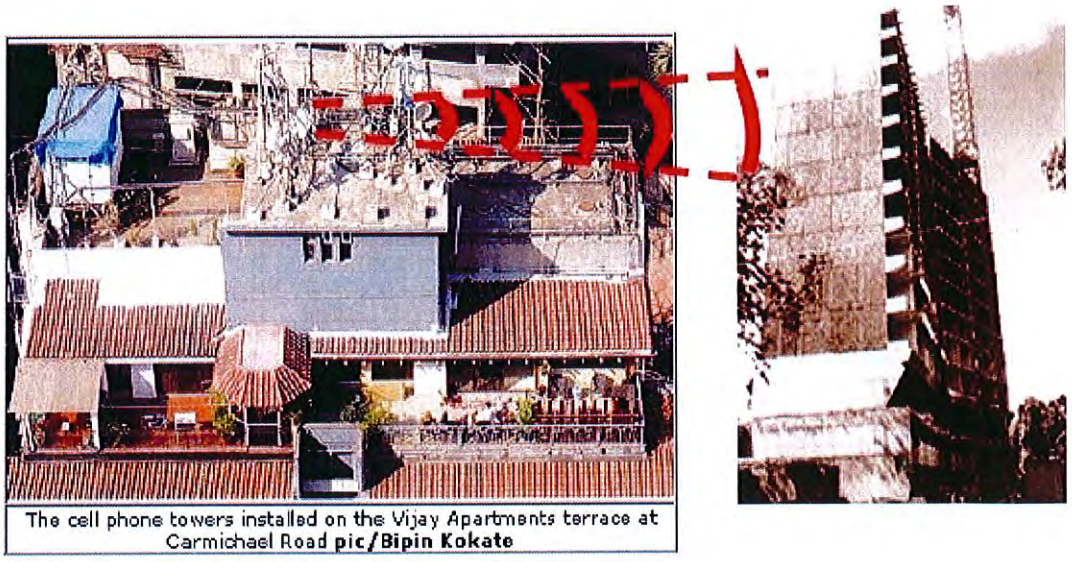
(a) (b)

Fig. 1 – (a) Horizontal and (b) Vertical radiation pattern of a 17 dB gain antenna

2.3 Case study of Usha Kiran Building, Mumbai

Through the help of the above typical radiation pattern, let's analyze the news reported in Mid-day, Mumbai dated Jan. 3, 2010, which stated - "Mumbai's swanky Usha Kiran building says the four cancer cases there could be linked to mobile towers installed on the facing Vijay Apartments". The picture taken from the Usha Kiran building of the several antennas installed on the seventh floor of Vijay Apartments is shown in Fig. 2. People living in the 6^{th}, 7^{th} and 8th floor in the opposite building will get maximum radiation as they are in the main beam direction. People living on the other floors will receive lesser radiation as beam maxima is reduced considerably as can be observed from vertical radiation pattern. In the horizontal direction again, people living in the front side of the antenna will receive much higher radiation compared to people living in the back side of antenna.

http://www.mid-day.com/news/2010/jan/030110-mobile-tower-cancer-cases-carmichael-road-posh-areas.htm



The cell phone towers installed on the Vijay Apartments terrace at Carmichael Road **pic/Bipin Kokate**

Fig. 2 – Cell phone towers installed at the roof top of a building in Mumbai

From Table 1, it may be noted that for a single transmitter, power density at R = 50m is equal to $0.0318 W/m^2 = 31,800\ \mu W/m^2$. Even for 3 transmitters in the same direction, it comes out to be approximately $0.1\ W/m^2 = 100,000\ \mu W/m^2$, which has caused cancer to several people in a duration of 2 to 3 years.

3. Radiation norms adopted in different countries

In India, we have adopted radiation norms given by ICNIRP guidelines of 1998 for safe power density of f/200, where frequency (f) is in MHz. Hence, for GSM900 transmitting band (935-960 MHz), power density is $4.7 W/m^2$ and for GSM1800 transmitting band (1810-1880 MHz), it is $9.2 W/m^2$. The ICNIRP guidelines clearly state that for simultaneous exposure to multiple frequency fields, the sum of all the radiation must be taken into consideration. However, in India, we have applied this limit to individual carrier, so the radiation level exceeds by several times than even prescribed by ICNIRP guidelines, depending upon the total number of transmitters in that area Some of the people (especially older people, house wives, small children) living near the towers are exposed to this radiation 24 hours a day. Unfortunately, ICNIRP has considered only the thermal effects of radiation, where as scientist all over the world have found non-thermal effects of these radiations to have significant health effects and these non-thermal health effects occurs at levels much below these norms.

Bio-Initiative Report in 2007 (610 pages long) has been prepared by a group of independent scientists after thorough and very careful survey of the literature and they concluded that the existing standards for public safety are inadequate to protect public health and proposed 1000 $\mu W/m^2$ for outdoor, cumulative RF exposure. Some of the proposed maximum exposure values through various reports are given below:

•Building Biology Institute, Germany, provided following guidelines for exposure:
a. <0.1 $\mu W/m^2$ (0.00001 $\mu W/cm^2$) - no concern
b. 0.1 - 10 $\mu W/m^2$ (0.00001 to 0.001 $\mu W/cm^2$) - slight concern
c. 10 - 1000 $\mu W/m^2$ (0.001 to 0.1 $\mu W/cm^2$) - severe concern
d. > 1000 $\mu W/m^2$ (> 0.1 $\mu W/cm^2$) - extreme concern
•H Thomas et al, Germany; power densities should not exceed 100 $\mu W/m^2$
•EU Parliament (STOA 2001) recommends - 100 $\mu W/m^2$

The current USA standard for radiation exposure from cell phone towers is 580-1,000 microwatts per sq. cm. ($\mu W/cm^2$), but they are now considering revising the norms. Over 100 physicians and scientists at Harvard and Boston University Schools of Public Health have called cellular towers a radiation hazard. And, 33 delegate physicians from 7 countries have declared cell phone towers a "public health emergency". Many countries in the world have adopted much stricter maximum radiation density values of 0.001 to 0.24 W/ m^2 ($1/100^{th}$ to $1/1000^{th}$ of ICNIRP guidelines) as shown in Table 2. The people in these countries have studied extensively the health hazards of cell tower radiation to adopt stricter radiation norms. As can be seen in the case described in Section 2.3, even 0.1 W/m^2 = 100,000 $\mu W/m^2$ has caused cancer to several people in a duration of 2 to 3 years.

Table 2 - International Radiation Density Limits for GSM1800

Power Density (W/m^2)	International Exposure limits adopted by various countries
10	FCC (USA) OET-65, Public Exposure Guidelines at 1800 MHz
9.2	**ICNIRP and EU recommandation 1998 – Adopted in India**
3	Canada (Safety Code 6, 1997)
2	Australia
1.2	Belgium (ex Wallonia)
0.5	New Zealand
0.24	Exposure limit in CSSR, Belgium, Luxembourg
0.1	Exposure limit in Poland, China, Italy , Paris
0.095	Exposure limit in Italy in areas with duration > 4hours
0.095	Exposure limit in Switzerland
0.09	ECOLOG 1998 (Germany) *Precaution recommendation only*
0.025	Exposure limit in Italy in sensitive areas
0.02	**Exposure limit in Russia (since 1970), Bulgaria, Hungary**
0.001	"Precautionary limit" in Austria, Salzburg City only
0.0009	*BUND 1997 (Germany) Precaution recommendation only*
0.00001	**New South Wales, Australia**

At many places, cell phone towers are mounted on the roof top of residential /commercial buildings. Even though antenna radiates less power vertically down but the distance between the antenna and top floor is usually a few meters, so the radiation level in the top two floors remain very high. From Table 1, power density at R = 3m is equal to 8,840,000 $\mu W/m^2$ in the main beam. In the vertically down direction, radiation is approximately 20-22 dB less and the roof may provide attenuation of 6 to 10 dB depending on the construction (implying $1/1000^{th}$ power), implying radiation density of 8,840 $\mu W/m^2$, which is still very high.

Let's do some simple calculation of how much microwave power will be absorbed by human body if exposed to the so called safe radiation level adopted in India of power density = 4.7 W/m^2 for GSM900 band,. If we model human body as a cylinder, then its area will be 1.436 square meter (average height 5'6" = 1.67 m and waist 34" = 86 cm). So, power recd. by human body will be power density x area = 6.75 Watts. In one hour, microwave energy absorbed will be 6.75 x 3600 = 24.3 KW-sec. In one day, microwave energy absorbed will be 24.3 x 24 = 583.2 KW-sec. A typical microwave oven has a rating of 700 to 1000 W, and with say 60% efficiency, microwave power output is approximately 500 W. This implies that human body can be safely kept in a microwave oven for 583.2 KW-sec / 500 W = 1166 seconds = 19 minutes per day. How many people in the world are willing to put themselves, their family members, and their unborn children in an open microwave oven for 19 minutes/day? Telecom providers or policy makers can argue about body being adaptable to external threats and the radiation is spread over whole day. However, question remains, would we like to put our citizens in an open microwave oven for 19 minutes/day over the years. Also, this is only for a single source. For multiple sources, it will increase correspondingly. Thus, the safe limit adopted by India is extremely high and millions of people are suffering because of this.

Interphone study in 2010 mentions that excessive use of mobile phones has doubled to quadrupled brain tumor risk. However, they claim that for an average user, increase in cancer cases is not significant but they have taken an average user as a person who uses cell phone for 2 hours/month. In India, many people use cell phones for 1 to 2 hours per day. Re-evaluation of the Interphone study by a group of eminent scientist has found that the risk of affected people is significantly higher than reported. Interphone Study excluded children from the study. Children are at higher risk from exposures to carcinogens than adults and today very large population of children are using cell phones and also many of them sleep with the cell phones beneath their pillows every night without realizing the health hazards.

A number of adverse health effects have been documented at levels below the FCC guidelines, which include altered white blood cells in children; childhood leukemia; impaired motor function, reaction time, and memory; headaches, dizziness, fatigue, weakness, and insomnia etc. Figure 3 shows guidelines adopted by various countries in the top right corner and health effects of radio frequency radiation at various power densities at much lower level.

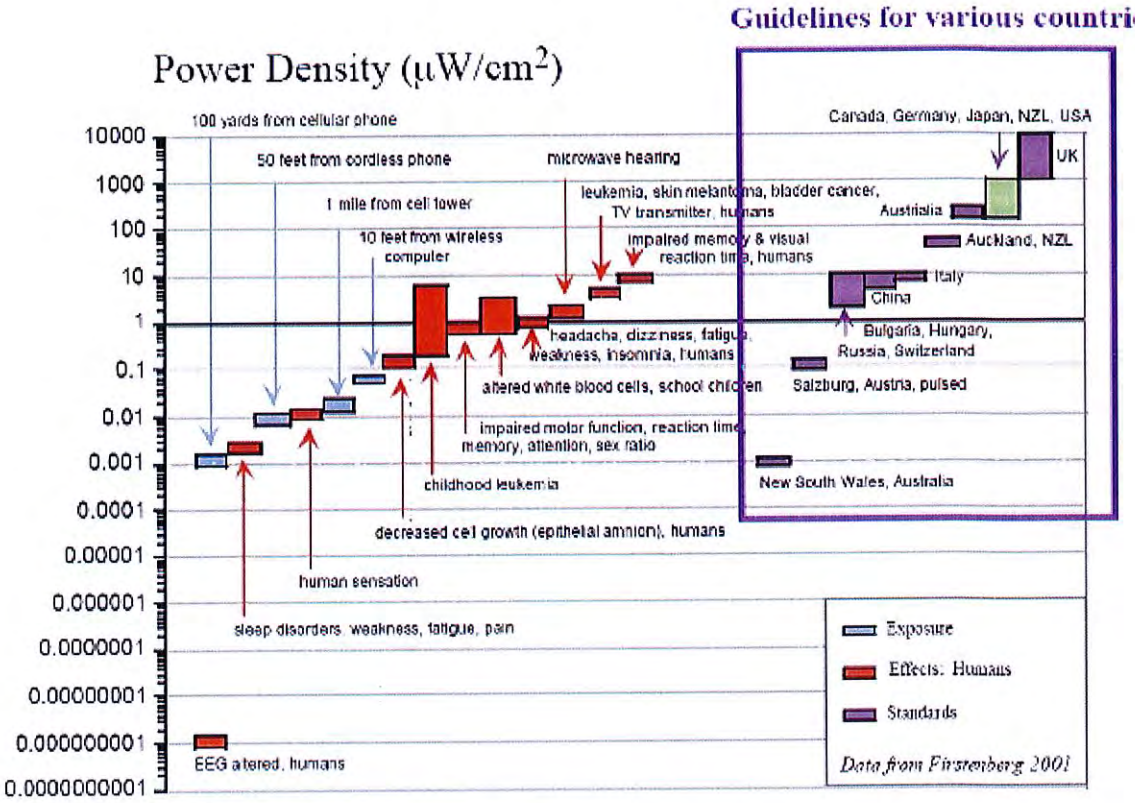


Figure 3: Guidelines, exposures and effects of radio frequency radiation at various power densities. Data from Firstenberg 2001.

4. Theoretical and Measured Radiated power

To measure the power at a distance R, an antenna is used to receive the power and a spectrum analyzer or power meter is used to measure received power.

Power Received P_r by an antenna at a distance R is given by:

$$P_r = P_t \times G_t \times G_r \times \left(\frac{\lambda}{4\pi R}\right)^2$$

Received power is directly proportional to the transmitted power, gain of transmitting and receiving antennas, and square of wavelength of the signal and it is inversely proportional to square of distance. For transmitter power P_t = 20 W, transmitting antenna gain G_t = 17 dB, receiving monopole antenna gain G_t = 2 dB, the received power at R = 50 m is:

At 887 MHz (tower transmitting frequency in CDMA), P_r = -3.2 dBm.

At 945 MHz (tower transmitting frequency in GSM900), P_r = -3.8 dBm.
At 1872 MHz (tower transmitting frequency in GSM1800), P_r = -9.7 dBm

The purpose of a cell tower is that mobile phone should receive adequate signal for its proper operation. A mobile phone shows full strength at -69 dBm input power and works satisfactorily in the received power range of -80 to -100 dBm. In comparison with -80 dBm level, the measured power level at R = 50m is at least 50 to 60 dB higher, which translates to 100,000 to 1,000,000 times stronger signal than a mobile phone requires. There are millions of people who live within 50m distance from cell towers and absorbing this radiation 24x7.

4.1 Conversion from measured power to power density

These measured power levels are in dBm whereas international standards are in terms of power density. In Table 3, conversion from measured power in dBm using a monopole antenna of gain = 2 dB (radiation monitor consists of this antenna) to power density is given.

Table 3 - Conversion from Power received from a monopole antenna of gain = 2 dB to Power Density at different frequencies.

Power received	Power density for different frequencies (Micro Watt/sq. meter)		
	f = 900 MHz	f = 1800 MHz	f = 2450 MHz
10 dBm = 10 mW	706,860	2,827,440	5,238,180
3 dBm = 2.0 mW	141,372	565,488	1,047,636
0 dBm = 1.0 mW	70,686	282,744	523,818
-7 dBm = 200μW	14,137	56,549	104,764
-10 dBm = 100μW	7,068.6	28,274.4	52,382
-17 dBm = 20 μW	1,414	5,655	10,476
-20 dBm = 10 μW	706.9	2,827.4	5,238
-27 dBm = 2 μW	141.4	565.5	1,048
-30 dBm = 1 μW	70.7	282.7	523.8
-37 dBm = 0.2 μW	14.1	56.6	104.8
-40 dBm = 0.1μW	7.1	28.3	52.4

where
f = 900 MHz is approximately the center frequency of CDMA tower (869 to 890 MHz) and GSM900 tower (935 to 960 MHz) transmit frequency bands
f = 1800 MHz corresponds to GSM1800 cell tower (1810 to 1880 MHz) transmit frequency band.
f = 2450 MHz is approximately the center frequency of WiFi, WLAN, Bluetooth, Microwave oven, etc.

4.2 Measurement at a cancer's patient residence

Since the radiation effect on the human body is cumulative, a hand held broadband radiation monitor (Frequency range of 800 to 2500 MHz) has been developed to measure the total received power. Radiation measurements were carried out in a lady's apartment, who had developed cancer within one year of installation of cell tower. The layout of the apartment and the measured readings are shown in Fig. 3. It may be noted that the radiation level is very high and it is between – 4 to -10 dBm. At 900 MHz, -10 dBm received power is equivalent to 7,068 $\mu W/m^2$, again implying that safe radiation norms must be reduced considerably than adopted by India, which is $4.7 W/m^2 = 4{,}700{,}000\ \mu W/m^2$.

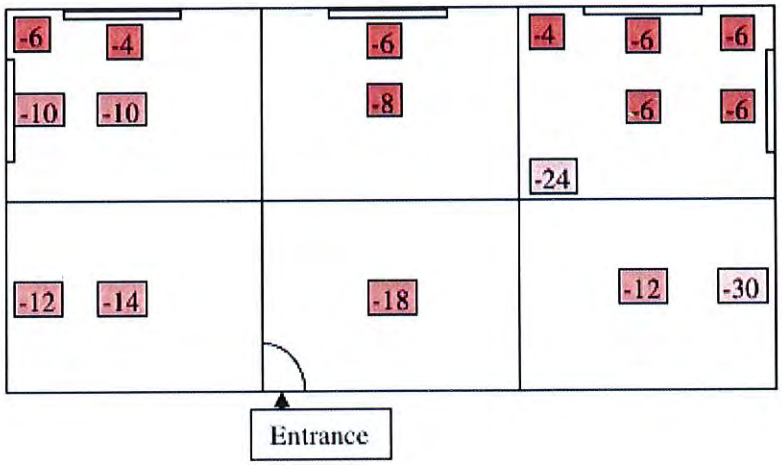


Fig. 3 – Measured power at a cancer patient's residence

4.3 Radiation Measurement at various places

Radiation measurements were carried out at various places in Gurgaon, Delhi and Mumbai. Some of these readings are given in Table 4. It may be noted that on Delhi-Gurgaon Highway bridge after Toll Naka towards Delhi, the measured radiated power was as high as 0 dBm, which is equivalent to $70{,}686 \mu W/m^2$ as there are 3 cell towers near the highway.

Table 4 – Measured Radiated power and power density at various locations

Location	Measured power in dBm	Power Density in W/m^2	Power Density in $\mu W/m^2$
Delhi-Gurgaon Highway near Toll (3 towers)	0	0. 70686	70,686
Khar Bridge, Mumbai	0	0.70686	70,686
Bridge b/w Vashi and Sanpada, Navi Mumbai	-4	0.028274	28,274
Worli Naka	-4	0.028274	28,274
Tilak Bridge, Dadar	-4	0.028274	28,274
Resident1,4th Fl. Sergeant House Lady w/cancer	-6	0.017756	17,756
Bandra Bridge	-6	0.017756	17,756
Airport Bridge	-6	0.017756	17,756
Resident 2, Rane Society, Powai	-10	0.007069	7,069
Near Hub mall, Goregaon	-10	0.007069	7,069
Mahalaxmi Temple, Bhulabhai Desai Road	-10	0.007069	7,069
Haji Ali, Juice Centre	-10	0.007069	7,069
IIT Bombay, Main Building	-10	0.007069	7,069
Gandhi Nagar-over railway bridge-near building	-12	0.00446	4,460
JK Cement group, Worli	-12	0.00446	4,460
Ustav Chowk, Kharghar	-12	0.00446	4,460
Siddhivinayak Temple	-14	0.002814	2,814
Vikroli - before Godrej	-14	0.002814	2,814
Govandi- Residential towers - near Indian Oil	-14	0.002814	2,814
Kemp's Corner	-14	0.002814	2,814
Race Course- Haji Ali	-14	0.002814	2,814
Powai Plaza	-14	0.002814	2,814
Belapur Flyover, near RBI- CIDCO	-16	0.001776	1,776
Vile Parle	-16	0.001776	1,776
Peddar Road (Punjab National Bank)	-16	0.001776	1,776
Dadar Plaza	-16	0.001776	1,776
Poddar Medical College	-16	0.001776	1,776
Vashi Highway – near Turbhe	-18	0.00112	1,120
Andheri Bridge- continuous high till Jogeshwari	-18	0.00112	1,120
Nerul Bridge	-20	0.00707	707
Vivero pre School (opposite powai lake)	-22	0.000446	446
Powai police station	-22	0.000446	446
L&T Bridge	-24	0.000446	281.4
Rajeev Gandhi nagar	-26	0.000177	177
On road near Evita (Hiranandani Building)	-28	0.000112	112
D-Mart,Hiranandani, Powai	-34	0.000028	28
Poddar Road opp. Mukesh Ambani Residence	-36	0.000028	17.8
IIT Bombay School of Management - Entrance	-46	0.00000178	1.78
Resident at Central Area, IIT Bombay	-56	0.000000178	0.178

In another research, a single two-hour exposure to a cell phone just once during its lifetime, permanently damaged the blood-brain barrier and, on autopsy 50 days later, was found to have damaged or destroyed up to 2 percent of an animal's brain cells, including cells in areas of the brain concerned with learning, memory and movement. It is known that this barrier is damaged in Alzheimers and Parkinsons disease. So there is a risk that disruption of this protection barrier may damage the brain.

5.2 Risk to Children and Pregnant Women

Children are more vulnerable to cell phone radiation as they:

- Absorb more energy than adults from the same phone owing to their smaller head and brain size, thinner cranial bones and skin, thinner, more elastic ears, lower blood cell volume, as well as greater conductivity of nerve cells and the energy penetrates more deeply. Tumors in the mid brain are more deadly than in the temporal lobe,
- Children's cells reproduce more quickly than adults which makes cancers more deadly,
- There immune system is not as well developed as adults hence are less effective against fighting cancer growth,
- Children have longer life time exposure.

Absorption of electromagnetic radiation from a cell phone (Frequency - GSM 900 MHz) is shown in Fig. 5 by an adult, 10 year old and a 5 year old child. When radiation hits the head, it penetrates the skull. The yellow area at the bottom is the location of the cell phone by the ear. The radiation penetrates the skull of an adult (25%), 10 year old (50%) and a 5 year old (75%).

Fig. 5 - Absorption of electromagnetic radiation from a cell phone based on age (Frequency GSM 900 MHz)

The younger the child, the deeper is the penetration due to the fact that their skulls are thinner and still developing. For these reasons it is critical that children under the age of 16 use cell phones only for short essential calls as they have much bigger danger of getting a brain tumor. Brain tumors have now taken over leukemia as the biggest cause of death amongst children. Due to these reasons countries like Belgium, France, Finland, Germany, Russia and Israel have publicly discouraged use of cell phones by children. An Independent research in Sweden last year concluded there was an astonishing 420 percent increased chance of getting brain cancer for cell phone users who were teenagers or younger when they first started using their phones.

A pregnant woman and the fetus both are vulnerable because of the fact that these RF radiations continuously react with the developing embryo and increasing cells. Microwave radiation can damage the placental barrier; the membrane which prevents the passage of some materials between the maternal and fetal blood, protecting the fetus, implying that pregnant woman should avoid cell phone or use during emergency.

In a recent finding, an association was found between a mother's cell phone use during pregnancy and greater likelihood for spontaneous abortion, congenital malformations and behavioral problems in their children. It is believed that the eggs, which form the embryo, are affected and the damage will become apparent after the child reaches puberty.

The Russian National Committee on Non-Ionizing Radiation Protection says that use of the phones by both pregnant women and children should be "limited". It concludes that children who talk on the handsets are likely to suffer from "disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability" in the short term, and that long-term hazards include "depressive syndrome" and "degeneration of the nervous structures of the brain".

5.3 Irreversible infertility

Recent studies confirm that cell phone radiation can drastically affect male fertility. In 2006, the American Society for Reproductive Medicine reported that use of cell phones by men is associated with decrease in semen quality, sperm count, motility, viability and normal morphology and is related to the duration of cell phone use. Studies have found 30% sperm decrease in intensive mobile phone users, in addition to damage of sperms. The average sperm count was found to be at 59 million sperm per milliliter of seminal fluid compared to 83 million for men not continually exposed to mobile phone radiation. Similarly, the study found that motility - the power of the sperm to swim - was affected by mobile phone transmissions. Men who made lengthy calls had fewer rapidly motile sperm, 36.3 per cent compared with 51.3 per cent for men who made no calls.

It was found that not only does using a phone affect a man's sperm quality, but simply having it switched ON in a pocket was enough to do damage as mobile phones periodically but briefly transmit information to cell towers to establish contact. Radiation from cell phone can also produce DNA breaks in sperm cells that can mutate and cause cancer. Damage to sperm DNA increases the risk further and can pass on the genetic changes to subsequent generations.

Animal studies indicate that EMR may have a wide range of damaging effects on the testicular function and male germ. It has been reported that mice on exposure to cell phone signals from an antenna park become less reproductive. After five generations of exposure, the mice were not able to produce offspring, showing that the effect of Radio frequency radiation can pass from one generation to another.

Due to these reasons it is advisable to never wear or use any wireless device near reproductive organs. Men planning to father children are advised to make sure that they stop using wireless devices well in advance of fertilization to reduce the chance of procreation with damaged sperm.

5.4 Calcium ion release from cell membranes

Studies have shown that weak electromagnetic fields remove calcium ions bound to the membranes of living cells, making them more likely to tear, develop temporary pores and leak. Leakage of calcium ions into the cytosol (the fluid found inside cells) acts as a metabolic stimulant, which accelerates growth and healing, but it also promotes the growth of tumors. Leakage of calcium ions into brain cells generates spurious action potentials (nerve impulses) accounting for pain and other neurological symptoms in electro-sensitive individuals. It also degrades the signal to noise ratio of the brain making it less likely to respond adequately to weak stimuli.

5.5 DNA damage

Cellular telephone frequencies can lead to damaged DNA. Studies show that microwave exposure at levels below the current FCC exposure standard, produces single and double strand breaks in DNA. EMR causes membrane leakage due to loss of calcium ions. Leaks in the membranes of lysosomes (small bodies in living cells packed with digestive enzymes) release DNAase (an enzyme that destroys DNA), which explains the fragmentation of DNA seen in cells exposed to mobile phone signals.

Microwave radiation can also interfere with the natural processes involved in DNA replication and repair, by subtly altering molecular conformation (architecture). Another possibility of DNA damage is via free radical formation inside cells. Free radicals kill cells by damaging macromolecules, such as DNA, protein and membrane and are shown to be carcinogenic. Several reports have indicated that electromagnetic fields (EMF) enhance free radical activity in cells as shown in Figure 6. The Fenton reaction is a catalytic process of iron to convert hydrogen peroxides, a product of oxidative respiration in the mitochondria, into hydroxyl free radical, which is a very potent and toxic free radical. Thus EMF affects the DNA via an indirect secondary process.

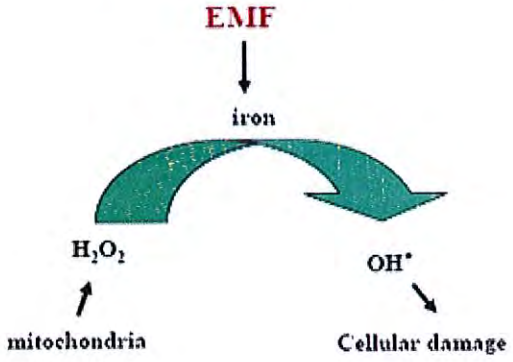


Figure 6 - The Fenton Reaction

Damage to DNA is a central mechanism for developing tumors and cancer. When the rate of damage to DNA exceeds the rate at which DNA can be repaired, there is the possibility of retaining mutations and initiating cancer. DNA damage in brain cells can affect neurological functions and also possibly lead to neurodegenerative diseases.

5.6 Interference with other gadgets including Pace Makers

Cell phone radiation interferes with navigational equipment; therefore its use is banned in airborne flights. Electromagnetic interference (EMI) from mobile phones can cause malfunctioning of life-line electronic gadgets in the hospitals thereby potentially endangering patients. It is also advisable to restrict mobile phone use in clinical areas like operating theatres and intensive care units.

Finally, hospital construction needs to take into account EMR from different areas within the hospital, as well as external sources, to limit interference with medical equipment. For example, allowing mobile phone use in a hospital corridor adjacent to a ward with sensitive medical equipment susceptible to EMR could be problematic.

RF exposure from mobile phones and cellular phone base antennas can also affect patients carrying Pace Maker, Implantable Cardiovascular Defibrillators (ICDs) and Impulse Generators. The signals generated by mobile phones cause electromagnetic interference with the device and interfere with its proper functioning. The signals produced by cell phone operating functions like, turning on, ringing, conversation and turning off, contain components of low frequencies that can interfere with the implanted pacemakers causing them to become arrhythmical which in adverse conditions can put the patient to death.

Due to these reasons government agencies have advised not to place mobile phones directly over pacemakers (such as in the chest pocket) and have issued recommendations to health care providers and patients with pacemakers. Also, the cellular phone should be used with the right ear if the pacemaker is implanted in the left side of the chest. As a safety measure, it is advisable to maintain a safe distance of about 50 cm between portable mobile phones from the patient.

5.7 Effects on Stress Proteins (Heat Shock Proteins)

Non-thermal effects of Radio frequency radiation accumulate over time and the risks are more pronounced after several years of exposure. The effects are not observed in the initial years of exposure as the body has certain defense mechanisms and the pressure is on the stress proteins of the body, namely the heat shock proteins (HSPs). The highly conserved HSPs accumulate in cells exposed to heat and a variety of other stressful stimuli like heavy metal poisoning and oxygen deprivation. HSPs, which function mainly as molecular chaperones, allow cells to adapt to gradual changes in their environment and to survive in otherwise lethal conditions.

It has been observed that GSM mobile phone exposure can activate the cellular stress response in both human and animal cells and cause the cells to produce stress proteins (heat shock proteins), in particular HSP27 and HSP70. This means that the body recognizes these electromagnetic radiations as a potential harm. Hence RF exposures add to the list of environmental stressors that

cause a physiological stress response. This further demonstrates that ELF and RF exposures can be harmful, and it happens at levels far below the existing public safety standards.
HSPs are known to inhibit natural programmed cell death (apoptosis), whereby cells that should have 'committed suicide' continue to live. Recent studies show that HSP27 and HSP70 inhibit apoptosis in cancer cells. Taken together, these various effects are, in turn, consistent with the 2 to 3 fold increase in the incidence of a rare form of cancers. If the stress goes on for too long, there is a reduced response, and the cells are less protected against the damage. This is why prolonged or chronic exposures may be quite harmful, even at very low intensities.

5.8 Effect on Skin

Radiation from cell towers and mobile phones affects human skin. People who talk often on cell phones have a higher concentration of the *transtyretin* protein than those who do not. *Transtyretin* is formed in the liver; it helps transport vitamin A in the body and plays an important role in nervous diseases such as Alzheimers.

The symptoms of *Morgellons* disease include those of electromagnetic hypersensitivity (EHS); may be based on how body uses electric currents to repair wounds to the skin. People who suffer from this condition report a range of skin symptoms including crawling, biting and stinging sensations; granules, threads or black speck-like materials on or beneath the skin and/or lesions (e.g., rashes or sores). EMFs degrade the immune system and stimulate various allergic and inflammatory responses. The high radiation from cell towers can result in an increase in mast cells, which explains the clinical symptoms of itch, pain, edema and erythema.

5.9 Tinnitus and Ear Damage

Tinnitus, popularly known as "Ringxiety"- is the psychological disease of hearing phantom sound and sensation of cell phone ring and it has been reported among millions of cell phone users in the world. People with severe tinnitus may have trouble hearing, working or even sleeping. The radiation emitted by mobile phones may damage the delicate workings of the inner ear, and long-term and intensive mobile phone use for more than four years and for longer periods than 30 minutes in a day are at a higher risk of developing hearing loss, which cannot be reversed.

This auditory perception has been shown to occur when a person's head is illuminated with microwave energy. The microwave pulse upon absorption in the head, launches a thermo-elastic wave of acoustic pressure that travels by bone conduction to the inner ear. There it activates the cochlear receptors via the same process involved for normal hearing, which explains the "clicks" heard by people exposed to microwave radiation.

Today, more and more young people between 18 and 25 years of age are suffering from hearing loss, which doctors say is due to excessive use of mobile phones and other gadgets. Good hearing depends on the health of some 16,000 hair cells present in each inner ear. But increasingly, doctors have been treating people whose hair cells have been damaged by the high radiation emitted from cell phones. Hearing problems occur because these cells do not regenerate. Anyone who spends two to three hours on the cell phone every day runs the risk of

partial deafness over three to five years. Most of the marketing and tele-consulting professionals are in their 20s, and their jobs demand long conversations on cell phones. The problem starts with a pain in the ear that gradually develops into tinnitus or a ringing sensation which finally leads to hearing loss.

5.10 Effect on Eye/ Uveal Melanoma

Frequent use of mobile phones can also damage the visual system in many ways and cause uveal melanoma i.e. tumor of the eye. Tumors involve the choroid (98%), iris (1%) and unknown parts of the uveal tract (1%). Computational modeling and experiments with several laboratory animals show that microwave radiation similar to mobile phone frequencies (900, 1800 MHz and 2450 MHz) can induce chromosomal breaks in the corneal epithelial cells and increase the intraocular temperature of the eye with prolonged exposure.

Increase in temperature close to the eye lens (as low as 3°C) can result in lens opacities and increase the risk of developing cataracts in humans, a condition characterized by clouding in the natural lens of the eye and lens opacities. When Bovine eye lenses were exposed to microwave radiation, it caused macroscopic damage and affected the optical function of the lens. The damage increased as the irradiation continued and reached a maximum level after a number of days. When the exposure stopped the optical damage began to heal gradually. A similar maximum level was observed when the irradiation intensity was reduced to one-half the original, except that it took twice the time. A lens of good optical quality is able to focus the laser beam from the various locations (green lines in the left frame of Fig. 7. When the lens is damaged due to exposure to microwave radiation, its ability to focus the laser beam at the various locations is altered, as clearly revealed in the right frame. The blue line connects the points of the back vertex distance for each ray passing through the lens. The pink line shows the relative intensity of each beam, that is, the transmitted intensity normalized to the incident one.

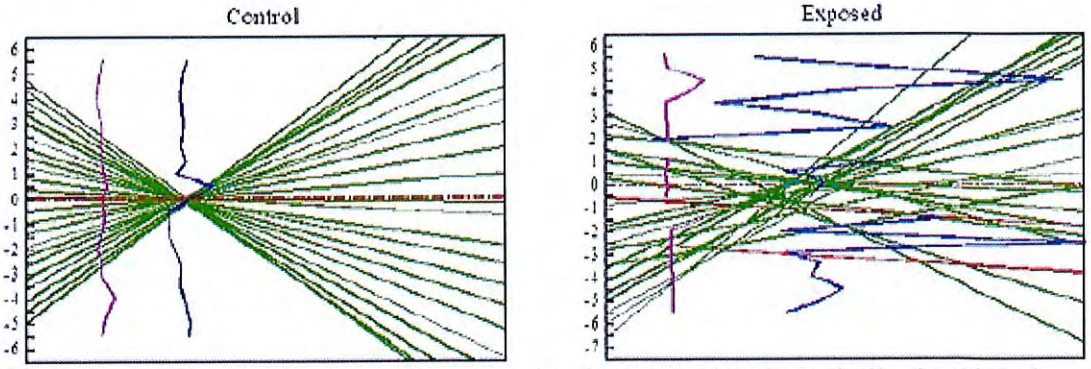


Fig. 7 – Left - Good quality lens - all rays passing through the lens have similar focal length. **Right** - Exposed lens, showing considerable variability in the focal length of the beams passing through the lens.

Prolonged exposure to microwave radiation similar to that used by cellular phones can lead to both macroscopic and microscopic damage to the lens and part of this damage seems to accumulate over time and does not heal.

5.11 Cell phone emission weaken bones

Researchers have measured bone density at the upper rims of the pelvis (iliac wings) in men who were mobile users and carried their phones on their belts. The iliac wings are widely used source of bone for bone grafting, so any reduction in bone density may be of special importance to reconstructive surgery. The results showed reduction in iliac wing bone density on the side where men carried their phones. In general, it is better to keep mobile phones as far as possible from our body during our daily lives.

5.12 Salivary gland tumor

Increased risk of salivary gland cancer among residents in Israel from 1970 to 2006 has been reported, which is believed to be linked to the use of mobile phones. Among salivary gland cancer cases, researchers found a worrying rise in the number of cases of malignant growth in parotid glands - the salivary gland located under the ear, near the location where cell phones are held during conversations. Users below the age of 20 were found to be more susceptible.
Another epidemiology study found that people who held a mobile handset against one side of their head for several hours a day have 50% more risk for tumor formation in the parotid gland - the largest salivary gland after 5-10 years.

5.13 Melatonin Reduction

Melatonin, a vital natural neuro-hormone is a powerful antioxidant, antidepressant and immune system enhancer that regulates our circadian rhythm. Every night as we go to sleep, our melatonin levels rise. Melatonin goes through our blood and clears our cells up, that is to say, scavenges free radicals in the cell to protect the DNA and reduce the possibility of cells becoming carcinogenic. The daily sleep/wake cycle, blood pressure and heart rate cycle, metabolic rate and thermal regulation, hormone production and immune system activity all have a daily cycle regulated by melatonin directly or indirectly through the autonomic system.

Various studies show that exposure to EMR reduce melatonin levels in animals and humans. Daily cellular telephone use of >25 minutes over years may lead to reduced melatonin production. Studies with animals show a reduction in melatonin levels following radiofrequency radiation exposure from cell phones and cell sites. Turning off the transmitters resulted in a significant increased melatonin levels within few days.

When availability of melatonin is impaired, a whole range of disorders including sleep disturbance, chronic fatigue, depression, cardiac, reproductive and neurological diseases and mortality can occur. Reduced melatonin is also associated with increased DNA damage and increased risk of cancer, arthritis, seasonally affective disorder (SAD), schizophrenia, increased eye stress, renal impairment, Alzheimer's and Parkinson's disease, miscarriage, sudden infant death syndrome (SIDS), and increased risk of childhood leukemia.

5.14 Sleep Disorders

Electromagnetic fields have been shown to affect the brain physiology. Use of mobile phones disturbs Stage 4 sleep, the stage important for full recuperation of brain and body. Use of the handsets before bed, delays and reduces sleep, and causes headaches, confusion and depression. The findings are especially alarming for children and teenagers as they use cell phones at night and also keep the phone next to their head; which may lead to mood and personality changes, depression, lack of concentration and poor academic performance.
The relationship of sleep disturbance with exposure to a cell phone/ tower radiation is shown in Fig. 8. It can be seen that percentage increase in sleep disturbance is proportional to the exposure dose. Even at $1nW/cm^2 = 0.001\mu W/cm^2 = 10\ \mu W/m^2$, disturbance in the sleep is of the order of 35%. When the transmitter was turned off, the symptoms resumed gradually

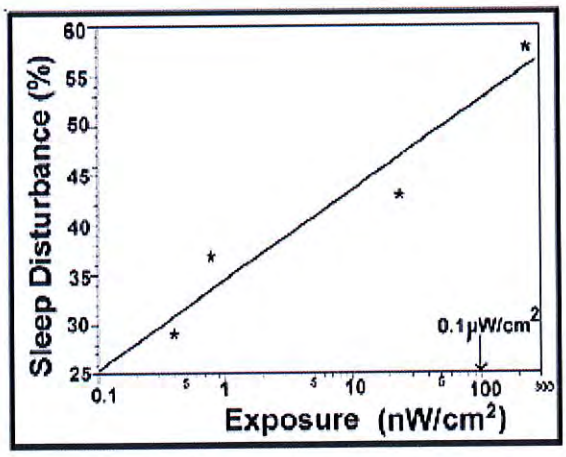


Figure 8 - Dose-response relationship for Sleep Disturbance with exposure in nW/cm^2

5.15 Neurodegenerative Diseases

Exposure to electromagnetic fields has shown to be in connection with Alzheimer's disease, motor neuron disease and Parkinson's disease. All these diseases are involved with the death of specific neurons and are classified as neurodegenerative diseases.

People living near mobile phone base stations are also at risk for developing neuropsychiatric problems as headache, memory loss, nausea, dizziness, tremors, muscle spasms, numbness, tingling, altered reflexes, muscle and joint paint, leg/foot pain, depression, and sleep disturbance. More severe reactions include seizures, paralysis, psychosis and stroke.

5.16 Increase in Cancer risk

Heavy use of mobile phones can cause cancer. Use of mobile phones for >10 years give a consistent pattern of increased risk for brain cancer - glioma (cancer of the glial cells that support the central nervous system) and acoustic neuroma (a benign tumor in the brain on a nerve

related to hearing). The risk is highest for ipsilateral (on the same side of the head where the instrument is held) exposure. Children and teenagers, before the age of 20 are five times more likely to get brain cancer, as their brain is not fully developed and radiation penetration is much deeper. It is possible that today's young people may suffer an "epidemic" of the disease in later life.

Besides increase in brain tumour and acoustic neuroma, there is an increased risk of several other types of cancers following prolonged exposure to mobile phone/ tower radiation, such as, salivary gland tumors, uveal melanoma, lymphoma, facial nerve tumors, skin, blood, testicular and breast cancer. Interphone study has also found a 'significantly increased risk' of some brain tumors for heavy users of mobile phones (> 20 minutes per day) for a period of 10 years or more. It is suggested that children should be discouraged from using mobile phones and restrict use to emergency while adults should "keep calls short".

5.17 Epidemiological studies in various countries

There have been several epidemiological studies of people living near cell phone antennas in Spain, the Netherlands, Israel, Germany, Egypt, Austria, etc. All these studies documents adverse health effects and exposures are orders of magnitude below the FCC or ICNIRP guidelines. Some of these studies are summarized below:

Example 1: FRANCE (Santini, 2002)

In this study the people who lived closest to the cellular antennas had the highest incidences of the following disorders: fatigue, sleep disturbances, headaches, feeling of discomfort, difficulty in concentrating, depression, memory loss, visual disruptions, irritability, hearing disruptions, skin problems, cardiovascular disorders, and dizziness (See Figure 9).

Women were found to have more symptoms than men. This study, based on the symptoms experienced by people living in vicinity of base stations recommend that the cellular phone base stations should not be sited closer than 300 m to populations. This is probably not possible in Urban area, so the solution is to reduce the transmitted power level.

Example 2: GERMANY (Eger H, 2004)

The aim of this study was to examine whether people living close to cellular transmitter antennas were exposed to a greater risk of becoming ill with malignant tumors. The researchers found that the proportion of newly developing cancer cases was significantly higher among those patients who had lived within **400 meters** from the cellular transmitter site during the past 10 years, compared to those patients living further away. They also found that the patients fell ill on average 8 years earlier. After five years of operation of the transmitting installation, the relative risk of getting cancer had increased by 3-fold for the residents of the area near the installation, compared to the inhabitants outside the area. Breast cancer topped the list, and the average age of contracting this disease was considerably lower, 50.8 years compared to 69.9 years for the people living in the outer area. Cancers of the prostate, pancreas, bowel, skin melanoma, lung and blood cancer were all increased.

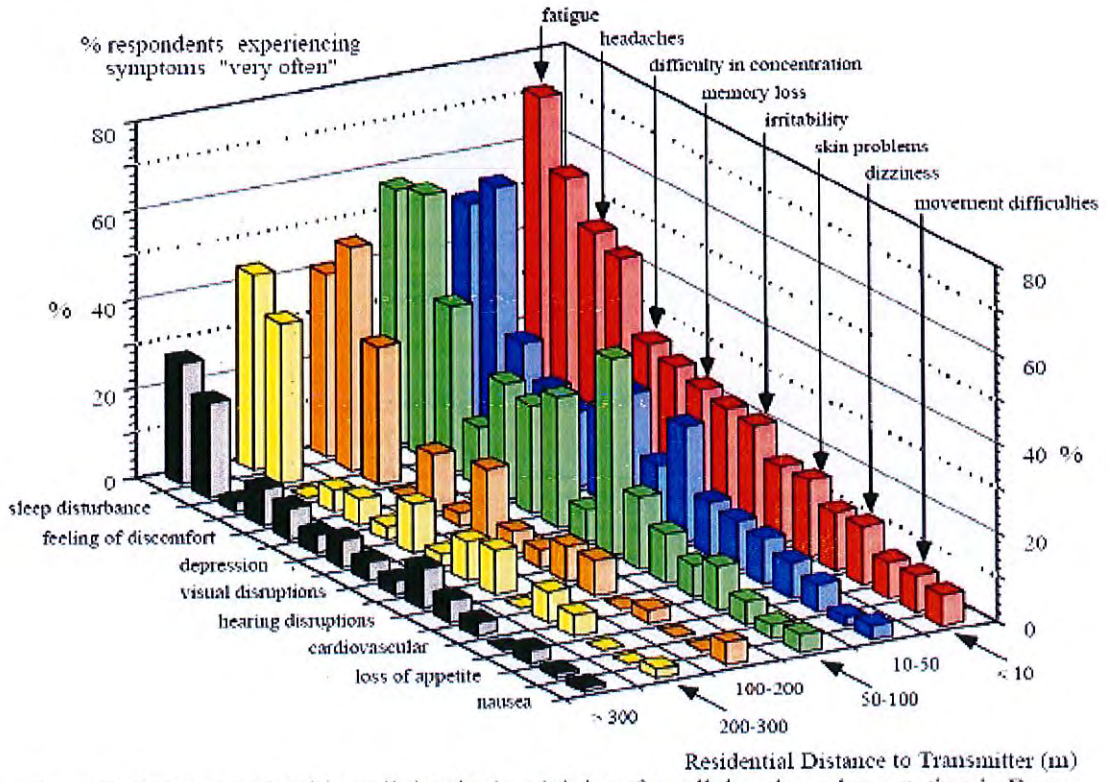


Figure 9. Response of residents living in the vicinity of a cellular phone base station in France.

Example 3: ISRAEL (Wolf R, Wolf D, 2004)

This study, based on medical records of people living within 350 meters of a long established phone mast, showed a fourfold increased incidence of cancer compared with the general population of Israel, and a tenfold increase specifically among women, compared with the surrounding locality further from the mast.

Example 4: SPAIN (Oberfeld 2004)

This study found significant ill-health effects among those living in the vicinity of two GSM mobile phone base stations. The strongest five associations found were depressive tendency, fatigue, sleeping disorder, difficulty in concentration and cardiovascular problems. The scientists reported the following symptoms within 50 to 150 m of the cell phone antenna at an average power density of 0.11 + 0.19 $\mu W/cm^2$. Note that 0.11 $\mu W/cm^2$ is considerably lower than 1000 $\mu W/ cm^2$ established by the FCC. This demonstrates that the FCC guideline does not protect the public from radio frequency radiation exposure.

When honey bee colonies were exposed with radiation, the honeycomb weight and area were reduced and returning time of honey bees increased compared to similar non-exposed colonies. Several other studies show that the high-frequency electromagnetic fields of mobile phones alter the resonant stimulus of living organisms and can cause modifications in certain areas of their brain. Changes in the brain structure of bees can be a cause of alterations of the returning capabilities of bees.

It's not just the honey that will be lost if populations plummet further. Bees are estimated to pollinate 90 commercial crops worldwide. The current dying/vanishing of honey bees can have serious consequences for human health. Scientists warn that the steady decline in bees and other pollinators could trigger crises bigger and more immediate than global warming.

Honey bees brain anatomy as well as the learning regions of the bee brain are well known and comparable to those of vertebrates and are well suited as a bio-indicator. We are fortunate that the warning bells have been sounded and it is for us to timely plan strategies to save not only the bees but human life and environment from the ill effects of such EMR.

6.2 Effect on Birds

When birds are exposed to weak electromagnetic fields, they disorient and begin to fly in all directions, which explain migratory birds undermining navigational abilities. A large number of birds like pigeons, sparrows, swans are getting lost due to interference from the new "unseen enemy", i.e. mobile phone masts. Several million birds of 230 species die each year from collisions with telecommunications masts in the United States during migration. Accidents happen mainly in the night, in fog, or bad weather, when birds might be using the earth's magnetic field for navigation, and could be seriously disoriented by the microwave radiation from telecommunication masts.

During recent decades there has been a marked decline of the house sparrow population. London has witnessed a steep fall in its sparrow population; a 75 per cent fall since 1994. There have been dramatic declines, almost to the point of extinction in Glasgow, Edinburgh, Hamburg, Ghent, Brussels, Dublin, Belgium, etc. Studies show that the disappearance of the sparrow and the introduction of phone mast GSM towers correlate closely in terms of time.

In Spain, to monitor the breeding success of the white stork population, 60 nests were selected and visited from May to June of 2003. Thirty nests were located within 200 m of mobile masts and other 30 were located at a distance of more than 300 m from any transmitter. 40% of the nests close to the antennae were without young, as opposed to 3.3% among those at a larger distance. Behavioural changes were also observed among birds close to the phone antennae. Young birds died from unknown causes and bird couples frequently fought while constructing their nests. Some nests were never completed and the storks remained passively in front of the antennae.

Microwaves from phone masts also interfere with reproductive success of birds. In an experiment, 75% of chicken embryos that were exposed to a GSM mobile phone during incubation died compared to 16%, who were not exposed to any radiation. Birds having nest near

towers were found to leave their nests within one week. The eggs laid in nests near towers failed to hatch.

A general disappearance of birds like Kestrel, White Stork, Rock Dove, pigeons, Magpie has been observed near base stations for mobile telecommunication. Locomotive problems, breeding problems, and tendency to stay long in lower parts of the trees and on the ground have been observed. In some tracked nests (blackbird), the eggs never hatched and also many dead specimens were found near phone masts areas.

A house sparrow is associated with human habitation. Being very sensitive to changes in the environment, it is one of the most preferred indicator species of urban ecosystems. A stable house sparrow population indicates a healthy ecosystem for human beings in terms of air and water quality, vegetation and other parameters of habitat quality. Whereas, a declining population of the bird provides a warning that the urban ecosystem is experiencing some environmental changes unsuitable for human health in the immediate future.

6.3 Effect on mammals and amphibians

The study in Germany showed that cows grazing near cell towers are more likely to experience still births, spontaneous abortions, birth deformities, behavioral problems and general declines in overall health. Moving cattle herds away from such towers has reportedly led to immediate health improvements. Exposing dairy cows to magnetic fields can also result in reduction in milk yield, changed milk composition and fertility problems. Recently, a significant increase of micronuclei in erythrocyte in the blood of cattle grazing on a farm near a transmitting facility was discovered. This is an indication of a genotoxic effect of the exposure, which means the change will pass on to their subsequent generations.

Similarly, impaired immune system in sheep, reproductive and developmental problems in dogs and cats, anxiety and alarm in rabbits, frequent death of domestic animals such as, hamsters, and guinea pigs living near base stations of mobile telecommunication towers has been observed.

Electromagnetic pollution is a possible cause for deformations and decline of some amphibian populations too. Morphological abnormalities, allergies, changes in blood counts, increase in the heart rate, arrhythmia and increased mortality has been found in amphibians like Newts and frog tadpoles. Bat activity is significantly reduced in habitats exposed to electromagnetic field. During a study, in a free-tailed bat colony, the number of bats decreased when several phone masts were placed 80m from the colony.

6.4 Effect on Plants

Apart from bees, birds and animals, electromagnetic radiation emanating from cell towers can also affect vegetables, crops and plants in its vicinity. Studies show definitive clues that cell phone EMF can choke seeds, inhibit germination and root growth, thereby affecting the overall growth of agricultural crops and plants. A reduction in wheat and corn yield in the fields near high EMF lines has also been reported.

Progressive deterioration of trees near phone masts has also been observed. Trees located inside the main lobe (beam), look sad and feeble, have dried tops, show slow growth and high susceptibility to illnesses and plagues. Also, electromagnetic radiations generate heat. Due to this, the microorganisms present in the soil near it would be killed. This in turn harms those organisms which feed on them and disturbs the ecological cycle.

7. Possible Solutions to reduce the ill effects of cell tower radiation

There are several health hazards due to radiation from the cell towers to the human, birds, animals and environment. In India, we have adopted very relaxed radiation norms of 4.7 W/m^2 for GSM900, whereas serious health effects have been noted at as low as 0.0001 W/m^2 = 100 $\mu W/m^2$. One of the first steps to be taken is to tighten the radiation norms and yet it should be practical enough to be cost effective without causing too much inconvenience to the users. It is recommended that maximum cumulative power density allowed should be reduced with immediate effect to 0.1 W/m^2, which should then be subsequently reduced to 0.01 W/m^2 within a year, so that network planning can be carried out in a phased manner. It must be noted that a few countries have even adopted 0.001 W/m^2 or lower, so our proposed recommendation is higher than these countries to keep it cost effective. All the operators must be strictly instructed that power density inside residential or office buildings, schools, hospitals, and at common frequently visited places should be within these guidelines. People must be informed about the harmful radiation effects and corrective measures taken by Govt. of India. Also, people must be informed that for some time, they may have network problem (especially people living far away from the cell tower) due to reduction in the transmitted power but it is for their overall health benefit.

Solution is to have more numbers of cell towers with lesser transmitted power. When power transmitted is reduced, it will not require power hungry power amplifiers having lower efficiency. Heating effect will also be reduced, so lesser cooling or no cooling will be required; all of these will reduce the power requirement, which can also be met by solar panel. Thus, high power diesel generators will also be not required; it will reduce the carbon emission and we can earn from carbon credits.

In addition, repeaters or signal enhancers or boosters may have to be installed where signal is weak. Care must be taken that maximum power transmitted by these must not exceed 0.1W because of their close proximity to the users.

Self certification by the operators must be immediately abolished; measurements must be done by third party, which is independent and trustworthy. Also, radiation measurements must be monitored continuously, so that operators should not increase the transmitted power during the peak period. Very strict penalties must be imposed on those operators, who violate these norms as it causes serious health hazards to innocent people.

The reduction in the transmitted power for the above solutions will definitely increase the installation and maintenance cost, because of this reason, operators all over the world are claiming that there are no radiation health hazards. Increase in the cost of deployment of network can be met by increasing per minute charges from Rs. 0.30 to 0.35, extra carbon credits earned,

etc. Also, Govt. may consider reducing the tax or license fee in the overall interest of saving the lives of people, birds, animals, plants, and environment, thereby saving mother earth.

8. Conclusion

The seriousness of the health hazards due to radiation from the cell phones and cell towers has not been realized among the common man. Cell operators continue to claim that there are no health issues. Even organizations like WHO, ICNIRP, FCC, etc. have not recommended stricter safe radiation guidelines, whereas several countries have adopted radiation norms, which are $1/100^{th}$ to $1/1000^{th}$ of these values based on their studies. Cell phone industry is becoming another cigarette industry, which kept claiming that smoking is not harmful and now there are millions of people around the world who have suffered from smoking. In fact, cell phone/tower radiation is worse than smoking; as one cannot see it or smell it, and its effect on health is noted after a long period of exposure. Therefore, majority of people tend to have casualness towards personal protection. Unfortunately, ignorance and non-awareness adds to this misery and all of us are absorbing this slow poison unknowingly. Even if people are aware of the radiation hazard, they may not have the choice to move away from it if the tower is installed near their office or residential building.

In addition to the continuous radiation from cell towers, there is radiation from cell phones, wireless phones, computers, laptops, TV towers, FM towers, AM towers, microwave ovens, etc. We are exposed to all these radiations which are additive in nature. Hence, it is imperative that stricter radiation norms must be enforced by the policy makers.

This does not mean that we have to stop living near these towers. We all know that automobiles create air pollution – have we stopped using them? Instead, solutions were found such as unleaded petrol, catalytic converters to reduce emission, CNG driven vehicles, hybrid vehicles, etc. If people in the mobile companies think there is no health hazard, then let them stand in front of their own transmitting tower at 1m distance in the main beam for 6 hours – are they willing to take the risk? Similar effect will be there at 10m distance in about 600 hours (25 days). If mobile companies accept that radiation causes serious health problems, will people stop using cell phones? Not really, because the cell technology has its several advantages. However, then researchers/technocrats/entrepreneurs will come out with possible solutions, which may be expensive but that cannot be greater than the health risk faced by humans, birds, animals and environment.

Appendix A – Conversion from power received to electric field and power density

Power Density S can be calculated from the following equation in W/m²

$$S = \frac{P \cdot 4\pi \cdot f^2}{c_0^2 \cdot G_i}$$

where,

P	Measured Power in W (Example: P= -30dBm = 0.000001W)
G_i	Gain of receiving antenna
f	Frequency in Hz
c_o	Velocity of light = 3 x 10^8 m/s.

Following table gives values of electric field and power density for an isotropic antenna G_i = 1 for different values of power received.

Conversion table

Conversion between units: dBm to V/m, W/m		
0 dBm	6.75V/m	0.121W/m²
-1 dBm	6.02V/m	0,096.0W/m²
-2 dBm	5,36V/m	0,076.3W/m²
-3 dBm	4.78V/m	0,060.6W/m²
-4 dBm	4.26V/m	0,048.1W/m²
-5 dBm	3,80V/m	0,038.2W/m²
-6 dBm	3.38V/m	0,030.4W/m²
-7 dBm	3.02V/m	0,024.1W/m²
-8 dBm	2,69V/m	0,019.2W/m²
-9 dBm	2.40V/m	0,015.2W/m²
-10dBm	2.13V/m	0,012.1W/m²
-11dBm	1.90V/m	0,009.60W/m²
-12dBm	1.70V/m	0,007.63W/m²
-13dBm	1.51V/m	0,006.06W/m²
-14dBm	1.35V/m	0,004.81W/m²
-15dBm	1,20V/m	0,003.82W/m²
-16dBm	1.07V/m	0,003.04W/m²
-17dBm	0.954V/m	0,002.41W/m²
-18dBm	0,850V/m	0,001.92W/m²
-19dBm	0.758V/m	0,001.52W/m²
-20dBm	0.675V/m	0,001.21W/m²
-21dBm	0,602V/m	0,000.960W/m²
-22dBm	0,536V/m	0,000.763W/m²
-23dBm	0.478V/m	0,000.606W/m²
-24dBm	0,426V/m	0,000.481W/m²
-25dBm	0,380V/m	0,000.382W/m²
-26dBm	0,338V/m	0,000.304W/m²
-27dBm	0.302V/m	0,000.241W/m²
-28dBm	0,269V/m	0,000.192W/m²
-29dBm	0,240V/m	0,000.152W/m²
-30dBm	0.213V/m	0,000.121W/m²
-31dBm	0,190V/m	0,000.096.0W/m²
-32dBm	0,170V/m	0,000.076.3W/m²
-33dBm	0,151V/m	0,000.060.6W/m²
-34dBm	0,135V/m	0,000.048.1W/m²
-35dBm	0,120V/m	0,000.038.2W/m²

dBm = decibel milliwatts, W/m² = watts per square meter, V/m = volts per meter, A/m amperes per meter

Conversion between units: dBm to V/m, W/m		
-36dBm	0,107V/m	0,000.030.4W/m²
-37dBm	0,095.4V/m	0,000.024.1W/m²
-38dBm	0,085.0V/m	0,000.019.2W/m²
-39dBm	0,075.8V/m	0,000.015.2W/m²
-40dBm	0,067.5V/m	0,000.012.1W/m²
-41dBm	0,060.2V/m	0,000.009.60W/m²
-42dBm	0,053.6V/m	0,000.007.63W/m²
-43dBm	0,047.8V/m	0,000.006.06W/m²
-44dBm	0,042.6V/m	0,000.004.81W/m²
-45dBm	0,038.0V/m	0,000.003.82W/m²
-46dBm	0,033.8V/m	0,000.003.04W/m²
-47dBm	0,030.2V/m	0,000.002.41W/m²
-48dBm	0,026.9V/m	0,000.001.92W/m²
-49dBm	0,024.0V/m	0,000.001.52W/m²
-50dBm	0,021.3V/m	0,000.001.21W/m²
-51dBm	0,019.0V/m	0,000.000.960W/m²
-52dBm	0,017.0V/m	0,000.000.763W/m²
-53dBm	0,015.1V/m	0,000.000.606W/m²
-54dBm	0,013.5V/m	0,000.000.481W/m²
-55dBm	0,012.0V/m	0,000.000.382W/m²
-56dBm	0,010.7V/m	0,000.000.304W/m²
-57dBm	0,009.54V/m	0,000.000.241W/m²
-58dBm	0,008.50V/m	0,000.000.192W/m²
-59dBm	0,007.58V/m	0,000.000.152W/m²
-60dBm	0,006.75V/m	0,000.000.121W/m²
-61dBm	0,006.02V/m	0,000.000.096.0W/m²
-62dBm	0,005.36V/m	0,000.000.076.3W/m²
-63dBm	0,004.78V/m	0,000.000.060.6W/m²
-64dBm	0,004.26V/m	0,000.000.048.1W/m²
-65dBm	0,003.80V/m	0,000.000.038.2W/m²
-66dBm	0,003.38V/m	0,000.000.030.4W/m²
-67dBm	0,003.02V/m	0,000.000.024.1W/m²
-68dBm	0,002.69V/m	0,000.000.019.2W/m²
-69dBm	0,002.40V/m	0,000.000.015.2W/m²
-70dBm	0,002.13V/m	0,000.000.012.1W/m²

Appendix B - Videos on Radiation

- **Cell Phone Antennas on Apartment Rooftops and their Health Effects**
  http://www.youtube.com/watch?v=-G3CWrgDS5E
  Woman experiences illness after two months of cell phone antennas installed on roof top
- **Phone tumour**
  http://au.video.yahoo.com/watch/8546044/22969162
  Anna , 27, and her doctor convinced that her brain tumour is due to heavy mobile use.
- **New evidence in mobile phone tumour link**
  http://www.youtube.com/watch?v=fMZhkDEsXU8&feature=player_embedded
  David,30,developed tumour the size of gulf ball behind right ear where he held his phone.
- **Cell phone towers in cities health hazards?**
  http://www.youtube.com/watch?v=IOc99xpiy2E&feature=player_embedded
  Mrs. Bhatt, brain aneurysm patient, blames the cell phone tower for her problem.
- **Cell phone antennas blamed for kindergarten cancer cases, Chicago**
  http://www.youtube.com/watch?v=BrQ9uXv57_s&feature=youtu.be
  3 students died of leukemia and 30% of staff sick
- **EMF RF Exposure from cell phone radiation is potentially harmful**
  http://www.youtube.com/watch?v=BXn8c41ZVTQ
  Sarah Dacre, suffers from EHS and wears special shielded clothes to protect herself
- **Health danger - wifi radiation - 2 –**
  http://www.youtube.com/watch?v=EykTJJMvjCs
  Lady lives in a room with Silver foiling
- **Growing Evidence That Cell Phones Create Tumors**
  http://www.youtube.com/watch?v=-9DuCzGLohc&feature=player_embedded
  Alan,57, developed a gulf ball size tumour on right side of brain where he held his phone.
- **Dr. Charlie Teo -"explosion" in brain tumours and truth about the wireless society**
  http://www.youtube.com/watch?v=Zq340oQPfK4&feature=player_embedded#!
  John developed malignant tumour behind right ear; Dr. Teo's (neurosurgeon) testimony
- **Cell Phones & Cigarettes: What do they have in Common?**
  http://www.youtube.com/watch?v=K4uz2TUcwnI
- **Live Blood & Electrosmog** - http://www.youtube.com/watch?v=L7E36zGHxRw
- **Street protests against Mobile masts in Taiwan –** http://bit.ly/a2JNnZ
- **Mumbai highly unsafe due to heavy mobile tower radiation but VVIPS house is safe**
  http://www.youtube.com/watch?v=JCN9FLSvwhQ&feature=youtu.be - IN HINDI
- **The National Cell Phones and Disease Sept 26 2010**
  http://www.youtube.com/watch?v=F4bp7Zi_8pk
  Facts and fine prints about cell phone use
- **Invisible Dangers of Cell Phone Radiation**
  http://www.youtube.com/watch?v=eVo2maA7h1E
- **Dr Magda Havas - On Cell /Transmission Towers and Your Health**
  http://video.google.ca/videoplay?docid=6284020723745580379#
- **Cell Phones and Brain Cancer - The Interphone Study**
  http://www.youtube.com/watch?v=npK5HSxukyA
  Interphone witnesses testified about research into cell phone use and its impact on health

More reports and videos have been uploaded at Blog: http://neha-wilcom.blogspot.com and Twitter: https://twitter.com/wilcom_neha

http://www.scribd.com/doc/3935076/Radiofrequency-and-Extremely-LowFrequency-Electromagnetic-Field-Effects-on-the-BloodBrain-Barrier
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Radiation from Mobile Tower - Health Hazard, Norms, Cases

1. 1. REPORT ONCELL TOWER RADIATION Submitted To Secretary, DOT, Delhi Prepared By Prof. Girish Kumar Electrical Engineering DepartmentIIT Bombay, Powai, Mumai – 400 076 gkumar@ee.iitb.ac.in December 2010 1

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3. 3. 1. Advantages and disadvantages of cell phone technologyCell phone technology has revolutionized the telecommunication scenario in India. Due to itsseveral advantages, cell phone technology has grown exponentially in the last decade. Currently,there are more than 50 crore cell phone users and nearly 4.4 lakh cell phone towers to meet thecommunication demand. The numbers of cell phones and cell towers are increasing withoutgiving due respect to its disadvantages. All over the world, people have been debating aboutassociated health risk due to radiation from cell phone and cell tower. Radiation effects aredivided into thermal and non-thermal effects. Thermal effects are similar to that of cooking in themicrowave oven. Non-thermal effects are not well defined but it has been reported that non-thermal effects are 3 to 4 times more harmful than thermal effects.A cell phone transmits 1 to 2 Watt of power in the frequency range of 824 - 849 MHz (CDMA),890 - 915 MHz (GSM900) and 1710 – 1780 MHz (GSM1800). A cell phone has a SAR (SpecificAbsorption Rate) rating. In USA, SAR limit for cell phones is 1.6W/Kg which is actually for 6minutes per day usage. It has a safety margin of 3 to 4, so a person should not use cell phone formore than 18 to 24 minutes per day. This information is not commonly known to the people inIndia, so crores of people use cell phones for more than an hour per day without realizing itsassociated health hazards.Cell tower antennas transmit in the frequency range of 869 - 894 MHz (CDMA), 935 - 960 MHz(GSM900) and 1810 – 1880 MHz (GSM1800). Also, 3G has been deployed in a few cities, inwhich base station antenna transmits

in the frequency range of 2110 – 2170 MHz. Mobile phoneoperators divide a region in large number of cells, and each cell is divided into number ofsectors. The base stations are normally configured to transmit different signals into each of thesesectors. In general, there may be three sectors with equal angular coverage of 120 degrees in thehorizontal direction as this is a convenient way to divide a hexagonal cell. If number of users isdistributed unevenly in the surrounding area, then the sectors may be uneven. These base stationsare normally connected to directional antennas that are mounted on the roofs of buildings or onfree-standing masts. The antennas may have electrical or mechanical down-tilt, so that thesignals are directed towards ground level.A base station and its transmitting power are designed in such a way that mobile phone should beable to transmit and receive enough signal for proper communication up to a few kilometers.Majority of these towers are mounted near the residential and office buildings to provide goodmobile phone coverage to the users. These cell towers transmit radiation 24x7, so people livingwithin 10's of meters from the tower will receive 10,000 to 10,000,000 times stronger signal thanrequired for mobile communication. In India, crores of people reside within these high radiationzones.2. Radiation from the cell towerA GSM900 base station antenna transmits in the frequency range of 935 - 960 MHz. Thisfrequency band of 25 MHz is divided into twenty sub-bands of 1.2 MHz, which are allocated tovarious operators. There may be several carrier frequencies (1 to 5) allotted to one operator withupper limit of 6.2 MHz bandwidth. Each carrier frequency may transmit 10 to 20W of power. So, 3

4. 4. one operator may transmit 50 to 100W of power and there may be 3-4 operators on the same rooftop or tower, thereby total transmitted power may be 200 to 400W. In addition, directionalantennas are used, which typically may have a gain of around 17 dB (numeric value is 50), soeffectively, several KW of power may be transmitted in the main beam direction.2.1 Radiated power density from the cell towerPower density Pd at a distance R is given by □ P ×G □ Pd = □ t 2 t □ Watt/m2 □ 4πR □where, Pt = Transmitter power in WattsGt = Gain of transmitting antennaR = Distance from the antenna in metersFor Pt = 20 W, Gt = 17 dB = 50, Pd for various values of R is given in Table 1. Table 1 – Power density at various distances from the transmitting tower Distance R (m) Power density Pd inW/m2 Power density Pd in μW/m2 1 79.6 79,600,000 3 8.84 8,840,000 5 3.18 3,180,000 10 0.796 796,000 50 0.0318 31,800 100 0.008 7,960 500 0.000318 318The power density values given in Table 1 are for a single carrier and a single operator. Ifmultiple carriers are being used and multiple operators are present on the same roof top or tower,then the above values will increase manifold. However, radiation density will be much lower inthe direction away from the main beam. One should know actual radiation pattern of the antenna(which unfortunately is not made public) to calculate exact radiation density at a point.2.2 Radiation pattern of the antennaThe simulated radiation pattern of GSM900 antenna of approximately 17 dB gain at 950 MHz ofsize 2400 mm x 30 mm is shown in Fig. 1. Radiation pattern of the antenna is shown in twoplanes – horizontal and vertical. There is one main lobe and several side lobes. For the mainlobe, half-power beam-width (HPBW – defined as angular range over which maximum powerdecreases to half of its value) in the horizontal direction is 65 degrees and HPBW in the verticaldirection is 6 degrees. There are several side lobes, whose maximum levels are about -13 to -20dB below the main level. 4

5. 5. (a) (b) Fig. 1 – (a) Horizontal and (b) Vertical radiation pattern of a 17 dB gain antenna2.3 Case study of Usha Kiran Building, MumbaiThrough the help of the above typical radiation pattern,

let's analyze the news reported in Mid-day, Mumbai dated Jan. 3, 2010, which stated - "Mumbais swanky Usha Kiran building says thefour cancer cases there could be linked to mobile towers installed on the facing VijayApartments". The picture taken from the Usha Kiran building of the several antennas installed onthe seventh floor of Vijay Apartments is shown in Fig. 2. People living in the 6th, 7th and 8thfloor in the opposite building will get maximum radiation as they are in the main beam direction.People living on the other floors will receive lesser radiation as beam maxima is reducedconsiderably as can be observed from vertical radiation pattern. In the horizontal direction again,people living in the front side of the antenna will receive much higher radiation compared topeople living in the back side of antenna.http://www.mid-day.com/news/2010/jan/030110-mobile-tower-cancer-cases-carmichael-road-posh-areas.htm 5

6. 6. Fig. 2 – Cell phone towers installed at the roof top of a building in MumbaiFrom Table 1, it may be noted that for a single transmitter, power density at R = 50m is equal to0.0318W/m2 = 31,800 μW/m2. Even for 3 transmitters in the same direction, it comes out to beapproximately 0.1 W/m2 = 100,000 μW/m2, which has caused cancer to several people in aduration of 2 to 3 years.3. Radiation norms adopted in different countriesIn India, we have adopted radiation norms given by ICNIRP guidelines of 1998 for safe powerdensity of f/200, where frequency (f) is in MHz. Hence, for GSM900 transmitting band (935-960MHz), power density is 4.7W/m2 and for GSM1800 transmitting band (1810-1880 MHz), it is9.2W/m2. The ICNIRP guidelines clearly state that for simultaneous exposure to multiplefrequency fields, the sum of all the radiation must be taken into consideration. However, in India,we have applied this limit to individual carrier, so the radiation level exceeds by several timesthan even prescribed by ICNIRP guidelines, depending upon the total number of transmitters inthat area Some of the people (especially older people, house wives, small children) living nearthe towers are exposed to this radiation 24 hours a day. Unfortunately, ICNIRP has consideredonly the thermal effects of radiation, where as scientist all over the world have found non-thermal effects of these radiations to have significant health effects and these non-thermal healtheffects occurs at levels much below these norms.Bio-Initiative Report in 2007 (610 pages long) has been prepared by a group of independentscientists after thorough and very careful survey of the literature and they concluded that theexisting standards for public safety are inadequate to protect public health and proposed 1000μW/m2 for outdoor, cumulative RF exposure. Some of the proposed maximum exposure valuesthrough various reports are given below: 6

7. 7. •Building Biology Institute, Germany, provided following guidelines for exposure:a. <0.1 μW/m2 (0.00001 μW/cm2) - no concernb. 0.1 - 10 μW/m2 (0.00001 to 0.001 μW/cm2) - slight concernc. 10 - 1000 μW/m2 (0.001 to 0.1 μW/cm2) - severe concernd. > 1000 μW/m2 (> 0.1 μW/cm2) - extreme concern•H Thomas et al, Germany; power densities should not exceed 100 μW/m2•EU Parliament (STOA 2001) recommends - 100 μW/m2The current USA standard for radiation exposure from cell phone towers is 580-1,000microwatts per sq. cm. (μW/cm2), but they are now considering revising the norms. Over 100physicians and scientists at Harvard and Boston University Schools of Public Health have calledcellular towers a radiation hazard. And, 33 delegate physicians from 7 countries have declaredcell phone towers a "public health emergency". Many countries in the world have adopted muchstricter maximum radiation density values of 0.001 to 0.24 W/ m2 (1/100th to 1/1000th of ICNIRPguidelines) as shown in Table 2. The people in these countries have studied extensively thehealth hazards of cell tower

radiation to adopt stricter radiation norms. As can be seen in the casedescribed in Section 2.3, even 0.1 W/m2 = 100,000 μW/m2 has caused cancer to several people ina duration of 2 to 3 years. Table 2 - International Radiation Density Limits for GSM1800 Power Density (W/m^2) International Exposure limits adopted by various countries 10 FCC (USA) OET-65, Public Exposure Guidelines at 1800 MHz 9.2 ICNIRP and EU recommandation 1998 – Adopted in India 3 Canada (Safety Code 6, 1997) 2 Australia 1.2 Belgium (ex Wallonia) 0.5 New Zealand 0.24 Exposure limit in CSSR, Belgium, Luxembourg 0.1 Exposure limit in Poland, China, Italy , Paris 0.095 Exposure limit in Italy in areas with duration > 4hours 0.095 Exposure limit in Switzerland 0.09 ECOLOG 1998 (Germany) Precaution recommendation only 0.025 Exposure limit in Italy in sensitive areas 0.02 Exposure limit in Russia (since 1970), Bulgaria, Hungary 0.001 "Precautionary limit" in Austria, Salzburg City only 0.0009 BUND 1997 (Germany) Precaution recommendation only 0.00001 New South Wales, Australia 7

8. 8. At many places, cell phone towers are mounted on the roof top of residential /commercialbuildings. Even though antenna radiates less power vertically down but the distance between theantenna and top floor is usually a few meters, so the radiation level in the top two floors remainvery high. From Table 1, power density at R = 3m is equal to 8,840,000 μW/m2 in the mainbeam. In the vertically down direction, radiation is approximately 20-22 dB less and the roofmay provide attenuation of 6 to 10 dB depending on the construction (implying 1/1000th power),implying radiation density of 8,840 μW/m2, which is still very high.Lets do some simple calculation of how much microwave power will be absorbed by humanbody if exposed to the so called safe radiation level adopted in India of power density = 4.7W/m2 for GSM900 band,. If we model human body as a cylinder, then its area will be 1.436square meter (average height 56" = 1.67 m and waist 34" = 86 cm). So, power recd. by humanbody will be power density x area = 6.75 Watts. In one hour, microwave energy absorbed will be6.75 x 3600 = 24.3 KW-sec. In one day, microwave energy absorbed will be 24.3 x 24 = 583.2KW-sec. A typical microwave oven has a rating of 700 to 1000 W, and with say 60% efficiency,microwave power output is approximately 500 W. This implies that human body can be safelykept in a microwave oven for 583.2 KW-sec / 500 W = 1166 seconds = 19 minutes per day. Howmany people in the world are willing to put themselves, their family members, and their unbornchildren in an open microwave oven for 19 minutes/day? Telecom providers or policy makerscan argue about body being adaptable to external threats and the radiation is spread over wholeday. However, question remains, would we like to put our citizens in an open microwave ovenfor 19 minutes/day over the years. Also, this is only for a single source. For multiple sources, itwill increase correspondingly. Thus, the safe limit adopted by India is extremely high andmillions of people are suffering because of this.Interphone study in 2010 mentions that excessive use of mobile phones has doubled toquadrupled brain tumor risk. However, they claim that for an average user, increase in cancercases is not significant but they have taken an average user as a person who uses cell phone for 2hours/month. In India, many people use cell phones for 1 to 2 hours per day. Re-evaluation of theInterphone study by a group of eminent scientist has found that the risk of affected people issignificantly higher than reported. Interphone Study excluded children from the study. Childrenare at higher risk from exposures to carcinogens than adults and today very large population ofchildren are using cell phones and also many of them sleep with the cell phones beneath theirpillows every night without realizing the health hazards.A number of adverse health effects have been documented

at levels below the FCC guidelines,which include altered white blood cells in children; childhood leukemia; impaired motorfunction, reaction time, and memory; headaches, dizziness, fatigue, weakness, and insomnia etc.Figure 3 shows guidelines adopted by various countries in the top right corner and health effectsof radio frequency radiation at various power densities at much lower level. 8

9. 9. Figure 3: Guidelines, exposures and effects of radio frequency radiation at various powerdensities. Data from Firstenberg 2001.4. Theoretical and Measured Radiated powerTo measure the power at a distance R, an antenna is used to receive the power and a spectrumanalyzer or power meter is used to measure received power.Power Received Pr by an antenna at a distance R is given by: 2 ? λ ? Pr = Pt × Gt × G r × ? ? ? 4πR ?Received power is directly proportional to the transmitted power, gain of transmitting andreceiving antennas, and square of wavelength of the signal and it is inversely proportional tosquare of distance. For transmitter power Pt = 20 W, transmitting antenna gain Gt = 17 dB,receiving monopole antenna gain Gt = 2 dB, the received power at R = 50 m is:At 887 MHz (tower transmitting frequency in CDMA), Pr = -3.2 dBm. 9

10. 10. At 945 MHz (tower transmitting frequency in GSM900), Pr = -3.8 dBm.At 1872 MHz (tower transmitting frequency in GSM1800), Pr = -9.7 dBmThe purpose of a cell tower is that mobile phone should receive adequate signal for its properoperation. A mobile phone shows full strength at -69 dBm input power and works satisfactorilyin the received power range of -80 to -100 dBm. In comparison with -80 dBm level, themeasured power level at R = 50m is at least 50 to 60 dB higher, which translates to 100,000 to1,000,000 times stronger signal than a mobile phone requires. There are millions of people wholive within 50m distance from cell towers and absorbing this radiation 24x7.4.1 Conversion from measured power to power densityThese measured power levels are in dBm whereas international standards are in terms of powerdensity. In Table 3, conversion from measured power in dBm using a monopole antenna of gain= 2 dB (radiation monitor consists of this antenna) to power density is given.Table 3 - Conversion from Power received from a monopole antenna of gain = 2 dB toPower Density at different frequencies.Power received Power density for different frequencies (Micro Watt/sq. meter) f = 900 MHz f = 1800 MHz f = 2450 MHz10 dBm = 10 mW 706,860 2,827,440 5,238,1803 dBm = 2.0 mW 141,372 565,488 1,047,6360 dBm = 1.0 mW 70,686 282,744 523,818-7 dBm = 200μW 14,137 56,549 104,764-10 dBm = 100μW 7,068.6 28,274.4 52,382-17 dBm = 20 μW 1,414 5,655 10,476-20 dBm = 10 μW 706.9 2,827.4 5,238-27 dBm = 2 μW 141.4 565.5 1,048-30 dBm = 1 μW 70.7 282.7 523.8-37 dBm = 0.2 μW 14.1 56.6 104.8-40 dBm = 0.1μW 7.1 28.3 52.4wheref = 900 MHz is approximately the center frequency of CDMA tower (869 to 890 MHz) andGSM900 tower (935 to 960 MHz) transmit frequency bandsf = 1800 MHz corresponds to GSM1800 cell tower (1810 to 1880 MHz) transmit frequencyband.f = 2450 MHz is approximately the center frequency of WiFi, WLAN, Bluetooth, Microwaveoven, etc. 10

11. 11. 4.2 Measurement at a cancer's patient residenceSince the radiation effect on the human body is cumulative, a hand held broadband radiationmonitor (Frequency range of 800 to 2500 MHz) has been developed to measure the totalreceived power. Radiation measurements were carried out in a lady's apartment, who haddeveloped cancer within one year of installation of cell tower. The layout of the apartment andthe measured readings are shown in Fig. 3. It may be noted that the radiation level is very highand it is between – 4 to -10 dBm. At 900 MHz, -10 dBm

received power is equivalent to 7,068μW/m2, again implying that safe radiation norms must be reduced considerably than adopted byIndia, which is 4.7W/m2 = 4,700,000 μW/m2. -6 -4 -6 -4 -6 -6 -10 -10 -8 -6 -6 -24 -12 -14 -18 -12 -30 Entrance Fig. 3 – Measured power at a cancer patient's residence4.3 Radiation Measurement at various placesRadiation measurements were carried out at various places in Gurgaon, Delhi and Mumbai.Some of these readings are given in Table 4. It may be noted that on Delhi-Gurgaon Highwaybridge after Toll Naka towards Delhi, the measured radiated power was as high as 0 dBm, whichis equivalent to 70,686μW/m2 as there are 3 cell towers near the highway. 11

12. 12. Table 4 – Measured Radiated power and power density at various locations Measured Power Density Power DensityLocation power in dBm in W/m2 in μW/m2Delhi-Gurgaon Highway near Toll (3 towers) 0 0. 70686 70,686Khar Bridge, Mumbai 0 0.70686 70,686Bridge b/w Vashi and Sanpada, Navi Mumbai -4 0.028274 28,274Worli Naka -4 0.028274 28,274Tilak Bridge, Dadar -4 0.028274 28,274 thResident1,4 Fl. Sergeant House Lady w/cancer -6 0.017756 17,756Bandra Bridge -6 0.017756 17,756Airport Bridge -6 0.017756 17,756Resident 2, Rane Society, Powai -10 0.007069 7,069 Near Hub mall, Goregaon -10 0.007069 7,069Mahalaxmi Temple, Bhulabhai Desai Road -10 0.007069 7,069Haji Ali, Juice Centre -10 0.007069 7,069IIT Bombay, Main Building -10 0.007069 7,069Gandhi Nagar-over railway bridge-near building -12 0.00446 4,460JK Cement group, Worli -12 0.00446 4,460Ustav Chowk, Kharghar -12 0.00446 4,460Siddhivinayak Temple -14 0.002814 2,814Vikroli - before Godrej -14 0.002814 2,814Govandi- Residential towers - near Indian Oil -14 0.002814 2,814Kemp's Corner -14 0.002814 2,814Race Course- Haji Ali -14 0.002814 2,814Powai Plaza -14 0.002814 2,814Belapur Flyover, near RBI- CIDCO -16 0.001776 1,776Vile Parle -16 0.001776 1,776Peddar Road (Punjab National Bank) -16 0.001776 1,776Dadar Plaza -16 0.001776 1,776Poddar Medical College -16 0.001776 1,776Vashi Highway – near Turbhe -18 0.00112 1,120Andheri Bridge- continuous high till Jogeshwari -18 0.00112 1,120Nerul Bridge -20 0.00707 707Vivero pre School (opposite powai lake) -22 0.000446 446Powai police station -22 0.000446 446L&T Bridge -24 0.000446 281.4Rajeev Gandhi nagar -26 0.000177 177On road near Evita (Hiranandani Building) -28 0.000112 112D-Mart,Hiranandani, Powai -34 0.000028 28Poddar Road opp. Mukesh Ambani Residence -36 0.000028 17.8IIT Bombay School of Management - Entrance -46 0.00000178 1.78Resident at Central Area, IIT Bombay -56 0.000000178 0.178 12

13. 13. 5. Biological effects of microwave radiationWhen a human body is exposed to the electromagnetic radiation, it absorbs radiation, becausehuman body consists of 70% liquid. It is similar to that of cooking in the microwave oven wherethe water in the food content is heated first. Microwave absorption effect is much moresignificant by the body parts which contain more fluid (water, blood, etc.), like the brain whichconsists of about 90% water. Effect is more pronounced where the movement of the fluid is less,for example, eyes, brain, joints, heart, abdomen, etc. Also, human height is much greater than thewavelength of the cell tower transmitting frequencies, so there will be multiple resonances in thebody, which creates localized heating inside the body. This results in boils, drying up of thefluids around eyes, brain, joints, heart, abdomen, etc.There are several health hazards associated with cell phones and cell towers. Some of these aredescribed in the following sub-sections.5.1 The Blood Brain BarrierThe brain is protected by tight junctions between adjacent cells of capillary walls by the blood-brain barrier (BBB), which selectively lets nutrients pass through from the blood to the brain,

butkeeps toxic substances out. Experiments conducted on young laboratory rats found that RF frommobile phones can significantly open the BBB in animals and cause leakage of albumin fromblood vessels in inappropriate locations (neurons and glial cells surrounding the capillaries) inthe brain. This is shown in Fig. 4 as dark dots in the exposed brain on the right side. Controlanimals, in contrast, showed either no albumin leakage or occasional isolated spots, as seen onthe left side. The presence of albumin in brain tissue is a sign that blood vessels have beendamaged and that the brain has lost some of its protection. Figure 4 - Comparison of brains from unexposed and exposed ratsA closer look at the cells within the brain also revealed that exposed animals had scattered andgrouped dark neurons often shrunken with loss of internal cell structures. Neuronal damage ofthis kind may not have immediate consequences but in the long run, it may result in reducedbrain reserve capacity that might be unveiled by other later neuronal diseases. It must be notedthat the blood-brain barrier and neurons are the same in a rat and a human being. 13

14. 14. In another research, a single two-hour exposure to a cell phone just once during its lifetime,permanently damaged the blood-brain barrier and, on autopsy 50 days later, was found to havedamaged or destroyed up to 2 percent of an animal's brain cells, including cells in areas of thebrain concerned with learning, memory and movement. It is known that this barrier is damagedin Alzheimers and Parkinsons disease. So there is a risk that disruption of this protection barriermay damage the brain.5.2 Risk to Children and Pregnant WomenChildren are more vulnerable to cell phone radiation as they:• Absorb more energy than adults from the same phone owing to their smaller head and brain size, thinner cranial bones and skin, thinner, more elastic ears, lower blood cell volume, as well as greater conductivity of nerve cells and the energy penetrates more deeply. Tumors in the mid brain are more deadly than in the temporal lobe,• Children's cells reproduce more quickly than adults which makes cancers more deadly,• There immune system is not as well developed as adults hence are less effective against fighting cancer growth,• Children have longer life time exposure.Absorption of electromagnetic radiation from a cell phone (Frequency - GSM 900 MHz) isshown in Fig. 5 by an adult, 10 year old and a 5 year old child. When radiation hits the head, itpenetrates the skull. The yellow area at the bottom is the location of the cell phone by the ear.The radiation penetrates the skull of an adult (25%), 10 year old (50%) and a 5 year old (75%). Fig. 5 - Absorption of electromagnetic radiation from a cell phone based on age (Frequency GSM 900 MHz)The younger the child, the deeper is the penetration due to the fact that their skulls are thinnerand still developing. For these reasons it is critical that children under the age of 16 use cellphones only for short essential calls as they have much bigger danger of getting a brain tumor.Brain tumors have now taken over leukemia as the biggest cause of death amongst children. Dueto these reasons countries like Belgium, France, Finland, Germany, Russia and Israel havepublicly discouraged use of cell phones by children. An Independent research in Sweden lastyear concluded there was an astonishing 420 percent increased chance of getting brain cancer forcell phone users who were teenagers or younger when they first started using their phones. 14

15. 15. A pregnant woman and the fetus both are vulnerable because of the fact that these RF radiationscontinuously react with the developing embryo and increasing cells. Microwave radiation candamage the placental barrier; the membrane which prevents the passage of some materialsbetween the maternal and fetal blood, protecting the fetus, implying that pregnant

woman shouldavoid cell phone or use during emergency.In a recent finding, an association was found between a mother's cell phone use duringpregnancy and greater likelihood for spontaneous abortion, congenital malformations andbehavioral problems in their children. It is believed that the eggs, which form the embryo, areaffected and the damage will become apparent after the child reaches puberty.The Russian National Committee on Non-Ionizing Radiation Protection says that use of thephones by both pregnant women and children should be "limited". It concludes that children whotalk on the handsets are likely to suffer from "disruption of memory, decline of attention,diminishing learning and cognitive abilities, increased irritability" in the short term, and thatlong-term hazards include "depressive syndrome" and "degeneration of the nervous structures ofthe brain".5.3 Irreversible infertilityRecent studies confirm that cell phone radiation can drastically affect male fertility. In 2006, theAmerican Society for Reproductive Medicine reported that use of cell phones by men isassociated with decrease in semen quality, sperm count, motility, viability and normalmorphology and is related to the duration of cell phone use. Studies have found 30% spermdecrease in intensive mobile phone users, in addition to damage of sperms. The average spermcount was found to be at 59 million sperm per milliliter of seminal fluid compared to 83 millionfor men not continually exposed to mobile phone radiation. Similarly, the study found thatmotility - the power of the sperm to swim - was affected by mobile phone transmissions. Menwho made lengthy calls had fewer rapidly motile sperm, 36.3 per cent compared with 51.3 percent for men who made no calls.It was found that not only does using a phone affect a mans sperm quality, but simply having itswitched ON in a pocket was enough to do damage as mobile phones periodically but brieflytransmit information to cell towers to establish contact. Radiation from cell phone can alsoproduce DNA breaks in sperm cells that can mutate and cause cancer. Damage to sperm DNAincreases the risk further and can pass on the genetic changes to subsequent generations.Animal studies indicate that EMR may have a wide range of damaging effects on the testicularfunction and male germ. It has been reported that mice on exposure to cell phone signals from anantenna park become less reproductive. After five generations of exposure, the mice were notable to produce offspring, showing that the effect of Radio frequency radiation can pass from onegeneration to another.Due to these reasons it is advisable to never wear or use any wireless device near reproductiveorgans. Men planning to father children are advised to make sure that they stop using wirelessdevices well in advance of fertilization to reduce the chance of procreation with damaged sperm. 15

16. 16. 5.4 Calcium ion release from cell membranesStudies have shown that weak electromagnetic fields remove calcium ions bound to themembranes of living cells, making them more likely to tear, develop temporary pores and leak.Leakage of calcium ions into the cytosol (the fluid found inside cells) acts as a metabolicstimulant, which accelerates growth and healing, but it also promotes the growth of tumors.Leakage of calcium ions into brain cells generates spurious action potentials (nerve impulses)accounting for pain and other neurological symptoms in electro-sensitive individuals. It alsodegrades the signal to noise ratio of the brain making it less likely to respond adequately to weakstimuli.5.5 DNA damageCellular telephone frequencies can lead to damaged DNA. Studies show that microwaveexposure at levels below the current FCC exposure standard, produces single and double strandbreaks in DNA. EMR causes membrane leakage due to loss of calcium ions. Leaks in themembranes of lysosomes (small bodies in living cells packed with digestive enzymes) releaseDNAase (an enzyme that destroys DNA), which

explains the fragmentation of DNA seen in cellsexposed to mobile phone signals.Microwave radiation can also interfere with the natural processes involved in DNA replicationand repair, by subtly altering molecular conformation (architecture). Another possibility of DNAdamage is via free radical formation inside cells. Free radicals kill cells by damagingmacromolecules, such as DNA, protein and membrane and are shown to be carcinogenic. Severalreports have indicated that electromagnetic fields (EMF) enhance free radical activity in cells asshown in Figure 6. The Fenton reaction is a catalytic process of iron to convert hydrogenperoxides, a product of oxidative respiration in the mitochondria, into hydroxyl free radical,which is a very potent and toxic free radical. Thus EMF affects the DNA via an indirectsecondary process. Figure 6 - The Fenton Reaction 16

17. 17. Damage to DNA is a central mechanism for developing tumors and cancer. When the rate ofdamage to DNA exceeds the rate at which DNA can be repaired, there is the possibility ofretaining mutations and initiating cancer. DNA damage in brain cells can affect neurologicalfunctions and also possibly lead to neurodegenerative diseases.5.6 Interference with other gadgets including Pace MakersCell phone radiation interferes with navigational equipment; therefore its use is banned inairborne flights. Electromagnetic interference (EMI) from mobile phones can causemalfunctioning of life-line electronic gadgets in the hospitals thereby potentially endangeringpatients. It is also advisable to restrict mobile phone use in clinical areas like operating theatresand intensive care units.Finally, hospital construction needs to take into account EMR from different areas within thehospital, as well as external sources, to limit interference with medical equipment. For example,allowing mobile phone use in a hospital corridor adjacent to a ward with sensitive medicalequipment susceptible to EMR could be problematic.RF exposure from mobile phones and cellular phone base antennas can also affect patientscarrying Pace Maker, Implantable Cardiovascular Defibrillators (ICDs) and Impulse Generators.The signals generated by mobile phones cause electromagnetic interference with the device andinterfere with its proper functioning. The signals produced by cell phone operating functionslike, turning on, ringing, conversation and turning off, contain components of low frequenciesthat can interfere with the implanted pacemakers causing them to become arrhythmical which inadverse conditions can put the patient to death.Due to these reasons government agencies have advised not to place mobile phones directly overpacemakers (such as in the chest pocket) and have issued recommendations to health careproviders and patients with pacemakers. Also, the cellular phone should be used with the rightear if the pacemaker is implanted in the left side of the chest. As a safety measure, it is advisableto maintain a safe distance of about 50 cm between portable mobile phones from the patient.5.7 Effects on Stress Proteins (Heat Shock Proteins)Non-thermal effects of Radio frequency radiation accumulate over time and the risks are morepronounced after several years of exposure. The effects are not observed in the initial years ofexposure as the body has certain defense mechanisms and the pressure is on the stress proteins ofthe body, namely the heat shock proteins (HSPs). The highly conserved HSPs accumulate incells exposed to heat and a variety of other stressful stimuli like heavy metal poisoning andoxygen deprivation. HSPs, which function mainly as molecular chaperones, allow cells to adaptto gradual changes in their environment and to survive in otherwise lethal conditions.It has been observed that GSM mobile phone exposure can activate the cellular stress response inboth human and animal cells and cause the cells to produce stress proteins (heat shock proteins),in particular HSP27 and HSP70. This means that the body

recognizes these electromagneticradiations as a potential harm. Hence RF exposures add to the list of environmental stressors that 17

18. 18. cause a physiological stress response. This further demonstrates that ELF and RF exposures canbe harmful, and it happens at levels far below the existing public safety standards.HSPs are known to inhibit natural programmed cell death (apoptosis), whereby cells that shouldhave 'committed suicide' continue to live. Recent studies show that HSP27 and HSP70 inhibitapoptosis in cancer cells. Taken together, these various effects are, in turn, consistent with the 2to 3 fold increase in the incidence of a rare form of cancers. If the stress goes on for too long,there is a reduced response, and the cells are less protected against the damage. This is whyprolonged or chronic exposures may be quite harmful, even at very low intensities.5.8 Effect on SkinRadiation from cell towers and mobile phones affects human skin. People who talk often on cellphones have a higher concentration of the transtyretin protein than those who do not.Transtyretin is formed in the liver; it helps transport vitamin A in the body and plays animportant role in nervous diseases such as Alzheimers.The symptoms of Morgellons disease include those of electromagnetic hypersensitivity (EHS);may be based on how body uses electric currents to repair wounds to the skin. People who sufferfrom this condition report a range of skin symptoms including crawling, biting and stingingsensations; granules, threads or black speck-like materials on or beneath the skin and/or lesions(e.g., rashes or sores). EMFs degrade the immune system and stimulate various allergic andinflammatory responses. The high radiation from cell towers can result in an increase in mastcells, which explains the clinical symptoms of itch, pain, edema and erythema.5.9 Tinnitus and Ear DamageTinnitus, popularly known as "Ringxiety"- is the psychological disease of hearing phantomsound and sensation of cell phone ring and it has been reported among millions of cell phoneusers in the world. People with severe tinnitus may have trouble hearing, working or evensleeping. The radiation emitted by mobile phones may damage the delicate workings of the innerear, and long-term and intensive mobile phone use for more than four years and for longerperiods than 30 minutes in a day are at a higher risk of developing hearing loss, which cannot bereversed.This auditory perception has been shown to occur when a person's head is illuminated withmicrowave energy. The microwave pulse upon absorption in the head, launches a thermo-elasticwave of acoustic pressure that travels by bone conduction to the inner ear. There it activates thecochlear receptors via the same process involved for normal hearing, which explains the "clicks"heard by people exposed to microwave radiation.Today, more and more young people between 18 and 25 years of age are suffering from hearingloss, which doctors say is due to excessive use of mobile phones and other gadgets. Goodhearing depends on the health of some 16,000 hair cells present in each inner ear. Butincreasingly, doctors have been treating people whose hair cells have been damaged by the highradiation emitted from cell phones. Hearing problems occur because these cells do notregenerate. Anyone who spends two to three hours on the cell phone every day runs the risk of 18

19. 19. partial deafness over three to five years. Most of the marketing and tele-consulting professionalsare in their 20s, and their jobs demand long conversations on cell phones. The problem startswith a pain in the ear that gradually develops into tinnitus or a ringing sensation which finallyleads to hearing loss.5.10 Effect on Eye/ Uveal MelanomaFrequent use of mobile phones can also damage the visual system in many ways and cause uvealmelanoma i.e. tumor of

The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer

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'Einfluss der räumlichen Nähe von Mobilfunksendeanlagen auf die Krebsinzidenz'

Summary

Following the call by Wolfram König, President of the Bundesamt für Strahlenschutz (Federal Agency for radiation protection), to all doctors of medicine to collaborate actively in the assessment of the risk posed by cellular radiation, the aim of our study was to examine whether people living close to cellular transmitter antennas were exposed to a heightened risk of taking ill with malignant tumors.

The basis of the data used for the survey were PC files of the case histories of patients between the years 1994 and 2004. While adhering to data protection, the personal data of almost 1,000 patients were evaluated for this study, which was completed without any external financial support. It is intended to continue the project in the form of a register.

The result of the study shows that the proportion of newly developing cancer cases was significantly higher among those patients who had lived during the past ten years at a distance of up to 400 metres from the cellular transmitter site, which has been in operation since 1993, compared to those patients living further away, and that the patients fell ill on average 8 years earlier.

In the years 1999-2004, *ie* after five years' operation of the transmitting installation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the installation compared to the inhabitants of Naila outside the area.

Key words: cellular radiation, cellular transmitter antennas, malignant tumours

The rapid increase in the use of mobile telephony in the last few years has led to an increasing number of cell phone transmission masts being positioned in or near to residential areas. With this in mind, the president of the German governmental department for protection against electromagnetic radiation (Bundesamtes für Strahlenschutz) Wolfram König, has challenged all doctors to actively help in the work to estimate the risks from such cell phone masts. The goal of this investigation was therefore to prove whether on not people living near to cell phone masts have a higher risk of developing cancerous tumours.

The basic data was taken from the medical records held by the local medical authority (Krankenkasse) for the years 1994 to 2004. This material is stored on computer. In this voluntary study the records of roughly 1,000 patients from Naila (Oberfranken) were used, respecting the associated data protection laws. The results from this study show a significantly increased likelihood of developing cancer for the patients that have lived within 400 metres of the cell phone transmission mast (active since 1993) over the last ten years, in comparison to those patients that live further away. In addition, the patients that live within 400 metres tend to develop the cancers at a younger age. For the years 1999 to 2004 (*ie* after five or more years of living with the cell phone transmission mast), the risk of developing cancer for those living within 400 metres of the mast in comparison to those living outside this area, was three times as high.

Introduction

A series of studies available before this investigation provided strong evidence of health risks and increased cancer risk associated with physical proximity to radio transmission masts. Haider *et al.* reported in 1993 in the Moosbrunn study frequent psychovegetive symptoms below the current safety limit for electromagnetic waves (1). In 1995, Abelin *et al.* in the Swiss- Schwarzenburg study found dose dependent sleep problems (5:1) and depression (4:1) at a shortwave transmitter station that has been in operation since 1939 (2).

In many studies an increased risk of developing leukaemia has been found; in children near transmitter antennas for Radio and Television in Hawaii (3); increased cancer cases and general mortality in the area of Radio and Television transmitter antennas in Australia (4); and in England, 9 times more leukaemia cases were diagnosed in people who live in a nearby

area to the Sutton Coldfield transmitter antennas (5). In a second study, concentrating on 20 transmitter antennas in England, a significant increased leukaemia risk was found (6). The Cherry study (7) indicates an association between an increase in cancer and living in proximity to a transmitter station. According to a study of the transmitter station of Radio Vatican, there were 2.2 times more leukaemia cases in children within a radius of 6 km, and adult mortality from leukaemia also increased (8).

In 1997 Goldsmith published the Lilienfeld-study that indicated 4 times more cancer cases in the staff of the American Embassy in Moscow following microwave radiation during the cold war. The dose was low and below the German limit (9).

The three studies of symptoms indicated a significant correlation between illness and physical proximity to radio transmission masts. A study by Santini *et al.* in France resulted in an association between irritability, depression, dizziness (within 100m) and tiredness within 300m of a cell phone transmitter station (10).

In Austria there was an association between field strength and cardiovascular symptoms (11) and in Spain a study indicates an association between radiation, headache, nausea, loss of appetite, unwellness, sleep disturbance, depression, lack of concentration and dizziness (12).

The human body physically absorbs microwaves. This leads to rotation of dipole molecules and to inversion transitions (13), causing a warming effect. The fact that the human body transmits microwave radiation at a very low intensity means that since every transmitter represents a receiver and transmitter at the same time, we know the human body also acts as a receiver.

In Germany, the maximum safe limit for high frequency microwave radiation is based on purely thermal effects. These limits are one thousand billion times higher than the natural radiation in these frequencies that reaches us from the sun.

The following study examines whether there is also an increased cancer risk close to cellular transmitter antennas in the frequency range 900 to 1800 MHz. Prior to this study there were no published results for long-term exposure (10 years) for this frequency range and its associated effects to be revealed. So far, no follow-up monitoring of the state of health of such a residential population has been systematically undertaken.

Materials and Methods

Study area

In June 1993, cellular transmitter antennas were permitted by the Federal Postal Administration in the Southern German city of Naila and became operational in September 1993.

The GSM transmitter antenna has a power of 15 dbW per channel in the 935MHz frequency range. The total

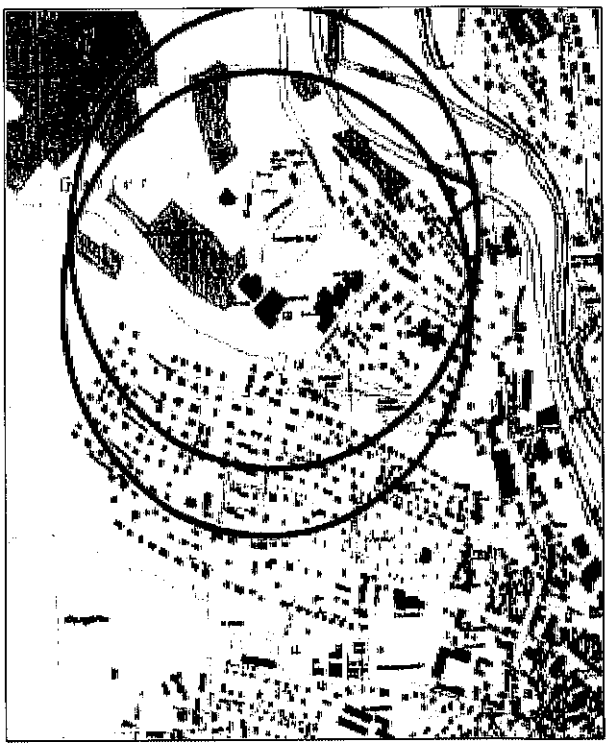

Fig. 1: Schematic plan of the antenna sites

transmission time for the study period is ca. 90,000 hours. In December 1997 there followed an additional installation from another company. The details are found in an unpublished report, appendix page 1-3 (14).

To compare results an 'inner' and 'outer' area were defined. The inner area covered the land that was within a distance of 400 metres from the cellular transmitter site. The outer area covered the land beyond 400 metres. The average distance of roads surveyed in the inner area (nearer than 400m) was 266m and in the outer area (further than 400m) 1,026m. Fig. 1 shows the position of the cellular transmitter sites 1 and 2, surrounded by circle of radius 400 metres. The geographical situation shows the transmitter sites (560m) are the highest point of the landscape, which falls away to 525m at a distance of 450m. From the height and tilt angle of the transmitter it is possible to calculate the distance where the transmitter's beam of greatest intensity strikes the ground (see Fig. 2).

The highest radiation values are in areas of the main

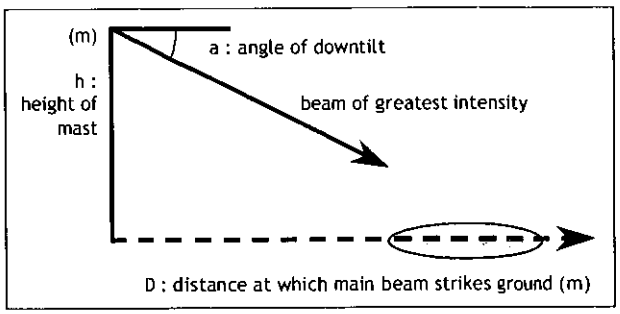

Fig. 2: From the mast height h and the downtilt angle a, the distance D at which the main beam reaches ground is given by D = tan(90-a) × h

beam where it hits the ground and from the expected associated local reflection; from this point the intensity of radiation falls off with the square of the distance from the transmitter.

In Naila the main beam hits the ground at 350m with a beam angle of 6 degrees (15). In the inner area, additional emissions are caused by the secondary lobes of the transmitter; this means in comparison that from purely mathematical calculations the outer area has significantly reduced radiation intensity.

The calculations from computer simulations and the measurements from the Bavaria agency for the environmental protection, both found that the intensity of radiation was a factor of 100 higher in the inner area as compared to the outer area. The measurements of all transmitter stations show that the intensity of radiation from the cell phone transmitter station in Naila in the inner area was higher than the other measurement shown in the previous studies of electromagnetic fields from radio, television or radar (14).

The study StSch 4314 from the ECOLOG Institute indicates an association between a vertical and horizontal distance from the transmitter station and expected radiation intensity on the local people (16). The reason for setting a distance of 400m for the differentiation point is partly due to physical considerations, and partly due to the study of Santini *et al.* who chose 300m (10).

Data Gathering

Similar residential streets in the inner area and outer areas were selected at random. The large old people's home in the inner area was excluded from the study because of the age of the inhabitants. Data gathering covered nearly 90% of the local residents, because all four GPs in Naila took part in this study over 10 years. Every team researched the names of the patients from the selected streets that had been ill with tumours since 1994. The condition was that all patients had been living during the entire observation time of 10 years at the same address.

The data from patients was handled according to data protection in an anonymous way. The data was evaluated for gender, age, tumour type and start of illness. All cases in the study were based on concrete results from tissue analysis. The selection of patents for the study was always done in exactly the same way. Self-selection was not allowed. Also the subjective opinion of patients that the radio mast detrimentally affected their health has not affected this study. Since patients with cancer do not keep this secret from GPs, it was possible to gain a complete data set.

Population study

In the areas where data was collected 1,045 residents were registered in 31.12.2003. The registration statistics for Naila at the beginning of the study (1.1.1994) show the number of old people in the inner and outer areas, as shown in Table 1. The average age at the beginning of the study (1.1.1994) in both the inner and outer areas was 40.2 years. In the study period between 1994-2004, 34 new cases of cancer where documented out of 967 patients (Table 3). The study covered nearly 90% of local residents.

	female	male	total
Inner area	41.48	38.70	40.21
Outer area	41.93	38.12	40.20
Naila total	43.55	39.13	41.45

Table 1 : Overview of average ages at the beginning of the study in 1994

1994	inner 22.4%	outer 2.8%	Naila total 24.8%
2004	inner 26.3%	outer 26.7%	

Table 2 : Proportion of patients aged over 60

The average age of the residents in Naila is one year more than that of the study due to the effects of the old people's home. From the 9,472 residents who are registered in Naila, 4,979 (52.6%) are women and 4,493 (47.4%) are men. According to the register office, in 1.1.1994 in the outer area, the percentage was 45.4% male and 54.5% female, and in the inner area 45.3% male and 54.6% female. The number of people who are over 60 years old is shown in Table 2.

The social differences in Naila are small. Big social differences like in the USA do not exist here. There is also no ethnic diversity. In 1994 in Naila the percentage of foreigners was 4%. Naila has no heavy industry, and in the inner area there are neither high voltage cable nor electric trains.

Results

Results are first shown for the entire 10 year period from 1994 until 2004. Secondly, the last five-year period 1999 to 2004 is considered separately.

Period 1994 to 2004

As a null hypothesis it was checked to see if the physical distance from the mobile transmission mast had no effect on the number cancer cases in the selected population, *ie* that for both the group nearer than 400 metres and the group further than 400 metres the chance of developing cancer was the same. The relative frequencies of cancer in the form of a matrix are shown in Table 3. The statistical test method used on this data was the chi-squared test with Yates's correction. Using this method we obtained the value of 6.27, which is over the critical value of 3.84 for a

Period 1994-2004	Inner area	Outer area	total
new cases of cancers	18	16	34
with no new cancer	302	631	933
total	320	647	967

Table 3 : numbers of patients with and without cancers, 1994-2004

statistical significance of 0.05).

This means the null hypothesis that both groups within the 400-metre radius of the mast and beyond the 400 metre radius, have the same chance of developing cancer, can be rejected with a 95% level of confidence. With a statistical significance of 0.05, an even more significant difference was observed in the rate of new cancer cases between the two groups.

Calculating over the entire study period of 1994 until 2004, based on the incidence matrix (Table 3) we arrive at a relative risk factor of 2.27 (quotient of proportion for each group, *eg* 18/320 in the strongly exposed inner area, against 16/647 in the lower exposed comparison group). If expressed as an odds ratio, the relationship of the chance of getting cancer between strongly exposed and the less exposed is 2.35.

The following results show clearly that inhabitants who live close to transmitter antennas compared to inhabitants who live outside the 400m zone, double their risk of developing cancer. In addition, the average age of developing cancer was 64.1 years in the inner area whereas in the outer area the average age was 72.6 years, a difference of 8.5 years. That means during the 10 year study that in the inner area (within 400 metres of the radio mast) tumours appear at a younger age.

In Germany the average age of developing cancer is approximately 66.5 years, among men it is approximately 66 and among women, 67 (18).

Over the years of the study the time trend for new cancer cases shows a high annual constant value (Table 4). It should be noted that the number of people in the inner area is only half that of the outer area, and therefore the absolute numbers of cases is smaller.

Table 7 shows the types of tumour that have developed in the cases of the inner area.

Period 1994 to 1999

No. of cases of tumours per year of study	inner area: of the 320 people		outer area: of the 647 people	
	total cases	per 1,000	total cases	per 1,000
1994	–	–	I	1.5
1995	–	–	–	–
1996	II	6.3	I	1.5
1997	I	3.1	III	4.6
1998	II	6.3	III	4.6
1999	II	6.3	I	1.5
2000	IIIII	15.6	I	1.5
2001	II	6.3	II	3.1
2002	II	6.3	II	3.1
2003-3/2004	II	6.3	II	3.1

Table 4 : Summary of the total tumours occurring per year (no. and per thousand)

Period 1994-1999	Inner area	Outer area	total
new cases of cancers	5	8	13
with no new cancer	315	639	954
total	320	647	967

Table 5 : numbers of patients with and without cancers, 1994-1999

For the first five years of the radio transmission mast operation (1994-1998) there was no significant increased risk of getting cancer within the inner area as compared to the outer area (Table 5).

Period 1999 to 2004

Under the biologically plausible assumption that cancer caused by detrimental external factors will require a time of several years before it will be diagnosed, we now concentrate on the last five years of the study between 1999 and 2004. At the start of this period the transmitter had been in operation for 5 years. The results for this period are shown in Table 6. The chi-squared test result for this data (with Yates's correction) is 6.77 and is over the critical value of 6.67 (statistical significance 0.01). This means, with 99% level of confidence, that there is a statistically proven difference between development of cancer between the inner group and outer group. The relative risk of 3.29 revealed that there was 3 times more risk of developing cancer in the inner area than the outer area during this time period.

Period 1999-2004	Inner area	Outer area	total
new cases of cancers	13	8	31
with no new cancer	307	639	946
total	320	647	967

Table 6 : numbers of patients with and without cancers, 1999-2004

The odds-ratio 3.38 (VI 95% 1.39-8.25, 99% 1.05-10.91) allows us with 99% confidence to say that the difference observed here is not due to some random statistical effect.

Discussion

Exactly the same system was used to gather data in the inner area and outer areas. The medical chip card, which has been in use for 10 years, enables the data to be processed easily. The four participating GPs examined the illness of 90% of Naila's inhabitants over the last 10 years. The basic data for this study were based on direct examination results of patients extracted from the medical chip cards, which record also the diagnosis and treatment. The study population is (in regards to age, sex and cancer risk) comparable, and therefore statistically neutral. The study deals only with people who have been living permanently at the same address for the entire study period and therefore

Type of tumour (organ)	no. of tumours found	total expected	incidence per 100,000	ratio inner: outer
breast	8	5.6	112	5:3
ovary	1	1.1	23	0:1
prostate	5	4.6	101	2:3
pancreas	m 3 f 2	0.6 0.9	14 18	2:1 1:1
bowel	m 4 f 0	3.7 4.0	81 81	2:2 0:0
skin melanoma	m 1 f 0	0.6 0.7	13 14	1:0 0:0
lung	m 3 f 0	3.6 1.2	79 24	2:1 0:0
kidney	m 2 f 1	1.0 0.7	22 15	1:1 1:0
stomach	m 1 f 1	1.2 1.1	27 23	0:1 0:1
bladder	m 1 f 0	2.0 0.8	44 16	0:1 0:0
blood	m 0 f 1	0.6 0.7	14 15	0:0 1:0

Table 7 : Summary of tumours occurring in Naila, compared with incidence expected from the Saarland cancer register

have the same duration of exposure regardless of whether they are in the inner area or outer area.

The result of the study shows that the proportion of newly developing cancer cases was significantly higher ($p<0.05$) among those patients who had lived during the past ten years within a distance of 400 metres from the cellular transmitter site, which has been in operation since 1993, in comparison to people who live further away. Compared to those patients living further away, the patients developed cancer on average 8.5 years earlier. This means the doubled risk of cancer in the inner area cannot be explained by an average age difference between the two groups. That the transmitter has the effect that speeds up the clinical manifestations of the illness and general development of the cancer cannot be ruled out.

In the years 1999-2004, *ie* after five years and more of transmitter operation, the relative risk of getting cancer had trebled for the residents of the area in the proximity of the mast compared to the inhabitants of Naila in the outer area ($p>0.01$). The division into inner area and outer area groups was clearly defined at the beginning of the study by the distance to the cell phone transmission mast. According to physical considerations people living close to cellular transmitter antennas were exposed to heightened transmitted radiation intensity.

Both calculated and empirical measurements revealed that the intensity of radiation is 100 times higher in the inner area compared to the outer area. According to the research StSch 4314 the horizontal and vertical position in regards to the transmitter antenna is the most important criterion in defining the radiation intensity area on inhabitants (16).

The layered epidemiological assessment method used in this study is also used in assessment of possible chemical environmental effects. In this case the layering is performed in regards to the distance from the cell phone transmitter station. Using this method it has been shown that there is a significant difference in probability of developing new cancers depending on the exposure intensity.

The number of patients examined was high enough according to statistical rules that the effects of other factors (such as use of DECT phones) should be normalised across the inner area and outer area groups. From experience the disruption caused by a statistical confounding factor is in the range between 20% and 30%. Such a factor could therefore in no way explain the 300% increase in new cancer cases. If structural factors such as smoking or excessive alcohol consumption are unevenly distributed between the different groups this should be visible from the specific type of cancers to have developed (*ie* lung, pharyngeal or oesophageal). In the study inner area there were two lung cancers (one smoker, one non-smoker), and one in the outer area (a smoker), but no oesophageal cancers. This rate of lung cancer is twice what is statistically to be expected and cannot be explained by a confounding factor alone. None of the patients who developed cancer was from a family with such a genetic propensity.

Through the many years experience of the GPs involved in this study, the social structures in Naila are well known. Through this experience we can say there was no significant social difference in the examined groups that might explain the increased risk of cancer.

The type and number of the diagnosed cancers are shown in Table 7. In the inner area the number of cancers associated with blood formation and tumour-controlling endocrine systems (pancreas), were more frequent than in the outer area (77% inner area and 69% outer area).

From Table 7, the relative risk of getting breast cancer is significantly increased to 3.4. The average age of patients that developed breast cancer in the inner area was 50.8 years. In comparison, in the outer area the average age was 69.9 years, approximately 20 years less. In Germany the average age for developing breast cancer is about 63 years. The incidence of breast cancer has increased from 80 per 100,000 in the year 1970 to 112 per 100,000 in the year 2000. A possible question for future research is whether breast cancer can be used as a 'marker cancer' for areas where there is high contamination from electromagnetic radiation. The report of Tynes *et al.* described an increased risk of breast cancer in Norwegian female radio and telegraph operators (20).

To further validate the results the data gathered were compared with the Saarland cancer register (21). In this register all newly developed cancers cases since 1970 are recorded for each Bundesland. These data are accessible via the Internet. Patents that suffer two separate tumours were registered twice, which increases the overall incidence up to 10%. In this

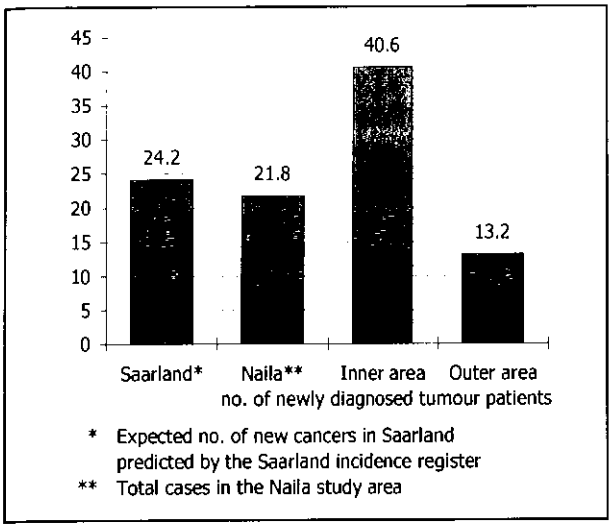

Fig. 3 : Number of new cancer cases 1999 to 2004, adjusted for age and gender, calculated for the 5,000 patient years

register there is no location-specific information, for instance proximity to cell phone transmission masts. The data in the cancer register therefore reflect no real control group but rather the effect of the average radiation on the total population.

From the Saarland cancer register for the year 2000 the incidence of new cancer cases was 498 per 100,000 for men and 462 per 100,000 for women. When adjusted for age and sex one would expect a rate of between 480 and 500 per 100,000 in Naila. For the years 1999 to 2004 there were 21 new cases of cancer among 967 patients. The expected number was 24 cases per 1,000 patients.

The results of the study are shown graphically in Fig. 3. The bars of the chart represent the number of new cancer cases per 1,000 patients in the separate areas, over the five years (bars 2 to 4). The first bar represents the expected number from the Saarland cancer register.

In spite of a possible underestimation, the number of newly developed cancer cases in the inner area is more than the expected number taken from the cancer register, which represents the total population being irradiated. The group who had lived during the past five years within a distance of 400 m from the cellular transmitter have a two times higher risk of developing cancer than that of the average population. The relative risk of getting cancer in the inner area compared with the Saarland cancer register is 1.7 (see to Table 7).

Conclusion

The result of this retrospective study in Naila shows that the risk of newly developing cancer was three times higher among those patients who had lived during past ten years (1994-2004), within a distance of 400m from the cellular transmitter, in comparison to those who had lived further away.

Cross-sectional studies can be used to provide the decisive empirical information to identify real problems. In the 1960s just three observations of birth deformities were enough to uncover what is today an academically indisputable Thalidomide problem.

This study, which was completed without any external financial support is a pilot project. Measurements of individual exposure as well as the focused search for further side effects would provide a useful extension to this work, however such research would need the appropriate financial support.

The concept of this study is simple and can be used everywhere, where there it a long-term electromagnetic radiation from a transmitting station.

The results presented are a first concrete epidemiological sign of a temporal and spatial connection between exposure to GSM base station radiation and cancer disease.

These results are, according to the literature relating to high frequency electromagnetic fields, not only plausible and possible, but also likely.

From both an ethical and legal standpoint it is necessary to immediately start to monitor the health of the residents living in areas of high radio frequency emissions from mobile telephone base stations with epidemiological studies. This is necessary because this study has shown that it is no longer safely possible to assume that there is no causal link between radio frequency transmissions and increased cancer rates.

Acknowledgements

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Footnotes

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the eye. Tumors involve the choroid (98%), iris (1%) and unknown partsof the uveal tract (1%). Computational modeling and experiments with several laboratoryanimals show that microwave radiation similar to mobile phone frequencies (900, 1800 MHz and2450 MHz) can induce chromosomal breaks in the corneal epithelial cells and increase theintraocular temperature of the eye with prolonged exposure.Increase in temperature close to the eye lens (as low as 3oC) can result in lens opacities andincrease the risk of developing cataracts in humans, a condition characterized by clouding in thenatural lens of the eye and lens opacities. When Bovine eye lenses were exposed to microwaveradiation, it caused macroscopic damage and affected the optical function of the lens. Thedamage increased as the irradiation continued and reached a maximum level after a number ofdays. When the exposure stopped the optical damage began to heal gradually. A similarmaximum level was observed when the irradiation intensity was reduced to one-half the original,except that it took twice the time. A lens of good optical quality is able to focus the laser beamfrom the various locations (green lines in the left frame of Fig. 7. When the lens is damaged dueto exposure to microwave radiation, its ability to focus the laser beam at the various locations isaltered, as clearly revealed in the right frame. The blue line connects the points of the backvertex distance for each ray passing through the lens. The pink line shows the relative intensityof each beam, that is, the transmitted intensity normalized to the incident one.Fig. 7 – Left - Good quality lens - all rays passing through the lens have similar focal length.Right - Exposed lens, showing considerable variability in the focal length of the beams passingthrough the lens.Prolonged exposure to microwave radiation similar to that used by cellular phones can lead toboth macroscopic and microscopic damage to the lens and part of this damage seems toaccumulate over time and does not heal. 19

20. 20. 5.11 Cell phone emission weaken bonesResearchers have measured bone density at the upper rims of the pelvis (iliac wings) in men whowere mobile users and carried their phones on their belts. The iliac wings are widely used sourceof bone for bone grafting, so any reduction in bone density may be of special importance toreconstructive surgery. The results showed reduction in iliac wing bone density on the sidewhere men carried their phones. In general, it is better to keep mobile phones as far as possiblefrom our body during our daily lives.5.12 Salivary gland tumorIncreased risk of salivary gland cancer among residents in Israel from 1970 to 2006 has beenreported, which is believed to be linked to the use of mobile phones. Among salivary glandcancer cases, researchers found a worrying rise in the number of cases of malignant growth inparotid glands - the salivary gland located under the ear, near the location where cell phones areheld during conversations. Users below the age of 20 were found to be more susceptible.Another epidemiology study found that people who held a mobile handset against one side oftheir head for several hours a day have 50% more risk for tumor formation in the parotid gland -the largest salivary gland after 5-10 years.5.13 Melatonin ReductionMelatonin, a vital natural neuro-hormone is a powerful antioxidant, antidepressant and immunesystem enhancer that regulates our circadian rhythm. Every night as we go to sleep, ourmelatonin levels rise. Melatonin goes through our blood and clears our cells up, that is to say,scavenges free radicals in the cell to protect the DNA and reduce the possibility of cellsbecoming carcinogenic. The daily sleep/wake cycle, blood pressure and heart rate cycle,metabolic rate and thermal regulation, hormone production and immune system activity all havea daily cycle regulated by melatonin directly or indirectly through the autonomic system.Various studies show that exposure to EMR reduce melatonin levels in animals and humans.Daily cellular telephone use of

>25 minutes over years may lead to reduced melatoninproduction. Studies with animals show a reduction in melatonin levels following radiofrequencyradiation exposure from cell phones and cell sites. Turning off the transmitters resulted in asignificant increased melatonin levels within few days.When availability of melatonin is impaired, a whole range of disorders including sleepdisturbance, chronic fatigue, depression, cardiac, reproductive and neurological diseases andmortality can occur. Reduced melatonin is also associated with increased DNA damage andincreased risk of cancer, arthritis, seasonally affective disorder (SAD), schizophrenia, increasedeye stress, renal impairment, Alzheimer's and Parkinson's disease, miscarriage, sudden infantdeath syndrome (SIDS), and increased risk of childhood leukemia. 20

21. 21. 5.14 Sleep DisordersElectromagnetic fields have been shown to affect the brain physiology. Use of mobile phonesdisturbs Stage 4 sleep, the stage important for full recuperation of brain and body. Use of thehandsets before bed, delays and reduces sleep, and causes headaches, confusion and depression.The findings are especially alarming for children and teenagers as they use cell phones at nightand also keep the phone next to their head; which may lead to mood and personality changes,depression, lack of concentration and poor academic performance.The relationship of sleep disturbance with exposure to a cell phone/ tower radiation is shown inFig. 8. It can be seen that percentage increase in sleep disturbance is proportional to the exposuredose. Even at 1nW/cm2 = 0.001μW/cm2 = 10 μW/m2, disturbance in the sleep is of the order of35%. When the transmitter was turned off, the symptoms resumed gradually 2 Figure 8 - Dose-response relationship for Sleep Disturbance with exposure in nW/cm5.15 Neurodegenerative DiseasesExposure to electromagnetic fields has shown to be in connection with Alzheimer's disease,motor neuron disease and Parkinson's disease. All these diseases are involved with the death ofspecific neurons and are classified as neurodegenerative diseases.People living near mobile phone base stations are also at risk for developing neuropsychiatricproblems as headache, memory loss, nausea, dizziness, tremors, muscle spasms, numbness,tingling, altered reflexes, muscle and joint paint, leg/foot pain, depression, and sleep disturbance.More severe reactions include seizures, paralysis, psychosis and stroke.5.16 Increase in Cancer riskHeavy use of mobile phones can cause cancer. Use of mobile phones for >10 years give aconsistent pattern of increased risk for brain cancer - glioma (cancer of the glial cells that supportthe central nervous system) and acoustic neuroma (a benign tumor in the brain on a nerve 21

22. 22. related to hearing). The risk is highest for ipsilateral (on the same side of the head where theinstrument is held) exposure. Children and teenagers, before the age of 20 are five times morelikely to get brain cancer, as their brain is not fully developed and radiation penetration is muchdeeper. It is possible that todays young people may suffer an "epidemic" of the disease in laterlife.Besides increase in brain tumour and acoustic neuroma, there is an increased risk of several othertypes of cancers following prolonged exposure to mobile phone/ tower radiation, such as,salivary gland tumors, uveal melanoma, lymphoma, facial nerve tumors, skin, blood, testicularand breast cancer. Interphone study has also found a 'significantly increased risk' of some braintumors for heavy users of mobile phones (> 20 minutes per day) for a period of 10 years or more.It is suggested that children should be discouraged from using mobile phones and restrict use toemergency while adults should "keep calls short".5.17 Epidemiological studies in various countriesThere have been several epidemiological studies of people living near cell

phone antennas inSpain, the Netherlands, Israel, Germany, Egypt, Austria, etc. All these studies documentsadverse health effects and exposures are orders of magnitude below the FCC or ICNIRPguidelines. Some of these studies are summarized below:Example 1: FRANCE (Santini, 2002)In this study the people who lived closest to the cellular antennas had the highest incidences ofthe following disorders: fatigue, sleep disturbances, headaches, feeling of discomfort, difficultyin concentrating, depression, memory loss, visual disruptions, irritability, hearing disruptions,skin problems, cardiovascular disorders, and dizziness (See Figure 9).Women were found to have more symptoms than men. This study, based on the symptomsexperienced by people living in vicinity of base stations recommend that the cellular phone basestations should not be sited closer than 300 m to populations. This is probably not possible inUrban area, so the solution is to reduce the transmitted power level.Example 2: GERMANY (Eger H, 2004)The aim of this study was to examine whether people living close to cellular transmitter antennaswere exposed to a greater risk of becoming ill with malignant tumors. The researchers found thatthe proportion of newly developing cancer cases was significantly higher among those patientswho had lived within 400 meters from the cellular transmitter site during the past 10 years,compared to those patients living further away. They also found that the patients fell ill onaverage 8 years earlier. After five years of operation of the transmitting installation, the relativerisk of getting cancer had increased by 3-fold for the residents of the area near the installation,compared to the inhabitants outside the area. Breast cancer topped the list, and the average age ofcontracting this disease was considerably lower, 50.8 years compared to 69.9 years for thepeople living in the outer area. Cancers of the prostate, pancreas, bowel, skin melanoma, lungand blood cancer were all increased. 22

23. 23. Figure 9. Response of residents living in the vicinity of a cellular phone base station in France.Example 3: ISRAEL (Wolf R, Wolf D, 2004)This study, based on medical records of people living within 350 meters of a long establishedphone mast, showed a fourfold increased incidence of cancer compared with the generalpopulation of Israel, and a tenfold increase specifically among women, compared with thesurrounding locality further from the mast.Example 4: SPAIN (Oberfeld 2004)This study found significant ill-health effects among those living in the vicinity of two GSMmobile phone base stations. The strongest five associations found were depressive tendency,fatigue, sleeping disorder, difficulty in concentration and cardiovascular problems. The scientistsreported the following symptoms within 50 to 150 m of the cell phone antenna at an averagepower density of 0.11 + 0.19 μW/cm2. Note that 0.11 μW/cm2 is considerably lower than 1000μW/ cm2 established by the FCC. This demonstrates that the FCC guideline does not protect thepublic from radio frequency radiation exposure. 23

24. 24. Among the 350 inhabitants of Pérez, near the town of Velez-Malaga, there have been 43 cases ofcancer, 35 of which have resulted in death.Example 4: SWEDENSweden was one of the first countries to claim 100% mobile connectivity. Survey studies showthat somewhere between 230,000 - 290,000 Swedish men and women out of a population of9,000,000 are now electrohypersensitive (EHS) and report a variety of symptoms when being incontact with electromagnetic field sources. Symptoms include - allergic reactions, redness ofskin, memory loss, sleep disruption, headache, nausea, tingling, altered reflexes, buzzing in thehead, palpitations of the heart, visual disorders, cardiovascular problems, respiratory problemsetc.

Severe symptoms like leukemia, brain cancer, and acoustic neuroma (tumor in the ear) havealso been reported. Sweden is the only country in the world to recognize EHS as a functionalimpairment/ physical degradation and not a disease.Example 5: UKIn Berkeley House, Staple Hill, Bristol, UK, where Orange mobile mast was erected on roof of afive story building; several people living on the top floor had cancer.In Warwickshire, 31 cancer patients were detected on a single street and a quarter of 30 odd staffat a special school, within sight of 90 ft high mast, developed brain tumors since 2000. The mastsare being pulled down under growing protests of thousands of people.Example 5: AustraliaThe top floors of a Melbourne office building were closed down and 100 people were evacuatedafter a seventh worker in seven years was diagnosed with a brain tumour. The Australian HealthResearch Institute indicates that due to billions of times more in volume electromagneticradiation emitted by billions of mobile phones, internet, intranet and wireless communicationdata transmission, almost one-third of world population (about 2 billion) may suffer from CellPhone Cancer beside other major body disorders like heart ailments, impotency, migraine,epilepsy by 2020Example 6: India:Builder in Riddhi Park, Thakurlee (West) had installed mobile tower before the residents hadoccupied the building. Within 4 months of occupying the top floor flat, Mrs. Bhat was diagnosedwith "brain tumor". She used to feel fatigued; and also suffered from white rashes on the body.Her neighbor delivered a baby with cancer of spinal cord. Another neighbor gave birth to a childhaving "Birth Defects"; and the child died immediately after birth. All the residents of thebuilding are now demanding the demolition of the tower. In spite of these demands by residents,builder has installed another tower. Mrs. Bhat has left her flat now staying in Goregaon and spentaround Rs. 10 lakhs for treatment on brain tumor. However her health is now improving. 24

25. 25. Mr. Bhagwant Deshpande of Solapur has reported 9 deaths due to cancer living within 91m fromthe two towers. Details of the dead people are given below:6. Adverse effect on birds, animals and environmentElectromagnetic radiation from Cell phone and cell tower affects the birds, animals, plant andenvironment. One would never see a bee, sparrow, pigeon, or any bird flying and staying nearthe cell tower? The reason is that surface area of a bird is relatively larger than their weight incomparison to human body, so they absorb more radiation (power = power density x area). Sincefluid content is small due to less weight, it gets heated up very fast and also the magnetic fielddisturbs their navigational skills. These effects are given in the following sub-sections.6.1 Effect on Honey BeesIt has been quoted that Albert Einstein had said, "If the bee disappears from the surface of theearth, man would have no more than four years to live." In the US, an abrupt disappearance ofbees was observed several years back and was associated with the rising electromagneticpollution. This is known as Colony Collapse Disorder (CCD) where bees cannot find their wayback to the hive as a result of consistent electromagnetic back ground noise that seems to disruptintercellular communication within individual bees. CCD has since spread to Germany,Switzerland, Spain, Portugal, Italy, Greece, Scotland, Wales and north-west England. InEngland, the bee population fell by 54 percent between 1985 and 2005 compared to an averageof 20 per cent across Europe.Recently, a sharp decline has also been noticed in commercial bee population in Kerala posing aserious threat to honey bees, hitting apiculture (the cultivation of bees on a commercial scale forthe production of honey). The State has the highest density of mobile towers. Similar cases havebeen observed in Bihar, Punjab, Nepal and

other parts of India and have been attributed toincreasing electro pollution in the environment. 25

26. 26. When honey bee colonies were exposed with radiation, the honeycomb weight and area werereduced and returning time of honey bees increased compared to similar non-exposed colonies.Several other studies show that the high-frequency electromagnetic fields of mobile phones alterthe resonant stimulus of living organisms and can cause modifications in certain areas of theirbrain. Changes in the brain structure of bees can be a cause of alterations of the returningcapabilities of bees.Its not just the honey that will be lost if populations plummet further. Bees are estimated topollinate 90 commercial crops worldwide. The current dying/vanishing of honey bees can haveserious consequences for human health. Scientists warn that the steady decline in bees and otherpollinators could trigger crises bigger and more immediate than global warming.Honey bees brain anatomy as well as the learning regions of the bee brain are well known andcomparable to those of vertebrates and are well suited as a bio-indicator. We are fortunate thatthe warning bells have been sounded and it is for us to timely plan strategies to save not only thebees but human life and environment from the ill effects of such EMR.6.2 Effect on BirdsWhen birds are exposed to weak electromagnetic fields, they disorient and begin to fly in alldirections, which explain migratory birds undermining navigational abilities. A large number ofbirds like pigeons, sparrows, swans are getting lost due to interference from the new "unseenenemy", i.e. mobile phone masts. Several million birds of 230 species die each year fromcollisions with telecommunications masts in the United States during migration. Accidentshappen mainly in the night, in fog, or bad weather, when birds might be using the earthsmagnetic field for navigation, and could be seriously disoriented by the microwave radiationfrom telecommunication masts.During recent decades there has been a marked decline of the house sparrow population. Londonhas witnessed a steep fall in its sparrow population; a 75 per cent fall since 1994. There havebeen dramatic declines, almost to the point of extinction in Glasgow, Edinburgh, Hamburg,Ghent, Brussels, Dublin, Belgium, etc. Studies show that the disappearance of the sparrow andthe introduction of phone mast GSM towers correlate closely in terms of time.In Spain, to monitor the breeding success of the white stork population, 60 nests were selectedand visited from May to June of 2003. Thirty nests were located within 200 m of mobile mastsand other 30 were located at a distance of more than 300 m from any transmitter. 40% of thenests close to the antennae were without young, as opposed to 3.3% among those at a largerdistance. Behavioural changes were also observed among birds close to the phone antennae.Young birds died from unknown causes and bird couples frequently fought while constructingtheir nests. Some nests were never completed and the storks remained passively in front of theantennae.Microwaves from phone masts also interfere with reproductive success of birds. In anexperiment, 75% of chicken embryos that were exposed to a GSM mobile phone duringincubation died compared to 16%, who were not exposed to any radiation. Birds having nest near 26

27. 27. towers were found to leave their nests within one week. The eggs laid in nests near towers failedto hatch.A general disappearance of birds like Kestrel, White Stork, Rock Dove, pigeons, Magpie hasbeen observed near base stations for mobile telecommunication. Locomotive problems, breedingproblems, and tendency to stay long in lower parts of the trees and on the ground have beenobserved. In some tracked nests (blackbird), the eggs never hatched and also

many deadspecimens were found near phone masts areas.A house sparrow is associated with human habitation. Being very sensitive to changes in theenvironment, it is one of the most preferred indicator species of urban ecosystems. A stablehouse sparrow population indicates a healthy ecosystem for human beings in terms of air andwater quality, vegetation and other parameters of habitat quality. Whereas, a decliningpopulation of the bird provides a warning that the urban ecosystem is experiencing someenvironmental changes unsuitable for human health in the immediate future.6.3 Effect on mammals and amphibiansThe study in Germany showed that cows grazing near cell towers are more likely to experiencestill births, spontaneous abortions, birth deformities, behavioral problems and general declines inoverall health. Moving cattle herds away from such towers has reportedly led to immediatehealth improvements. Exposing dairy cows to magnetic fields can also result in reduction in milkyield, changed milk composition and fertility problems. Recently, a significant increase ofmicronuclei in erythrocyte in the blood of cattle grazing on a farm near a transmitting facilitywas discovered. This is an indication of a genotoxic effect of the exposure, which means thechange will pass on to their subsequent generations.Similarly, impaired immune system in sheep, reproductive and developmental problems in dogsand cats, anxiety and alarm in rabbits, frequent death of domestic animals such as, hamsters, andguinea pigs living near base stations of mobile telecommunication towers has been observed.Electromagnetic pollution is a possible cause for deformations and decline of some amphibianpopulations too. Morphological abnormalities, allergies, changes in blood counts, increase in theheart rate, arrhythmia and increased mortality has been found in amphibians like Newts and frogtadpoles. Bat activity is significantly reduced in habitats exposed to electromagnetic field.During a study, in a free-tailed bat colony, the number of bats decreased when several phonemasts were placed 80m from the colony.6.4 Effect on PlantsApart from bees, birds and animals, electromagnetic radiation emanating from cell towers canalso affect vegetables, crops and plants in its vicinity. Studies show definitive clues that cellphone EMF can choke seeds, inhibit germination and root growth, thereby affecting the overallgrowth of agricultural crops and plants. A reduction in wheat and corn yield in the fields nearhigh EMF lines has also been reported. 27

28. 28. Progressive deterioration of trees near phone masts has also been observed. Trees located insidethe main lobe (beam), look sad and feeble, have dried tops, show slow growth and highsusceptibility to illnesses and plagues. Also, electromagnetic radiations generate heat. Due tothis, the microorganisms present in the soil near it would be killed. This in turn harms thoseorganisms which feed on them and disturbs the ecological cycle.7. Possible Solutions to reduce the ill effects of cell tower radiationThere are several health hazards due to radiation from the cell towers to the human, birds,animals and environment. In India, we have adopted very relaxed radiation norms of 4.7 W/m2for GSM900, whereas serious health effects have been noted at as low as 0.0001 W/m2 = 100μW/m2. One of the first steps to be taken is to tighten the radiation norms and yet it should bepractical enough to be cost effective without causing too much inconvenience to the users. It isrecommended that maximum cumulative power density allowed should be reduced withimmediate effect to 0.1 W/m^2, which should then be subsequently reduced to 0.01 W/m^2 within ayear, so that network planning can be carried out in a phased manner. It must be noted that a fewcountries have even adopted 0.001 W/m^2 or lower, so our proposed recommendation is higherthan these countries to keep it cost effective. All the operators must be strictly instructed thatpower density inside residential or office

buildings, schools, hospitals, and at common frequentlyvisited places should be within these guidelines. People must be informed about the harmfulradiation effects and corrective measures taken by Govt. of India. Also, people must be informedthat for some time, they may have network problem (especially people living far away from thecell tower) due to reduction in the transmitted power but it is for their overall health benefit.Solution is to have more numbers of cell towers with lesser transmitted power. When powertransmitted is reduced, it will not require power hungry power amplifiers having lowerefficiency. Heating effect will also be reduced, so lesser cooling or no cooling will be required;all of these will reduce the power requirement, which can also be met by solar panel. Thus, highpower diesel generators will also be not required; it will reduce the carbon emission and we canearn from carbon credits.In addition, repeaters or signal enhancers or boosters may have to be installed where signal isweak. Care must be taken that maximum power transmitted by these must not exceed 0.1Wbecause of their close proximity to the users.Self certification by the operators must be immediately abolished; measurements must be doneby third party, which is independent and trustworthy. Also, radiation measurements must bemonitored continuously, so that operators should not increase the transmitted power during thepeak period. Very strict penalties must be imposed on those operators, who violate these normsas it causes serious health hazards to innocent people.The reduction in the transmitted power for the above solutions will definitely increase theinstallation and maintenance cost, because of this reason, operators all over the world areclaiming that there are no radiation health hazards. Increase in the cost of deployment of networkcan be met by increasing per minute charges from Rs. 0.30 to 0.35, extra carbon credits earned, 28

29. 29. etc. Also, Govt. may consider reducing the tax or license fee in the overall interest of saving thelives of people, birds, animals, plants, and environment, thereby saving mother earth.8. ConclusionThe seriousness of the health hazards due to radiation from the cell phones and cell towers hasnot been realized among the common man. Cell operators continue to claim that there are nohealth issues. Even organizations like WHO, ICNIRP, FCC, etc. have not recommended strictersafe radiation guidelines, whereas several countries have adopted radiation norms, which are1/100th to 1/1000th of these values based on their studies. Cell phone industry is becominganother cigarette industry, which kept claiming that smoking is not harmful and now there aremillions of people around the world who have suffered from smoking. In fact, cell phone/towerradiation is worse than smoking; as one cannot see it or smell it, and its effect on health is notedafter a long period of exposure. Therefore, majority of people tend to have casualness towardspersonal protection. Unfortunately, ignorance and non-awareness adds to this misery and all ofus are absorbing this slow poison unknowingly. Even if people are aware of the radiation hazard,they may not have the choice to move away from it if the tower is installed near their office orresidential building.In addition to the continuous radiation from cell towers, there is radiation from cell phones,wireless phones, computers, laptops, TV towers, FM towers, AM towers, microwave ovens, etc.We are exposed to all these radiations which are additive in nature. Hence, it is imperative thatstricter radiation norms must be enforced by the policy makers.This does not mean that we have to stop living near these towers. We all know that automobilescreate air pollution – have we stopped using them? Instead, solutions were found such asunleaded petrol, catalytic converters to reduce emission, CNG driven vehicles, hybrid vehicles,etc. If people in the mobile companies think there is no

health hazard, then let them stand in frontof their own transmitting tower at 1m distance in the main beam for 6 hours – are they willing totake the risk? Similar effect will be there at 10m distance in about 600 hours (25 days). If mobilecompanies accept that radiation causes serious health problems, will people stop using cellphones? Not really, because the cell technology has its several advantages. However, thenresearchers/technocrats/entrepreneurs will come out with possible solutions, which may beexpensive but that cannot be greater than the health risk faced by humans, birds, animals andenvironment. 29

30. 30. Appendix A – Conversion from power received to electric field and power densityPower Density S can be calculated from the following equation in W/m²where,P Measured Power in W (Example: P= -30dBm = 0.000001W)Gi Gain of receiving antennaf Frequency in Hzco Velocity of light = 3 x 108 m/s.Following table gives values of electric field and power density for an isotropic antenna Gi = 1for different values of power received. 30

31. 31. Appendix B - Videos on Radiation • Cell Phone Antennas on Apartment Rooftops and their Health Effects http://www.youtube.com/watch?v=-G3CWrgDS5E Woman experiences illness after two months of cell phone antennas installed on roof top • Phone tumour http://au.video.yahoo.com/watch/8546044/22969162 Anna , 27, and her doctor convinced that her brain tumour is due to heavy mobile use. • New evidence in mobile phone tumour link http://www.youtube.com/watch?v=fMZhkDEsXU8&feature=player_embedded David,30,developed tumour the size of gulf ball behind right ear where he held his phone. • Cell phone towers in cities health hazards? http://www.youtube.com/watch?v=IOc99xpiy2E&feature=player_embedded Mrs. Bhatt, brain aneurysm patient, blames the cell phone tower for her problem. • Cell phone antennas blamed for kindergarten cancer cases, Chicago http://www.youtube.com/watch?v=BrQ9uXv57_s&feature=youtu.be 3 students died of leukemia and 30% of staff sick • EMF RF Exposure from cell phone radiation is potentially harmful http://www.youtube.com/watch?v=BXn8c41ZVTQ Sarah Dacre, suffers from EHS and wears special shielded clothes to protect herself • Health danger - wifi radiation - 2 – http://www.youtube.com/watch?v=EykTJJMvjCs Lady lives in a room with Silver foiling • Growing Evidence That Cell Phones Create Tumors http://www.youtube.com/watch?v=-9DuCzGLohc&feature=player_embedded Alan,57, developed a gulf ball size tumour on right side of brain where he held his phone. • Dr. Charlie Teo -"explosion" in brain tumours and truth about the wireless society http://www.youtube.com/watch?v=Zq340oQPfK4&feature=player_embedded#! John developed malignant tumour behind right ear; Dr. Teo's (neurosurgeon) testimony • Cell Phones & Cigarettes: What do they have in Common? http://www.youtube.com/watch?v=K4uz2TUcwnI • Live Blood & Electrosmog - http://www.youtube.com/watch?v=L7E36zGHxRw • Street protests against Mobile masts in Taiwan – http://bit.ly/a2JNnZ • Mumbai highly unsafe due to heavy mobile tower radiation but VVIPS house is safe http://www.youtube.com/watch?v=JCN9FLSvwhQ&feature=youtu.be - IN HINDI • The National Cell Phones and Disease Sept 26 2010 http://www.youtube.com/watch?v=F4bp7Zi_8pk Facts and fine prints about cell phone use • Invisible Dangers of Cell Phone Radiation http://www.youtube.com/watch?v=eVo2maA7h1E • Dr Magda Havas - On Cell /Transmission Towers and Your Health http://video.google.ca/videoplay?docid=6284020723745580379# • Cell

Phones and Brain Cancer - The Interphone Study
http://www.youtube.com/watch?v=npK5HSxukyA Interphone witnesses testified about research into cell phone use and its impact on healthMore reports and videos have been uploaded at Blog: http://neha-wilcom.blogspot.com and Twitter:https://twitter.com/wilcom_neha 31

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Nadia DiTommaso

From: Claudia Wendel <ccwendel@bigplanet.com>
Sent: Wednesday, March 09, 2016 3:33 PM
To: Nadia DiTommaso
Cc: Claudia Heisler Wendel
Subject: For the March 21, 2016 Agenda Packet-CELL TOWER
Attachments: Marina; ATT00001.htm

Dear Nadia,

Please print out (from the following seven links) the specific pages and include them in the March 21, 2016 Agenda Packet.
I would also like you to include this email in the agenda.
Thank you very much.

Respectfully submitted,
Claudia Wendel

Decrease in Property Value:
The following links address address the public's concern when a cell tower base is erected in a residential area. The data references a distance of one city block. In our situation, the cell tower base is within 300 feet of our windows.

The overwhelming majority of respondents (94%) reported that cell towers and antennas in a neighborhood or on a building would impact interest in a property and the price they would be willing to pay for it. And 79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antenna.

The results of the sales analysis showed prices of properties were reduced by around 21% after a cell phone base station was built in the neighborhood."

So, if we assume that the average condo unit in our building has a current market value of $200,000 and there is a decrease of 20% (which is $40,000) and multiply that by 84 residences, the decrease in property value for our building alone would total $3.3 Million.
And if we multiply that $3.3 Million total property value by a 2.7% tax rate, there would be a loss of tax revenue of $90,720 for our building alone.
And in our complex, we have 3 other buildings. So that would total a tax revenue loss of $362,880 each year for our area alone. That doesn't take into account other buildings to the west and south of the marina.
That $362,880 tax revenue loss per year economically makes not sense, when the guaranteed cell tower tax revenue is only $36,000 per year.
It would also thwart the revitalization of the US 1 Corridor.

The following is a view showing how close 300 feet actually appears.

Business Wire
A Berkshire Hathaway Company

Survey by the National Institute for Science, Law & Public Policy Indicates Cell Towers and Antennas Negatively Impact Interest in Real Estate Properties

94% of respondents said a nearby cell tower or group of antennas would negatively impact interest in a property or the price they would be willing to pay for it

July 03, 2014 01:57 PM Eastern Daylight Time

WASHINGTON--(BUSINESS WIRE)--A survey conducted in June 2014 by the National Institute for Science, Law and Public Policy (NISLAPP) in Washington, D.C., *"Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?"*, shows home buyers and renters are less interested in properties located near cell towers and antennas, as well as in properties where a cell tower or group of antennas are placed on top of or attached to a building.

Of the 1,000 survey respondents, 94% reported that cell towers and antennas in a neighborhood or on a building would impact interest in a property and the price they would be willing to pay for it. And 79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antennas. And almost 90% of respondents said they were concerned about the increasing number of cell towers and antennas in their residential neighborhood, generally. See Full Results here: http://electromagnetichealth.org/electromagnetic-health-blog/survey-property-desirability/.

The NISLAPP survey reinforced the findings of a study by Sandy Bond, Ph.D. of the New Zealand Property Institute, and Past President of the Pacific Rim Real Estate Society (PRRES), published in *The Appraisal Journal* in 2006, The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods. That study found buyers would pay as much as 20% less, as determined at that time by an opinion survey in addition to a sales price analysis.

Jim Turner, Esq., Chairman of the National Institute for Science, Law and Public Policy, says, "The results of the 2014 NISLAPP survey suggest there is now high awareness about potential risks from cell towers and antennas, including among people who have never experienced cognitive or physical effects from the radiation." He adds, "A study of real estate sales prices would be beneficial at this time in the Unites States to determine what discounts homebuyers are currently placing on properties near cell towers and antennas."

Read More

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"Our lives begin to end the day we become silent about things that matter."
- Martin Luther King, Jr.

Electromagnetic Health.org

EMF Real Estate Survey Results: "Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?"

03.07.2014 by emily Category Electromagnetic Health Blog

The National Institute for Science, Law and Public Policy's survey **"Neighborhood Cell Towers & Antennas—Do They Impact a Property's Desirability?"** initiated June 2, 2014, has now been completed by 1,000 respondents as of June 28, 2014. The survey, which circulated online through email and social networking sites, in both the U.S. and abroad, sought to determine if nearby cell towers and antennas, or wireless antennas placed on top of or on the side of a

building, would impact a home buyer's or renter's interest in a real estate property.

The overwhelming majority of respondents (94%) reported that cell towers and antennas in a neighborhood or on a building would impact interest in a property and the price they would be willing to pay for it. And 79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antenna.

- **94% said a nearby cell tower or group of antennas would negatively impact interest in a property or the price they would be willing to pay for it.**
- **94% said a cell tower or group of antennas on top of, or attached to, an apartment building would negatively impact interest in the apartment building or the price they would be willing to pay for it.**
- **95% said they would opt to buy or rent a property that had zero antennas on the building over a comparable property that had several antennas on the building.**
- **79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antennas.**
- **88% said that under no circumstances would they ever purchase or rent a property with a cell tower or group of antennas on top of, or attached to, the apartment building.**
- **89% said they were generally concerned about the increasing number of cell towers and antennas in their residential neighborhood.**

The National Institute for Science, Law and Public Policy (NISLAPP) was curious if respondents had previous experience with physical or cognitive effects of wireless radiation, or if their concern about neighborhood antennas was unrelated to personal experience with the radiation. **Of the 1,000 respondents, 57% had previously experienced cognitive effects from radiation emitted by a cell phone, wireless router, portable phone, utility smart meter, or neighborhood antenna or cell tower, and 43% had not experienced cognitive effects. 63% of respondents had previously experienced physical effects from these devices or neighborhood towers and antennas and 37% had not experienced physical effects.**

The majority of respondents provided contact information indicating they would like to receive the results of this survey or news related to the possible connection between neighborhood cell towers and antennas and real estate decisions.

Comments from real estate brokers who completed the NISLAPP survey:

"I am a real estate broker in NYC. I sold a townhouse that had a cell tower attached. Many potential buyers chose to avoid purchasing the property because of it. There was a long lease."

"I own several properties in Santa Fe, NM and believe me, I have taken care not to buy near cell towers. Most of these are rental properties and I think I would have a harder time renting those units… were a cell tower or antenna nearby. Though I have not noticed any negative health effects myself, I know many people are affected. And in addition, these antennas and towers are often extremely ugly–despite the attempt in our town of hiding them as chimneys or fake trees."

"We are home owners and real estate investors in Marin County and have been for the last 25 years. We own homes and apartment building here in Marin. We would not think of investing in real estate that would harm our tenants. All our properties are free of smart meters. Thank you for all of your work."

"I'm a realtor. I've never had a single complaint about cell phone antennae. Electric poles, on the other hand, are a huge problem for buyers."

Concern was expressed in the comments section by respondents about potential property valuation declines near antennas and cell towers. While the NISLAPP survey did not evaluate property price declines, a study on this subject by Sandy Bond, PhD of the New Zealand Property Institute, and Past President of the Pacific Rim Real Estate Society (PRRES), The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods, was published in *The Appraisal Journal* of the Appraisal Institute in 2006. The Appraisal Institute is the largest global professional organization for appraisers with 91 chapters. The study indicated that **homebuyers would pay from 10%–19% less to over 20% less for a property if it were in close proximity to a cell phone base station.** The 'opinion' survey results were then confirmed by a market sales analysis. **The results of the sales analysis showed prices of properties were reduced by around 21% after a cell phone base station was built in the neighborhood."**

The Appraisal Journal study added,

"Even buyers who believe that there are no adverse health effects from cell phone base stations, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a cell phone base station."

James S. Turner, Esq., Chairman of the National Institute for Science, Law & Public Policy and Partner, Swankin & Turner in Washington, D.C., says,

"The recent NISLAPP survey suggests there is now a high level of awareness about potential risks from cell towers and antennas. In addition, the survey indicates respondents believe they have personally experienced cognitive (57%) or physical (63%) effects from radiofrequency radiation from towers, antennas or other radiating devices, such as cell phones, routers, smart meters and other consumer electronics. Almost 90% are concerned about the increasing number of cell towers and antennas generally. A study of real estate sales prices would be beneficial at this time in the Unites States to determine what discounts homebuyers are currently placing on properties near cell towers and antennas."

Betsy Lehrfeld, Esq., an attorney and Executive Director of NISLAPP, says,

"The proliferation of this irradiating infrastructure throughout our country would never have occurred in the first place had Section 704 of the Telecommunications Act of 1996 not prohibited state and local governments from regulating the placement of wireless facilities on health or environmental grounds. The federal preemption leaves us in a situation today where Americans are clearly concerned about risks from antennas and towers, some face cognitive and physical health consequences, yet they and their families increasingly have no choice but to endure these exposures, while watching their real property valuations decline."

The National Institute for Science, Law, and Public Policy (NISLAPP) in Washington, D.C. was founded in 1978 to bridge the gap between scientific uncertainties and the need for laws protecting public health and safety. Its overriding objective is to bring practitioners of science and law together to develop intelligent policy that best serves all interested parties in a given controversy. Its focus is on the points at which these two disciplines converge.

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features

The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods

by Sandy Bond, PhD, and Ko-Kang Wang

abstract

This article examines whether proximity to cellular phone towers has an impact on residential property values and the extent of any impact. First, a survey approach is used to examine how residents perceive living near cellular phone base stations (CPBSs) and how residents evaluate the impacts of CPBSs. Next, a market study attempts to confirm the perceived value impacts reported in the survey by analyzing actual property sales data. A multiple regression analysis in a hedonic pricing framework is used to measure the price impact of proximity to CPBSs. Both the survey and market sales analysis find that CPBSs have a negative impact on the prices of houses in the study areas.

The introduction of cellular phone systems and the rapid increase in the number of users of cellular phones have increased exposure to electromagnetic fields (EMFs). Health consequences of long-term use of cellular phones are not known in detail, but available data indicates that development of nonspecific health symptoms is possible.[1] Conversely, it appears health effects from cellular phone equipment (antennas and base stations) pose few, if any, known health hazards.[2]

A concern associated with cellular phone usage is the siting of cellular phone transmitting antennas (CPTAs) and cellular phone base stations (CPBSs). In New Zealand, CPBS sites are increasingly in demand as the major cellular phone companies there, Telecom and Vodafone, upgrade and extend their network coverage. This demand could provide the owner of a well-located property a yearly income for the siting of a CPBS.[3] However, new technology that represents potential hazards to human health and safety may cause property values to diminish due to public perceptions of hazards. Media attention to the potential health hazards of CPBSs has spread concerns among the public, resulting in increased resistance to CPBS sites.

Some studies suggest a positive correlation between long-term exposure to the electromagnetic fields and certain types of cancer,[4] yet other studies report inconclusive results on health effects.[5] Notwithstanding the research results, media reports indicate that the extent of opposition from some property owners

1. Stanislaw Szmigielski and Elizbieta Sobiczewska, "Cellular Phone Systems and Human Health—Problems with Risk Perception and Communication," *Environmental Management and Health* 11, no. 4 (2000): 352–368.
2. Jerry R. Barnes, "Cellular Phones: Are They Safe?" *Professional Safety* 44, no. 12 (Dec. 1999): 20–23.
3. R. Williams, "Phone Zone—Renting Roof Space to Ma Bell," *The Property Business* 12 (April 2001): 6–7.
4. C. M. Krause et al., "Effects of Electromagnetic Field Emitted by Cellular Phones on the EEG During a Memory Task," *Neuroreport* 11, no. 4 (2000): 761–764.
5. Independent Expert Group on Mobile Phones, *Mobile Phones and Health* (Report to the United Kingdom Government, 2000), http://www.iegmp.org.uk.

Service providers prefer to locate cell sites in commercial or industrial areas due to the "resource consent" procedure required by the Resource Management Act 1991[9] for towers located in residential areas.

Despite the high level of demand for better cell phone coverage, the location of cell sites continues to be a contentious issue. The majority of people want better cell phone coverage where they live and work, but they do not want a site in their neighborhood. Thus, cell sites in or near residential areas are of particular concern. Concerns expressed usually relate to health, property values, and visual impact.[10]

In general, uncertainties in the assessment of health risks from base stations are presented and distributed in reports by organized groups of residents who protest against siting of base stations. When the media publishes these reports it amplifies the negative bias and raises public concerns. According to Covello, this leads to incorrect assessment of risks and threats by the public, with a tendency to overestimate risks from base stations and neglect risks from the use of cell phones.[11]

Assessment of Environmental Effects

Under the Resource Management Act 1991 (RMA), an assessment of environmental effects is required every time an application for resource consent is made. Information that must be provided includes "an assessment of any actual or potential effects that the activity may have on the environment, and the ways in which any adverse effects may be mitigated."[12] An assessment of the environmental effects of cell sites would take into consideration such things as health and safety effects; visual effects; effects on the neighborhood; and interference with radio and television reception.

Radio Frequency and Microwave Emissions from CPBSs

According to the Ministry for the Environment, the factors that affect exposure to radiation are as follows:

- Distance. Increasing the distance from the emitting source decreases the radiation's strength and decreases the exposure.
- Transmitter power. The stronger the transmitter, the higher the exposure.
- Directionality of the antenna. Increasing the amount of antennas pointing in a particular direction increases the transmitting power and increases the exposure.
- Height of the antenna above the ground. Increasing the height of an antenna increases the distance from the antenna and decreases the exposure.
- Local terrain. Increasing the intervening ridgelines decreases the exposure.[13]

The amount of radiofrequency power absorbed by the body (the dose) is measured in watts per kilogram, known as the specific absorption rate (SAR). The SAR depends on the power density in watts per square meter. The radio frequencies from cellular phone systems travel in a "line of sight." The antennas are designed to radiate energy horizontally so that only small amounts of radio frequencies are directed down to the ground. The greatest exposures are in front of the antenna so that near the base of these towers, exposure is minimal. Further, power density from the transmitter decreases rapidly as it moves away from the antenna. However, it should be noted that by initially walking away from the base, the exposure rises and then decreases again. The initial increase in exposure corresponds to the point where the lobe from the antenna beam intersects the ground.[14]

Health Effects

According to Szmigielski and Sobiczewska, the analogue phone system (using the 800–900 megahertz band) and digital phone system (using the 1850–1990 megahertz band) expose humans to electromagnetic field (EMF) emissions: radio frequency radiation (RF) and microwave radiation (MW), respectively. These two radiations are emitted from both cellular phones and CPBSs.[15]

For years cellular phone companies have assured the public that cell phones are safe. They state that the particular set of radiation parameters associated with cell phones is the same as any other ra-

9. The Resource Management Act 1991 is the core of the legislation intended to help achieve sustainability in New Zealand; see http://www.mfe.govt.nz/laws/rma.

10. Szmigielski and Sobiczewska; and Barnes.

11. Vincent T. Covello, "Risk Perception, Risk Communication, and EMF Exposure: Tools and Techniques for Communicating Risk Information," in *Risk Perception, Risk Communication and Its Application to EMF Exposure: Proceedings of the World Health Organization and ICNIRP Conference*, ed. R. Matthes, J. H. Bernhardt, M. H. Repucholi, 179–214 (Munich, Germany, May 1998).

12. Section 88(4), (b), Resource Management Act 1991.

13. Ministry for the Environment and Ministry of Health, *National Guidelines for Managing the Effects of Radiofrequency Transmitters*, available at http://www.mfe.govt.nz and http://www.moh.govt.nz (accessed May 21, 2002).

14. Ibid.; and Szmigielski and Sobiczewska.

15. Szmigielski and Sobiczewska.

Council[20] and *Shirley Primary School v. Telecom Mobile Communications Ltd.*[21] Very few cell site cases have actually proceeded to Environment Court hearings. In these two cases the plaintiffs claimed that there was a risk of adverse health effects from radio frequency radiation emitted from cell phone base stations and that the CPBSs had adverse visual effects.

In *McIntyre*, Bell South applied for resource consent to erect a CPBS. The activity was a noncomplying activity under the Transitional District Plan. Residents objected to the application. Their objections were related to the harmful health effects from radio frequency radiation. In particular, they argued it would be an error of law to decide, based on the present state of scientific knowledge, that there are no harmful health effects from low-level radio frequency exposure. It was also argued that the Resource Management Act contains a precautionary policy and also requires a consent authority to consider potential effects of low probability but high impact in reviewing an application.

The Planning Tribunal considered residents' objections and heard experts' opinions as to the potential health effects, and granted the consent, subject to conditions. It was found that there would be no adverse health effects from low levels of radiation from the proposed transmitter, not even effects of low probability but high potential impact.

In *Shirley Primary School*, Telecom applied to the Christchurch City Council for resource consent to establish, operate, and maintain a CPBS on land adjacent to the Shirley Primary School. This activity was a noncomplying activity under the Transitional District Plan. Again, the city council granted the consent subject to conditions. However, the school appealed the decision, alleging the following four adverse effects:

- Risk of adverse health effects from the radio frequency radiation emitted from the cell site
- Adverse psychological effects on pupils and teachers because of the perceived health risks
- Adverse visual effects
- Reduced financial viability of the school if pupils withdraw because of the perceived adverse health effects

The court concluded that the risk of the children or teachers at the school developing leukemia or other cancers from radio frequency radiation emitted by the cell site is extremely low, and the risk to the pupils of developing sleep disorders or learning disabilities because of exposure to radio frequency radiation is higher, but still very small. Accordingly, the Telecom proposal was allowed to proceed.

In summary, the Environmental Court ruled that there are no established adverse health effects from the emission of radio waves from CPBSs and no epidemiological evidence to show this. The court was persnaded by the ICNIRP guidelines that risk of health effects from low-level exposure is very low and that the cell phone frequency imposed by the NZ standard is safe, being almost two and one-half times lower than that of the ICNIRP.

The court did concede that while there are no proven health effects, there was evidence of property values being affected by both of the health allegations. The court suggested that such a reduction in property values should not be counted as a separate adverse effect from, for example, adverse visual or amenities effects. That is, a reduction in property values is not an environmental effect in itself; it is merely evidence, in monetary terms, of the other adverse effects noted.

In a third case, *Goldfinch v. Auckland City Council*,[22] the Planning Tribunal considered evidence on potential losses in value of the properties of objectors to a proposal for the siting of a CPBS. The court concluded that the valuer's monetary assessments support and reflect the adverse effects of the CPBS. Further, it concluded that the effects are more than just minor as the CPBS stood upon the immediately neighboring property.

Literature Review

While experimental and epidemiological studies have focused on the adverse health effects of radiation from the use of cell phones and CPBSs, few studies have been conducted to ascertain the impact of CPBSs on property values. Further, little evidence of property value effects has been provided by the courts. Thus, the extent to which opposition from property owners affected by the siting of CPBSs is reflected in lower property values is not well known in New Zealand.

Two studies have been conducted to ascertain the adverse health and visual effects of CPBSs on property values. Telecom commissioned Knight Frank (NZ) Ltd to undertake a study in Auckland in 1998/

20. NZRMA 289 (1996).
21. NZRMA 66 (1999).
22. NZRMA 97 (1996).

warn that the results cannot and should not be generalized outside of the data. They explain that

> limits on generalizations are a universal problem for real property sale data because analysis is constrained to properties that sell and sold properties are never a randomly drawn representative sample. Hence, generalizations must rely on the weight of evidence from numerous studies, samples, and locations.[29]

Thus, despite the varying results reported in the literature on property value effects from HVOTLs, each study adds to the growing body of evidence and knowledge on this (and similar) valuation issue(s). The study reported here is one such study.

Opinion Survey Research Objectives and Methodology

Research by Abelson;[30] Chalmers and Roehr;[31] Kinnard, Geckler and Dickey;[32] Bond;[33] and Flynn et al.,[34] recommend the use of market sales analysis in tandem with opinion survey studies to measure the impact of environmental hazards on residential property values. The use of more than one approach provides the opportunity to compare the results from each and to derive a more informed conclusion than obtained from relying solely on one approach. Thus, the methods selected for this study include a public opinion survey and a hedonic house price approach (as proposed by Freeman[35] and Rosen[36]). A comparison of the results from both of these techniques will reveal the extent to which the market reacts to cell phone towers.

Public Opinion Survey

An opinion survey was conducted to investigate the current perceptions of residents towards living near CPBSs and how this proximity might affect property values. Case study areas in the city of Christchurch were selected for this study. The study included residents in ten suburbs: five case study areas (within 300 meters of a cell phone tower) and five control areas (over 1 kilometer from the cell phone tower). The five case study suburbs were matched with five control suburbs that had similar living environments (in socioeconomic terms) except for the presence of a CPBS.

The number of respondents to be surveyed (800) and the nature of the data to be gathered (perceptions/personal feelings towards CPBSs) governed the choice of a self-administered questionnaire as the most appropriate collection technique. Questionnaires were mailed to residents living in the case study and control areas.

A self-administered survey helps to avoid interviewer bias and to increase the chances of an honest reply where the respondent is not influenced by the presence of an interviewer. Also, mail surveys provide the time for respondents to reflect on the questions and answer these at their leisure, without feeling pressured by the time constraints of an interview. In this way, there is a better chance of a thoughtful and accurate reply.

The greatest limitation of mail surveys is that a low response rate is typical. Various techniques were used to help overcome this limitation, including careful questionnaire design; inclusion of a free-post return envelope; an accompanying letter ensuring anonymity; and reminder letters. An overall response rate of 46% was achieved for this study.

The questionnaire contained 43 individual response items. The first question acted as an identifier to determine whether the respondent was a homeowner or tenant. While responses from both groups were of interest, the former was of greater importance, as they are the group of purchasers/sellers that primarily influence the value of property. However, it was considered relevant to survey both groups as both are affected by proximity to a CPBS to much the same extent from an occupiers' perspective, i.e., they both may perceive risks associated with a CPBS. It was hypothesized that tenants, being less-permanent residents, would perceive the effects in a similar way, but to a much lesser degree.

Other survey questions related to overall neighborhood environmental desirability; the timing of

29. Ibid., 252.

30. P. W. Abelson, "Property Prices and Amenity Values," *Journal of Environmental Economics and Management* 6 (1979): 11–28.

31. James A. Chalmers and Scott Roehr, "Issues in the Valuation of Contaminated Property," *The Appraisal Journal* (January 1993): 28–41.

32. W. N., Kinnard, M. B. Geckler, and S. A. Dickey, "Fear (as a Measure of Damages) Strikes Out: Two Case Studies Comparisons of Actual Market Behaviour with Opinion Survey Research" (paper presented at the Tenth Annual American Real Estate Society Conference, Santa Barbara, California, April 1994).

33. S. G. Bond, "Do Market Perceptions Affect Market Prices? A Case of a Remediated Contaminated Site," in *Real Estate Valuation Theory*, ed. K. Wang and M. L. Wolverton, 285–321 (Boston: Kluwer Academic Publishers, 2002).

34. James Flynn et al., "Survey Approach for Demonstrating Stigma Effects in Property Value Litigation," *The Appraisal Journal* (Winter 2004): 35–45.

35. A. Myrick Freeman, *The Benefits of Environmental Improvement: Theory and Practice* (Baltimore: John Hopkins Press, 1979).

36. Sherwin Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," *Journal of Political Economy* 82, no. 1 (Jan/Feb 1974): 34–55.

from the control area were completed and returned. Over three-quarters (78.5%) of the case study respondents were homeowners compared to 94% in the control area.

Desirability of the Suburb as a Place to Live

More than half (58.3%) the case study respondents have lived in their suburb for more than five years (compared to 65% in the control group) and a qnarter (25%) have lived in their suburb between 1 and 4 years (compared to 28% in tbe control group).

Around two-thirds (65% of the case study respondents and 68% of the control group respondents) rated their neighborhoods as either above average or superior as a place to live when compared with other similar named suburbs. The reasons given for this include close proximity to amenities (shops, library, medical facilities, public transport, and recreational facilities) and good schools.

Reasons given for rating the case study neighborhoods inferior to other similar neighborhoods include lower house prices, older homes, more student housing and lower-income residents. The reasons given by the control group respondents for an inferior rating include distance from the central business district (Avonhead); smell from the sewerage oxidation ponds and composting ponds (Bromley); and lower socioeconomic area and noise from the airport (Linwood).

Feelings About a CPBS as an Element of the Neighborhood

In the case study areas, a CPBS had already been constructed when only 39% of the respondents bought their houses or began renting in the neighborhood. Some responded that they were not notified that the CPBS was to be built, that they had no opportunity to object to it, and that they felt they should have been consulted about its construction. For the respondents who said that proximity to the tower was of concern to them, the most common reasons given for this were the impact of the CPBS on health, aesthetics, and property values. Nearly three-quarters (74%) of the respondents said they would have gone ahead with the purchase or rental of their property anyway if they had known that the CPBS was to be constructed.

In the control areas nearly three-quarters (72%) of the respondents indicated they would be opposed to construction of a CPBS nearby. The location of a CPBS would be taken into account by 83% of respondents if they were to consider moving. As with the case study respondents, the control group respondents who were concerned about proximity to a CPBS were most often concerned about the effects of CPBSs on health, aesthetics, and property values.

Impact on Decision to Purchase or Rent

In the case study areas, the tower was visible from the houses of 46% of the respondents, yet two-thirds (66%) of these said it was barely noticeable, and one-quarter said it mildly obstructed their view. When asked in what way the CPBS impacts the enjoyment of living in their home, 37% responded that its impact was related to health concerns, 21% said it impacted neighborhood aesthetics, 20% said it impacted property value, and 12% said it impacted the view from their property.

When asked about the impact tbat the CPBS had on the price/rent they were prepared to pay for their property, over half the case study respondents (53.1%) said that the tower was not constructed at the time of purchase/rental, and 51.4% of the respondents said the proximity to the CPBS did not affect the price they were prepared to pay for the property. Nearly 3% said they were prepared to pay a little less, 2% said they were prepared to pay a little more. For the control group respondents, 45% of the respondents would pay substantially less for a property if a CPBS were located nearby, over one-third (38%) were prepared to pay just a little less for such a property, and 17% responded that a CPBS would not influence the price they would pay.

Only 10% of the case study respondents gave an indication of the impact that the CPBS had on the price/rent they were prepared to pay for the property; one-third of these felt it would decrease price/rent by 1% to 9%. For the control group, over one-third (38%) of the respondents felt that a CPBS would decrease price/rent by more than 20%, and a similar number (36%) said they would be prepared to pay 10% to 19% less for property located near a CPBS. The responses are outlined in Table 1.

Table 1 Impact of a CPBS on Purchase/Rental Price Decision

Price/Rent Effect	Percent of Case Study Respondents (Control Group Responses)
20% more	5% (3%)
10–19% more	10% (2%)
1–9% more	14% (2%)
1–9% less	33% (19%)
10–19% less	24% (36%)
20% or greater reduction in price/rent	14% (38%)

after they had purchased their homes, because to do so might have a negative impact on property values.

Regardless of the reasons for the difference in responses from the case study and control groups, the overall results show that residents perceive CPBSs negatively. In both the case study and control areas, the impact of proximity to CPBSs on future property values was the issue of greatest concern for respondents. Overall, respondents felt that proximity to a CPBS would reduce value by from 10% to over 20%. The second part of the study outlined below, involving an econometric analysis of Christchurch property sales transaction data, helps to confirm these results.

Respondents' comments added at the end of the survey indicate that residents have ongoing concerns about CPBSs. Although some people accepted the need for CPBSs, they said that they did not want them built in their back yard, or they preferred that they be disguised to blend better with their environment.

Market Study Research Objectives and Methodology

A market study was undertaken to test the hypothesis that in suburbs where there is a CPBS it will be possible to observe discounts to the selling price of homes located near these structures. Such discounts would be observed where buyers of proximate homes view the CPBSs in negative terms due to a perceived risk of adverse effects on health, aesthetics, and property value.

The literature dealing specifically with the measurement of the impact of environmental hazards on residential sale prices (including proximity to transmission lines, landfill sites, and ground water contamination) indicates the popularity of hedonic pricing models, as introduced by Court[43] and later Griliches,[44] and further developed by Freeman[45] and Rosen.[46] The more recent studies, including those by Dotzour;[47] Simons and Sementelli;[48] and Reichert,[49] focus on proximity to an environmental hazard and demonstrate that this reduces residential house prices by varying amounts depending on the distance from the hazard.[50] However, there are no known published studies that use hedonic housing models to measure the impact of proximity to a CPBS on residential property values.

As in the previous residential house price studies, the standard hedonic methodology was used here to quantify the impact of a CPBS on sale prices of homes located near a CPBS. The results from this study in tandem with the opinion survey results will help test the hypothesis that proximity to a CPBS has a negative impact on property value and will reveal the extent to which the market reacts to CPBSs.

Model Specification

A hedonic price model is constructed by treating the price of a property as a function of its utility-bearing attributes. Independent variables used in the model to account for the property attributes are limited to those available in the data set and known, based on other well-tested models reported in the literature and from valuation theory, to be related to property price. The basic model used to analyze the impact on sale price of a house located near a CPBS, is as follows:

$$P_i = f(X_{1,i}, X_{2,i} \ldots \ldots \ldots \ldots \ldots X_{n,i})$$

where:

P_i = property price at the i th location

$X_{1,i} \ldots X_{n,i}$ = individual characteristics of each sold property (e.g., land area, age of house, floor area, sale date, construction materials, house condition, CPBS construction date, etc.)

The more recent hedonic pricing studies that demonstrate the effects of proximity to an environmental hazard use different functional forms to represent the relationship between price and various property characteristics.[51] In hedonic housing models the linear and log-linear models are most popular. The linear model implies constant partial effects between house prices and housing characteristics, while the log-linear model allows for nonlinear price effects and is shown in the following equation:

43. A. T. Court, "Hedonic Price Indexes with Automotive Examples," in *The Dynamics of Automobile Demand* (New York: General Motors, 1939).

44. Zvi Griliches, ed. *Price Indexes and Quality Change* (Cambridge, Mass.: Harvard University Press, 1971).

45. Freeman.

46. Rosen.

47. Mark Dotzour, "Groundwater Contamination and Residential Property Values," *The Appraisal Journal* (July 1997): 279–285.

48. Robert A. Simons and Arthur Sementelli, "Liquidity Loss and Delayed Transactions with Leaking Underground Storage Tanks," *The Appraisal Journal* (July 1997): 255–260.

49. Alan K. Reichert, "Impact of a Toxic Waste Superfund Site on Property Values," *The Appraisal Journal* (October 1997): 381–392.

50. Only Dotzour found no significant impact of the discovery of contaminated groundwater on residential house prices. This was likely due to the nonhazardous nature of the contamination where the groundwater was not used for drinking purposes.

51. See for example L. Dale et al., "Do Property Values Rebound from Environmental Stigmas? Evidence from Dallas," *Land Economics* 75, no. 2 (May 1999): 311–326; Dotzour; Simons and Sementelli; and Reichert.

thetics. Hence, view of a CPBS was not included as an independent variable. The variable descriptions are listed in Table 3. Variable codes are shown in Appendix III and basic descriptive statistics for selected quantitative variables are shown in Appendix IV.

Table 3 Variable Descriptions

Variable*	Definition
SLNETX	Sale price of the house (NZ$)
SITSTX	Street name
CATGYX2	Category of dwelling: D, E, etc.†
CATGYX4	Quality of the structure: A, B, C†
TIMESOLD.Q	Using the time the cell phone tower was built as a baseline quarter, the number of quarters before (–) and after (+) it was built
AGE	Year the house was built
LANDAX	Land area (ha)
MATFAX	Total floor area (m^2)
WALLCNX	Wall construction: W, B, C, etc.†
ROOFCNX	Roof construction: W, B, C, etc.†
TOWER	An indicator variable: 0 if before the cell phone tower was built, or 1 after it was built

* Sale price is the dependent variable.

† See Appendix III for explanation of variable codes.

Market Study Results

An econometric analysis of Christchurch property transaction data helped to confirm the opinion survey results. In the analysis of selected suburbs, the sales data from sales that occurred before a CPBS was built was compared to sales data from after a CPBS was built to determine any variance in price, after accounting for all the relevant independent variables.

Empirical Results

The model of choice is one that best represents the relationships between the variables and has a small variance and unbiased parameters. Various models were tested and the results are described in the next section. The following statistics were used to help select the most appropriate model: the adjusted coefficient of determination (adjusted R^2); the standard error of the regression equation; the AIC[53] and BIC[54] statistics; and *t*-test of significance of the coefficients and *F*-statistic.

Significance of Variables and the Equation: St Albans

As hedonic prices can vary significantly across different functional forms, various commonly used functional forms were examined to determine the model specification that best describes the relationship between price and the independent variables. Also, to test the belief that the relationship between *Price* and *Land Area* is not a linear function of *Price*, the variable *LANDAX* (land area) was transformed to reflect the correct relationship. Several transformations were tested including: linear of *SLNETX* (sale price) and log of *LANDAX*; log of *SLNETX* and linear of *LANDAX;* and log of *SLNETX* and log of *LANDAX*. All dummy variables remained in their linear form in each model.

It was found that the best result was obtained from using the log of *SLNETX* and log of *LANDAX*, and the linear form of all the dummy variables. Taking the log of an independent variable implies diminishing marginal benefits. For example, an extra 50 square meters of land area on a 550-square-meter site would be worth less than the previous 50 square meters. The log-log model shows the percent change in price for a one-percent change in the independent variable, while all other independent variables are held constant (as explained in Hill, Griffiths, and Judge).[55]

In the semilogarithmic equation the interpretation of the dummy variable coefficients involves the use of the formula: $100(e^{b_n} - 1)$, where b_n is the dummy variable coefficient.[56] This formula derives the percentage effect on price of the presence of the factor represented by the dummy variable and is advocated over the alternative, and commonly misused, formula of 100. (b_n). The resulting model included all the available variables as follows:

$$\begin{aligned}\log(SLNETX) = {} & \alpha + \beta_1 \times TOWER + \beta_2 \times SITSTX \\ & + \beta_3 \times CATGYX2 + \beta_4 \times CATGYX4 \\ & + \beta_5 \times TIMESOLD \times Q + \beta_6 \times AGE \\ & + \beta_7 \times \log(LANDAX) \\ & + \beta_8 \times MATFAX \\ & + \beta_9 \times WALLCNX \\ & + \beta_{10} \times ROOFCNX\end{aligned}$$

53. AIC is the Akaike Information Criterion, and is a "goodness of fit" measure involving the standard error of the regression adjusted by a penalty factor. The model selected is the one that minimizes this criterion (Microsoft SPSSPC Online Guide, 1997).

54. The BIC is the Bayesian Information Criterion. Like the AIC, BIC takes into account both how well the model fits the observed data, and the number of parameters used in the model. The model selected is the one that adequately describes the series and has the minimum SBC. The SBC is based on Bayesian (maximum-likelihood) considerations. (Microsoft SPSSPC Online Guide, 1997).

55. R. Carter Hill, William E. Griffiths, and George G. Judge, *Undergraduate Econometrics* (New York: John Wiley & Sons, 1997).

56. See Robert Halvorsen and Raymond Palmquist, "The Interpretation of Dummy Variables in Semi-Logarithmic Equations," *American Economic Review* 70, no. 3 (1980): 474–475.

market was increasing over time since the CPBS was built (2000), but only by 1.4% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0042576} \approx 1.00427$ (0.43%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in Papanui, the price of a house would decrease by $e^{-0.2510} \approx 0.79$ (21% decrease).

Significance of Variables and the Equation: Beckenham

The same functional form used for Papanui and St Albans was used for Beckenham. From the regression output, the variable *ROOFCNX* was found to be insignificant so it was removed from the model and the regression was rerun; Appendix VII summarizes these results. The *F*-statistic (214) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 6 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding this variable was selected for analysis.

Table 6 Test Statistics — Beckenham

	Adjusted R^2	AIC	BIC
Full Model	0.89	-819.00	-641.39
Sub Model	0.89	-818.66	-650.66

The coefficient of determination (R^2) indicates that approximately 89% of the variation in sale price is explained by the variation in the independent variable set. Again, as with the model for Papanui this amount of explanation would be considered high.

The most significant variables were *TIMESOLD.Q*, *MATFAX*, and *TOWER*. The former two have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 2000, but only by 1.91% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0042051} \approx 1.00421$ (0.42%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in Beckenham, the price of a house would decrease by $e^{-0.25019} \approx 0.793$ (20.7% decrease).

Significance of Variables and the Equation: Bishopdale

The same functional form used for the other three suburbs was used for Bishopdale. From the regression output, the variables *ROOFCNX* and *CATGYX* were found to be insignificant so these were removed from the model and the regression was rerun; Appendix VIII summarizes these results. The *F*-statistic (122) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 7 Test Statistics — Bishopdale

	Adjusted R^2	AIC	BIC
Full Model	0.79	-927.48	-775.71
Sub Model	0.79	-929.32	-796.52

Table 7 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* and *CATGYX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding these variables was selected for analysis.

Again, the most significant variables were *TIMESOLD.Q* and *MATFAX*; the variable of interest, *TOWER*, was not a significant variable in the model so it is not discussed further. The former two variables have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 1994, but only at 0.98% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by $e^{0.0039665} \approx 1.004$ (0.40%), with increasing size.

Summary of Results

The above analysis shows that the most significant variables and their impact on price were similar between suburbs. This indicates the relative stability of the coefficients between each model. Interestingly, the impact of *TOWER* on price (a decrease of between 20.7% and 21%) was very similar in the two suburbs where the towers were built in the year 2000. This may be due to the much greater media publicity given to CPBSs after the two legal cases in Christchurch (*McIntyre* and *Shirley Primary School*

ever, this result varies between neighborhoods, with a positive impact on price being recorded in one neighborhood, possibly due to the CPBS being built in that suburb before any adverse media publicity about CPBSs appeared in the local Christchurch press.

Research to date reports no clearly established health effects from radio frequency emissions of CPBSs operated at or below the current safety standards, yet recent media reports indicate that people still perceive that CPBSs have harmful effects. Thus, whether or not CPBSs are proven to be free from health risks is only relevant to the extent that buyers of properties near CPBSs perceive this to be true. Even buyers who believe that there are no adverse health effects from CPBSs, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a CPBS.

The comments of survey participants indicate the ongoing concerns that residents have about CPBSs. There is the need to increase the public's understanding of how radio frequency transmitting facilities operate and the strict exposure-limit standards imposed on the telecommunication industry. As more information is discovered that refutes concerns regarding adverse health effects from CPBSs, and as information about the NZ safety standards are made more publicly available, the perception of risk may gradually change, eliminating the discounts for neighboring properties.

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Additional Reading

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Appendix II Summary of the Survey Results

Variable	Response	Valid Percent (%)	
		Case Study	Control
Occupancy	Homeowner	78.5	94.2
	Tenant	21.5	5.8
How long have you lived there?	Less than 6 months	8.0	2.6
	6 months–1 year	8.6	4.5
	1–4 years	25.1	27.7
	More than 5 years	58.3	65.2
How would you rate the desirability of your neighborhood?	Superior	27.4	30.9
	Above Average	37.4	36.8
	Average	28.5	27.0
	Below Average	5.6	4.6
	Inferior	1.1	0.7
Would you be opposed to construction of a cell phone tower nearby?	Yes		72.1
	No		27.9
When you purchased/began renting was the cell phone tower already constructed?	Yes	39.3	
	No	60.7	
Was the proximity of the cell phone tower a concern to you?	Yes	20.0	
	No	80.0	
Would you have gone ahead with rental/purchase if you had known a cell phone site was to be constructed?	Yes	73.9	
	No	26.1	
Is location of a cell phone tower a factor you would consider when moving?	Yes		83.4
	No		16.6
Is the cell phone tower visible from your house?	Yes	45.7	
	No	54.3	
If yes, how much does it impact on your view?	Very obstructive	9.6	
	Mildly obstructive	24.5	
	Barely noticeable	66.0	
In what way does it impact on the enjoyment of living in your house?	Views	11.8	
	Aesthetics	20.6	
	Health concerns	36.8	
	Change in property value	19.9	
	Other	11.0	
Effect a nearby cell phone tower would have on the price/rent you would pay for the property	Tower wasn't constructed	53.1	
	Pay substantially more	0.0	0.0
	Pay a little more	2.3	0.0
	Pay a little less	2.8	37.6
	Pay substantially less	0.6	45.4
	Not influence price	51.4	17.0
% Effect a nearby cell phone tower would have on the price/rent you would pay for the property	20% higher or more	5	3.2
	10–19% more	10	1.6
	1–9% more	14	2.4
	1–9% less	33	19.2
	10–19% less	24	36.0
	20% or a greater reduction	14	37.6
Concern about the possibility of harmful health effects in the future	Does not worry me	50.3	19.9
	Worries me somewhat	38.0	38.4
	Worries me a lot	11.7	41.7
Concern about the stigma associated with houses near the cell phone sites	Does not worry me	54.6	20.8
	Worries me somewhat	33.9	45.0
	Worries me a lot	11.5	34.2
Concern about the affect on your properties value in the future	Does not worry me	61.3	15.4
	Worries me somewhat	25.4	37.2
	Worries me a lot	13.3	47.4
Concern about the aesthetic problems caused by the tower	Does not worry me	63.3	18.2
	Worries me somewhat	25.4	37.0
	Worries me a lot	11.3	44.8

Appendix V Regression Model: St Albans

log(*SLNETX*) = *TOWER* + *CATGYX2* + *CATGYX4* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *SITSTX*

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.72855	-0.15032	0.01593	0.14263	0.72047

Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**
(Intercept)	9.1781868	0.6769096	13.559	< 2e-16 ***
TOWER	**0.1133186**	0.0318188	**3.561**	0.000395 ***
CATGYX2D	0.1846417	0.0702520	2.628	0.008776 **
CATGYX2O	0.0334663	0.1008594	0.332	0.740134
CATGYX4B	-0.1551409	0.0245485	-6.320	4.75e-10 ***
CATGYX4C	-0.1483169	0.0722959	-2.052	0.040600 *
TIMESOLD.Q	**0.0136663**	**0.0008208**	**16.650**	< 2e-16 ***
AGE	0.0016408	0.0003521	4.660	3.81e-06 ***
log(LANDAX)	**0.3285367**	**0.0283610**	**11.584**	< 2e-16 ***
MATFAX	**0.0022314**	**0.0001962**	**11.373**	< 2e-16 ***
SITSTXAIKMANS RD	0.4029259	0.0533671	7.550	1.41e-13 ***
SITSTXBEVERLEY ST	0.2330787	0.0803137	2.902	0.003827 **
SITSTXBRISTOL ST	0.1706840	0.0521716	3.272	0.001124 **
SITSTXBROWNS RD	0.2492536	0.0720854	3.458	0.000579 ***
SITSTXCOX ST	0.3055798	0.0581672	5.253	2.00e-07 ***
SITSTXGORDON AVE	0.0823422	0.0679833	1.211	0.226236
SITSTXKNOWLES ST	0.1690979	0.0558911	3.025	0.002576 **
SITSTXMANSFIELD AVE	0.2954242	0.0652983	4.524	7.16e-06 ***
SITSTXMCDOUGALL AVE	0.3303105	0.0623720	5.296	1.60e-07 ***
SITSTXMURRAY PL	0.3613773	0.0629166	5.744	1.40e-08 ***
SITSTXOFFICE RD	0.3681146	0.0543368	6.775	2.71e-11 ***
SITSTX Other	0.0618491	0.0736629	0.840	0.401416
SITSTXPAPANUI RD	0.1940369	0.0560474	3.462	0.000570 ***
SITSTXRANFURLY ST	0.1701716	0.0617504	2.756	0.006012 **
SITSTXST ALBANS ST	0.1458665	0.0571172	2.554	0.010873 *
SITSTXWEBB ST	0.1895432	0.0725061	2.614	0.009143 **
SITSTXWESTON RD	0.2084419	0.0527555	3.951	8.60e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.2175 on 677 degrees of freedom
Multiple *R*-Squared: 0.8253, Adjusted *R*-squared: 0.8186
F-statistic: 123 on 26 and 677 DF, *p*-value: < 2.2e-16

Appendix VI Regression Model: Papanui

ln(formula = log(*SLNETX*) ~ *TOWER* + *SITSTX* + *TIMESOLD.Q* + *AGE* + log(*LANDAX*) + *MATFAX* + *WALLCNX* + *ROOFCNX* + *CATGYX4*, data = *Papanui.final*)

Residuals:	**Min**	**1Q**	**Median**	**3Q**	**Max**
	-0.484987	-0.098006	0.003859	0.106253	0.563126

Coefficients:	**Estimate**	**Std. Error**	**t-value**	**Pr(>|t|)**
(Intercept)	5.9482316	0.6998186	8.500	< 2e-16 ***
TOWER	**-0.2339640**	0.0240908	**-9.712**	< 2e-16 ***
SITSTXHOANI ST	-0.1966982	0.0265429	-7.411	4.26e-13 ***
SITSTXLANGDONS RD	-0.1192547	0.0281242	-4.240	2.58e-05 ***
SITSTXLEANDER ST	0.0305555	0.0449437	0.680	0.496853
SITSTXMATSONS AVE	0.0949636	0.0292461	3.247	0.001231 **
SITSTXMORELAND AVE	-0.0892332	0.0397622	-2.244	0.025183 *
SITSTXMORRISON AVE	-0.1984492	0.0289772	-6.848	1.84e-11 ***
SITSTXOther	-0.1543194	0.0337436	-4.573	5.83e-06 ***
SITSTXSAILS ST	-0.0761412	0.0433455	-1.757	0.079490 .
SITSTXSAWTELL PL	0.1840793	0.0393904	4.673	3.66e-06 ***
SITSTXSAWYERS ARMS RD	0.0872393	0.0201388	4.332	1.73e-05 ***
SITSTXST JAMES AVE	0.2497688	0.0289940	8.615	< 2e-16 ***
TIMESOLD.Q	**0.0138914**	0.0004137	**33.575**	< 2e-16 ***
AGE	0.0029307	0.0003512	8.345	4.85e-16 ***
log(LANDAX)	0.0904764	0.0270812	3.341	0.000886 ***
MATFAX	**0.0042576**	0.0002410	**17.664**	< 2e-16 ***
WALLCNXC	0.0054100	0.0200666	0.270	0.787558
WALLCNXF	-0.0980851	0.0464442	-2.112	0.035106 *
WALLCNXO	-0.1158407	0.0468334	-2.473	0.013655 *
WALLCNXR	-0.0670051	0.0244382	-2.742	0.006291 **
WALLCNXW	-0.0679166	0.0192628	-3.526	0.000454 ***
WALLCNXX	-0.0571365	0.0358369	-1.594	0.111381
ROOFCNXI	0.1502973	0.1139845	1.319	0.187810
ROOFCNXO	0.0870092	0.1164152	0.747	0.455111
ROOFCNXT	0.0954874	0.1138506	0.839	0.401965
CATGYX4B	-0.0623758	0.0343487	-1.816	0.069872 .
CATGYX4C	-0.3669901	0.0905659	-4.052	5.74e-05 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 0.1579 on 604 degrees of freedom
Multiple *R*-Squared: 0.8718, Adjusted *R*-squared: 0.8661
F-statistic: 152.2 on 27 and 604 DF, *p*-value: < 2.2e-16

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Cell Phone Towers: How Far is Safe?

by Taraka Serrano

If you or people you know live within a quarter mile of a cell phone tower, this may be of concern. Two studies, one in Germany and the other in Israel, reveal that living in proximity of a cell phone tower or antenna could put your health at significant risk.

German study: 3 times increased cancer risk

Several doctors living in Southern Germany city of Naila conducted a study to assess the risk of mobile phone radiation. Their researh examined whether population living close to two transmitter antennas installed in 1993 and 1997 in Naila had increased risk of cancer.

Data was gathered from nearly 1,000 patients who had been residing at the same address during the entire observation period of 10 years. The social differences are small, with no ethnic diversity. There is no heavy industry, and in the inner area there are neither high voltage cable nor electric trains. The average ages of the residents are similar in both the inner and outer areas.

What they found is quite telling: the proportion of newly developed cancer cases was three times higher among those who had lived during the past ten years at a distance of up to 400m (about 1300 feet) from the cellular transmitter site, compared to those living further away. They also revealed that the patients fell ill on average 8 years earlier.

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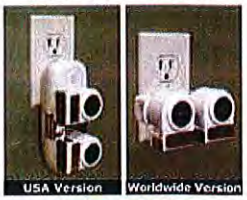

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Computer simulation and measurements used in the study both show that radiation in the inner area (within 400m) is 100 times higher compared to the outer area, mainly due to additional emissions coming from the secondary lobes of the transmitter.

Looking at only the first 5 years, there was no significant increased risk of getting cancer in the inner area. However, for the period 1999 to 2004, the odds ratio for getting cancer was 3.38 in the inner area compared to the outer area. Breast cancer topped the list, with an average age of 50.8 year compared with 69.9 years in the outer area, but cancers of the prostate, pancreas, bowel, skin melanoma, lung and blood cancer were all increased

Israel study: fourfold cancer risk

Another study, this one from Israel's Tel Aviv University, examined 622 people living near a cell-phone transmitter station for 3-7 years who were patients in one clinic in Netanya and compared them against 1,222 control patients from a

nearby clinic. Participants were very closely matched in environment, workplace and occupational characteristics. The people in the first group live within a half circle of 350m (1148 feet) radius from the transmitter, which came into service in July 1996.

The results were startling. Out of the 622 exposed patients, 8 cases of different kinds of cancer were diagnosed in a period of just one year (July 1997 to June 1998): 3 cases of breast cancer, one of ovarian cancer, lung cancer, Hodgkin's disease (cancer of the lymphatic system), osteoid osteoma (bone tumour) and kidney cancer. This compares with 2 per 1 222 in the matched controls of the nearby clinic. The relative risk of cancer was 4.15 for those living near the cell-phone transmitter compared with the entire population of Israel.

Women were more susceptible. As seven out of eight cancer cases were women, the relative cancer rates for females were 10.5 for those living near the transmitter station and 0.6 for the controls relative for the whole town of Netanya. One year after the close of the study, 8 new cases of cancer were diagnosed in the microwave exposed area and two in the control area.

Locate the Cell Phone Towers and Antennas Near You

Do you know how many cell phone transmitters are in your neighborhood? You'd be surprised. Visit antennasearch.com to find out where the towers and antennas are in your area and how close they are to your home or place of work. The site will also pinpoint future tower locations, additional helpful information for those considering buying a home.

For clarity, towers are tall structures where antennas are installed. A typical tower may easily hold over 10 antennas for various companies. Antennas, on the other hand, are the actual emitters of signals for various radio services including cellular, paging and others. Antennas are placed on high towers or can be installed by themselves (stand alone) on top of buildings and other structures.

Using where I live as an example, I've located 3 cell phone towers and 22 antennas within a quarter mile from our home, with the closest one at 845 feet.. And this is in a relatively quiet residential neighborhood by the ocean in the small city of Hilo in Hawaii. As you may guess, I did my research only well after we've moved in. Fortunately, we're here on just a lease and we'll be a bit wiser next time we look for a new home.

What to Do If You Live Near a Cell Phone Transmitter

Short of relocating, there are some things you can do to fight the effects of electromagnetic radiation (EMR). The Safe Wireless Initiative of the Science and Public Policy Institute in Washington, DC, outlines three levels of intervention in accordance with the public health paradigm that everyone can apply. Here are our suggestions based on these guidelines:

The primary means of intervention is through avoidance or minimizing exposure. This simply means to avoid contact with EMR as much as possible. In case of a cell phone tower close to your home, this could mean using specially formulated RF shield paint, shielding fabric, shielding glass or film for windows, etc. Although they may sound extreme, these measures are a life-saver for someone who suffers from electrosensitivity, a condition in which a person experiences physical symptoms aggravated by electromagnetic fields. (Sweden is the only country so far that recognizes electrosensitivity as a real medical condition, and their government pays for measures to reduce exposure in their homes and workplaces).

The secondary means of intervention is to minimize the effects of exposure. This includes the use of bioenergetic devices that help reduce the effects of EMR,

such as pendants, chips or other devices designed to strengthen the biofield of the individual. A biofield is the matrix of weak electromagnetic signals that the body's cells use to communicate with each other. EMR disrupts these signals, causing the cells to eventually shut down and result in build up of toxins and waste products within the cells, including free radicals known to result in cellular dysfunction and interference with DNA repair. A scientifically validated bioenergetic device restores intercellular communications and normal cellular function by strengthening the biofield against the effects of EMR.

The third means of intervention is to help reverse damage caused by exposure.This includes nutritional support such as anti-oxidant supplementation, particularly helpful in countering the effects of free radicals. Supplementing with anti-oxidants SOD, catalase, glutathione, and Coq10 are especially recommended. Microwave radiation has been shown to decrease levels of these anti-oxidants that the body normally produces to protect itself. These levels are sensitive indicators in stress, aging, infections and various other disease states.

Additional information:

1. The Influence of Being Physically Near to a Cell Phone Transmission Mast on the Incidence of Cancer (PDF) *(German study)*
2. Increased Incidence of Cancer Near a Cell-Phone Transmitter Station (PDF) *(Israel study)*
3. Environmental Epidemiological Study of Cancer Incidence in the Municipalities of Hausmannstätten & Vasoldsberg (Austria) (PDF)

(Note: This article is shared for educational purposes only and does not constitute medical advice. If you believe that you have a health problem, see your doctor or health professional immediately.)

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Taraka Serrano is a health advocate dedicated to sharing information and solutions relating to serious health issues of our time. Watch video reports on the dangers of cell phone and EMF radiation, and learn more about the right emf protection solutions for you. Visit EMf-Health.com

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NORTHSTAR WEBRADIO

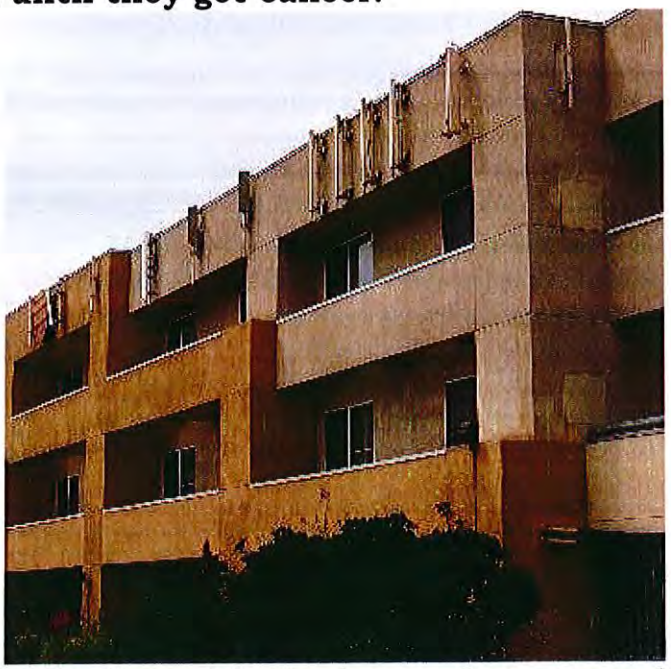
THE TRUTH ABOUT CELL TOWERS

Cell Towers are popping up in everyone's backyard these days. And most of us fail to realize the dangers involved in having these monsters looming over our neighborhoods or even strategically placed atop our schools, churches or apartment buildings. Having a mobile phone - and the risks of using one - is an individual choice. What is NOT an individual choice is whether a mobile phone tower - with all of it's health risks - is placed in your neighborhood.

A 2004 German government study found that people living within 1300 feet of cell towers had THREE TIMES the normal cancer risk. A French medical study of people living within 1,000 feet of cell towers documented an unusually high level of complaints of extreme fatigue, memory loss, headaches, sleep disorders, depression, skin problems, hearing loss and cardiovascular problems. The Indian government has banned mobile phone towers in school and hospital premises and directed cellular firms to take permission from residents welfare associations before setting up base stations in residential areas, in efforts to limit the harmful effects of electromagnetic radiation exposure.

*** For the location of cell tower antennas in your neighborhood Click Here ***

A resolution by the International Association of Fire Fighters (IAFF) opposed commercial cell towers on fire stations after a medical study showed increased cancer, brain and nerve problems for irradiated personnel. There is an undertone to the arguments on the side for cell towers of "If you can't see or smell or taste anything wrong, what's the problem?" The fact of the matter is that unless you have a geiger counter, you don't know how much radiation is present. If you don't have a gaussmeter, you cannot measure electromagnetic fields, so the intangibility of of the damage is enough for the ignorant masses to pretend they don't exist, at least until they get cancer.



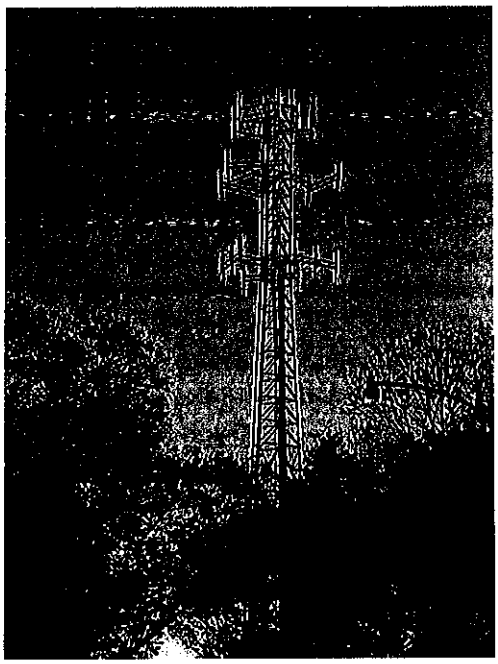
We are dealing with the issue of pure greed on the part of these wireless companies. They care NOTHING about the dangerous health effects on people living near these towers of doom. Telecom providers are not required by law to consider health effects in their siting proposals thanks to our sellout traitorous politicians. The Telecom Act of 1996 prevents local planning authorities from prohibiting cell tower construction on the basis of health considerations. Thanks to this corrupt unconstitutional federal law, city planners are obligated to rubber stamp whatever facilities wireless providers say they need for 'essential'

services. Do we need to sacrifice our health for the convenience of cell phone users, and for the billion dollar corporations that get rich at our expense?

Despite all of this, you still have SOME rights concerning the placement of these towers, such as finding the owners of the property on which these towers are located, and letting them and everyone concerned know that you oppose what they are doing, and explaining why. Get to know what these towers look like, and the chances are you won't have to look very far to find one. And don't let that funny looking tree fool you, its actually a poorly disguised cell tower. Those tubular objects on the side of your apartment building or office near the roof? That strange looking smokestack recently placed on top of your building? More cell towers. Microwave radiation from cell towers can pass easily through walls, windows and roofs.

Let's think about it, if these carriers say there is no danger from these towers, then why would they assemble a tower in less than 2 hours, and then run like a thief in the night? Why would they try to hide them? The way we see it the "get in - get out - and hide" method limits exposure to the public eye, thus creating less publicity for these unsightly and dangerous menaces surrounding us. Time and time again the stories unfold with the same dire circumstances, someone is diagnosed with leukemia, and someone is left pondering the idea as to whether there are any other people in the area diagnosed with the same condition. And with a little investigation, they discover multiple cases of leukemia and cancer in the surrounding area. And all within a mile of one of these cellular towers or a power substation. Educate others on the dangers of cellular towers, and what they can do to prevent them from becoming a part of their backyard, affecting their health, and their way of life!

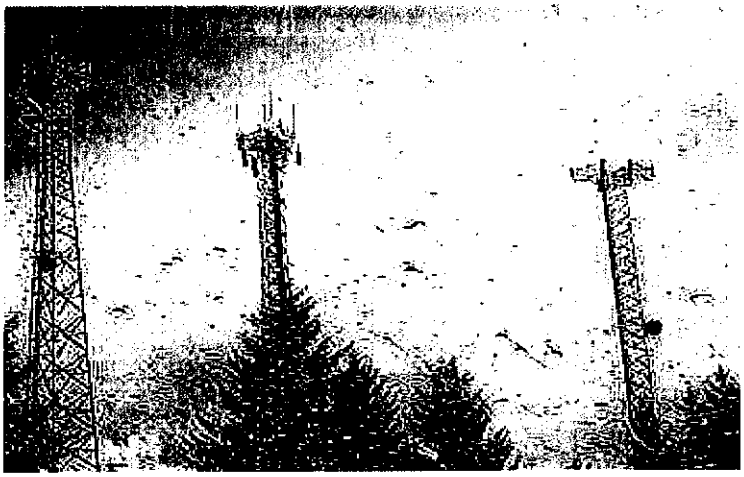
Wi-Fi systems essentially take small versions of cell phone masts and puts them into the home and classroom - they emit much the same kind of radiation. Though virtually no research has been carried out, campaigners and scientists expect them to cause similar ill-effects from the radiation. We are all now living in a soup of electromagnetic radiation one billion times stronger than the natural fields which our living cells were designed for. This could cause a medical catastrophe in the near future.



Apart from the devastating health effects of cell towers, the day is now approaching in which government mind control technologies will be directed at you, your neighbors, and your loved ones. Every single day, equipment is being erected and installed in this country with the hidden purpose of exerting mind control over the entire population. Everywhere in this country, ELF/microwave transmission (cell phone) towers are being erected. The antennae usually look like four slightly curved vertical plates about 2 to 4 feet in length and located in either 3 or 4 quadrants around the tower, roof, or chimney. Just look around and you'll see them. And you'll also notice more of them going up once you begin to pay attention. No

one is saying anything, but you're expected to presume that they're for cell phones.

Do you really think that we need that much 'cell phone' transmission capability? Hardly. These mind control technologies have been in place for a long time. It's not an accident that the frequency band chosen for cell phone use just happens to match the second order waves that Wilhelm Reich discovered in the late 1940's to effect thought transmission and allow the mind to be manipulated without the victim realizing it. Reich worked on this project secretly for the CIA for over 5 years, from 1947-1952, until he realized who the CIA was planning to use the mind control on - the American people. He was outraged that he was deceived and used for such a devious motive and swore never to cooperate with the CIA ,NSA, or FDA again.



Reich was murdered in Federal prison in 1957, just a few weeks before he was due to be released, having been in prison for 2 years on a false, trumped up charge of contempt of court. The mind control effects of these transmission frequencies can vary from bringing on sedation, nausea, or emotional and mental confusion. Behind the proliferation of cell phones being hyped upon us, despite their health dangers, there is a hidden motive. And with the rapid proliferation of ELF transmission towers, that motive is abundantly clear. Mass mind control of the population, and the destruction of our

health in the process. These microwave emissions from phone masts may become the biggest singular cause of human suffering, and possible premature death, in the years to come.

*** For help in fighting the placement of cell towers near your home Click Here ***

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"And these signs will follow those who believe: In My name they will cast out demons; they will speak with new tongues; they will take up serpants; and if they drink anything deadly, it will by no means hurt them; they will lay hands on the sick, and they will recover." - Jesus; Mark 16: 17-18

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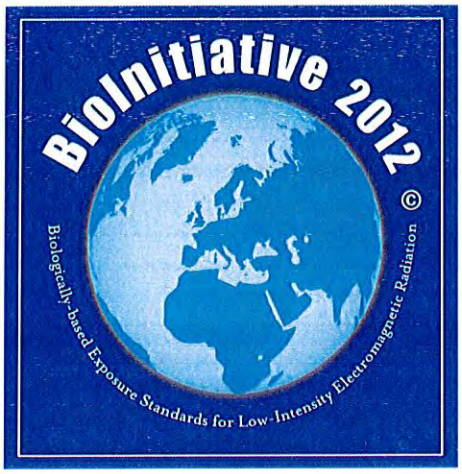

SECTION 1

Summary for the Public

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Prepared for the BioInitiative Working Group

August 2007

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I. SUMMARY FOR THE PUBLIC

A. Introduction

You cannot see it, taste it or smell it, but it is one of the most pervasive environmental exposures in industrialized countries today. Electromagnetic radiation (EMR) or electromagnetic fields (EMFs) are the terms that broadly describe exposures created by the vast array of wired and wireless technologies that have altered the landscape of our lives in countless beneficial ways. However, these technologies were designed to maximize energy efficiency and convenience; not with biological effects on people in mind. Based on new studies, there is growing evidence among scientists and the public about possible health risks associated with these technologies.

Human beings are bioelectrical systems. Our hearts and brains are regulated by internal bioelectrical signals. Environmental exposures to artificial EMFs can interact with fundamental biological processes in the human body. In some cases, this can cause discomfort and disease. Since World War II, the background level of EMF from electrical sources has risen exponentially, most recently by the soaring popularity of wireless technologies such as cell phones (two billion and counting in 2006), cordless phones, WI-FI and WI-MAX networks. Several decades of international scientific research confirm that EMFs are biologically active in animals and in humans, which could have major public health consequences.

In today's world, everyone is exposed to two types of EMFs: (1) extremely low frequency electromagnetic fields (ELF) from electrical and electronic appliances and power lines and (2) radiofrequency radiation (RF) from wireless devices such as cell phones and cordless phones, cellular antennas and towers, and broadcast transmission towers. In this report we will use the term EMFs when referring to all electromagnetic fields in general; and the terms ELF and RF when referring to the specific type of exposure. They are both types of non-ionizing radiation, which means that they do not have sufficient energy to break off electrons from their orbits around atoms and ionize (charge) the atoms, as do x-rays, CT scans, and other forms of ionizing radiation. A glossary and definitions are provided in Section 18 to assist you. Some handy definitions you will probably need when reading about ELF and RF in this summary section (the language for measuring it) are shown with the references for this section.

B. Purpose of the Report

This report has been written by 14 (fourteen) scientists, public health and public policy experts to document the scientific evidence on electromagnetic fields. Another dozen outside reviewers have looked at and refined the Report.

The purpose of this report is to assess scientific evidence on health impacts from electromagnetic radiation below current public exposure limits and evaluate what changes in these limits are warranted now to reduce possible public health risks in the future.

Not everything is known yet about this subject; but what is clear is that the existing public safety standards limiting these radiation levels in nearly every country of the world look to be thousands of times too lenient. Changes are needed.

New approaches are needed to educate decision-makers and the public about sources of exposure and to find alternatives that do not pose the same level of possible health risks, while there is still time to make changes.

A working group composed of scientists, researchers and public health policy professionals (The BioInitiative Working Group) has joined together to document the information that must be considered in the international debate about the adequacy (or inadequacy) of existing public exposure standards.

This Report is the product of an international research and public policy initiative to give an overview of what is known of biological effects that occur at low-intensity EMFs exposures (for both radiofrequency radiation RF and power-frequency ELF, and various forms of combined exposures that are now known to be bioactive). The Report examines the research and current standards and finds that these standards are far from adequate to protect public health.

Recognizing that other bodies in the United States, United Kingdom, Australia, many European Union and eastern European countries as well as the World Health Organization are actively debating this topic, the BioInitiative Working Group has conducted a independent science and public health policy review process. The report presents solid science on this issue, and makes recommendations to decision-makers and the public. Conclusions of the individual authors, and overall conclusions are given in Table 2-1 (BioInitiative Overall Summary Chart).

Eleven (11) chapters that document key scientific studies and reviews identifying low-intensity effects of electromagnetic fields have been written by members of the BioInitiative Working Group. Section 16 and 17 have been prepared by public health and policy experts. These sections discusses the standard of evidence which should be applied in public health planning, how the scientific information should be evaluated in the context of prudent public health policy, and identifies the basis for taking precautionary and preventative actions that are proportionate to the knowledge at hand. They also evaluate the evidence for ELF that leads to a recommendation for new public safety limits (not precautionary or preventative actions, as need is demonstrated).

Other scientific review bodies and agencies have reached different conclusions than we have by adopting standards of evidence so unreasonably high as to exclude any conclusions likely to lead to new public safety limits. Some groups are actually recommending a relaxation of the existing (and inadequate) standards. Why is this happening? One reason is that exposure limits for ELF and RF are developed by bodies of scientists and engineers that belong to professional societies who have traditionally developed recommendations; and then government agencies have adopted those recommendations. The standard-setting processes have little, if any, input from other stakeholders outside professional engineering and closely-related commercial interests. Often, the industry view of allowable risk and proof of harm is most influential, rather than what public health experts would determine is acceptable.

Main Reasons for Disagreement among Experts

1) Scientists and public health policy experts use very different definitions of the standard of evidence used to judge the science, so they come to different conclusions about what to do. Scientists do have a role, but it is not exclusive and other opinions matter.
2) We are all talking about essentially the same scientific studies, but use a different way of measuring when "enough is enough" or "proof exists".
3) Some experts keep saying that all studies have to be consistent (turn out the same way every time) before they are comfortable saying an effect exists.
4) Some experts think that it is enough to look only at short-term, acute effects.
5) Other experts say that it is imperative we have studies over longer time (showing the effects of chronic exposures) since that is what kind of world we live in.
6) Some experts say that everyone, including the very young, the elderly, pregnant women, and people with illnesses have to be considered – others say only the average person (or in the case of RF, a six-foot tall man) matter.
7) There is no unexposed population, making it harder to see increased risk of diseases.
8) The lack of consensus about a single biological mechanism of action.
9) The strength of human epidemiological studies reporting risks from ELF and RF exposures, but animal studies don't show a strong toxic effect.
10) Vested interests have a substantial influence on the health debate.

Public Policy Decisions

Safety limits for public exposure to EMFs need to be developed on the basis of interaction among not only scientists, but also public health experts, public policy makers and the general public.

"In principle, the assessment of the evidence should combine with judgment based on other societal values, for example, costs and benefits, acceptability of risks, cultural preferences, etc. and result in sound and effective decision-making. Decisions on these matters are eventually taken as a function of the views, values and interests of the stakeholders participating in the process, whose opinions are then weighed depending on several factors. Scientific evidence perhaps carries, or should carry, relatively heavy weight, but grants no exclusive status; decisions will be evidence-based but will also be based on other factors." (1)

The clear consensus of the BioInitiative Working Group members is that the existing public safety limits are inadequate for both ELF and RF.

These proposals reflect the evidence that a positive assertion of safety with respect to chronic exposure to low-intensity levels of ELF and RF cannot be made. As with many other standards for environmental exposures, these proposed limits may not be totally protective, but more stringent standards are not realistic at the present time. Even a small increased risk for cancer and neurodegenerative diseases translates into an enormous public health consequence. Regulatory action for ELF and preventative actions for RF are warranted at this time to reduce exposures and inform the public of the potential for increased risk; at what levels of chronic exposure these risks may be present; and what measures may be taken to reduce risks.

C. Problems with Existing Public Health Standards (Safety Limits)

Today's public exposure limits for telecommunications are based on the presumption that heating of tissue (for RF) or induced electric currents in the body (for ELF) are the only concerns when living organisms are exposed to RF. These exposures can create tissue heating that is well known to be harmful in even very short-term doses. As such, thermal limits do serve a purpose. For example, for people whose occupations require them to work around radar facilities or RF heat-sealers, or for people who install and service wireless antenna tower, thermally-based limits are necessary to prevent damage from heating (or, in the case of power-frequency ELF from induced current flow in tissues). In the past, scientists and engineers developed exposure standards for electromagnetic radiation based what we now believe are faulty assumptions that the right way to measure how much non-ionizing energy humans can tolerate (how much exposure) without harm is to measure only the heating of tissue (RF) or induced currents in the body (ELF).

In the last few decades, it has been established beyond any reasonable doubt that bioeffects and some adverse health effects occur at far lower levels of RF and ELF exposure where no heating (or induced currents) occurs at all; some effects are shown to occur at several hundred thousand times below the existing public safety limits where heating is an impossibility.

It appears it is the INFORMATION conveyed by electromagnetic radiation (rather than heat) that causes biological changes - some of these biological changes may lead to loss of wellbeing, disease and even death.

Effects occur at non-thermal or low-intensity exposure levels thousands of times below the levels that federal agencies say should keep the public safe. For many new devices operating with wireless technologies, the devices are exempt from any regulatory standards. The existing standards have been proven to be inadequate to control against harm from low-intensity, chronic exposures, based on any reasonable, independent assessment of the scientific literature. It means that an entirely new basis (a biological basis) for new exposure standards is needed. New standards need to take into account what we have learned about the effects of ELF and RF (all non-ionizing electromagnetic radiation and to design new limits based on biologically-

demonstrated effects that are important to proper biological function in living organisms. It is vital to do so because the explosion of new sources has created unprecedented levels of artificial electromagnetic fields that now cover all but remote areas of the habitable space on earth. Mid-course corrections are needed in the way we accept, test and deploy new technologies that expose us to ELF and RF in order to avert public health problems of a global nature.

Recent opinions by experts have documented deficiencies in current exposure standards. There is widespread discussion that thermal limits are outdated, and that biologically-based exposure standards are needed. Section 4 describes concerns expressed by WHO, 2007 in its ELF Health Criteria Monograph; the SCENIHR Report, 2006 prepared for the European Commission; the UK SAGE Report, 2007; the Health Protection Agency, United Kingdom in 2005; the NATO Advanced Research Workshop in 2005; the US Radiofrequency Interagency Working Group in 1999; the US Food and Drug Administration in 2000 and 2007; the World Health Organization in 2002; the International Agency for Cancer Research (IARC, 2001), the United Kingdom Parliament Independent Expert Group Report on Mobile Phones – Stewart Report, 2000) and others.

A pioneer researcher, the late Dr. Ross Adey, in his last publication in Bioelectromagnetic Medicine (P. Roche and M. Markov, eds. 2004) concluded:

> *"There are major unanswered questions about possible health risks that may arise from exposures to various man-made electromagnetic fields where these human exposures are intermittent, recurrent, and may extend over a significant portion of the lifetime of the individual."*
>
> *"Epidemiological studies have evaluated ELF and radiofrequency fields as possible risk factors for human health, with historical evidence relating rising risks of such factors as progressive rural electrification, and more recently, to methods of electrical power distribution and utilization in commercial buildings. Appropriate models describing these bioeffects are based in non-equilibrium thermodynamics, with nonlinear electrodynamics as an integral feature. Heating models, based in equilibrium thermodynamics, fail to explain an impressive new frontier of much greater significance. ..... Though incompletely understood, tissue free radical interactions with magnetic fields may extend to zero field levels." (2)*

There may be no lower limit at which exposures do not affect us. Until we know if there is a lower limit below which bioeffects and adverse health impacts do not occur, it is unwise from a public health perspective to continue "business-as-usual" deploying new technologies that increase ELF and RF exposures, particularly involuntary exposures.

II. SUMMARY OF THE SCIENCE

A. Evidence for Cancer

1. Childhood Leukemia

The evidence that power lines and other sources of ELF are consistently associated with higher rates of childhood leukemia has resulted in the International Agency for Cancer Research (an arm of the World Health Organization) to classify ELF as a Possible Human Carcinogen (in the Group 2B carcinogen list). Leukemia is the most common type of cancer in children.

There is little doubt that exposure to ELF causes childhood leukemia.

The exposure levels for increased risk are quite low – just above background or ambient levels and much lower than current exposure limits. The existing ICNIRP limit is 1000 mG (904 mG in the US) for ELF. Increased risk for childhood leukemia starts at levels almost one thousand times below the safety standard. Leukemia risks for young boys are reported in one study to double at only 1.4 mG and above (7) Most other studies combine older children with younger children (0 to 16 years) so that risk levels do not reach statistical significance until exposure levels reach 2 mG or 3 mG. Although some reviews have combined studies of childhood leukemia in ways that indicate the risk level starts at 4 mG and above; this does not reflect many of the studies reporting elevated risks at the lower exposure levels of 2 mG and 3 mG.

2. Other Childhood Cancers

Other childhood cancers have been studied, including brain tumors, but not enough work has been done to know if there are risks, how high these risks might be or what exposure levels might be associated with increased risks. The lack of certainty about other childhood cancers should not be taken to signal the "all clear"; rather it is a lack of study.

The World Health Organization ELF Health Criteria Monograph No 322 (2007) says that other childhood cancers "cannot be ruled out". (8)

There is some evidence that other childhood cancers may be related to ELF exposure but not enough studies have been done.

Several recent studies provide even stronger evidence that ELF is a risk factor for childhood leukemia and cancers later in life. In the first study (9), children who were recovering in high-ELF environments had poorer survival rates (a 450% increased risk of dying if the ELF fields were 3 mG and above). In the second study, children who were recovering in 2 mG and above ELF environments were 300% more likely to die than children exposed to 1 mG and below. In

this second study, children recovering in ELF environments between 1 and 2 mG also had poorer survival rates, where the increased risk of dying was 280%. (10) These two studies give powerful new information that ELF exposures in children can be harmful at levels above even 1 mG. The third study looked what risks for cancer a child would have later in life, if that child was raised in a home within 300 meters of a high-voltage electric power line. (11) For children who were raised for their first five years of life within 300 meters, they have a life-time risk that is 500% higher for developing some kinds of cancers.

Children who have leukemia and are in recovery have poorer survival rates if their ELF exposure at home (or where they are recovering) is between 1mG and 2 mG in one study; over 3 mG in another study.

Given the extensive study of childhood leukemia risks associated with ELF, and the relatively consistent findings that exposures in the 2 mG to 4 mG range are associated with increased risk to children, a 1 mG limit for habitable space is recommended for new construction. While it is difficult and expensive to retrofit existing habitable space to a 1 mG level, and is also recommended as a desirable target for existing residences and places where children and pregnant women may spend prolonged periods of time.

New ELF public exposure limits are warranted at this time, given the existing scientific evidence and need for public health policy intervention and prevention.

3. Brain Tumors and Acoustic Neuromas

Radiofrequency radiation from cell phone and cordless phone exposure has been linked in more than one dozen studies to increased risk for brain tumors and/or acoustic neuromas (a tumor in the brain on a nerve related to our hearing).

People who have used a cell phone for ten years or more have higher rates of malignant brain tumor and acoustic neuromas. It is worse if the cell phone has been used primarily on one side of the head.

For brain tumors, people who have used a cell phone for 10 years or longer have a 20% increase in risk (when the cell phone is used on both sides of the head). For people who have used a cell phone for 10 years or longer predominantly on one side of the head, there is a 200% increased risk of a brain tumor. This information relies on the combined results of many brain tumor/cell phone studies taken together (a meta-analysis of studies).

People who have used a cordless phone for ten years or more have higher rates of malignant brain tumor and acoustic neuromas. It is worse if the cordless phone has been used primarily on one side of the head.

The risk of brain tumor (high-grade malignant glioma) from cordless phone use is 220% higher (both sides of the head). The risk from use of a cordless phone is 470% higher when used mostly on only one side of the head.

For acoustic neuromas, there is a 30% increased risk with cell phone use at ten years and longer; and a 240% increased risk of acoustic neuroma when the cell phone is used mainly on one side of the head. These risks are based on the combined results of several studies (a meta-analysis of studies).

For use of cordless phones, the increased risk of acoustic neuroma is three-fold higher (310%) when the phone is mainly used on one side of the head.

The current standard for exposure to the emissions of cell phones and cordless phones is not safe considering studies reporting long-term brain tumor and acoustic neuroma risks.

Other indications that radiofrequency radiation can cause brain tumors comes from exposures to low-level RF other than from cell phone or cordless phone use. Studies of people who are exposed in their work (occupational exposure) show higher brain tumor rates as well. Kheifets (1995) reported a 10% to 20% increased risk of brain cancer for those employed in electrical occupations. This meta-analysis surveyed 29 published studies of brain cancer in relation to occupational EMFs exposure or work in electrical occupations. (6). The evidence for a link between other sources of RF exposure like working at a job with EMFs exposure is consistent with a moderately elevated risk of developing brain tumors.

4. *Other Adult Cancers*

There are multiple studies that show statistically significant relationships between occupational exposure and leukemia in adults (see Chapter 11), in spite of major limitations in the exposure assessment. A very recent study by Lowenthal et al. (2007) investigated leukemia in adults in relation to residence near to high-voltage power lines. While they found elevated risk in all adults living near to the high voltage power lines, they found an OR of 3.23 (95% CI = 1.26-8.29) for individuals who spent the first 15 years of life within 300 m of the power line. This study provides support for two important conclusions: adult leukemia is also associated with EMF exposure, and exposure during childhood increases risk of adult disease.

A significant excess risk for adult brain tumors in electrical workers and those adults with occupational EMF exposure was reported in a meta-analysis (review of many individual studies) by Kheifets et al., (1995). This is about the same size risk for lung cancer and secondhand smoke (US DHHS, 2006). A total of 29 studies with populations from 12 countries were included in this meta-analysis. The relative risk was reported as 1.16 (CI = 1.08 – 1.24) or a 16% increased risk

for all brain tumors. For gliomas, the risk estimate was reported to be 1.39 (1.07 – 1.82) or a 39% increased risk for those in electrical occupations. A second meta-analysis published by Kheifets et al., ((2001) added results of 9 new studies published after 1995. It reported a new pooled estimate (OR = 1.16, 1.08 – 1.01) that showed little change in the risk estimate overall from 1995.

The evidence for a relationship between exposure and breast cancer is relatively strong in men (Erren, 2001), and some (by no means all) studies show female breast cancer also to be elevated with increased exposure (see Chapter 12). Brain tumors and acoustic neuromas are more common in exposed persons (see Chapter 10). There is less published evidence on other cancers, but Charles et al. (2003) report that workers in the highest 10% category for EMF exposure were twice as likely to die of prostate cancer as those exposed at lower levels (OR 2.02, 95% CI = 1.34-3.04). Villeneuve et al. (2000) report statistically significant elevations of non-Hodgkin's lymphoma in electric utility workers in relation to EMF exposure, while Tynes et al. (2003) report elevated rates of malignant melanoma in persons living near to high voltage power lines. While these observations need replication, they suggest a relationship between exposure and cancer in adults beyond leukemia.

In total the scientific evidence for adult disease associated with EMF exposure is sufficiently strong for adult cancers that preventive steps are appropriate, even if not all reports have shown exactly the same positive relationship. This is especially true since many factors reduce our ability to see disease patterns that might be related to EMF exposure: there is no unexposed population for comparison, for example, and other difficulties in exposure assessment, The evidence for a relationship between EMF exposure and adult cancers and neurodegenerative diseases is sufficiently strong at present to merit preventive actions to reduce EMF exposure.

5. *Breast Cancer*

There is rather strong evidence from multiple areas of scientific investigation that ELF is related to breast cancer. Over the last two decades there have been numerous epidemiological studies (studies of human illness) on breast cancer in both men and women, although this relationship remains controversial among scientists. Many of these studies report that ELF exposures are related to increased risk of breast cancer (not all studies report such effects, but then, we do not expect 100% or even 50% consistency in results in science, and do not require it to take reasonable preventative action).

The evidence from studies on women in the workplace rather strongly suggests that ELF is a risk factor for breast cancer for women with long-term exposures of 10 mG and higher.

Breast cancer studies of people who work in relatively high ELF exposures (10 mG and above) show higher rates of this disease. Most studies of workers who are exposed to ELF have defined high exposure levels to be somewhere between 2 mG and 10 mG; however this kind of mixing of relatively low to relatively high ELF exposure just acts to dilute out real risk levels. Many of the occupational studies group exposures so that the highest group is exposed to 4 mG and above. What this means is that a) few people are exposed to much higher levels and b) illness patterns show up at relatively low ELF levels of 4 mG and above. This is another way of demonstrating

that existing ELF limits that are set at 933-1000 mG are irrelevant to the exposure levels reporting increased risks.

Laboratory studies that examine human breast cancer cells have shown that ELF exposure between 6 mG and 12 mG can interfere with protective effects of melatonin that fights the growth of these breast cancer cells. For a decade, there has been evidence that human breast cancer cells grow faster if exposed to ELF at low environmental levels. This is thought to be because ELF exposure can reduce melatonin levels in the body. The presence of melatonin in breast cancer cell cultures is known to reduce the growth of cancer cells. The absence of melatonin (because of ELF exposure or other reasons) is known to result in more cancer cell growth.

Laboratory studies of animals that have breast cancer tumors have been shown to have more tumors and larger tumors when exposed to ELF and a chemical tumor promoter at the same time. These studies taken together indicate that ELF is a likely risk factor for breast cancer, and that ELF levels of importance are no higher than many people are exposed to at home and at work. A reasonable suspicion of risk exists and is sufficient evidence on which to recommend new ELF limits; and to warrant preventative action.

Given the very high lifetime risks for developing breast cancer, and the critical importance of prevention; ELF exposures should be reduced for all people who are in high ELF environments for prolonged periods of time.

Reducing ELF exposure is particularly important for people who have breast cancer. The recovery environment should have low ELF levels given the evidence for poorer survival rates for childhood leukemia patients in ELF fields over 2 mG or 3 mG. Preventative action for those who may be at higher risk for breast cancer is also warranted (particularly for those taking tamoxifen as a way to reduce the risk of getting breast cancer, since in addition to reducing the effectiveness of melatonin, ELF exposure may also reduce the effectiveness of tamoxifen at these same low exposure levels). There is no excuse for ignoring the substantial body of evidence we already have that supports an association between breast cancer and ELF exposure; waiting for conclusive evidence is untenable given the enormous costs and societal and personal burdens caused by this disease.

Studies of human breast cancer cells and some animal studies show that ELF is likely to be a risk factor for breast cancer. There is supporting evidence for a link between breast cancer and exposure to ELF that comes from cell and animal studies, as well as studies of human breast cancers.

These are just some of the cancer issues to discuss. It may be reasonable now to make the assumption that all cancers, and other disease endpoints might be related to, or worsened by exposures to EMFs (both ELF and RF).

If one or more cancers are related, why would not all cancer risks be at issue? It can no longer be said that the current state of knowledge rules out or precludes risks to human health. The

enormous societal costs and impacts on human suffering by not dealing proactively with this issue require substantive public health policy actions; and actions of governmental agencies charged with the protection of public health to act on the basis of the evidence at hand.

B. Changes in the Nervous System and Brain Function

Exposure to electromagnetic fields has been studies in connection with Alzheimer's disease, motor neuron disease and Parkinson's disease. (4) These diseases all involve the death of specific neurons and may be classified as neurodegenerative diseases. There is evidence that high levels of amyloid beta are a risk factor for Alzheimer's disease, and exposure to ELF can increase this substance in the brain. There is considerable evidence that melatonin can protect the brain against damage leading to Alzheimer's disease, and also strong evidence that exposure to ELF can reduce melatonin levels. Thus it is hypothesized that one of the body's main protections against developing Alzheimer's disease (melatonin) is less available to the body when people are exposed to ELF. Prolonged exposure to ELF fields could alter calcium (Ca2+) levels in neurons and induce oxidative stress (4). It is also possible that prolonged exposure to ELF fields may stimulate neurons (particularly large motor neurons) into synchronous firing, leading to damage by the buildup of toxins.

Evidence for a relationship between exposure and the neurodegenerative diseases, Alzheimer's and amyotrophic lateral sclerosis (ALS), is strong and relatively consistent (see Chapter 12). While not every publication shows a statistically significant relationship between exposure and disease, ORs of 2.3 (95% CI = 1.0-5.1 in Qio et al., 2004), of 2.3 (95% CI = 1.6-3.3 in Feychting et al., 2003) and of 4.0 (95% CI = 1.4-11.7 in Hakansson et al., 2003) for Alzheimer's Disease, and of 3.1 (95% CI = 1.0-9.8 in Savitz et al., 1998) and 2.2 (95% CI = 1.0-4.7 in Hakansson et al., 2003) for ALS cannot be simply ignored.

Alzheimer's disease is a disease of the nervous system. There is strong evidence that long-term exposure to ELF is a risk factor for Alzheimer's disease.

Concern has also been raised that humans with epileptic disorders could be more susceptible to RF exposure. Low-level RF exposure may be a stressor based on similarities of neurological effects to other known stressors; low-level RF activates both endogenous opioids and other substances in the brain that function in a similar manner to psychoactive drug actions. Such effects in laboratory animals mimic the effects of drugs on the part of the brain that is involved in addiction.

Laboratory studies show that the nervous system of both humans and animals is sensitive to ELF and RF. Measurable changes in brain function and behavior occur at levels associated with new technologies including cell phone use. Exposing humans to cell phone radiation can change brainwave activity at levels as low as 0.1 watt per kilogram SAR (W/Kg)*** in comparison to the US allowable level of 1.6 W/Kg and the International Commission for Non-ionizing Radiation Protection (ICNIRP) allowable level of 2.0 W/Kg. It can affect memory and learning. It can affect normal brainwave activity. ELF and RF exposures at low levels are able to change behavior in animals.

There is little doubt that electromagnetic fields emitted by cell phones and cell phone use affect electrical activity of the brain.

Effects on brain function seem to depend in some cases on the mental load of the subject during exposure (the brain is less able to do two jobs well simultaneously when the same part of the brain is involved in both tasks). Some studies show that cell phone exposure speeds up the brain's activity level; but also that the efficiency and judgment of the brain are diminished at the same time. One study reported that teenage drivers had slowed responses when driving and exposed to cell phone radiation, comparable to response times of elderly people. Faster thinking does not necessarily mean better quality thinking.

Changes in the way in which the brain and nervous system react depend very much on the specific exposures. Most studies only look at short-term effects, so the long-term consequences of exposures are not known.

Factors that determine effects can depend on head shape and size, the location, size and shape of internal brain structures, thinness of the head and face, hydration of tissues, thickness of various tissues, dialectric constant of the tissues and so on. Age of the individual and state of health also appear to be important variables. Exposure conditions also greatly influence the outcome of studies, and can have opposite results depending on the conditions of exposure including frequency, waveform, orientation of exposure, duration of exposure, number of exposures, any pulse modulation of the signal, and when effects are measured (some responses to RF are delayed). There is large variability in the results of ELF and RF testing, which would be expected based on the large variability of factors that can influence test results. However, it is clearly demonstrated that under some conditions of exposure, the brain and nervous system functions of humans are altered. The consequence of long-term or prolonged exposures have not been thoroughly studied in either adults or in children.

The consequence of prolonged exposures to children, whose nervous systems continue to develop until late adolescence, is unknown at this time. This could have serious implications to adult health and functioning in society if years of exposure of the young to both ELF and RF result in diminished capacity for thinking, judgment, memory, learning, and control over behavior.

People who are chronically exposed to low-level wireless antenna emissions report symptoms such as problems in sleeping (insomnia), fatigue, headache, dizziness, grogginess, lack of concentration, memory problems, ringing in the ears (tinnitus), problems with balance and orientation, and difficulty in multi-tasking. In children, exposures to cell phone radiation have resulted in changes in brain oscillatory activity during some memory tasks. Although scientific studies as yet have not been able to confirm a cause-and-effect relationship; these complaints are

widespread and the cause of significant public concern in some countries where wireless technologies are fairly mature and widely distributed (Sweden, Denmark, France, Germany, Italy, Switzerland, Austria, Greece, Israel). For example, the roll-out of the new 3rd Generation wireless phones (and related community-wide antenna RF emissions in the Netherlands) caused almost immediate public complaints of illness.(5)

Conflicting results from those few studies that have been conducted may be based on the difficulty in providing non-exposed environments for testing to compare to environments that are intentionally exposed. People traveling to laboratories for testing are pre-exposed to a multitude of RF and ELF exposures, so they may already be symptomatic prior to actual testing. Also complicating this is good evidence that RF exposures testing behavioral changes show delayed results; effects are observed after termination of RF exposure. This suggests a persistent change in the nervous system that may be evident only after time has passed, so is not observed during a short testing period.

The effects of long-term exposure to wireless technologies including emissions from cell phones and other personal devices, and from whole-body exposure to RF transmissions from cell towers and antennas is simply not known yet with certainty. However, the body of evidence at hand suggests that bioeffects and health impacts can and do occur at exquisitely low exposure levels: levels that can be thousands of times below public safety limits.

The evidence reasonably points to the potential for serious public health consequences (and economic costs), which will be of global concern with the widespread public use of, and exposure to such emissions. Even a small increase in disease incidence or functional loss of cognition related to new wireless exposures would have a large public health, societal and economic consequences. Epidemiological studies can report harm to health only after decades of exposure, and where large effects can be seen across "average" populations; so these early warnings of possible harm should be taken seriously now by decision-makers.

C. Effects on Genes (DNA)

Cancer risk is related to DNA damage, which alters the genetic blueprint for growth and development. If DNA is damaged (the genes are damaged) there is a risk that these damaged cells will not die. Instead they will continue to reproduce themselves with damaged DNA, and this is one necessary pre-condition for cancer. Reduced DNA repair may also be an important part of this story. When the rate of damage to DNA exceeds the rate at which DNA can be repaired, there is the possibility of retaining mutations and initiating cancer. Studies on how ELF and RF may affect genes and DNA is important, because of the possible link to cancer.
Even ten years ago, most people believed that very weak ELF and RF fields could not possibly have any effect at all on DNA and how cells work (or are damaged and cannot do their work properly). The argument was that these weak fields are do not possess enough energy (are not physically strong enough) to cause damage. However, there are multiple ways we already know about where energy is not the key factor in causing damage. For example, exposure to toxic chemicals can cause damage. Changing the balance of delicate biological processes, including

hormone balances in the body, can damage or destroy cells, and cause illness. In fact, many chronic diseases are directly related to this kind of damage that does not require any heating at all. Interference with cell communication (how cells interact) may either cause cancer directly or promote existing cancers to grow faster.

Using modern gene-testing techniques will probably give very useful information in the future about how EMFs targets and affects molecules in the body. At the gene level, there is some evidence now that EMFs (both ELF and RF) can cause changes in how DNA works. Laboratory studies have been conducted to see whether (and how) weak EMFs fields can affect how genes and proteins function. Such changes have been seen in some, but not all studies.

Small changes in protein or gene expression might be able to alter cell physiology, and might be able to cause later effects on health and well-being. The study of genes, proteins and EMFs is still in its infancy, however, by having some confirmation at the gene level and protein level that weak EMFs exposures do register changes may be an important step in establishing what risks to health can occur.

What is remarkable about studies on DNA, genes and proteins and EMFs is that there should be no effect at all if it were true that EMFs is too weak to cause damage. Scientists who believe that the energy of EMFs is insignificant and unlikely to cause harm have a hard time explaining these changes, so are inclined to just ignore them. The trouble with this view is that the effects are occurring. Not being able to explain these effects is not a good reason to consider them imaginary or unimportant.

The European research program (REFLEX) documented many changes in normal biological functioning in tests on DNA (3). The significance of these results is that such effects are directly related to the question of whether human health risks might occur, when these changes in genes and DNA happen. This large research effort produced information on EMFs effects from more than a dozen different researchers. Some of the key findings included:

> *"Gene mutations, cell proliferation and apoptosis are caused by or result in altered gene and protein expression profiles. The convergence of these events is required for the development of all chronic diseases."* (3)
>
> *"Genotoxic effects and a modified expression of numerous genes and proteins after EMF exposure could be demonstrated with great certainty."* (3)
>
> *"RF-EMF produced genotoxic effects in fibroblasts, HL-60 cells, granulosa cells of rats and neural progenitor cells derived from mouse embryonic stem cells."* (Participants 2, 3 and 4). (3)
>
> *"Cells responded to RF exposure between SAR levels of 0.3 and 2 W/Kg with a significant increase in single- and double-strand DNA breaks and in micronuclei frequency."* (Participants 2, 3 and 4). (3)
>
> *"In HL-60 cells an increase in intracellular generation of free radicals accompanying RF-EMF exposure could clearly be demonstrated."* (Participant 2). (3)
>
> *"The induced DNA damage was not based on thermal effects and arouses consideration about the environmental safety limits for ELF-EMF exposure." (3)*

"The effects were clearly more pronounced in cells from older donors, which could point to an age-related decrease of DNA repair efficiency of ELF-EMF induced DNA strand breaks." (3)

Both ELF and RF exposures can be considered genotoxic (will damage DNA) under certain conditions of exposure, including exposure levels that are lower than existing safety limits.

D. Effects on Stress Proteins (Heat Shock Proteins)

In nearly every living organism, there is a special protection launched by cells when they are under attack from environmental toxins or adverse environmental conditions. This is called a stress response, and what are produced are stress proteins (also known as heat shock proteins). Plants, animals and bacteria all produce stress proteins to survive environmental stressors like high temperatures, lack of oxygen, heavy metal poisoning, and oxidative stress (a cause of premature aging). We can now add ELF and RF exposures to this list of environmental stressors that cause a physiological stress response.

Very low-level ELF and RF exposures can cause cells to produce stress proteins, meaning that the cell recognizes ELF and RF exposures as harmful. This is another important way in which scientists have documented that ELF and RF exposures can be harmful, and it happens at levels far below the existing public safety standards.

An additional concern is that if the stress goes on too long, the protective effect is diminished. There is a reduced response if the stress goes on too long, and the protective effect is reduced. This means the cell is less protected against damage, and it is why prolonged or chronic exposures may be quite harmful, even at very low intensities.

The biochemical pathway that is activated is the same for ELF and for RF exposures, and it is non-thermal (does not require heating or induced electrical currents, and thus the safety standards based on protection from heating are irrelevant and not protective). ELF exposure levels of only 5 to 10 mG have been shown to activate the stress response genes (Table 2, Section 6). The specific absorption rate or SAR is not the appropriate measure of biological threshold or dose, and should not be used as the basis for a safety standard, since SAR only regulates against thermal damage.

E. Effects on the Immune System

The immune system is another defense we have against invading organisms (viruses, bacteria, and other foreign molecules). It protects us against illness, infectious diseases, and tumor cells.

There are many different kinds of immune cells; each type of cell has a particular purpose, and is launched to defend the body against different kinds of exposures that the body determines might be harmful.

There is substantial evidence that ELF and RF can cause inflammatory reactions, allergy reactions and change normal immune function at levels allowed by current public safety standards.

The body's immune defense system senses danger from ELF and RF exposures, and targets an immune defense against these fields, much like the body's reaction in producing stress proteins. These are additional indicators that very low intensity ELF and RF exposures are a) recognized by cells and b) can cause reactions as if the exposure is harmful. Chronic exposure to factors that increase allergic and inflammatory responses on a continuing basis are likely to be harmful to health. Chronic inflammatory responses can lead to cellular, tissue and organ damage over time. Many chronic diseases are thought to be related to chronic problems with immune system function.

The release of inflammatory substances, such as histamine, are well-known to cause skin reactions, swelling, allergic hypersensitivity and other conditions that are normally associated with some kind of defense mechanism. The human immune system is part of a general defense barrier that protects against harmful exposures from the surrounding environment. When the immune system is aggravated by some kind of attack, there are many kinds of immune cells that can respond. Anything that triggers an immune response should be carefully evaluated, since chronic stimulation of the immune system may over time impair the system's ability to respond in the normal fashion.

Measurable physiological changes (mast cell increases in the skin, for example that are markers of allergic response and inflammatory cell response) are triggered by ELF and RF at very low intensities. Mast cells, when activated by ELF or RF, will break (degranulate) and release irritating chemicals that cause the symptoms of allergic skin reactions.

There is very clear evidence that exposures to ELF and RF at levels associated with cell phone use, computers, video display terminals, televisions, and other sources can cause these skin reactions. Changes in skin sensitivity have been measured by skin biopsy, and the findings are remarkable. Some of these reactions happen at levels equivalent to those of wireless technologies in daily life. Mast cells are also found in the brain and heart, perhaps targets of immune response by cells responding to ELF and RF exposures, and this might account for some of the other symptoms commonly reported (headache, sensitivity to light, heart arrhythmias and other cardiac symptoms). Chronic provocation by exposure to ELF and RF can lead to immune dysfunction, chronic allergic responses, inflammatory diseases and ill health if they occur on a continuing basis over time.

These clinical findings may account for reports of persons with electrical hypersensitivity, which is a condition where there is intolerance for any level of exposure to ELF and/or RF. Although there is not yet a substantial scientific assessment (under controlled conditions, if that is even possible); anecdotal reports from many countries show that estimates range from 3% to perhaps 5% of populations, and it is a growing problem. Electrical hypersensitivity, like multiple

chemical sensitivity, can be disabling and require the affected person to make drastic changes in work and living circumstances, and suffer large economic losses and loss of personal freedom. In Sweden, electrohypersensitivity (EHS) is officially recognized as fully functional impairment (i.e., it is not regarded as a disease – see Section 6, Appendix A).

F. Plausible Biological Mechanisms

Plausible biological mechanisms are already identified that can reasonably account for most biological effects reported for exposure to RF and ELF at low-intensity levels (oxidative stress and DNA damage from free radicals leading to genotoxicity; molecular mechanisms at very low energies are plausible links to disease, e.g., effect on electron transfer rates linked to oxidative damage, DNA activation linked to abnormal biosynthesis and mutation). It is also important to remember that traditional public health and epidemiological determinations do not require a proven mechanism before inferring a causal link between EMFs exposure and disease (12). Many times, proof of mechanism is not known before wise public health responses are implemented.

"Obviously, melatonin's ability to protect DNA from oxidative damage has implications for many types of cancer, including leukemia, considering that DNA damage due to free radicals is believed to be the initial oncostatic event in a majority of human cancers [Cerutti et al., 1994]. In addition to cancer, free radical damage to the central nervous system is a significant component of a variety of neurodegenerative diseases of the aged including Alzheimer's disease and Parkinsonism. In experimental animal models of both of these conditions, melatonin has proven highly effective in forestalling their onset, and reducing their severity [Reiter et al., 2001]." (13)

Oxidative stress through the action of free radical damage to DNA is a plausible biological mechanism for cancer and diseases that involve damage from ELF to the central nervous system.

G. Another Way of Looking at EMFs: Therapeutic Uses

Many people are surprised to learn that certain kinds of EMFs treatments actually can heal. These are medical treatments that use EMFs in specific ways to help in healing bone fractures, to heal wounds to the skin and underlying tissues, to reduce pain and swelling, and for other post-surgical needs. Some forms of EMFs exposure are used to treat depression.

EMFs have been shown to be effective in treating conditions of disease at energy levels far below current public exposure standards. This leads to the obvious question. How can scientists dispute the harmful effects of EMF exposures while at the same time using forms of EMF treatment that are proven to heal the body?

Medical conditions are successfully treated using EMFs at levels below current public safety standards, proving another way that the body recognizes and responds to low-intensity EMF signals. Otherwise, these medical treatments could not work. The FDA has approved EMFs medical treatment devices, so is clearly aware of this paradox.

Random exposures to EMFs, as opposed to EMFs exposures done with clinical oversight, could lead to harm just like the unsupervised use of pharmaceutical drugs. This evidence forms a strong warning that indiscriminate EMF exposure is probably a bad idea.

No one would recommend that drugs used in medical treatments and prevention of disease be randomly given to the public, especially to children. Yet, random and involuntary exposures to EMFs occur all the time in daily life.

The consequence of multiple sources of EMFs exposures in daily life, with no regard to cumulative exposures or to potentially harmful combinations of EMFs exposures means several things. First, it makes it very difficult to do clinical studies because it is almost impossible to find anyone who is not already exposed. Second, people with and without diseases have multiple and overlapping exposures – this will vary from person to person.

Just as ionizing radiation can be used to effectively diagnose disease and treat cancer, it is also a cause of cancer under different exposure conditions. Since EMFs are both a cause of disease, and also used for treatment of disease, it is vitally important that public exposure standards reflect our current understanding of the biological potency of EMF exposures, and develop both new public safety limits and measures to prevent future exposures.

III. EMF EXPOSURE AND PRUDENT PUBLIC HEALTH PLANNING

- **The scientific evidence is sufficient to warrant regulatory action for ELF; and it is substantial enough to warrant preventative actions for RF.**
- **The standard of evidence for judging the emerging scientific evidence necessary to take action should be proportionate to the impacts on health and well-being**
- **The exposures are widespread.**
- **Widely accepted standards for judging the science are used in this assessment.**

Public exposure to electromagnetic radiation (power-line frequencies, radiofrequency and microwave) is growing exponentially worldwide. There is a rapid increase in electrification in developing countries, even in rural areas. Most members of society now have and use cordless phones, cellular phones, and pagers. In addition, most populations are also exposed to antennas in communities designed to transmit wireless RF signals. Some developing countries have even given up running land lines because of expense and the easy access to cell phones. Long-term and cumulative exposure to such massively increased RF has no precedent in human history. Furthermore, the most pronounced change is for children, who now routinely spend hours each day on the cell phone. Everyone is exposed to a greater or lesser extent. No one can avoid exposure, since even if they live on a mountain-top without electricity there will likely be exposure to communication-frequency RF exposure. Vulnerable populations (pregnant women, very young children, elderly persons, the poor) are exposed to the same degree as the general population. Therefore it is imperative to consider ways in which to evaluate risk and reduce exposure. Good public health policy requires preventative action proportionate to the potential risk of harm and the public health consequence of taking no action.

IV. RECOMMENDED ACTIONS

A. Defining new exposure standards for ELF

This chapter concludes that new ELF limits are warranted based on a public health analysis of the overall existing scientific evidence. The public health view is that new ELF limits are needed now. They should reflect environmental levels of ELF that have been demonstrated to increase risk for childhood leukemia, and possibly other cancers and neurological diseases. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky. These levels are in the 2 to 4 milligauss* (mG) range, not in the 10s of mG or 100s of mG. The existing ICNIRP limit is 1000 mG (904 mG in the US) for ELF is outdated and based on faulty assumptions. These limits are can no longer be said to be protective of public health and they should be replaced. A safety buffer or safety factor should also be applied to a new, biologically-based ELF limit, and the conventional approach is to add a safety factor lower than the risk level.

While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG limit for all other new construction. It is also recommended for that a 1 mG limit be established for existing habitable space for children and/or women who are pregnant (because of the possible link between childhood leukemia and *in utero* exposure to ELF). This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies. While it is not realistic to reconstruct all existing electrical distribution
systems, in the short term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged. These limits should reflect the exposures that are commonly associated with increased risk of child hood leukemia (in the 2 to 5 mG range for all children, and over 1.4 mG for children age 6 and younger). Nearly all of the occupational studies for adult cancers and neurological diseases

report their highest exposure category is 4 mG and above, so that new ELF limits should target the exposure ranges of interest, and not necessarily higher ranges.

Avoiding chronic ELF exposure in schools, homes and the workplace above levels associated with increased risk of disease will also avoid most of the possible bioactive parameters of ELF discussed in the relevant literature.

B. Defining preventative actions for reduction in RF exposures

Given the scientific evidence at hand (Chapter 17), the rapid deployment of new wireless technologies that chronically expose people to pulsed RF at levels reported to cause bioeffects, which in turn, could reasonably be presumed to lead to serious health impacts, is of public health concern. Section 17 summarizes evidence that has resulted in a public health recommendation that preventative action is warranted to reduce or minimize RF exposures to the public. There is suggestive to strongly suggestive evidence that RF exposures may cause changes in cell membrane function, cell communication, cell metabolism, activation of proto-oncogenes and can trigger the production of stress proteins at exposure levels below current regulatory limits. Resulting effects can include DNA breaks and chromosome aberrations, cell death including death of brain neurons, increased free radical production, activation of the endogenous opioid system, cell stress and premature aging, changes in brain function including memory loss, retarded learning, slower motor function and other performance impairment in children, headaches and fatigue, sleep disorders, neurodegenerative conditions, reduction in melatonin secretion and cancers (Chapters 5, 6, 7, 8, 9, 10, and 12).

As early as 2000, some experts in bioelectromagnetics promoted a 0.1 μW/cm2 limit (which is 0.614 Volts per meter) for ambient outdoor exposure to pulsed RF, so generally in cities, the public would have adequate protection against involuntary exposure to pulsed radiofrequency (e.g., from cell towers, and other wireless technologies). The Salzburg Resolution of 2000 set a target of 0.1 μW/cm2 (or 0.614 V/m) for public exposure to pulsed radiofrequency. Since then, there are many credible anecdotal reports of unwellness and illness in the vicinity of wireless transmitters (wireless voice and data communication antennas) at lower levels. Effects include sleep disruption, impairment of memory and concentration, fatigue, headache, skin disorders,

visual symptoms (floaters), nausea, loss of appetite, tinnitus, and cardiac problems (racing heartbeat), There are some credible articles from researchers reporting that cell tower -level RF exposures (estimated to be between 0.01 and 0.5 μW/cm2) produce ill-effects in populations living up to several hundred meters from wireless antenna sites.

This information now argues for thresholds or guidelines that are substantially below current FCC and ICNIPR standards for whole body exposure. Uncertainty about how low such standards might have to go to be prudent from a public health standpoint should not prevent reasonable efforts to respond to the information at hand. No lower limit for bioeffects and adverse health effects from RF has been established, so the possible health risks of wireless WLAN and WI-FI systems, for example, will require further research and no assertion of safety at any level of wireless exposure (chronic exposure) can be made at this time. The lower limit for reported human health effects has dropped 100-fold below the safety standard (for mobile phones and PDAs); 1000- to 10,000-fold for other wireless (cell towers at distance; WI-FI and WLAN devices). The entire basis for safety standards is called into question, and it is not unreasonable to question the safety of RF at any level.

A cautionary target level for pulsed RF exposures for ambient wireless that could be applied to RF sources from cell tower antennas, WI-FI, WI-MAX and other similar sources is proposed. The recommended cautionary target level is 0.1 microwatts per centimeter squared (μW/cm2)** (or 0.614 Volts per meter or V/m)** for pulsed RF where these exposures affect the general public; this advisory is proportionate to the evidence and in accord with prudent public health policy. A precautionary limit of 0.1 μW/cm2 should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. An outdoor precautionary limit of 0.1 μW/cm2 would mean an even lower exposure level inside buildings, perhaps as low as 0.01 μW/cm2. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to

elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

Broadcast facilities that chronically expose nearby residents to elevated RF levels from AM, FM and television antenna transmission are also of public health concern given the potential for very high RF exposures near these facilities (antenna farms). RF levels can be in the 10s to several 100's of μW/cm2 in residential areas within half a mile of some broadcast sites (for example, Lookout Mountain, Colorado and Awbrey Butte, Bend, Oregon). Such facilities that are located in, or expose residential populations and schools to elevated levels of RF will very likely need to be re-evaluated for safety.

For emissions from wireless devices (cell phones, personal digital assistant or PDA devices, etc) there is enough evidence for increased risk of brain tumors and acoustic neuromas now to warrant intervention with respect to their use. Redesign of cell phones and PDAs could prevent direct head and eye exposure, for example, by designing new units so that they work only with a wired headset or on speakerphone mode.

These effects can reasonably be presumed to result in adverse health effects and disease with chronic and uncontrolled exposures, and children may be particularly vulnerable. The young are also largely unable to remove themselves from such environments. Second-hand radiation, like second-hand smoke is an issue of public health concern based on the evidence at hand.

V. CONCLUSIONS

• We cannot afford 'business as usual" any longer. It is time that planning for new power lines and for new homes, schools and other habitable spaces around them is done with routine provision for low-ELF environments. The business-as-usual deployment of new wireless technologies is likely to be risky and harder to change if society does not make some educated decisions about limits soon. Research must continue to define what levels of RF related to new wireless technologies are acceptable; but more research should not prevent or delay substantive changes today that might save money, lives and societal disruption tomorrow.

• New regulatory limits for ELF are warranted. ELF limits should be set below those exposure levels that have been linked in childhood leukemia studies to increased risk of disease, plus an additional safety factor. It is no longer acceptable to build new power lines and electrical facilities that place people in ELF environments that have been determined to be risky (at levels generally at 2 mG and above).

• While new ELF limits are being developed and implemented, a reasonable approach would be a 1 mG planning limit for habitable space adjacent to all new or upgraded power lines and a 2 mG limit for all other new construction, It is also recommended for that a 1 mG limit be established for existing habitable space for children and/or women who are pregnant . This recommendation is based on the assumption that a higher burden of protection is required for children who cannot protect themselves, and who are at risk for childhood leukemia at rates that are traditionally high enough to trigger regulatory action. This situation in particular warrants extending the 1 mG limit to existing occupied space. "Establish" in this case probably means formal public advisories from relevant health agencies.

• While it is not realistic to reconstruct all existing electrical distributions systems, in the short term; steps to reduce exposure from these existing systems need to be initiated, especially in places where children spend time, and should be encouraged.

• A precautionary limit of 0.1 (μW/cm2 (which is also 0.614 Volts per meter) should be adopted for outdoor, cumulative RF exposure. This reflects the current RF science and prudent public health response that would reasonably be set for pulsed RF (ambient) exposures where people

live, work and go to school. This level of RF is experienced as whole-body exposure, and can be a chronic exposure where there is wireless coverage present for voice and data transmission for cell phones, pagers and PDAs and other sources of radiofrequency radiation. Some studies and many anecdotal reports on ill health have been reported at lower levels than this; however, for the present time, it could prevent some of the most disproportionate burdens placed on the public nearest to such installations. Although this RF target level does not preclude further rollout of WI-FI technologies, we also recommend that wired alternatives to WI-FI be implemented, particularly in schools and libraries so that children are not subjected to elevated RF levels until more is understood about possible health impacts. This recommendation should be seen as an interim precautionary limit that is intended to guide preventative actions; and more conservative limits may be needed in the future.

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Some Quick Definitions for Units of Measurement of ELF and RF

***Milligauss (mG)**

A milligauss is a measure of ELF intensity and is abbreviated mG. This is used to describe electromagnetic fields from appliances, power lines, interior electrical wiring.

****Microwatts per centimeter squared (μW/cm2)**

Radiofrequency radiation in terms of power density is measured in microwatts per centimeter squared and abbreviated (μW/cm2). It is used when talking about emissions from wireless facilities, and when describing ambient RF in the environment. The amount of allowable RF near a cell tower is 1000 μW/cm2 for some cell phone frequencies, for example.

*****Specific Absorption Rate (SAR is measured in watts per kilogram or W/Kg)**

SAR stands for specific absorption rate. It is a calculation of how much RF energy is absorbed into the body, for example when a cell phone or cordless phone is pressed to the head. SAR is expressed in watts per kilogram of tissue (W/Kg). The amount of allowable energy into 1 gram of brain tissue from a cell phone is 1.6 W/Kg in the US. For whole body exposure, the exposure is 0.8 W/Kg averaged over 30 minutes for the general public. International standards in most countries are similar, but not exactly the same.