

Oct. 30, 1998

Tim Carl

As a resident of the I-70 Corridor for over 17 years, how many letters, meetings & "no"s will it take from people to get our message across? What is it about "no" that is not understood?

"No more towers" of any kind, or trade offs on Lookout Mountain or Morrison Mountain. Don't even put them elsewhere.

There is only one & best solution for everyone, taking into consideration health, real estate values, environmental pollution, etc, etc, ... the answer is Satellite Technology. It is available. Yes it is costly. Forget digital & bypass it. Lets get a real solution

Chestra Johnston
23970 Genesee Vlg Rd.
Golden, Co.

RECEIVED
NOV 2 1998
JEFFERSON COUNTY
PLANNING AND ZONING

80401

Thank you —

October 30, 1998

Tim Carl
Jefferson County Planning Dept
100 JeffCo Prkwy
Golden, CO 80419

Dear Mr. Carl:

We are opposed to the installation of any additional antennae within or near residential communities within Jefferson County. Please give unpopulated and remote areas higher priority than residential sites when considering alternatives.

We realize unpopulated sites may be more expensive to developers than existing sites within residential communities, but the cost to residents having to live with antennae is also high.

Thank you.

Sincerely,

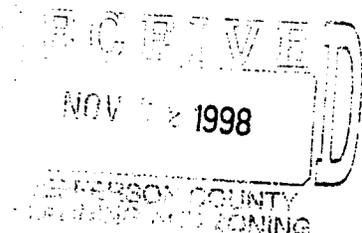


Scott Shuler
22108 Red hawk Lane
Golden, CO 80401



Brenda Shuler

cc: **CARE**



CYNTHIA POUZIALES
ARCHITECT
PINE STUDIO

November 1 1998

Tim Carl
Jeffco Planning Dept.
100 Jeffco Pkwy.
Golden, Co. 80419

re: Lookout Antennae Farm

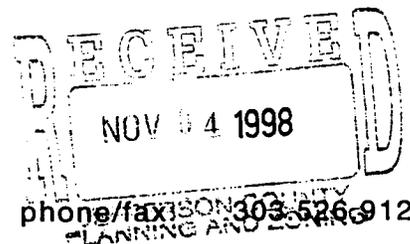
Dear Mr. Carl;

As technologies are changing @ a rapid pace,
so is Jefferson County. Jefferson^{City} is a national
leader in many respects and on many issues. Its
time to add "Compliance to FCC Standards" and
a commitment to clean up our community based on
these regulations as a part of next year's goals.

Thank you for your consideration. No to more antennas!

Cynthia Pouziales, AIA
CARE delegate, neighbor

CC: CARE



1 November 1998

Tim Carl
Jefferson County Planning Department
100 Jeff Co Parkway
Golden, CO 80419

Dear Mr. Carl,

As a resident of Jefferson County , living within a few miles of the antennas on Lookout Mountain, I want of express my concern about the existing towers, and major concern about the proposed expansion of new towers.

First the existing towers are unsightly, especially in a residential area. These towers reduce our ability to sell our properties. The reduction in property values should be reflected in our taxes.

Second I have a concern for our safety, living so close to the existing towers. At a very minimum the county should have independent third party studies run to determine the emission levels from the existing towers. Are the radiation levels safe for residents living in the proximity of the towers?

Third, before adding additional towers, third party testing needs to be run on the new technology to insure its safety. Why not solve both the unsightly appearance of the towers, and the safety concerns by locating the new towers in non residential area.

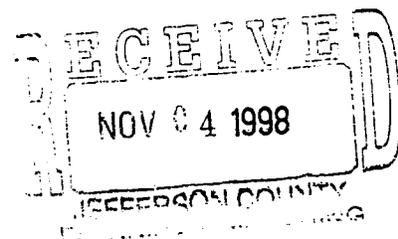
Sincerely,



Al and Merryanne Kibbler
25853 Gateway Drive
Golden, CO 80401

Telephone 303 - 526 - 1537

Copy to:
Canyon Area Residents for the Environment
25958 Genesee Trail Road - Unit K - 203
Golden, CO 80401



November 4, 1998

Tim Carl
Jeffco Planning Dept.
100 Jeffco Pkwy.
Golden, Co. 80419

Dear Mr. Carl,

I AM STRICTLY OPPOSED TO ANY MORE ANTENNAS ON LOOKOUT MOUNTAIN!

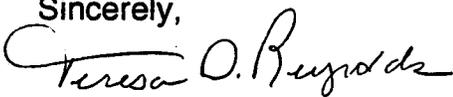
The environmental pollution is **already** beyond limits set by the FCC and Jefferson County. Many alternative sites are available in **unpopulated** areas. Why hasn't Jefferson County cared about it's residents who live on this mountain and have allowed the levels to exceed, what is allowable by law?

The heavy industrial use of residential land platted as early as 1889, should never have become antenna farms. It is the ugliest eyesore of the 8-county Front Range mountain backdrop.

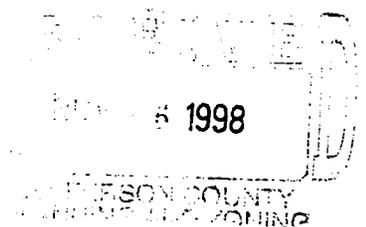
The environmental pollution has the ability to effect our Real Estate Values and more importantly, **OUR HEALTH.**

NO MORE ANTENNAS.

Sincerely,



Teresa D. Reynolds and Jon B. Reynolds
743 Aspen Rd.
Golden, Co 80401



November 3, 1998

Mr. Tim Carl
Jefferson County Planning Department
100 Jefferson County Parkway, Golden, CO 80419

Dear Mr. Carl,

I am writing to you to express my feelings concerning proposals that may come before Jefferson County relative to erecting new broadcast towers on Lookout Mountain, either by the Lake Cedar Group or others. I am adamantly opposed to any new towers on Lookout Mountain, and in fact I believe that all existing towers on the mountain should be removed, for the following reasons:

1. The towers seem to pose a health risk to people that live nearby. While some may debate this point, there certainly are valid concerns about the situation, and when we are dealing with people's health and lives, we should be very cautious. There are other places where broadcast towers can be located that would not potentially endanger people, and given this situation, the county would not be fulfilling its duty if some citizens are needlessly being exposed to a potential health threat. Asbestos is being removed from buildings, now that we know better. Similarly, threatening broadcast towers should be removed from areas where residences are present.

2. The towers are ugly to look at as one travels toward the mountains or along the front range. The view gives the impression that the citizens of this area put the convenience of the broadcasters ahead of thoughts of protecting and preserving the natural beauty of this area.

3. The towers are ugly to look at up close. It is sad when one travels to Buffalo Bill's Grave and Museum, the Lookout Mountain overlooks, Boettcher Mansion, or the beautiful new Jefferson County Nature Center to have to weave your way through all the broadcast towers. A terrific area is severely diminished by the presence of the towers.

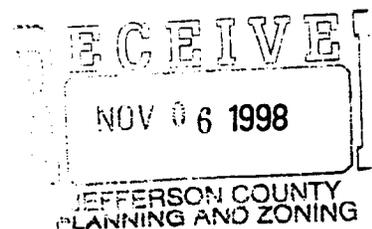
4. The taxpayers of Jefferson County are being shortchanged. If the towers were not present, imagine the conference centers, restaurants, banquet facilities, upscale homes etc. that would love to locate on the mountain to take advantage of the view. Those environmentally friendly land uses would be a benefit to the community, and would pay much more in taxes to Jefferson County than are currently being collected from the broadcasters.

I am opposed to relocating the broadcast towers to Mount Morrison because of item 2. above and because some Genesee homeowners would be adversely affected. However, Squaw Mountain would be a very suitable location that would welcome the broadcast towers. I recognize that the broadcasters might find the Squaw Mountain location less convenient than Lookout Mountain, but I don't feel that this factor should overshadow all other considerations concerning siting broadcast towers.

Thank you for considering my views on this matter.

Sincerely,


Jay N. Statler
25836 Buffalo Lane
Golden, CO 80401



Guenter L. Grothe
Vera L. Grothe
425 Colorow Rd
Golden, CO 80401
11-9-1998

RECEIVED
NOV 10 1998
JEFFERSON COUNTY
CLERK

Mr. Tim Carl
JeffCo Planning Department
100 JeffCo Pkwy
Golden, Co 80419

Dear Mr. Carl,
we are writing this letter to you and the Planning Commission to express our concern about environmental pollution by the TV and Radio transmitters using the antennas on Lookout Mountain.

We assumed that EMR was regulated by the FCC and Jefferson County, but when readings were taken at our home, we found out that the emissions by far exceeded the allowable limits.

Now we find out, that the broadcasters want to add more than 100 new transmitters on Lookout Mountain.

We strongly oppose any additional antennas and transmitters, and we urge you and the Planning Commission to reject all such applications. We also want you to do everything within your power to bring the present transmitters within compliance of the law. There are possibly other locations to install antennas without jeopardizing hundreds of families health, safety, and welfare.

We would greatly appreciate your support in this matter.

Sincerely,

Guenter L. Grothe
Guenter L. Grothe

Vera L. Grothe
Vera L. Grothe

LOOKOUT MOUNTAIN
PARADISE HILLS HOMEOWNERS' ASSOCIATION
A Not-For-Profit Homeowners' Corporation

November 10, 1998

Mr. Tim Carl
Jeffco Planning Department
100 Jeffcp Parkway
Golden, Co. 80419

RE: proposed Expansion of the Antenna Problem

Paradise Hills Homeowners Association has a population of 556 residents living on the southwest portion of Lookout Mountain. Our area is well within the electromagnetic radiation field of the existing and planned television towers.

The Board of Directors urge the Jefferson County Commissioners

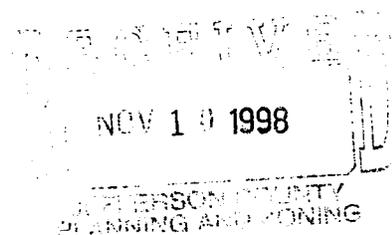
1. To fund an independent study of the health problems that exist now and those that would be enhanced with future tower expansion.
2. To lead and urge the industry relocation of their towers from populated Lookout Mountain to Squaw Mountain or other non-populated mountains on the front range.

Political leadership brought about the relocation of Stapleton Airport, surely this would be less of a task!

For the Board,



Peter M. Bates
323 Paradise Road
Golden. Co. 80401

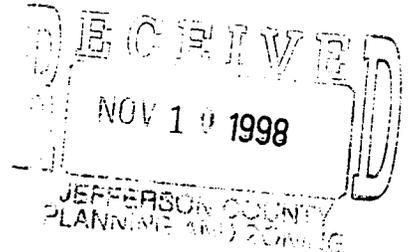


LOOKOUT MOUNTAIN ELECTRIC, INC

703 ASPEN ROAD
GOLDEN, COLORADO 80401
(303) 526-5720

9 November, 1998

Tim Carl
Jeffco Planning Dept.,
100 Jeffco Pkwy
Golden, Colorado 80419



Dear Tim,

As a concerned resident and business owner of Lookout Mountain, I would like to express my concern about the existence and the potential growth of the antenna farms. As a resident of Aspen Road, I can look out of my living room window and directly view numerous unsightly antennas. Along with this unattractive picture, I fear for the safety of my family, which includes 2 small children, from electromagnetic pollution. In addition I worry about the environmental effects that these towers may pose on all of us. As well, I am extremely concerned about the real estate value of my residence due to the current existence and potential existence of more antennas.

I desperately would like to see the removal of all of the existing antennas, and any new transmitters, to an alternative site, in an unpopulated area, where there would be no risk from exposure such as Squaw Mountain, Eldorado Mountain or numerous other high altitude U.S. Forest sites.

At this time, I would like for the Jeffco Planning Dept. to **JUST SAY NO** to the Lake Cedar Group.

Thank you.

Walter R. Thomoff (a concerned resident)

Furniture By Design

Susan M. Abel

703 Aspen Road - Lookout Mountain - Golden, Colorado 80401
(303) 526-9654

9 November, 1998

Tim Carl
Jeffco Planning Dept.,
100 Jeffco Pkwy
Golden, Colorado 80419

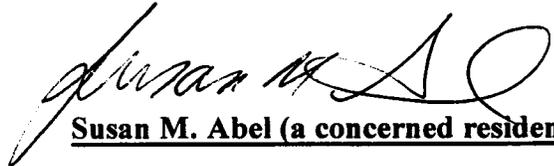
Dear Tim,

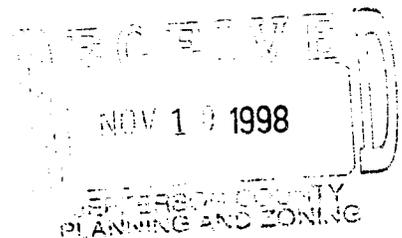
As a resident of Lookout Mountain, I would like to express my concern about the existence and the potential growth of the antenna farms. I currently reside at 703 Aspen Road, and the view out of my living room window is of numerous unsightly antennas. Along with this hideous picture, I fear for the safety of my family, which includes 2 small children, from electromagnetic pollution. In addition I worry about the environmental effects that these towers may pose on all of us. As well, I am extremely concerned about the depreciation of my residence due to the current existence and potential existence of more antennas.

I desperately would like to see the removal of all of the existing antennas, and any new transmitters, to an alternative site, in an unpopulated area, where there would be no risk from exposure such as Squaw Mountain, Eldorado Mountain or numerous other high altitude U.S. Forest sites.

At this time, I would like for the Jeffco Planning Dept. to **JUST SAY NO** to the Lake Cedar Group.

Thank you.


Susan M. Abel (a concerned resident)



52 Paradise Road
Golden, CO 80401
November 9, 1998

Mr. Tim Carl
Jefferson County Planning Department
100 Jefferson County Parkway
Golden, CO 80419

Dear Mr. Carl:

What is the County going to do to make certain that the residents of Lookout Mountain do not continue to be exposed to potential health risks from electromagnetic radiation (EMR) by the radio and television transmitters located on Lookout Mountain?

Several weeks ago we attended a meeting where the proposal for additional radio and television transmitters on Lookout Mountain was presented. The consultant to the radio and television stations assured us that the EMR was below Federal Communication Commission (FCC) standards now and would be in the future and therefore there was no health risk from the EMR. Recently it was proven that the levels in certain areas are considerably above the safe limits. It is very interesting to note that it was in the best interest of the owners of the towers to have their consultant conclude that there was no health risk from EMR and also the County apparently did nothing to check these findings.

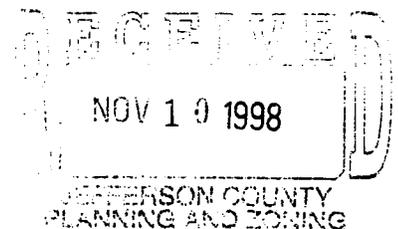
Since there is evidence that EMR exceeds FCC standards and that the radio and TV station owners cannot be trusted to provide accurate information of health risks and the County apparently has no way to check or control the EMR from the transmitters, we are opposed to any new transmitters. Additionally, standards related to health risks, over time, usually become more strict. If this happens with EMR standards, how will the County deal with the EMR on Lookout Mountain?



Bonnie Saxton

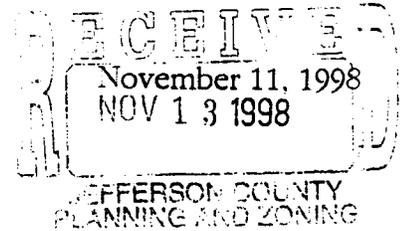


Paul Kalkwar



John Hathaway
RR 5 21109 Cedar Lake Road
Golden, CO 80401
303-526-9659

Tim Carl
JeffCo Planning Dept.
100 JeffCo Pkwy
Golden, CO 80419



Dear Mr Carl,

I'm writing you today to inform you that IN NO WAY am I going to accept this digital antenna array that is proposed for the Lookout Mountain area by the Cedar Lake Group.

First of all, this antenna array is located in an area that not only blocks my view of the metropolitan area, but will create a horrible eyesore every time I look towards Denver.

Second, this antenna array is held up by guy wires to keep it erect, that will go right next to my property and above my house. There are already 10 one inch diameter guy wires from the existing 800 ft. channel 4 tower that loom above my house and my property. This will not only add an increased eyesore to my property and the area, additionally, it is an added health hazard. In the winter, ice forms on these guy wires, creating giant ice spears that come falling to earth when the sun starts to melt them on the wires. I can't even walk around my property, much less work on my property without wearing a protective "crash helmet" and the Cedar Lake Group wants to add more guy wires above my property, so that more ice spears can come shooting down threatening my health and my property. This is ridiculous when there are alternate sites available for this massive array of antennas. How would you like to be trapped out in your yard, while these ice spears are falling from the sky, and you have nowhere to retreat to? These are not spears of soft snow. They are ice spears that spiral to the earth looking for a human target! Must I be their target?

Thirdly, and most importantly, these are radiation producing antennas that will flood the Lookout Mountain area with levels of radiation that are already above FCC and Jefferson County limits. No one in their right mind would even consider putting this antenna array next to a populated area such as the Lookout Mountain area, when there are alternate sights available such as Squaw Mountain (3 sites) or Mt. Morrison. I'm sure that the protection of young children and pregnant women alone in this area makes this antenna location absolutely absurd.

Fourth, this antenna array will not only effect the property values of the residents of the Lookout Mountain area, but the commercial success of businesses in the Lookout Mountain area could be jeopardized from not only the ugly appearance of this antenna array, but the increased radiation levels that will be present.

THE TIMES HAVE CHANGED and the Lookout Mountain area is becoming more populated all the time This isn't the 1950's when corporations had the freedom to pollute and jeopardize both the health and lifestyles of the Lookout Mountain residents and businesses.

In closing, I'm offering the planning department of Jefferson County a chance to take a stand AGAINST this monstrosity of both health and environmental hazards.

Conscientiously Aware,

May 22, 1997

Jefferson County Commissioners
100 Jefferson Co Parkway
Golden, Co. 80401

To: The Jefferson Co. Commissioners

I am writing regarding the proposed tower on Lookout Mountain by the Lake Cedar Group LLC. I am strongly apposed to this tower for two reasons:

- * The adverse health problems have not been answered to my satisfaction.
- * My home at 21189 Cedar Lake Rd. is inside the 110 degree radius of the proposed tower.

It's my understanding Jefferson County regulations state that no tower shall be constructed if a persons residence is inside this radius. I have owned and lived permanently in my home for many years and intend to do the same for many years to come.

It is requested you enter this letter into the case file and make all parties concerned aware of its contents.

Sincerely,

David P. Gunderson
21189 Cedar Lake Rd.
Golden Co. 80401

Appendix C

Colorado Senate Joint Resolution 00-031

Volume II Part 2

RECEIVED

MAY 10 2000

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

FCC MAIL ROOM

In the Matter of)
Lake Cedar Group LLC's) CA 00-764
Petition for Expedited Special Relief)
And Declaratory Ruling Seeking)
Preempting of a Resolution by)
the Board of County Commissioners of)
Jefferson County, Colorado)

Sixty-second General Assembly

LLS NO. R00-1142.01 Kate Rooney

STATE OF COLORADO

BY SENATORS Sullivant, Congrove, Evans, and Teck;
also REPRESENTATIVE Witwer.

SENATE JOINT RESOLUTION 00-031

101 CONCERNING URGING THE FEDERAL COMMUNICATIONS COMMISSION TO
102 REJECT LAKE CEDAR GROUP'S PETITION TO PREEMPT LOCAL
103 GOVERNMENT LAND USE DECISION-MAKING AUTHORITY.

1 WHEREAS, According to its comprehensive plan and its duly
2 adopted zoning regulations, the Board of County Commissioners of
3 Jefferson County, Colorado denied an application by Lake Cedar Group,
4 LLC, to rezone land on Lookout Mountain from residential and
5 agricultural zoning to planned development zoning in order to allow
6 construction of an 854-foot telecommunications supertower and a 26,000
7 square foot support building; and

8 WHEREAS, Such decision was a quasi-adjudicative decision
9 based on factual evidence presented to the Jefferson County Board of
10 County Commissioners and application of applicable legal standards and
11 as such can be appealed judicially to Jefferson County District Court,
12 which court is fully empowered to grant full and appropriate relief to the
13 appellant if appropriate under the facts of the case; and

14 WHEREAS, Lake Cedar Group filed an appeal of Jefferson
15 County's decision in Jefferson County District Court, which appeal is
16 now pending the filing of briefs by the parties; and

17 WHEREAS, Despite the pending judicial appeal, and after
18 Jefferson County spent several months preparing the voluminous record
19 of proceedings for the Jefferson County District Court action, Lake Cedar
20 Group, without notifying the Jefferson County Board of County
21 Commissioners or any other interested party, filed a petition with the
22 Federal Communications Commission (FCC) requesting the FCC to
23 "preempt" Jefferson County's decision and to declare Jefferson County's
24 decision "prohibited and unenforceable"; and

25 WHEREAS, By Public Notice dated April 10, 2000, the FCC
26 seeks public comment on Lake Cedar Group's petition; and

27 WHEREAS, In the United States, control over individual land use

1 decisions is firmly vested in local governments, through statutory
2 delegation from state governments; and

3 WHEREAS, The FCC is barred by the 10th Amendment to the
4 United States Constitution from attempting to preempt decisions made by
5 local governments on individual land use applications because the United
6 States Congress has not directed or authorized the FCC to preempt such
7 local decisions; and

8 WHEREAS, The FCC lacks not only the authority, but also the
9 expertise and any adopted standards to second-guess and invalidate local
10 government land use decisions; and

11 WHEREAS, Any attempt by the FCC to preempt local government
12 land use decision-making in this manner would represent an illegal,
13 unauthorized, and unjustified attack on state- and local- government land
14 use authority; now, therefore,

15 *Be It Resolved by the Senate of the Sixty-second General Assembly*
16 *of the State of Colorado, the House of Representatives concurring herein:*

17 That the General Assembly of the State of Colorado hereby
18 encourages the FCC not to preempt local government land use
19 decision-making and state judicial processes, thus overriding local and
20 state government authority.

21 *Be It Further Resolved,* That copies of this Joint Resolution be
22 sent to the President of the United States Senate; the Speaker of the
23 United States House of Representatives; each member of Colorado's
24 Congressional delegation; each member of the House of Representatives
25 Subcommittee on Telecommunications, Trade and Consumer Protection
26 of the Committee on Commerce; the Governor of Colorado; and the
27 Commissioners of the Federal Communications Commission.

Appendix D

Chronology of Radio Frequency Radiation Measurements and Reports

CHRONOLOGY OF RADIO FREQUENCY RADIATION MEASUREMENTS AND REPORTS appendix

Overview

The Federal Government has measured RF on Lookout 3 times in the 46 years since the first broadcast off Lookout Mountain. Every time the Federal Government has measured, the measurements in publicly accessible areas documented that the Radiation limits were higher than the safety limit.

Jeffco has measured RF levels over FCC standards near every tower with FM radio. KHIH tower was brought into compliance by fencing off the public out of Jefferson County Open Space land through March 31, 2000. The TV stations try to maintain that it is they who are within the FCC limits and the FM stations that are over but all the radiation combines and three of the TV stations derive revenue from renting their tower space to the FM stations. None of these 3 TV tower owners got Jefferson County's permission to add the FM stations to their towers. Channel 2 tower- KBPI and KALC-FM. Channel 4 - KRFX, Channel 6- KUVU and KCFR.

1986

September 22, 1986

On September 22, 1986 EPA and FCC conduct extensive measurements on Lookout Mountain and document areas over ANSI Standard in a public area. The 12 page report was published 5 months later as "An Investigation of Radio-frequency Radiation Levels on Lookout Mountain, Jefferson County, Co." Electromagnetics Branch, U.S. Environmental Protection Agency, Las Vegas, NV 89114, February 1987.

Near KOSI radio measurements in public areas were as high as 580 micro watts per centimeter squared. p.6

Publicly accessible areas near KYGO had electromagnetic radiation as high as 10,000 micro watts per centimeter squared. p. 11 "The KYGO tower is located in a complex of buildings where some people live throughout the year and where seasonal, residential workshops are held to teach square dancing." p. 7 (This is the where Beryl and Mae Elma Main and their family lived and worked with the square dance camp, The Lighted Lantern, as described by the Main's attorney Bruce DeBoskey at the May 27 hearing. Beryl Main died of lymphoma and his son was also stricken with cancer. Suit was filed against KYGO in Federal Court around 1987-1988. Mr. DeBoskey is under an obligation not to reveal the terms of the settlement.

This EPA report is revealing.

"In a mountainous area, one cannot rely on such a rapid reduction in power density with distance because the measurement locations may be moving up into the main-beam of radiation. Additional data collected near KYGO actually show an

increasing power density with distance from the antenna as the measurement location moves closer to the main beam of radiation. ” p. 10 “it is interesting to note the effect of different elevations (in mountainous areas) on the power densities” Usually, tripling the distance from an antenna would reduce the power density by a factor of 9. In this case however, the effect of greater distance was overcome by moving higher into the main beam of radiation. These data illustrate the need to consider the relative elevations of areas surrounding a station in the overall RF exposure evaluation.” p.8 (“An Investigation of Radio-frequency Radiation Levels on Lookout Mountain, Jefferson County, Co.” Electromagnetics Branch, U.S. Environmental Protection Agency, Las Vegas, NV 89114, February 1987.)

From the Federal Government come these admissions:

“this area presented a complex electromagnetic environment” p.2 Radar, FM, TV, two-way radio and other types of antenna are present. But, “broadcasters dominate the spectrum on Lookout Mountain” p. 5 see also Tables 1 and 2.

“The number of stations and their close proximity to one another and to residential areas make the Lookout Mountain antenna farms unusual. p.1

“in a mountainous area, one cannot rely on such a rapid reduction in power density with distance because the measurement locations may be moving up into the main-beam of radiation. Additional data collected near KYGO actually show an increasing power density with distance from the antenna as the measurement location moves closer to the main beam of radiation. ” p. 10 “it is interesting to note the effect of different elevations (in mountainous areas) on the power densities” Usually, tripling the distance from an antenna would reduce the power density by a factor of 9. In this case however, the effect of greater distance was overcome by moving higher into the main beam of radiation. These data illustrate the need to consider the relative elevations of areas surrounding a station in the overall RF exposure evaluation.” p.8

1987

1988

1989-FCC REVEALS THAT RARELY IS RF OVER STANDARDS, LOOKOUT IS EXCEPTION

Lookout Mountain is one of the few residential areas in the country that has exceeded the FCC radiation standards according to FCC OET document published in 1989.

“Measurements made by EPA and others (References 15 and 19) have shown that RF radiation levels in inhabited areas near broadcasting facilities are generally well below levels believed to be hazardous. There have been a few situations around the country where exposure levels have been found to be higher than those recommended by applicable safety standards (e.g. Reference 20 Page 17, Reference 20 “An Investigation of Radio-frequency Radiation Levels on Lookout Mountain, Jefferson County, Co.”

Electromagnetics Branch, U.S. Environmental Protection Agency, Las Vegas, NV 89114, February 1987.)

"But such cases are relatively rare, and few members of the general public are likely to be routinely exposed to excessive levels of RF radiation from broadcast towers." Page 9, Paragraph 4. 1989) FCC OET (Office of Engineering and Technology) Bulletin # 56

1990

1991

1992

1993

1994

1995

January 20, 1995

Mr. Richard Tell conducted an RF survey ordered and paid for by Andrews and Anderson, the architects for the Jefferson County Lookout Mountain Nature Center. Mr. Tell finds that the RF fields at the Nature Center are strong enough to interfere with electronic systems such as public address, intercoms and various types of audio equipment. Although shielding materials can be installed in new or existing construction to help reduce RF field strength's impact on sensitive equipment, Mr. Tell warns at page 19 of his report , "there are no reliable means for predicting whether specific electronic systems will be interfered with at certain field strengths; the only reliable approach is by trial and error." Various mitigation measures are discussed at pages 16-18 that show the expense to the landowner afflicted with electromagnetic interference.

1996

5/9/96-JEFFERSON COUNTY CONFIRMS RF LIMIT IS THE ANSI STANDARD

letter from Jefferson County Manager, Dora Harrison Jefferson County Commissioners

to Carole Lomond

1. The recent ANSI standard of 200 micro watts per square centimeter is the Jefferson County standard. This was further confirmed by Dan Brindle of the County that this 200 standard is a zoning requirement in a letter to CARE

Jeffco trying to get an inventory of devices on Lookout from the FCC

July 12, 1996

Richard Tell, who did the 1986 NIER (non-ionizing Electromagnetic Radiation) study of the towers' emissions, takes RF measurements around community at Jeffco request

Report of Survey of Radio-frequency Fields Completed. This study documents that levels of broadcast radiation over 1 microwatt per centimeter squared are documented over a wide area of the community. Areas as far away as three miles show radiation amounts thousands of times above the national average.

1997

October 21 & 22, 1997

Robert Weller of Hammett & Edison, RF engineer for Lake Cedar Group (LCG), measures RF exposure levels on Lookout Mountain. He finds "ground level areas that exceed the public limits" in the vicinity of the Channel 6 tower, and reports this to the FCC on October 28, 1997.

10/21/97-LCG takes RF measurements but does not follow Zoning Regulations Rather than make the mandatory measurements of the NIER levels at up to 12 sites selected by mutual agreement of the applicant, the resident community and the Planning and Zoning Department, Lake Cedar Group's Engineer, Robert Weller, unilaterally substituted his own locations for his measurements of existing RF exposure conditions on October 21 and 22 of 1997. (Hammett and Edison Analysis of Ground-Level Radio Frequency Power Densities for Proposed Joint DTV Tower pg. 4

1998

July 18, 1998

CARE engineers make measurements on Lookout Mountain and confirm the excessive levels found by Weller near the Channel 6 tower. They also find RF exposure levels above the allowable standard on Cedar Lake road near KOSI FM and KKHK FM and on the hill where the towers for TV Channels 7, 9 and 31 are located. Exposure levels are found to be as high as 250% of the allowable standard.

7/28/98-Weller Report to FCC on Channel 4-Bates # 041285-88

7/28/98-Channel 4 application for Digital Channel 35 on Supertower

Q. 22 Environmental Statement-See 47 CFR Section 1.1301 et seq.

No significant environmental impact

"Grant of this application is not considered to be a major environmental action as defined in Sec. 1.1307 of the FCC rules.

None of the conditions listed in Sect. 1.1307(a) are believed to apply.

(c) pursuant to OST Bulletin No. 65, the applicant must explain in an

Exhibit what steps will be taken to limit the RF radiation exposure to the

Public and to persons authorized access to the tower site. In addition,

where there are multiple contributors to radio frequency radiation,

you must certify that the established RF radiation exposure procedures will be coordinated with all stations.

See EXHIBIT 6

Exhibit 6 is a July 14, 98 Weller report

ERP will be 1000 kw

Used computer model to calculate ground RF -

Highest would be

1.5% of public limit therefore categorical exclusion claimed pursuant to Section 1.1307(b)(3) (ii) of the Rules which

states that "renewal applicants whose transmitters or facilities contribute to the power density of an accessible

are not in compliance with the limits must submit an EA if emissions from the applicant's facility results, in the area in question, in a power density that exceeds 5% of the power density exposure limit applicable to that facility.

August 5, 1998

RF exposure measurements are made on Lookout Mountain as part of the proposal by FOX TV to obtain a permit from Jefferson County to add a digital antenna on its existing tower

August 25, 1998

As part of the LCG (Lake Cedar Group Supertower) proposal, Hammett & Edison presents to Jefferson County an analysis of RF exposure levels on Lookout Mountain, based on the measurements made by Weller on October 21 & 22, 1997. This report states that the maximum RF exposure levels on Lookout Mountain are 66% of the maximum allowable. The report also states that the levels near the Channel 6 tower are only 57% of the maximum allowable, even though Weller's earlier statement to the FCC admitted the levels were over 100%.

September 29, 1998

Hammett & Edison, on behalf of LCG, submits to the FCC a report claiming that RF exposure levels on Lookout Mountain are below the maximum permissible exposure (MPE).

October 29, 1998

The FCC makes measurements on Lookout Mountain and confirms the excessive RF exposure levels measured by CARE engineers. Exposure levels of 250% MPE are found

on the Channel 7 driveway, and 140% MPE is found on the public roadway in front of the Channel 7 driveway. Exposure levels as high as 220% MPE are found on Jefferson County Open Space property between the KHIH FM tower and the Channel 2 tower.

Actual footage of the measurements taken that date and the dialog with the FCC's Engineer, Dr. Robert Cleveland, Lake Cedar Group's Engineer, Bob Weller and CARE's volunteer resident engineer, Al Hislop is included in the Documentary film, "Broadcast Blues," by independent Emmy award winning filmmaker, Len Aitken. The comments of Dr. Cleveland at the beginning of the measurement session starting on Cedar Lake Road near the proposed supertower are attached as an additional exhibit.

November 12, 1998

The FCC issues a report summarizing the results of the measurements of October 29, 1998, and recommending remedial actions to bring Lookout Mountain into compliance with RF exposure standards. The remedial actions include fencing of hot spots on public and private property where possible, and power reductions by certain stations to reduce exposure levels in public areas. The power reductions recommended for KOSI and KKHK can mathematically be shown to be insufficient to reduce the 140% MPE hot spot on the public roadway to a compliant level.

December 15, 1998

Jefferson County grants a one-year fence permit to surround hot spots on the public right-of-way on Colorow Road, near the Channel 6 tower. Representatives of KCFR and KUVO promise to resolve the RF radiation problem "one way or another" by December 31, 1999.

December 16, 1998

The FCC again visits Lookout Mountain to measure exposure levels and confirm that the requested remedial actions have resulted in a compliant situation. Instead, the FCC again finds excessive levels at all three sites as the FCC begins their measurements. Further power reductions are requested of KCFR FM, KUVO FM and KHIH FM. KHIH is reduced to transmitting at 39% of its licensed power. (KHIH subsequently obtained a permit to block access to Jefferson County Open Space with a fence, and resumed transmitting at full power.) The FCC also requires an expansion of the fences on the Channel 7 property.

1999

January 4, 1999

The FCC issues a report summarizing the results of the measurements taken on December 16, 1998. The report does not explain how the 17% reduction in total power output from stations KOSI and KKHK resulted in a reduction in the exposure level of a known hot spot on the public roadway near the channel 7 driveway from 140%MPE to 70% MPE. CARE measurements at the hot spot show exposure levels greater than 100% MPE. The

FCC report concludes that Lookout Mountain is now in compliance with RF exposure standards.

February 23, 1999

Jefferson County issues a permit for FOX TV to add a digital TV transmitting antenna on FOX's existing tower. The county relies on the FCC's assertions that the mountain is in compliance with the standards.

June, 1999

Jefferson County obtains RF survey meter and begins to make RF exposure measurements.

June 12, 1999

KOSI FM and KKHK FM further reduce transmitted power after Russell Clark of Jefferson County confirms CARE's claim that RF exposure levels exceed county and federal standards on the roadway near the Channel 7 driveway. This location is between the Channel 7 and Channel 31 (FOX) towers. (This was the point now affectionately called "Pericle Rock.")

July 1, 1999

Representatives of Jefferson County, CARE and Tribune Broadcasting have a joint measurement session at Pericle Rock. With the power reductions implemented June 12 still in effect, measurements by Jefferson County and CARE indicate RF exposure levels exceeding 100% MPE, but Tribune Broadcasting measurements are lower. Measurement results are given to the FCC. The FCC discards Jefferson County's maximum readings, averages the remaining Jefferson County readings with Tribune's lower readings, and declares the level to be 98.6% MPE.

December 14, 1999

Jefferson County grants a two-year extension for the one-year permit to fence the public right-of-way on Colorow road near the Channel 6 tower. KUVO and KCFR have made no attempt to remedy the RF excesses.

December 23, 1999

Russell Clark of Jefferson County, Jim Hart, independent consulting engineer for Jefferson County and FOX, Jim Hollinger and their engineer, Bob Bonner, measured areas around the FOX tower. Each had a meter. CARE representatives, Dr. Ron Larson and Deb Carney observed. Russell Clark said that FOX must do required county measurements within 90 days of turning on the Channel 32 Antenna (turned on Nov. 1, 99)

Location I-Between Channel 7 and Channel 31 Tower. Jeffco measured over the RF limits but FOX did not. Road leading up to several different towers, near turnoff for Channel 7 Tower. There are 3 wooden stakes, the stake closest to Denver says Pericle and has

orange paint Measurements were taken 3 ft from this N.E. stake. This is the site referred to earlier as Pericle rock.

Due to major inconsistency between the readings of the FOX meter and the JEFFCO meter and the fact that the JEFFCO meter consistently showed that the RF limits for uncontrolled areas were exceeded, the measurements were discontinued after 1 hour with the plan to come back with a third meter next Tues or Wed. Only 2 locations were measured

2000

January 8, 2000

With newly calibrated RF survey meter CARE engineer makes RF exposure measurements at Pericle Rock. Measurements indicate 106% MPE.

January 24, 2000

CARE engineer makes measurements of RF exposure levels near the Channel 6 tower on Colorow Road. RF levels on the public right-of-way on both sides of Colorow road now appear higher than before the power reductions required by the FCC in 1998.

January 25, 2000

Jefferson County and CARE have a joint measurement session at several places on Lookout Mountain. With good agreement between the two meters, RF exposure levels are found to exceed county and federal standards near the Channel 6 tower on Colorow road, with levels typically 125% MPE.

Exposure levels at Pericle Rock also exceed 100% MPE.

Levels near the KHHH tower are as high as 240% MPE. This portion of Jefferson County open space is now fenced off, but the gate is missing.

Many newly discovered hot spots are found to the south, east and north sides of the Channel 2 tower site on open space property belonging to Jefferson County and the City and County of Denver.

That same day, FOX took their RF measurements without Jefferson County or CARE representatives present and then turned these measurements over to the County. FOX did not remeasure the hot spot previously found by Jeffco at the pericle rock location between the FOX and Channel 7 Towers.

February 10, 2000

Jefferson County, Tribune Broadcasting and CARE to measure RF. Tribune issues press release that advises that the previous day they had KALC-FM (on the Channel 2 tower) turn down their power. Tribune verbally admits they turned it down 30%. Russell Clark and Jim Hart are present for Jeffco. Don Mooney, Andy Bader and a number of others are present for Channel 2. Leo Servo attends with another person from the FCC. Dave

Venetti tapes measurement techniques and Al measures. Al finds one spot that had been 147.9 % of MPE was now 101% of MPE. Kieran Nicholson and a photographer from the Post attend.

Both Russell and Al found readings in excess of 100% MPE. Bob Hensler of KCFR almost always found levels lower than ours. When he and Russell traded meters, Russell was still able to find some readings higher than 100%, with the "Lake Cedar Group" meter, as Bob Hensler called it. The Channel 2 area was right at the ragged edge, and that the Channel 6 area was still slightly over. Russell Clark agreed. Jeffco and CARE will measure again Tuesday, with representatives of KRMA, KCFR and KUVO all present

3/2/2000- Measurements

Channel 6 Tower

Russell Clark, Bob Hensler and Al Hislop again made measurements at the Channel 6 tower. Al and Russell's showed higher than Bob Hensler's. Jim Hart averaged the averages of the readings from the three meters, and the result was that levels across the street from the tower were found to be 105.8% MPE. Near the power pole on the same side of the street as the tower, the average of averages was 112.44%.

Pericle Rock

Russell and Al then made measurements at Pericle Rock, across from the green building near the FOX tower. The average of the averages was 115.15% MPE.

3/9/2000- Report by Al Hislop on measurements with Russell Clark

This morning KCFR and KUVO reduced power and we measured approximately 100% near the power pole by the Channel 6 tower. Russell Clark said he would periodically make measurements because it is so close. KUVO is now down to 42.5% and KCFR is down to 62%. Some adjustments may be made, increasing KUVO and decreasing KCFR, but keeping the total RF transmitted power constant.

4/3/2000-KHIIH Fence Taken Down

KHIIH estimated to be operating and 50% power. Russell: Al Hislop made measurements at the known hot spot on publicly accessible Jefferson County Open Space near KHIIH. four spatially averaged measurements: (uncorrected)

133.3% MPE

118.3% MPE

133.7% MPE

123.1% MPE

Taking into account the .93 calibration factor of Al Hislop's probe, the average of these measurements is 118.2% MPE.

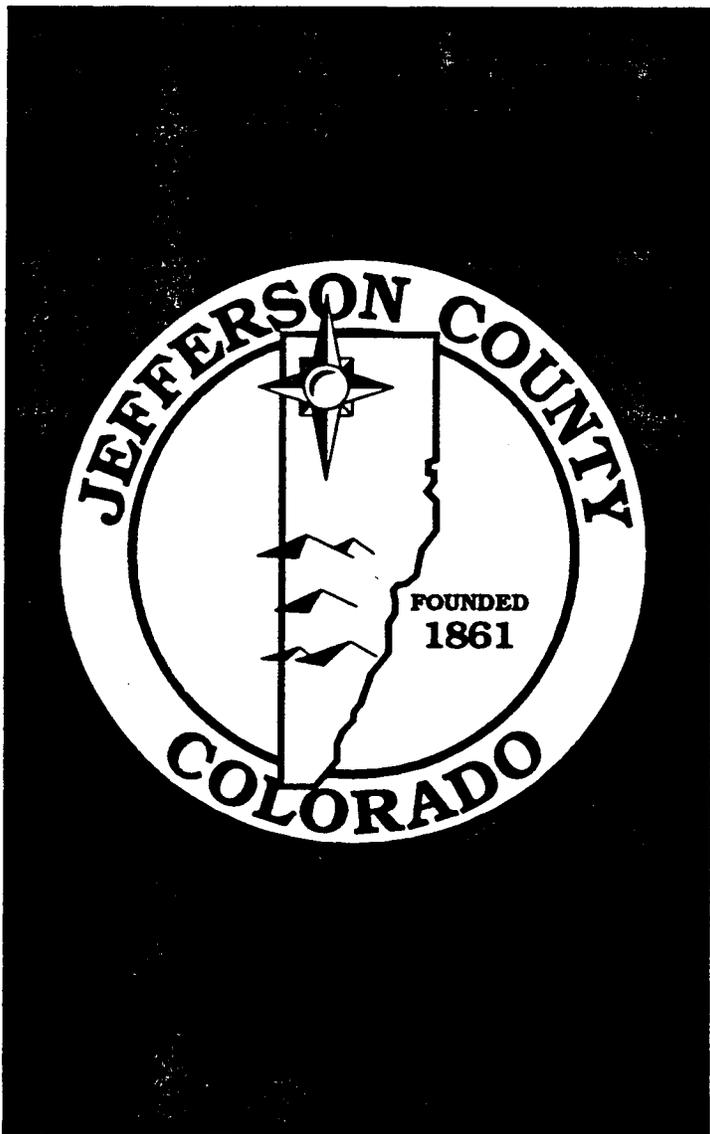
Appendix E

**Zoning Resolution of Jefferson County Colorado
October 1998**



Z O N I N G

RESOLUTION



this edition printed October 1998



- i. A final operational mine plan consistent with the Official Development Plan depicting method of mining, bench orientation, direction of mining and concurrent reclamation plans. (orig. 6-1-93)
 - j. Detailed plans for all monitoring required by the Official Development Plan, including the location of monitoring stations, frequency of monitoring and criteria for monitoring. (orig. 6-1-93)
 - k. All state and federal permits required for the mining operation. (orig. 6-1-93)
3. The site plan shall be reviewed by the Planning Director for conformance with the Official Development Plan and other County regulations. (orig. 6-1-93)
- a. Upon receipt of a site plan, the Planning Director shall cause notice of filing of the site plan to be posted on the property, which shall indicate that there is a 60 day period commencing on the date of posting to submit written comments to the Planning Director concerning the site plan. (orig. 6-1-93)
 - b. The applicant shall deposit 10 copies of the site plan with the Planning Department. Five copies of the site plan shall remain at the Planning Department. Five copies shall be deposited at public libraries in the area of the proposal. The copies shall be available to the public to check out for a two week period. (orig. 6-1-93)
 - c. After the close of the comment period, the Planning Director shall determine whether the site plan conforms to the requirements herein and may request such changes as are deemed necessary to render the plan in conformance. (orig. 6-1-93)
4. The Planning Director's decision on the site plan may be appealed to the Board of Adjustment under the provisions set forth in Section 13 of this Zoning Resolution. (orig. 6-1-93)
5. After approval of a site plan, the Planning Director may approve minor modifications to the site plan so long as such modifications are consistent with the overall intent of the Official Development Plan and do not result in adverse impacts that were not considered at the time of zoning approval. (orig. 6-1-93)



F. PLANNED DEVELOPMENT FOR TELECOMMUNICATION TOWERS:

The purpose of the Planned Development is to minimize adverse visual effects of towers through careful design, siting, and vegetative screening; to maximize the use of any transmission tower in order to reduce the total number of towers needed to serve the telecommunications needs of the area; and to site and design towers so that electromagnetic radiation emissions to which the public will be exposed do not exceed safe levels. (orig. 5-11-93)

1. **Application Requirements:**

All rezoning applications must contain the following materials, however failure to submit a complete application shall not deprive the Planning Commission or the Board of County Commissioners of jurisdiction to consider the application. These application requirements are not intended to specify criteria for decision. (orig. 5-11-93)

- a. Site plan(s) drawn to scale identifying the site boundary; tower(s); guy wire anchors; existing and proposed structures, including accessory structures; existing and proposed ground-mounted equipment; vehicular parking and access; and uses,

- (6) Existing easements or rights-of-way (e.g., utility, irrigation, access, etc.) on or contiguous to the site. (orig. 5-11-93)
 - (7) Identified mineral resource areas. (orig. 5-11-93)
 - (8) Where the area in which construction will occur contains slopes greater than 10 percent, a slope analysis of the area affected by construction depicting locations and direction of slope faces for slopes within the following categories: 0-8 percent, 8-15 percent, 15-22 percent, 22-30 percent, greater than 30 percent. (orig. 5-11-93)
 - (9) Floodplains, as designated by the Urban Drainage and Flood Control District or other agency, and overlay zoned floodplain (FPS) areas. (orig. 5-11-93)
 - (10) Areas within the Geologic Hazard (GH) Overlay Zone. (orig. 5-11-93)
 - (11) Location of other potential hazards such as wildfire, geologic, airport or radiological hazards. (orig. 5-11-93)
 - (12) Location of special resources such as wildlife, historic structures, and archaeologically significant remains. (orig. 5-11-93)
- j. Elevations of the proposed tower and accessory building generally depicting all proposed antennas, platforms, finish materials, and all other accessory equipment. (orig. 5-11-93)
- k. The Board of County Commissioners and/or the Planning Commission may require the applicant to submit funds in escrow up to a maximum of \$10,000 to pay for expert review of technical submissions by the applicant, including expert review of engineering data and financial data concerning costs of modifying existing towers and costs of ameliorating interference. The Planning Department shall recommend the amount of funds to be deposited up to \$10,000 based on the nature of the application and the anticipated complexity of review. Selection of the expert(s) shall be within the sole discretion of the County, however the applicant and interested parties shall have an opportunity to comment on the proposed expert(s). Any funds not utilized for expert review shall be returned to the applicant at the completion of the rezoning case. (orig. 5-11-93).

2. Review and Approval:

a. General Criteria:

- (1) In reviewing a proposal under this Section, the Planning Commission and the Board of County Commissioners shall consider the compatibility of the proposal with existing and allowed land uses in the surrounding area; the County's Comprehensive Plan including but not limited to the applicable community plan or the General Land Use Plan and the Telecommunications Land Use Plan, according to the priorities set forth in the plans; the Local Government Land Use Control Enabling Act; the provisions of section 30-28-115, C.R.S., and any other applicable law, adopted public policies or plans, or studies presented as part of the zoning case. The Board has the sole discretion to determine what weight, if any, to give each of these factors. (orig. 5-11-93)

- (2) If the Board of County Commissioners approves a rezoning to Planned Development pursuant to this Section, the Board may impose such conditions on access, accessory structures, landscaping, tower coloring, lighting, design, size and siting as it deems necessary to render the proposal compatible with existing and allowed land uses in the surrounding area, to comply with the policies in the Jefferson County Comprehensive Plan or applicable land use plan, the telecommunications Land Use Plan, its land use enabling authority, the laws, policies, plans and studies referenced above, except where such conditions are preempted by and conflict with regulations promulgated by the Federal Communications Commission or the Federal Aviation Administration, or where the Board of County Commissioners determines, based on evidence presented at the hearing, that such conditions would contravene sound engineering practices. (orig. 5-11-93)

b. Minimum Standards:

- (1) The applicant must provide expert testimony that demonstrates to the satisfaction of the Board of County Commissioners that no existing telecommunications site is available to accommodate the equipment or purpose for which the tower or increase in height is proposed at a reasonable cost or other business terms. The need for structural or equipment modifications shall not alone be sufficient to demonstrate nonavailability. Any one or more of the following shall be considered to demonstrate nonavailability. (orig. 5-11-93)
 - (a) Evidence with reference to EIA-RS 222, in its then current adopted revision, that the structural capacity of existing and approved towers cannot accommodate the planned equipment and cannot be reinforced to accommodate the planned equipment at a reasonable costs, or the owner of the site is unwilling to rezone if necessary to accommodate a new user. The applicant shall be required to calculate the capacity of existing or approved towers based on information on file with the County or requested from the tower owner, if supplied. (orig. 5-11-93)
 - (b) Evidence that the planned equipment may or will cause objectionable radio frequency interference with other existing or planned equipment on that tower, which cannot be ameliorated at a reasonable cost. (orig. 5-11-93)
 - (c) Evidence that existing or approved towers do not have space to locate the planned equipment where it can function effectively and at the strength of signal required by the FCC. (orig. 5-11-93)
 - (d) Evidence that the addition of the planned equipment to existing or approved towers would result in NIER levels in excess of those permitted by OST-65 and ANSI C95.1 or any revisions thereto, or any adopted local standard. (orig. 5-11-93)
 - (e) Evidence that the fees and/or costs for shared use, including the cost to adapt existing facilities to the proposed use, exceed the cost of the proposed tower, or that the parties have not been able to reach agreement on reasonable business terms or other issues associated with locating on the tower. (orig. 5-11-93)

- (2) All new structures must be set back from the property line sufficient to prevent all ice-fall materials and debris from tower failure or collapse from falling onto occupied dwellings other than those occupied by the tower owner, and protect the public from NIER in excess of that allowed herein. Where more than one tower is located on a site, the set back between such towers shall be sufficient to prevent multiple failures in the event one tower fails. (orig. 5-11-93)
- (3) The tower must be designed to accommodate structurally multiple antennas if recommended by the Telecommunications Plan. (orig. 5-11-93)
- (4) NIER emissions from the tower facility, when operating with maximum power output from all proposed antennas and transmitting facilities, may not exceed the level set forth in this Zoning Resolution, as measured in accordance with methods published by the United States Office of Science and Technology or any other applicable federal agency by qualified experts. (orig. 5-11-93)
- (5) The written restrictions must state that at such time as there have not been any antennas on a tower or the use of the tower has been abandoned for 6 consecutive months, it will be removed within 180 days of the end of said six month period. (orig. 5-11-93)
- (6) Satisfaction of the minimum standards set forth above shall not entitle an applicant to approval of the rezoning if the Board of County Commissioners determines that rezoning should not be allowed pursuant to the General criteria for review. (orig. 5-11-93)

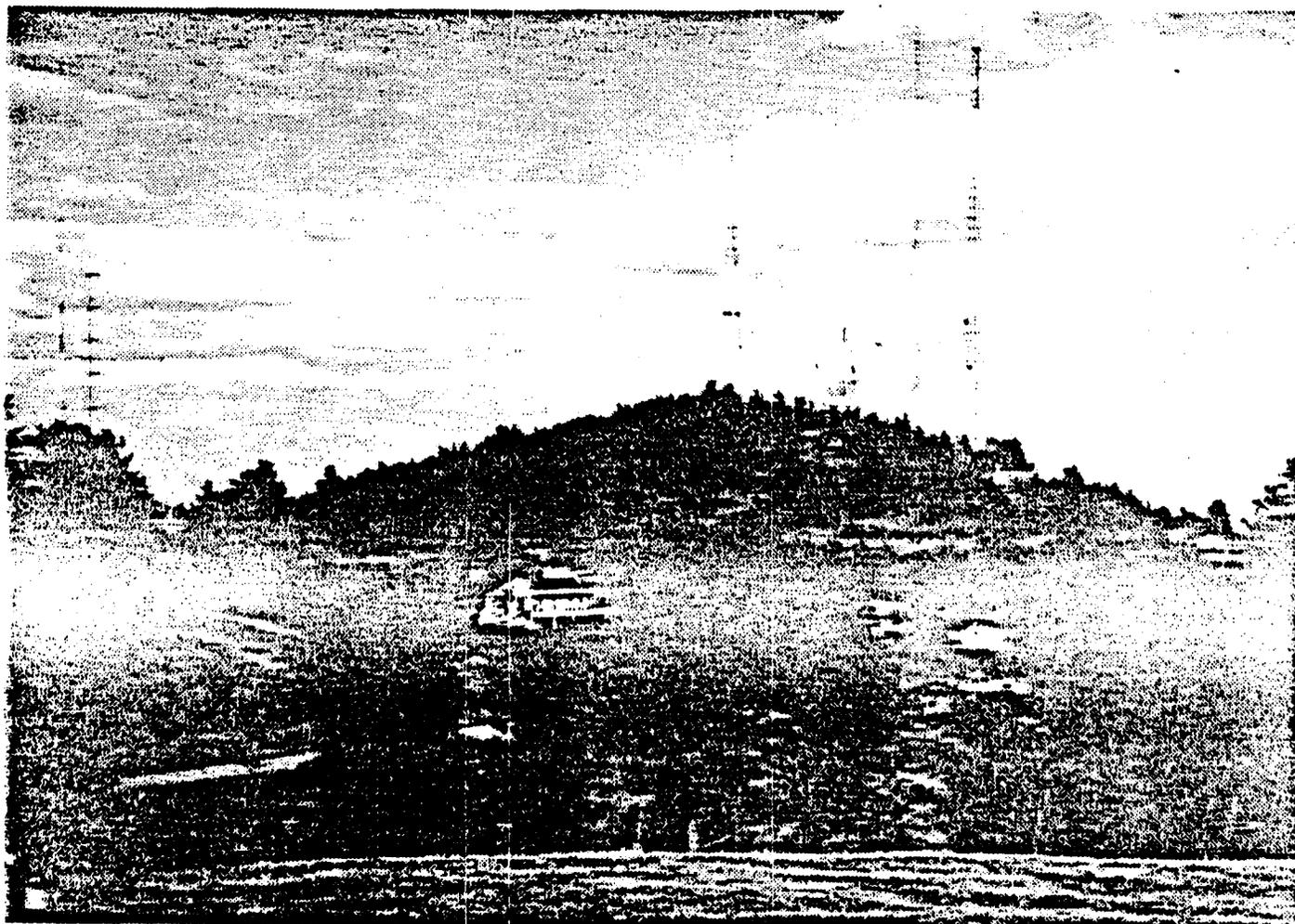
G. GENERAL REQUIREMENTS

1. Multiple buildings per lot, except for single-family detached structures, are allowed only for property platted pursuant to the Jefferson County Land Development Regulation. (orig. 3-8-82)
2. The "General Requirements" portion of each of the standard zone districts of this Zoning Resolution as amended at the time an applicable permit is issued, together with their parking, fencing, signage, and other regulations and requirements shall be applicable to all comparable areas in the Planned Development Districts unless otherwise specified in the particular Official Development Plan. (orig. 1-17-84; am. 6-1-93)
3. No Official Development Plan shall be approved which contains restrictive or protective covenants which limit the transfer, rental, or lease of any housing because of race, creed, religion, color, sex, marital status, national origin or ancestry or handicap as prohibited by C.R.S. 1973, 24-34-502 and Title VIII of the Fair Housing Act of 1968, 42 U.S.C. § 3604(c). (orig. 5-12-81; am. 6-1-93)
4. Upon approval of any planned development by the Board of County Commissioners, the written conditions or restrictions and the appropriate accompanying graphic documentation shall be filed with the Jefferson County Clerk and Recorder as an Official Development Plan as set forth in Section 1 of this Zoning Resolution. (orig. 6-1-93)

Appendix F

An Investigation of Radiofrequency Radiation Levels on Lookout Mountain

**An Investigation of Radiofrequency Radiation
Levels on Lookout Mountain,
Jefferson County, Colorado
September 22 - 26, 1986**



**Electromagnetics Branch
Office of Radiation Programs
U.S. Environmental Protection Agency
P.O. Box 18416
Las Vegas, Nevada 89114-8416**

February 1987

**An Investigation of Radiofrequency Radiation
Levels on Lookout Mountain,
Jefferson County, Colorado
September 22 - 26, 1986**

**Prepared for the
Office of Engineering and Technology
Federal Communications Commission
through Interagency Agreement RW27931344-01-0**

**Electromagnetics Branch
Office of Radiation Programs
U.S. Environmental Protection Agency
P.O. Box 18416
Las Vegas, Nevada 89114-8416**

February 1987

EXECUTIVE SUMMARY

During the week of September 22, 1986, Environmental Protection Agency and Federal Communications Commission personnel investigated radiofrequency radiation intensities near the Lookout Mountain antenna farms, west of Denver, Colorado. Typical power densities near several area residences did not exceed $100 \mu\text{W}/\text{cm}^2$. The highest value found near the towers along Cedar Lake Road was $580 \mu\text{W}/\text{cm}^2$, which is below the $1000 \mu\text{W}/\text{cm}^2$ FCC guidelines. However, near the base of the KYGO-FM tower, a $10,000 \mu\text{W}/\text{cm}^2$ value was found and power densities exceeding $1,000 \mu\text{W}/\text{cm}^2$ were measured over a large area. The areas exceeding the FCC guidelines are in a residential area and are accessible to the public. EPA urges the FCC to order KYGO to correct the problem as soon as possible.

TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	i
TABLE OF CONTENTS	ii
PARTICIPANTS	iii
BACKGROUND	1
EQUIPMENT	1
PROCEDURE AND RESULTS	3
Cedar Lake Road	3
Spectrum Survey	3
Cedar Lake Road Measurements	4
Measurements Near KOSI-FM	6
Measurements Near KYGO-FM	7
Measurements Near Other Lookout Mountain Towers	8
Community Measurements	8
DISCUSSION	9
CONCLUSIONS	11
REFERENCES	12
FIGURE	
TABLES	
APPENDIX A, ZOOM DATA FILES	
APPENDIX B, EQUIPMENT AND CALIBRATION INFORMATION	

PARTICIPANTS

Environmental Protection Agency
Office of Radiation Programs, Las Vegas Facility
Richard A. Tell, Chief, Electromagnetics Branch
Edwin D. Mantiply
Paul Wagner

Region VIII, Radiation Programs Branch
Carl V. Peterson

Federal Communications Commission
Office of Engineering and Technology
Robert F. Cleveland, Jr., Physical Scientist

Denver Field Office
Dennis P. Carlton, Engineer in Charge

BACKGROUND

* Lookout Mountain is the location for broadcast antennas for many of the television and FM radio stations that serve the Denver area. The number of stations and their close proximity to one another and to residential areas make the Lookout Mountain antenna farms unusual. Table 1 lists these stations and their frequencies. Figure 1 shows the location of stations on a map of the Lookout Mountain area. Interference to consumer electronic devices and subsequent concern over possible health effects led the residents and the Jefferson County Planning Commission to request a survey of radiofrequency (RF) radiation levels on Lookout Mountain in 1983. That survey was conducted in 1983 and 1984 and found no locations where the RF intensity exceeded the American National Standards Institute RF protection guide of $1,000 \mu\text{W}/\text{cm}^2$ (1). However the study was limited by the fact that permission was not obtained to investigate the RF levels on private property near some broadcast antennas. In 1986, residents contacted the Federal Communications Commission (FCC) seeking a more comprehensive study. The FCC consulted EPA, and EPA found that modeled power densities near the base of the KYGO-FM tower approached $10,000 \mu\text{W}/\text{cm}^2$. The earlier study could not corroborate or refute this prediction since the owners of the property surrounding the KYGO tower (KYGO does not own the property) had not been reached to grant EPA permission to conduct measurements on their land in 1983 and 1984. Because the projected power density near KYGO was so high and because the accuracy of the calculational model had been verified with measurements in other locations, EPA Electromagnetics Branch personnel traveled to the Denver area to conduct a study on Lookout Mountain during the period September 22 to 26, 1986. This study was conducted at the request of the FCC under the provisions of an interagency agreement between the FCC and the EPA. Accordingly, FCC personnel were present and assisted in the study.

EQUIPMENT

RF field strength is usually measured using broadband isotropic electric or magnetic field strength meters, or tunable field strength meters connected to appropriate antennas. Broadband equipment is used to determine the total RF field at a point while narrowband equipment provides details of the RF field intensity at any particular frequency. This study employed both types of equipment.

For automated, narrowband measurements, two antennas were used. A NanoFast Fiber Optic Isolated Spherical Dipole (FOISD) was used for frequencies from 10 kHz to 700 MHz. A Watkins Johnson omnidirectional biconical antenna (OMNI) was used for frequencies above 500 MHz. Both detect electric fields and both are linearly polarized antennas. The axis of each antenna was oriented at 55° from the axis of its support mast. With this orientation, one can place the antenna in each of three orthogonal positions by rotating the support mast to three azimuths, 120° apart. Each OMNI and FOISD data value presented in this report is the result of three orthogonal measurements. All OMNI measurements were made with the antenna on a fiberglass mast above the roof of the measurement vehicle at a height of about 12 feet. Some of the FOISD measurements were also made at this height, but others were made at various heights between 1 and 8 feet above ground.

RF power directly proportional to the electromagnetic wave power density was conveyed via coaxial cable from the OMNI to a Hewlett Packard 8566A spectrum analyzer and from there to a Hewlett Packard 9845B computer. The computer applies antenna factors, combines the three orthogonal spectra and stores the results on disk.

In contrast to the Watkins Johnson OMNI antenna, the NanoFast FOISD does not conduct RF power directly to the analyzer. The conventional RF coaxial cable would act as part of the antenna itself and decrease the accuracy of the information collected by the FOISD at lower frequencies - particularly in the AM radio band. To avoid this source of error the FOISD does not use electrically conductive coaxial cable but rather a fiber optic cable which conducts light instead of RF power. The voltage that the electric field induces across the two halves of the FOISD is used to amplitude modulate a light signal. This light is conducted to the inside of the measurement vehicle via a fiber optic cable. The light signal is demodulated back to an RF signal, and fed to the spectrum analyzer via coaxial cable. Then, as with the OMNI antenna, the analyzer delivers frequency specific information to the computer for processing and storage.

Two computer programs were used to process the information supplied by the spectrum analyzer. The first, DRIVER, has been used for several years by the Electromagnetics Branch for similar field studies. It is especially useful for measuring peak spectra like those associated with radar and paging systems. Those measurements that were processed with the DRIVER system are identified with file names beginning with "I". The second program, ZOOM, was developed recently to allow more rapid and accurate measurements at predetermined frequencies. The measurements made using ZOOM are identified in the report with file names beginning with "Z". ZOOM was tailored before the study began to look only at the eight FM and six TV frequencies that are broadcasting from antennas on Lookout Mountain. These frequencies are the main consideration in this study (see Procedures and Results). The data collected with ZOOM are listed in Appendix A by file name.

* Several different broadband instruments were brought for the Lookout Mountain study because this area presented a complex electromagnetic environment that could affect broadband instruments to extents that were not simple to predict. Bringing a variety of meters whose responses could be evaluated on Lookout Mountain would allow the study to be completed even if the limitations of some of the instruments made their use impractical for the Lookout Mountain measurements. Three Holaday Industries field strength meters with electric field probes, one Narda magnetic field probe/meter system, two Narda electric field probe/meter systems, and one Instruments for Industry (IFI) electric field meter were used. The Holaday and Narda probes are isotropic. The IFI unit detects only one polarization at a time and must be reoriented if three orthogonal measurements are necessary. These systems were calibrated at the Electromagnetics Branch laboratory during the summer of 1986. In addition, a Holaday Industries data logger was used to store and reduce large amounts of data for spatial averaging of RF levels. Appendix B contains more detailed information on the equipment and calibrations.

Although all the antennas used in the Denver study sense either electric or magnetic fields, the data presented here have been converted to conventional units of plane-wave equivalent power density.

PROCEDURE AND RESULTS

The Denver area measurements can be sorted into four categories: those conducted around the Cedar Lake Road circle near the Lookout Mountain towers, those near KYGO-FM, those at other nearby towers, and those near residences or public attractions. Each will be addressed in turn.

Cedar Lake Road

Spectrum Survey

The top of the access road leading from Cedar Lake Road to most of the Lookout Mountain towers is the highest point topographically in the area. Its elevation allows the best line of sight to the nearby antennas, and therefore measurements were made at this location in several frequency ranges in order to establish which bands were major contributors to power density on Lookout Mountain. These data are listed in Table 2. All these data were obtained with the antenna (FOISD or OMNI) mounted above the measurement vehicle. All values for broadcast frequencies represent average power densities. Values for land mobile, two-way radio, and radar frequencies are peak power densities. * The peak radar value should be multiplied by the duty cycle of the pulse (determined from repetition rate and width) and the rotational duty cycle to obtain true average values for comparison to RF exposure guidelines. Typically these duty cycles are 0.001 and 0.01 respectively so the peak value would be multiplied by 0.00001 to obtain a typical average power density for the radar beam. Once this factor is applied, the radar power density is among the lowest in Table 2. Similarly, the power densities for land mobile and two-way radio would be reduced if the duty cycles for signals in these bands were incorporated; however, because even the peak values in these bands were relatively low and because determining duty cycle would be very time consuming, these peak power densities were not adjusted to reflect the lower, average values.

The power densities in Table 2 confirmed expectations that broadcast band sources, particularly FM radio, dominate the RF environment on Lookout Mountain. FM radio accounts for over twice the power density caused by VHF and UHF TV on Lookout Mountain. This information justified deleting all bands but radio and TV from further detailed investigation.

The data in Table 2 also provide quality assurance checks between antennas and between data reduction programs. Four bands were evaluated using both the DRIVER and ZOOM programs. The difference between the reported power densities in each band using the different programs ranged from 1 to about 2.5 dB, a reasonably good comparison for programs developed for different purposes. The ZOOM program was developed recently to increase the speed and accuracy with which measurements could be made at a set of predetermined FM and TV frequencies. The primary reason for greater accuracy in the ZOOM program is its use of narrow frequency ranges and the more accurate 1 dB per division display mode on the spectrum analyzer, rather than wide frequency

ranges and the 10 dB per division display mode as used in DRIVER. ZOOM is designed to provide high accuracy in predetermined narrow frequency bands. DRIVER is better suited to studying unknown RF environments with widely disparate field intensities using the analyzer's wide dynamic range (10 dB/division) and its broad frequency range display. The ZOOM program was used for the remainder of the narrowband measurements in the Denver study.

A comparison between the data collected for UHF-TV Channel 31 using the DRIVER program shows a difference of less than 2 dB, between values obtained with the FOISD and OMNI antennas. This is probably due to the difference in the heights of the two antennas, causing them to intercept different electric field intensities along the short wavelength standing waves.

Cedar Lake Road Measurements

Narrowband measurements provide useful information concerning the particular frequencies that contribute to the power density at any location. However, narrowband antennas remain cumbersome to use, requiring a heavy base for support and three orientations for every measurement. They are not practical for investigating large areas to find locations of elevated power densities. The lightweight, isotropic, broadband instruments meet this need. Broadband instruments are not ideal, however, suffering from limitations that may be important in the presence of low frequency fields such as AM broadcasts, and multiple frequency, strong fields such as the FM and TV spectra on Lookout Mountain. Nevertheless, broadband equipment is used in order to help evaluate the RF environment in a timely manner. The question is how much faith, if any, should the investigator place in the data obtained with broadband equipment. To answer this question, six comparisons were made between the values obtained with the FOISD and the data collected with a few broadband survey instruments. The FOISD was considered the reference standard for these comparison measurements.

The comparison procedure consisted of the following steps. A Holaday was used to probe the area around a measurement site to locate the maximum electric field (E-field) value. The FOISD was then placed at the point of the highest E-field value to obtain the reference field value at that point. After measuring the field with the FOISD, the FOISD was removed from its supporting mast and the electric field probe of a broadband instrument was placed where the FOISD had been. These comparisons were made using the moveable FOISD base which allows measurements to be made close to the ground.

One of the survey instruments used in this comparison was a Narda magnetic field probe. The team did not have a magnetic field narrowband antenna system that could serve as a reference standard for this instrument as the FOISD had for the broadband electric field meters. Instead, the team used the FOISD as the reference as follows. Once the maximum electric field had been quantified and the FOISD had been removed, the area directly above and below the E-field maximum location was probed with the Narda 8616 meter and 8631 magnetic field (H-field) probe to find the H-field maximum associated with the standing wave. The E- and H-field maxima were then converted to units of plane wave equivalent power density for comparison.

Table 3 presents these comparison data for locations around Cedar Lake Road as well as for one additional location near the KYGO-FM tower, about one-third of a mile from Cedar Lake Road. The data collected near KYGO will be discussed later. The third column of Table 3 shows the power densities measured with the FOISD at six locations around Cedar Lake Road. None of the values approaches the 1000 $\mu\text{W}/\text{cm}^2$ American National Standards Institute Radiofrequency Radiation Protection Guide. This standard has been adopted by the Federal Communications Commission (FCC) for administrative use as a guide in the processing of license applications (2). However, near the KOSI tower, the power density exceeds the most stringent value (100 $\mu\text{W}/\text{cm}^2$) being considered by EPA (3) as it evaluates options for the protection of the general public from RF radiation exposure.

The data in Table 3 are listed in three categories defined by the frequency responses of the broadband instruments of interest. The first category includes all the frequencies used by broadcasters on Lookout Mountain (55 MHz to 578 MHz) including UHF Channel 31. Because broadcasters dominate the spectrum on Lookout Mountain, the FOISD values listed here are, for practical purposes, the total power density that one would find at these locations. The Holaday meters are designed to measure electric fields at all these FM and TV broadcast frequencies, so the Holaday data can be compared with the total power density FOISD values listed in the third column. With one exception, all the differences between the Holaday and FOISD values are less than 2 dB. The average deviation is less than 1 dB, showing good agreement for broadband meters in field measurements.

The second category, described on page 2 of Table 3, consists of data for frequencies below 200 MHz. This includes FM and VHF-TV. Two Narda probes and the IFI meter operate in this range. The FOISD value listed in this category includes the power density from all the Lookout Mountain broadcasters except Channel 31, which at 575 MHz is beyond the recommended range of these IFI and Narda broadband instruments. Comparisons between the FOISD values and the numbers reported by the Narda and IFI meters show good agreement in most cases. However the use of the Narda and IFI meters was limited by other considerations. When the IFI meter was used at Location B, it responded erratically, making an accurate reading impossible. The cause of this problem may have been a sensitivity to frequencies outside the design range for the meter such as the 575 MHz Channel 31 signal. Like the IFI, both Narda probes in category two responded accurately, but the Narda probes suffered from a zero-drift problem. This drift makes it difficult or impossible to obtain reliable data at relatively weak RF field levels. These problems led the team to abandon these instruments for routine measurements throughout the remainder of the study.

The third category in Table 3 includes data for frequencies only above 300 MHz. The only broadcast source on Lookout Mountain that operates above 300 MHz is KDVR-TV, Channel 31. The FOISD column in this category therefore lists only KDVR's power density. The only broadband instrument that the investigators had for which the operating range extends from 300 MHz upward, was the Narda 8621 E-field probe and meter. The sensitivity of the Narda 8621 is such that the relatively low power densities in the area could not be read reliably on the 8621 meter. Hence no Narda 8621 broadband meter data are included in Table 3.

The narrowband measurements made along Cedar Lake Road were useful for identifying the sources of the RF exposure and for evaluating the response of the broadband instruments. Based on this information, the team decided to use the Holaday meters to study typical exposure levels and to search for localized areas of elevated intensity.

The Holaday HI-3320 data logger was used with the Holaday HI-3001 meter (S/N 26046) to evaluate typical power densities along Cedar Lake Road. The data logger stores information from the meter at a rate of four values per second. At the conclusion of the sampling period, the logger reports the maximum, minimum, and average values that it recorded. For this part of the study, the Cedar Lake Road circle was divided into eleven segments of approximately 300 feet each. The endpoints of these segments are identified as locations A through K on Figure 1. The data were obtained as one of the investigators walked each of the segments, while continuously scanning with the Holaday probe from near ground level to a height of about eight feet. The data gathered in this way represent the spatially averaged power densities along Cedar Lake Road. Table 4 presents these data. None of the average values exceeds the FCC guideline or any standard that has been officially adopted or is being considered in the United States. Two of the maximum power densities exceed one of the proposed EPA guidance options ($100 \mu\text{W}/\text{cm}^2$), and one exceeds other standards ($200 \mu\text{W}/\text{cm}^2$) published by the National Council on Radiation Protection and Measurements (NCRP) (4) or the International Radiation Protection Association (IRPA) (5).

Measurements Near KOSI-FM

Both the narrowband measurement made near the base of the KOSI tower and the broadband spatially averaged survey of Cedar Lake Road indicated that the highest levels along the Cedar Lake Road loop were near the KOSI tower. Further measurements were made near the KOSI tower using the Holaday meter (S/N 26046). The highest value that could be found was about $580 \mu\text{W}/\text{cm}^2$ in a limited area about 3 to 5 feet in front of the KOSI gate. This value does not exceed the FCC guideline, but it does exceed the nonregulatory $200 \mu\text{W}/\text{cm}^2$ NCRP and IRPA standards. The investigators searched for the greatest distances from the KOSI tower at which $200 \mu\text{W}/\text{cm}^2$ power densities could be measured, and found that $200 \mu\text{W}/\text{cm}^2$ values were measurable out to a radius of about 27 feet centered on the KOSI gate. Since the surveyor searched for the greatest radius at which the $200 \mu\text{W}/\text{cm}^2$ value could be found, even in localized areas, it follows that the power densities inside this semicircle did not always exceed $200 \mu\text{W}/\text{cm}^2$. To estimate the typical values inside the $200 \mu\text{W}/\text{cm}^2$ contour line, the surveyor again used the Holaday meter connected to the Holaday data logger, and made several traverses until he was confident that the power densities within the $200 \mu\text{W}/\text{cm}^2$ contour had been thoroughly sampled. This process was repeated to evaluate its reproducibility. The average power densities for the trials were $215 \mu\text{W}/\text{cm}^2$ and $211 \mu\text{W}/\text{cm}^2$. The minimum values were $35 \mu\text{W}/\text{cm}^2$ and $24 \mu\text{W}/\text{cm}^2$. The maximum values were $494 \mu\text{W}/\text{cm}^2$ and $430 \mu\text{W}/\text{cm}^2$. These data indicate that the typical power density averaged over the entire area within the $200 \mu\text{W}/\text{cm}^2$ contour does exceed $200 \mu\text{W}/\text{cm}^2$ although the power density at any particular location could be much higher or much lower. The generality of this correlation between average value within the boundary of a contour line and the value of the contour line itself has not been established.

One additional measurement was made to evaluate KOSI. Since the KOSI antenna is mounted close to the ground on a mountain slope, structures further up the slope could be in the main beam of radiation. A cursory inspection suggested this could be the case at a house painted green along the access road to the transmitter buildings on Lookout Mountain. A survey of the deck of this house using the Holaday (S/N 26046) found power densities to be generally between 50 and 100 $\mu\text{W}/\text{cm}^2$. These levels are well below the FCC guidelines.

Measurements near KYGO-FM

* The KYGO-FM antenna is about one-third mile from the Lookout Mountain antenna farm. It differs from other antennas in the area because the KYGO antenna is mounted close to the ground with its bottom element at a height of about 30 to 35 feet. This prompted the investigators to survey the area in the immediate vicinity of KYGO. Near the fence at the base of the tower, the Holaday (S/N 26046 with 103GR probe) reported 10.35 mW/cm^2 (10,350 $\mu\text{W}/\text{cm}^2$) and the Narda magnetic field system read 9.5 mW/cm^2 (9,500 $\mu\text{W}/\text{cm}^2$). A typical value around the fence was 4.5 mW/cm^2 (4,500 $\mu\text{W}/\text{cm}^2$) based on the Holaday and 4.4 mW/cm^2 (4,400 $\mu\text{W}/\text{cm}^2$) as reported by the Narda. The electric and magnetic field data corroborated one another and confirmed that power densities ten times the FCC guideline could be found in publicly accessible areas near the KYGO tower. The lower typical value remained a factor of four over the FCC guideline.

These data led the investigators to map the distances and bearings from the tower to the 1000 $\mu\text{W}/\text{cm}^2$ and 200 $\mu\text{W}/\text{cm}^2$ contours. Table 5 presents these data. The locations of the 1000 $\mu\text{W}/\text{cm}^2$ power density were identified with the Holaday (S/N 26046) electric field meter. These locations were confirmed with magnetic field measurements using the Narda 8631 probe. The 1000 $\mu\text{W}/\text{cm}^2$ locations found with the Narda were within about five feet of the locations found with the Holaday. The 200 $\mu\text{W}/\text{cm}^2$ power densities were located using only the Holaday. The 1000 $\mu\text{W}/\text{cm}^2$ power densities extended to approximately 30 feet from the tower; 200 $\mu\text{W}/\text{cm}^2$ values were usually found at 50 to 70 feet from the tower. To be certain that KYGO was responsible for the elevated power densities, a FOISD narrowband measurement was made near the KYGO transmitter building. This measurement, saved as file ZOIXJN and summarized in Table 3, showed that KYGO was responsible for 99.7% of the FM and TV power density at the location of the measurement.

* The base of the KYGO tower is fenced, but most of the area within the 1000 $\mu\text{W}/\text{cm}^2$ contour is not. The KYGO tower is located in a complex of buildings where some people live throughout the year and where seasonal, residential workshops are held to teach square dancing. Many people could therefore visit areas where power densities exceed 1000 $\mu\text{W}/\text{cm}^2$. The main building of the compound is located within about 100 feet of the KYGO tower. The team found maximum power densities of 59 $\mu\text{W}/\text{cm}^2$ in the laundry room, approximately 100 $\mu\text{W}/\text{cm}^2$ in the commissary and outside the dining hall, and up to 300 $\mu\text{W}/\text{cm}^2$ on the patio/deck. Electric and magnetic field measurements made outside a dormitory (the "Tiltin' Hilton") near the tower found 40 to 50 $\mu\text{W}/\text{cm}^2$ power densities.

Finally it is interesting to note the effect of different elevations (in mountainous areas) on the power densities one records. Another narrowband FOISD measurement (file ZOIZIU) made on top of the vehicle in the parking lot at 756 Lookout Mountain Road, in the property on which the KYGO antenna is located, found a power density of $37.2 \mu\text{W}/\text{cm}^2$. This measurement location was perhaps 100 feet from the KYGO tower and below the center of radiation. The elevation increases as one moves across Lookout Mountain Road, approaching the apparent height of the center of radiation of the KYGO antenna. Another FOISD measurement (file ZOIZJD) was made at this higher, but more distant location (perhaps 200 to 300 feet from KYGO). Usually, tripling the distance from an antenna in this way would reduce the power density by a factor of 9. In this case however, the effect of greater distance was overcome by moving higher into the main beam of radiation. The power density rose to $85.8 \mu\text{W}/\text{cm}^2$ in the driveway of a home across Lookout Mountain Road from KYGO. Even at 1054 Colorow Road, approximately 800 feet from KYGO but still elevated with respect to the base of the KYGO tower, the power density remains greater than in the parking lot at 756 Lookout Mountain Road. The power density measured near 1054 Colorow Road was $55.8 \mu\text{W}/\text{cm}^2$ (file ZOIYQx). These data illustrate the need to consider the relative elevations of areas surrounding a station in the overall RF exposure evaluation.

Measurements Near Other Lookout Mountain Towers

Approximately three quarters of a mile from the Lookout Mountain antenna farm are two towers which support a variety of communications antennas, two FM antennas, and one VHF-TV antenna. KRMA-TV, KCFR-FM, and KUVO-FM are located at the Colorow Hill site. Electric field measurements were made at this site using two Holaday meters (S/N 26046, 26042). At the base of the broadcast tower the power densities ranged from 2 to $124 \mu\text{W}/\text{cm}^2$. Between the antennas and Colorow Road power densities of 350 to $425 \mu\text{W}/\text{cm}^2$ were found. Across the road values up to $200 \mu\text{W}/\text{cm}^2$ were found.

These data prompted the team to search for the $200 \mu\text{W}/\text{cm}^2$ contour along Colorow Road. Power densities up to $200 \mu\text{W}/\text{cm}^2$ were found along a 125 foot length of Colorow Road, centered approximately at the door to the transmitter building. The $200 \mu\text{W}/\text{cm}^2$ levels extended to about 12 feet beyond the far side of Colorow Road from the transmitter building. A FOISD narrowband measurement, made near the antennas reported a power density of $204 \mu\text{W}/\text{cm}^2$. This file, identified as ZOIZMF, found the major contributor to be KCFR-FM. KUVO-FM and KRMA-TV were the next strongest contributors but together provided only about half the power density of KCFR at that location.

At another location, one third of a mile north of the Lookout Mountain antenna farm, is a smaller group of towers supporting antennas for TV and FM stations. A survey near these towers using the Holaday (S/N 26042) found locations where the power densities reached $273 \mu\text{W}/\text{cm}^2$. However, power densities were usually below $200 \mu\text{W}/\text{cm}^2$, and over the entire area the levels were generally between 50 and $100 \mu\text{W}/\text{cm}^2$, well below the FCC guidelines.

Community Measurements

The purpose of studies like this one is to evaluate the extent of human exposure to RF radiation. This was a concern of many Lookout Mountain

residents who attended an informal gathering with the EPA and FCC investigators on the evening of September 24. At that meeting, EPA agreed to make limited measurements at several homes in the area. These measurements included collection of narrowband FOISD data at each location and broadband survey data at several homes. For these measurements the FOISD was positioned on top of the vehicle, and the vehicle moved to an arbitrary point along the road or in the driveway. Because these locations were arbitrarily chosen, the FOISD power densities probably are neither maxima nor minima, but are useful because they indicate the major source(s) of the RF radiation at each location. Another measurement a few feet away would probably find a different absolute power density. The broadband data were collected with two Holadays. Table 6 presents all these data.

None of the power densities in Table 6 exceeds the FCC guideline. With only two exceptions, none of the values exceeds even the most stringent RF radiation safety guideline being considered in the United States. The two exceptions, a $200 \mu\text{W}/\text{cm}^2$ power density near a trampoline spring and a $589 \mu\text{W}/\text{cm}^2$ power density near a piece of metal furniture, are more representative of the concentrating effect metal objects have on electric field lines than they are representative of typical power densities. Electric field intensity can be dramatically increased near conductive objects, particularly if those objects have sharp corners. This is why lightning preferentially strikes lightning rods. However, the presence of another conductive object, such as a human, can further alter the electric field, generally lowering the intensity near pointed conductive objects. Because of this, the importance of high measured electric field intensities near conductive objects is controversial. Traditional thinking on this subject is that relatively high, localized fields, near conductive objects where the surrounding field is substantially less, do not cause energy absorption rates in tissue that would normally be associated with whole-body exposures to fields of the same high values.

In order to place these values into perspective, two measurements were made in an area that is relatively distant from the Lookout Mountain antennas. At the end of the 700 block of Chimney Creek Road in the Genesee residential area, power densities from Lookout Mountain broadcasters and from Mount Morrison broadcasters (located near Genesee) were measured with the FOISD. At this location, the power density from Lookout Mountain broadcast sources was $0.2 \mu\text{W}/\text{cm}^2$ and that from the Mount Morrison FM broadcasters was $0.00015 \mu\text{W}/\text{cm}^2$. These values can be compared with the $0.005 \mu\text{W}/\text{cm}^2$ median level to which the populations of 15 major U.S. cities are exposed (6).

Holaday (S/N 26046) measurements were also made at the Buffalo Bill grave tourist attraction. At the overlook near the visitor center, the highest value found was about $2 \mu\text{W}/\text{cm}^2$. At the grave itself, power densities up to $8 \mu\text{W}/\text{cm}^2$ were measured. Typical values ranged from about 5 to $14 \mu\text{W}/\text{cm}^2$ at the overlook near the grave.

DISCUSSION

The height and topographic location of the KYGO antenna make it a convenient "field laboratory" to illustrate two characteristics of FM signals. The KYGO antenna is unusually low on its tower causing excessive

power densities directly below the elements. This is the "grating lobe" which points directly down to the ground and straight up into the air from the elements. Because the antenna is so low to the ground, moving a short distance away from the tower base places one at a large angle away from vertical with respect to the elements. The 10,000 $\mu\text{W}/\text{cm}^2$ value found at the base of the tower decreases rapidly as one moves away from the base of the tower and out of the grating lobe. The power density falls to 1000 $\mu\text{W}/\text{cm}^2$ at about 30 feet, and to 200 $\mu\text{W}/\text{cm}^2$ by 50 to 70 feet from the tower. The second point illustrated by KYGO is that in a mountainous area, one cannot rely on such a rapid reduction in power density with distance because the measurement locations may be moving up into the main-beam of radiation. Additional data collected near KYGO actually show an increasing power density with distance from the antenna as the measurement location moves closer to the main beam of radiation. RF hazard investigators should be aware of this property not only in mountainous terrain but also in urban environments where the main beam of radiation may be intercepted by nearby tall buildings.

A surprising finding in Table 3 is that the Holaday electric field meter reported values that were below the actual (FOISD) value. While the Holaday data in Table 3 are not far from the FOISD data, the Holaday values are almost always low. The authors' experience, however, is that diode detectors, such as the Holaday, tend to overrespond rather than underrespond in complex RF environments. Because of this, diode detectors have been considered conservative. However, the authors' judgement in this case is that the value reported by the FOISD represented the maximum field in an area with no nearby perturbations, while the Holaday values were collected in the presence of a 6 foot tall individual, the surveyor, within a few feet of the probe. It is likely that the presence of the person would lower the field at the probe, particularly when the probe is at the location of the maximum field value in the area, thereby causing the discrepancy. Additional comparison measurements in other complex environments will help resolve the issue. The IFI meter's erratic response at location B and the Narda system's zero drift problems further underscore the fact that no single meter is adequate for all monitoring situations.

It is worthy of note that the maximum value measured at the base of the KYGO tower compares closely with that predicted by an EPA program designed for this purpose. The program calculated a maximum power density of 9,620 $\mu\text{W}/\text{cm}^2$. The maximum values measured with electric and magnetic field meters were 10,350 $\mu\text{W}/\text{cm}^2$ and 9,500 $\mu\text{W}/\text{cm}^2$ respectively for a maximum difference between theory and data of about 0.3 dB. A similar comparison between predicted and measured values in an earlier study in Oregon, also found approximately 0.3 dB difference. This correspondence is encouraging because it helps EPA and FCC decide which antennas are likely to produce ground-level power densities that exceed the FCC guidelines. Output from this modeling technique could be used to identify areas of potentially high public exposures and to select additional areas for field study. The application of the model to other FM facilities has shown that power densities as great as that predicted at KYGO are unusual but not unique.

CONCLUSIONS

1. Near the base of the KYGO-FM tower power densities reach $10,000 \mu\text{W}/\text{cm}^2$ in a publicly accessible area. This far exceeds the FCC $1,000 \mu\text{W}/\text{cm}^2$ guideline (2) for FM frequencies. The KYGO tower is located in a complex of buildings where some people live throughout the year and where seasonal residential workshops are held to teach square dancing. EPA urges the FCC to order KYGO to correct these extreme values in publicly accessible areas as soon as possible. The few measurements made inside the main building of the compound found no power densities exceeding $100 \mu\text{W}/\text{cm}^2$.
2. The maximum power density near the KOSI-FM tower, $580 \mu\text{W}/\text{cm}^2$, is below the FCC guideline, however the spatially averaged power density within an area of about 1,000 square feet near the tower exceeds the $200 \mu\text{W}/\text{cm}^2$ NCRP (4) and IRPA (5) standards and two of the options that EPA (3) is considering for RF radiation protection guidance.
3. With the exception of the area near the base of the KOSI tower, none of the averaged power density data collected around the Cedar Lake Road circle exceeds any recommendation that has been adopted or is being considered by major organizations within the United States.
4. Typical power densities at several residences on Lookout Mountain did not exceed $100 \mu\text{W}/\text{cm}^2$, the most stringent value that exists (7) or is being considered in the United States although higher power densities of limited extent can be found, particularly near field-enhancing, metal objects. At a location more distant from the Lookout Mountain antennas, a power density of $0.2 \mu\text{W}/\text{cm}^2$ was measured in the Genesee residential area.
5. TV and FM antennas on Colorow Road produce power densities that exceed $200 \mu\text{W}/\text{cm}^2$ along a 125 foot length of Colorow Road. However, the maximum value found near the Colorow Hill antennas did not exceed the FCC guideline.
6. The maximum power density measured at the TV and FM towers along Lookout Mountain Road (one third mile north of the Cedar Lake Road area) was $273 \mu\text{W}/\text{cm}^2$. However, power densities were typically between $50 \mu\text{W}/\text{cm}^2$ and $100 \mu\text{W}/\text{cm}^2$ in this nonresidential area.