widely varying outcomes on legislative initiatives, zoning board decisions, and community planning board appeals, and creates "an unworkable checkerboard of RF standards."[61]

The magnitude of the problems faced by carriers is readily evident from the comments describing the treatment of RF exposure in non-federal jurisdictions. McCaw provided detailed information about its experiences in comments filed in this docket. Other commenters added additional examples, including:

- Sheldon Epstein discusses how the Village of Wilmette, Illinois, "adopted a requirement that power densities from cellular base stations be below 0.25 $\mu W/cm^2$ at ground levels 1,000 feet from the proposed site."[62] The Village itself states that it has based its policy of "prudent avoidance" "on the absence of clear evidence concerning the health effects of long term exposure to RF radiation," and therefore attempts to justify "seek[ing] to minimize public exposure to an uncertain health risk."[63]

- Hammett & Edison's comments discuss a statute adopted by Multnomah County, Oregon, that "requires [field] measurements in all cases, stipulates that these measurements must be done only by a registered professional engineer, and requires continuous measurements for a 168-hour (7-day) period if the measurements show a level greater than one-fifth of the 200 $\mu W/cm^2$ level (*i.e.*, 40 $\mu W/cm^2$) allowed at VHF frequencies allowed by the ordinance."[64] As stated by Hammett & Edison, "[t]he demand by local governments . . . for actual

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[61] CBS *et al.* at 46.

[62] CBS *et al.* at 44 (citing The Village of Wilmette Reply Memorandum, ET Docket No. 93-62 (filed Nov. 29, 1993)). Illustrating the irrationality of local decision making about communications facilities, the Village's rationale for the limits adopted is that *one* test site operated by Ameritech was able to provide functional communications within these parameters. This rationale, however, utterly ignores the fact that all cellular sites will have very different radiation characteristics due to the type of antenna, the number of channels, the surrounding terrain, the other cells in the network, and other technical factors.

[63] Comments of the Village of Wilmette ("Wilmette") at 2.

[64] H&E at 4 (citing Multnomah County, Oregon, Ordinance MCC.7035(F)(4)(b)(v), MCC.7035(F)(4)(b)(iii)).

measurements, even though conservative calculations predict maximum power densities two or more orders of magnitude below the ANSI limit for continuous exposures, places an unnecessary burden on cellular common carriers attempting to establish new service or to improve existing service."[65]

- PacTel relates how in a recent case in Rancho Palos Verdes, California, the local planning commission used RF exposure concerns to limit PacTel to 15 cellular transmitters at a site, "unlawfully interfering with established federal policy regarding safe power levels, as well as the proper and efficient technical operations of cellular radio facilities."[66]

- PacTel also discusses a situation that arose in West Hollywood, California, where the city council overturned two conditional use permits approved by the planning commission to *modify* existing facilities, "conclud[ing] that absent proof that cellular emissions were safe, it had a duty to protect the public from the risk of harm from new or modified cellular and microwave facilities."[67]

- Hammett & Edison provide documentation regarding "a potentially serious burden to broadcasters' ability to implement their Communications Act mandate to serve their communities . . . in New Jersey[, which] has just proposed to establish a mind-boggling bureaucracy to regulate RFR exposures." Hammett & Edison note that "[n]ot only do the proposed regulations demonstrate [New Jersey's] inability to apply correctly the units of measurement for RF energy ('[w]avelengths in the range of 300 Megahertz to 300 Gigahertz. . .'), by confusing wavelength and frequency, but they represent an unwarranted duplication of the RFR reviews already done by the Commission as part of its licensing process."[68]

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[65] H&E at 3-4.

[66] PacTel at 4, Attachment 1.

[67] PacTel at 5, Attachment 2.

[68] H&E at 6.

- CBS *et al.* note that "Massachusetts adopted regulations containing specific power density limits for non-ionizing RF radiation, including an 'occupational'/'public' dichotomy" and "intricate compliance procedures and notification requirements . . . none of which bear any relation to the ANSI/IEEE standard." As a result, "emissions from broadcast transmitters in that state largely have been classified as involving exposure of the public, necessitating compliance with emission limits vastly different from the new ANSI/IEEE standard."[69]

- CBS *et al.* also state that "Washington State, Seattle and King County nearly adopted rules that would have limited RF power densities . . . to 100 μW/cm^2, half that of the ANSI/IEEE standard."[70] This measure was apparently only narrowly defeated by "a concerted effort by broadcasters [that] persuaded the town and county to codify a 200 μW/cm^2 limit."[71]

- Both CBS *et al.* and Celpage relate how "[t]he Commonwealth of Puerto Rico adopted its own RF radiation rules . . . accompanied by a new bureaucracy, as well as substantial and burdensome regulatory requirements that could slow the growth of radio services in Puerto Rico."[72] The RF rules in Puerto Rico "require FCC licensees to perform extremely complicated, and unnecessary, engineering studies prior to using any new transmitter site, and whenever an additional transmitter is installed at an existing site."[73] Celpage further notes that "[i]f [Celpage's experience in Puerto Rico] is the indication of a trend, it is a most troubling trend for all FCC licensees."[74]

- Hammett & Edison also note that the Port Authority of New York and New Jersey, which regulates stations on the World Trade Center, "adopted a frequency-independent (*i.e.*, 'flat')

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[69] CBS *et al.* at 43 (citing Mass. Regs. Code tit. 150, § 122.015 (1986); Mass. Regs. Code tit. 453, § 5.07 (1986)).

[70] CBS *et al.* at 43 (citing Microwave News at 8-9 (Jan./Feb. 1992)).

[71] *Id.*

[72] CBS *et al.* at 43 (citing Celpage at 5).

[73] Celpage at 5.

[74] Celpage at 4.

100 μW/cm^2 exposure standard, 16 to 27 (12 to 14 dB) more restrictive than ANSI 1992."[75]

- Hammett & Edison indicate that for a proposed facility in Berkeley, California, a "major reason" why a new site was approved was because the antenna was modified to "reduce[] the predicted power densities at all publicly accessible areas to less than the then-existing Soviet RFR standard of 2.4 *micro*W/cm^2"[76]

Decisions and actions like these could seriously cripple the nation's communications infrastructure and should not be tolerated. As Hammett & Edison observe, "without federal pre-emption, . . . an ever-tightening spiral of more-stringent and unjustified local standards will inevitably arise."[77]

The record in this proceeding also demonstrates that the Commission has ample legal authority to preempt in this area. The record is replete with evidence this unnecessary local regulation has already strangled the extension, maintenance,[78] and improvement of the cellular network; imposed significant costs on customers of radio services; and, in cases, denied the availability of service altogether. As CBS *et al.* states, "[t]he Commission and the courts have on numerous occasions preempted state and local regulations in order to

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[75] H&E at 4.

[76] H&E at 5.

[77] H&E at 7.

[78] Indeed, state and local jurisdiction over RF exposure has even been exercised to require the removal of existing facilities. *See, e.g.*, "Satellite Disk is Removed at School," Los Angeles Times (Jan. 6, 1994); "Ojai Residents Fight Tower on 2 Fronts," Los Angeles Times (Jan. 6, 1994).

preserve the public's right to radio services provided under Commission authorization."[79] The Commission should not hesitate to do so again in this case.

Indeed, "[w]ith the conclusion of the instant proceeding, the FCC will have a record upon which to base explicitly federal determinations that compliance with the ANSI/IEEE criteria is sufficient to protect the public from any demonstrated risk of RF exposure."[80] Based upon the broad record consensus that the exposure levels in ANSI/IEEE C95.1-1992 are sufficient to protect the public and workers from exposure to cellular base station facilities, the FCC should further determine that, absent compelling scientific evidence to the contrary, state and local oversight of RF exposure does not offer increased protection and adversely affects the public interest in access to cellular radio services. In the absence of a lawful and effective policy of federal preemption, "the frustration now experienced by many existing communications companies will be eclipsed by the effects of nonfederal opposition to the introduction of new communications technologies such as [HDTV] and [PCS]."[81]

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[79] CBS *et al.* at 41 (citing Louisiana Pub. Serv. Comm'n v. FCC, 476 U.S. 355 (1986); Capital Cities Cable, Inc. v. Crisp, 467 U.S. 691 (1984); American Broadcasting Co. v. FCC, 191 F.2d 492 (D.C. Cir. 1951); Bodony v. Incorporated Village of Sands Point, 681 F. Supp. 1009 (E.D.N.Y. 1987); Van Meter v. Township of Maplewood, 696 F. Supp. 1024 (D.N.J. 1988); Satellite Earth Stations (Preemption), 59 Rad. Reg. 2d (P & F) 1073, 1085, *recon. denied*, 61 Rad. Reg. 2d (P & F) 608 (1986); Vertical Blanking Interval, 57 Rad. Reg. 2d (P & F) 832, 838, *recon. denied*, 58 Rad. Reg. 2d (P & F) 819 (1985); Hon. Harvey I. Sloane, 35 Rad. Reg. 2d (P & F) 845 (1975)); *See also* Mobilecomm of New York, Inc., 2 FCC Rcd 5519 (1987).

[80] CBS *et al.* at 46.

[81] NAB at ii.

IV. CONCLUSION

The record in this proceeding demonstrates that the Commission's obligations under NEPA will be best served by expeditiously revising its rules and policies to base its regulation of RF exposure on ANSI/IEEE C95.1-1992. The record also reflects substantial accord that, in so doing, the Commission should minimize regulatory burdens on radio licensees through adoption of policies that would avoid excessive and unnecessary paperwork and would continue to use categorical exclusions to exempt Part 21 and Part 22 facilities from routine environmental processing. Finally, the record provides compelling evidence that state and local oversight of RF exposure impedes licensees' ability to deploy authorized radio facilities to meet public demand for service, and that the Commission should promptly issue a further notice to limit state regulation of RF exposure.

Respectfully submitted,

McCAW CELLULAR COMMUNICATIONS, INC.

By: R. Michael Senkowski

R. Michael Senkowski
Eric W. DeSilva
WILEY, REIN & FIELDING
1776 K Street, N.W.
Washington, D.C. 20006
(202) 828-3182

Candy A. Castle, Manager
Corporate External Affairs
McCaw Cellular Communications, Inc.
5400 Carillon Point
Kirkland, Washington 98033
(206) 828-8407

April 25, 1994

ATTACHMENT A

HATFIELD & DAWSON
CONSULTING ELECTRICAL ENGINEERS
4226 SIXTH AVE. N.W.
SEATTLE, WASHINGTON 98107

JAMES B. HATFIELD, PE
BENJAMIN F. DAWSON III, PE
THOMAS M. ECKELS, PE

PAUL W. LEONARD, PE
L.S. CHRISTIANE ENSLOW
STEPHEN S. LOCKWOOD, EIT

TELEPHONE
(206) 783-9151
FACSIMILE
(206) 789-9834

MAURY L. HATFIELD, PE
CONSULTANT
BOX 1326
ALICE SPRINGS, NT 5950
AUSTRALIA

POWER DENSITY MEASUREMENTS

AT

THE PALISADES BUILDING

AND CONTINENTAL PLAZA

DALLAS / FORT WORTH, TEXAS

MOBILFONE SERVICE, INC.

2/94

INTRODUCTION

The engineering firm of Hatfield & Dawson Consulting Engineers Inc. was engaged to measure the Radio Frequency (RF) electromagnetic field human exposure from various antennas on the Palisades Building, outside Dallas, and on the Continental Plaza in Fort Worth, Texas. The measurements were made to determine compliance with the new RF human exposure standard ANSI/IEEE C95.1-1992.

SUMMARY

The spatially averaged power densities, as measured according to the IEEE/ANSI procedures, at distances greater than 20 centimeters from rooftop antennas at the Palisades building did not exceed the Maximum Permissible Exposures (MPE) specified in Table 2 of IEEE/ANSI C95.1-1992 for "Uncontrolled Environments". Localized peak measured fields did not exceed the allowed partial body exposures shown in Table 3 of that standard. Neither window washers nor RF workers are exposed to fields that exceed ANSI MPE's near the antennas on the roof of the Palisades Building. The highest spatially averaged measured field would be 20% of the "Uncontrolled Environment" MPE if the antenna operated continuously for 30 minutes.

The highest spatially averaged measured power density found at distances greater than 20 cm from any antenna on the roof of the Continental Plaza Building in Fort Worth was less than the ANSI/IEEE "Uncontrolled Environment" MPE and 19% of the "Controlled Environment" MPE with the transmitters in continuous operation. The maximum measured partial body exposure is 12.5% of Table 3 of the standard for continuous operation.

The MPE limits specified by C95.1-1992 are for exposures averaged over a 30 minute period for the "Uncontrolled Environment" and a 6 minute period for the "Controlled Environment". Cellular telephone antennas and paging antennas operate intermittently at various duty cycles and continuous operation represents the highest possible exposure.

TEST EQUIPMENT AND PROCEDURES

Power density measurements were made using a Holaday Industries Model HI-3004 Isotropic Broadband Field Strength Meter with an HSE electric field probe, sn 037 (0.5 MHz to 1.5 GHZ,

+/- 2 dB, and 0.1 to 30 Volts per meter), and an STE electric field probe, sn 604 HR (0.5 MHz to 6 GHz, +/- 2 dB, and 30 to 3000 V/m). The meter and probes were calibrated by the manufacturer January 31, 1994 (The calibration factor for the HSE probe was 1.0 at 915 MHz.). The readings were spatially averaged and recorded using a Holaday HI-3320 Data Logger, sn 001046. The tabulation of measured data shown in this report is the output of the data stored by the Datalogger.

The Recorder Output of the HI-3004 supplies a voltage proportional to the square of the electric field. The Data Logger converts the squared electric field readings to equivalent plane wave power density, in micro Watts per square centimeter ($\mu W/cm^2$)[1], by dividing the squared electric field by 3.77.

Spatially averaged measurements were made at 20 cm from antennas or other metallic objects as required by the terms of ***ANSI/IEEE C95.1-1992, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*** (Pages 13,15 & 18). The measurement procedure followed the recommendations of ***ANSI/IEEE Std C95.3-1991, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields–RF and Microwave***. The measured fields were spatially averaged over an area equivalent to the vertical cross-section of the human body (projected area) while the antennas were transmitting. The average field during the measurement process was computed by the Datalogger. The Datalogger also recorded the maximum field measured during the spatially averaging measurement process. The maximum field represents the highest partial body exposure.

There was an ice storm when the measurements were made and the duty cycle of the paging and cellular antennas was very high. The antennas transmitted long enough for accurate spatial averaging to be performed.

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[1] NOTE: The ANSI MPE value is expressed in mW/cm^2. Because of the low values of measured power density, the equipment used for measurement reads $\mu W/cm^2$. The conversion is: 1 $\mu W/cm^2$ = 0.001 mW/cm^2.

PALISADES BUILDING MEASUREMENTS

The drawing depicts the roof area of the Palisades building where the antennas of various communications companies, including Mobilfone Service, Skytell, and Comnet are located. The antennas are mounted on a parapet around the outer wall of the building. This parapet is reached by climbing two iron rung ladders. The first ladder leads to an open area below the parapet which would be classified by the ANSI/IEEE C95.1-1992 standard as an "Uncontrolled Environment" because access is not restricted to RF technicians. The upper ladder leads from the lower area to the parapet where window washers attach their support cable to a series of metal anchor posts in the vicinity of the transmitting antennas. Measurements were made at each metal anchor post and at all nearby antennas. The greatest RF exposure to the window washers occurs as they pass the antennas on their way to the metal anchor posts. This exposure will normally be a fraction of a minute. Those who attach the window washing cables to the anchor posts would spend most of their time at the posts when they are on the parapet.

The highest spatially averaged field was 20 cm from the Mobilfone Service antenna where the measured power density was 100 $\mu W/cm^2$. The highest measured partial body exposure was 253 $\mu W/cm^2$ at the anchor post nearest the Mobilfone Service antenna. Table 3 of C95.1-1992 shows that the Maximum Permissible Exposure (MPE) for Uncontrolled Environments is 0.533 milli Watts per centimeter squared (mW/cm^2), which is 533 $\mu W/cm^2$, at 800 MHz for 30 minutes. Table 3 of the standard show the partial body MPE as 4 mW/cm^2, which is 4000 $\mu W/cm^2$, for 30 minutes. These measurements demonstrate that a worker subject to the Uncontrolled Environment limitations could remain for 30 minutes on the parapet within 20 cm of an antenna or anchor post and be exposed to 19% of the whole body spatially averaged ambient power density MPE and receive a maximum partial body exposure that was 6% of Uncontrolled Environment MPE. These are "Worst Case" exposures computed under the assumption that the antennas transmit continuously. Actual exposures would be lower because they are proportional to the amount of time the transmitters are on (duty cycle).

RF exposures at other locations on the roof are a small fraction of those discussed in the preceding paragraph (See roof plan sketch and table of data).

CONTINENTAL PLAZA MEASUREMENTS

The paging, two way and cellular antennas are mounted on a metal grid structure on an isolated portion of the roof accessible by metal rung ladder. The area where the antenna grid is located is a Controlled Environment since the only reason to be on this portion of the roof would be to work on the antennas or associated cables. The area immediately below the antennas is occupied by the elevator equipment room. Spot measurements were made at each of the antennas while they were transmitting. More detailed measurements were performed at the two antennas where the highest fields were found (See roof plan sketch).

The highest field was at the antenna lowest to the metal grid that exposed the greatest portion of the body. The spatially averaged field 20 cm. from this antenna (measurement point #15) was 504 $\mu W/cm^2$ and the highest partial body exposure was 1096 $\mu W/cm^2$. The spatially averaged power density at the other antenna (measurement point #14) was 160 $\mu W/cm^2$ with a maximum partial body exposure of 790 $\mu W/cm^2$.

The Controlled Environment MPE listed in Table 1 for 800 MHz is 2.667 mW/cm^2, or 2667 $\mu W/cm^2$, for 6 minutes while the Controlled environment partial body MPE is 20 mW/cm^2, or 20,000 $\mu W/cm^2$, for 6 minutes. These measurements demonstrate that a worker could remain 20 cm away from an antenna for 6 minutes and receive 19% of the C95.1-1992 whole body exposure MPE and 5.5% of the partial body exposure MPE with the antennas transmitting continuously.

Measurements made on the platform at the top of the stairway leading to the elevator room showed a spatially average field of 68 $\mu W/cm^2$ and a partial body exposure of 245 $\mu W/cm^2$. These fields are 13% and 6% of the C95.1-1992 Uncontrolled Environment whole body and partial body MPEs, respectively.

CONCLUSION

The measured power densities near the antennas at the Palisades and Continental Plaza Buildings do not exceed the 6 minute or 30 minute continuous Maximum Permitted Exposures for either uncontrolled or controlled environments allowed by the ANSI/IEEE C95.1-1992 standard

for whole or partial body exposures at any frequency. The actual exposures to persons near the antennas on these building would, in all probability, be even less than the levels shown in this report due to the fact that the antennas do not normally transmit for 6 minutes or 30 minutes continuously.

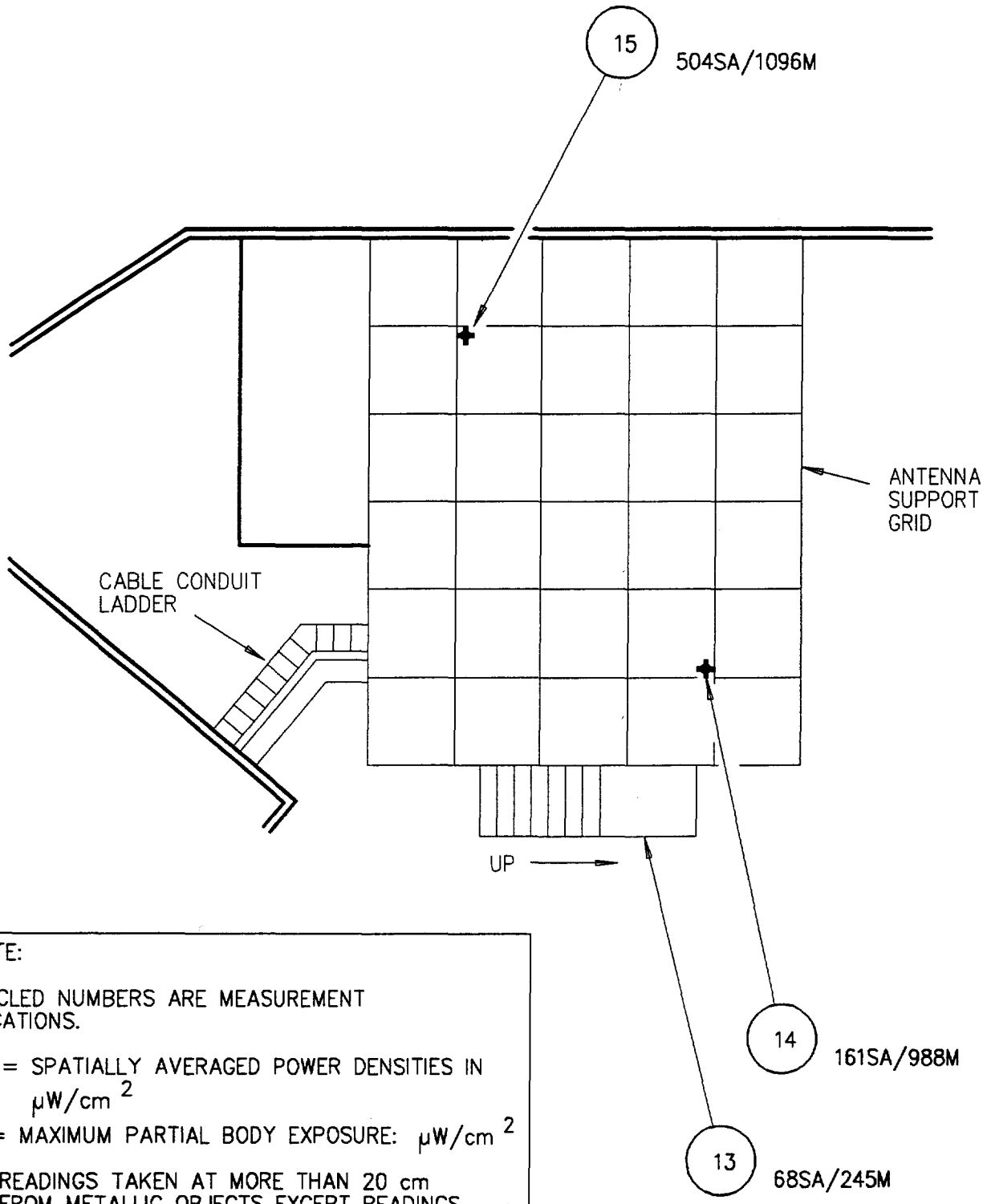
STATEMENT OF ENGINEER

This Engineering Report regarding the measurements of Power Density at the Palisades Building and Continental Plaza has been performed by myself or under my supervision and all representations herein are true to the best of my knowledge.

19 February 1994

James B. Hatfield, P.E.

JAMES B. HATFIELD
STATE OF WASHINGTON
14851
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 12/19/ 95



NOTE:

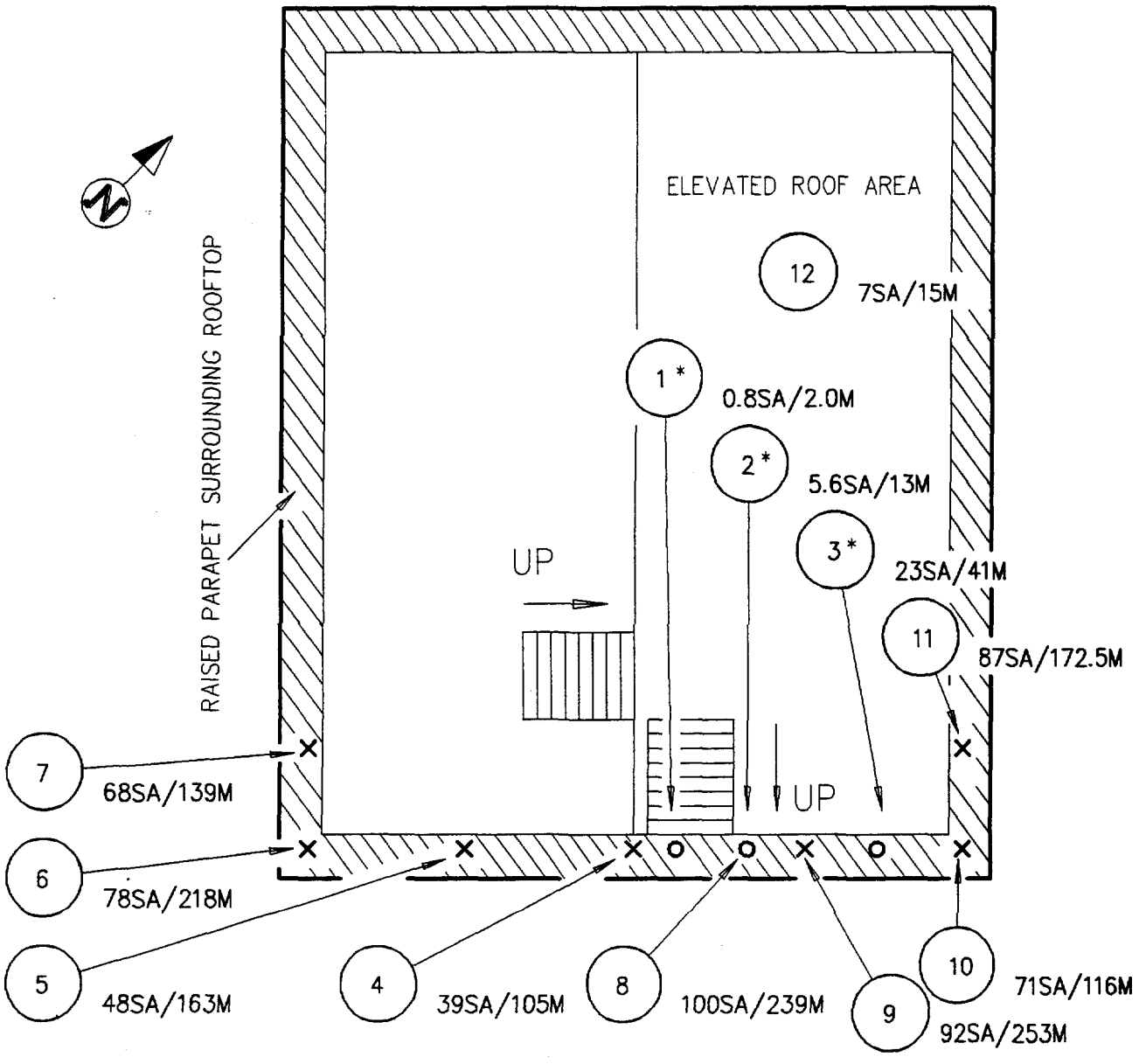
CIRCLED NUMBERS ARE MEASUREMENT LOCATIONS.

SA = SPATIALLY AVERAGED POWER DENSITIES IN $\mu W/cm^2$

M = MAXIMUM PARTIAL BODY EXPOSURE: $\mu W/cm^2$

READINGS TAKEN AT MORE THAN 20 cm FROM METALLIC OBJECTS EXCEPT READINGS AT ANTENNAS WHICH WERE TAKEN AT 20cm FROM THE ANTENNA BEING MEASURED.

HATFIELD & DAWSON CONSULTING ENGINEERS	CONTINENTAL PLAZA ROOF MAP FORT WORTH, TEXAS 2/94



NOTE:

CIRCLED NUMBERS ARE MEASUREMENT LOCATIONS.

SA = SPATIALLY AVERAGED POWER DENSITIES IN $\mu W/cm^2$

M = MAXIMUM PARTIAL BODY EXPOSURE: $\mu W/cm^2$

READINGS TAKEN AT MORE THAN 20 cm FROM METALLIC OBJECTS EXCEPT READINGS AT ANTENNAS WHICH WERE TAKEN AT 20cm FROM THE ANTENNA BEING MEASURED.

* MEASUREMENT POINTS ON ELEVATED ROOF AREA BELOW PARAPET:
#1 BELOW COMNET ANTENNA
#2 BELOW MOBILFONE SERVICE ANTENNA
#3 BELOW SKYTELL ANTENNA

LEGEND:

X = WINDOW WASHER ANCHOR POSTS

O = ANTENNAS WHERE MEASUREMENTS WERE MADE

HATFIELD & DAWSON

CONSULTING ENGINEERS

PALISADES BUILDING ROOF MAP

DALLAS, TEXAS 2/94

HOLADAY HI-3320 SN 1046 V2.3 3/86

CURRENT DATE: 2/17/94
CURRENT TIME: 17:46:12

CALIBRATION
0.0000 V = 0.000 uwc2
1.0000 V = 26.525 uwc2

UNITS: uwc2

	MIN	AVG	MAX	
DATE: 2/10/94 TIME: 10:40:34				1*
@	0.366	0.822	1.904	
DATE: 2/10/94 TIME: 10:49:01				2#
@	1.300	5.589	12.992	

* MEASUREMENT POINT #1 ON ELEVATED ROOF AREA BELOW COMNET ANTENNA

\# MEASUREMENT POINT #2 ON ELEVATED ROOF AREA BELOW BELOW MOBILFONE SERVICE ANTENNA

HATFIELD & DAWSON CONSULTING ENGINEERS	MEASUREMENT DATA SHEET PALISADES BUILDING ROOF TOP SHEET 1 OF 3 DALLAS, TEXAS 2/94

HOLADAY HI-3320 SN 1046 V2.3 3/86

CURRENT DATE: 2/17/94
CURRENT TIME: 17:18:26

CALIBRATION
0.0000 V = 0.00 uwc2
1.0000 V = 238.72 uwc2
UNITS: uwc2

	MIN	AVG	MAX	
DATE: 2/10/94 TIME: 10:57:56				3*
@	7.49	22.89	41.32	
DATE: 2/10/94 TIME: 11:37:52				4
@-	0.01	38.95	105.10	
DATE: 2/10/94 TIME: 11:41:06				5
@-	0.01	47.76	162.70	
DATE: 2/10/94 TIME: 11:44:08				6
@	11.05	78.05	218.09	
DATE: 2/10/94 TIME: 11:46:47				7
@	22.41	67.46	139.10	
DATE: 2/10/94 TIME: 11:51:50				8
@	38.33	99.64	238.76	
DATE: 2/10/94 TIME: 11:55:02				9
@	7.04	91.81	253.01	
DATE: 2/10/94 TIME: 11:55:35				10
@	31.12	70.85	116.01	
DATE: 2/10/94 TIME: 11:55:57				11
@	38.67	87.17	172.47	
DATE: 2/10/94 TIME: 11:58:53				12
@	1.69	6.87	14.94	

* MEASUREMENT POINT #3 ON ELEVATED ROOF AREA BELOW SKYTELL ANTENNA

HATFIELD & DAWSON CONSULTING ENGINEERS	MEASUREMENT DATA SHEET PALISADES BUILDING ROOF TOP SHEET 2 OF 3 FORT WORTH, TEXAS 2/94

HOLADAY HI-3320 SN 1046 V2.3 3/86

CURRENT DATE: 2/17/94
CURRENT TIME: 17:18:26

CALIBRATION
0.0000 V = 0.00 uwc2
1.0000 V = 238.72 uwc2
UNITS: uwc2

MIN	AVG	MAX
DATE: 2/10/94 TIME: 14:55:31		
@ 3.65	68.36	244.97

13

HOLADAY HI-3320 SN 1046 V2.3 3/86

CURRENT DATE: 2/17/94
CURRENT TIME: 16:59:53

CALIBRATION
0.0000 V = 0.0000 mwc2
1.0000 V = 2.6256 mwc2

UNITS: mwc2

DATE: 2/10/94 TIME: 15:17:41		
@-0.0011	0.1607	0.7877

14

DATE: 2/10/94 TIME: 15:21:30		
@-0.0040	0.5038	1.0967

15

HATFIELD & DAWSON CONSULTING ENGINEERS	MEASUREMENT DATA SHEET CONTINENTAL PLAZA SHEET 3 OF 3 FORT WORTH, TEXAS 2/94

RELEVANT EXCERPTS FROM

ANSI/IEEE C95.1-1992

Hatfield & Dawson Consulting Engineers

yspace power densities (S) and the induced currents (I) in the body that can be associated with exposure to such fields or contact with objects exposed to such fields, is given in Table 1 as a function of frequency. Exposure associated with a controlled environment includes: exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, exposure of other cognizant individuals, or exposure that is the incidental result of passage through areas where analysis shows the exposure levels may be above those shown in Table 2, but do not exceed those in Table 1, and where the induced currents may exceed the values in Table 2, Part B, but do not exceed the values in Table 1, Part B.[3]

Table 1
Maximum Permissible Exposure for Controlled Environments

Part A
Electromagnetic Fields*

1 Frequency Range (MHz)	2 Electric Field Strength (E) (V/m)	3 Magnetic Field Strength (H) (A/m)	4 Power Density (S) E-Field, H-Field (mW/cm^2)	5 Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.003 - 0.1	614	163	(100, 1 000 000)†	6
0.1 - 3.0	614	16.3/*f*	(100, 10 000/f^2)†	6
3 - 30	1842/*f*	16.3/*f*	(900/f^2, 10 000/f^2)†	6
30 - 100	61.4	16.3/*f*	(1.0, 10 000/f^2)†	6
100 - 300	61.4	0.163	1.0	6
300 - 3 000			*f*/300	6
3 000 - 15 000			10	6
15 000 - 300 000			10	616 000/$f^{1.2}$

Part B
Induced and Contact Radiofrequency Currents‡

Frequency Range	Maximum Current (mA) Through both feet	Maximum Current (mA) Through each foot	Contact
0.003 - 0.1 MHz	2 000*f*	1 000*f*	1 000*f*
0.1 - 100 MHz	200	100	100

f=frequency in MHz

*The exposure values in terms of electric and magnetic field strengths are the values obtained by spatially averaging values over an area equivalent to the vertical cross-section of the human body (projected area).

†These plane-wave equivalent power density values, although not appropriate for near-field conditions, are commonly used as a convenient comparison with MPEs at higher frequencies and are displayed on some instruments in use.

‡It should be noted that the current limits given above may not adequately protect against startle reactions and burns caused by transient discharges when contacting an energized object. See text for additional comment.

(a) In a controlled environment, access should be restricted to limit the rms RF body current (averaged over any 1 second) and potential for RF shock or burn as follows:
   (i) For freestanding individuals (no contact with metallic objects), RF current induced in the human body, as measured through each foot, should not exceed the following values:

[3] The means for the identification of these areas is at the discretion of the operator of a source.

$$\sum \textit{Peak MPE} \times \textit{Pulsewidth (seconds)} = \frac{\textit{MPE} \times \textit{Avg. Time (seconds)}}{5}$$

4.1.2 MPE in Uncontrolled Environment. For human exposure in uncontrolled environments to electromagnetic energy at radio frequencies from 3 kHz to 300 GHz, the MPE, in terms of rms electric (E) and magnetic (H) field strengths, the equivalent plane-wave free-space power densities (S) and the induced currents (I) in the body that can be associated with exposure to such fields or contact with objects exposed to such fields are given in Table 2 as a function of frequency.

Exposure associated with an uncontrolled environment is the exposure of individuals who have no knowledge or control of their exposure. The exposures may occur in living quarters or workplaces where there are no expectations that the exposure levels may exceed those shown in Table 2, and where the induced currents do not exceed those in Table 2, Part B. Transitory exposures are treated in 4.1.1.

Table 2
Maximum Permissible Exposure for Uncontrolled Environments

Part A
Electromagnetic Fields*

1 Frequency Range (MHz)	2 Electric field Strength (E) (V/m)	3 Magnetic Field Strength (H) (A/m)	4 Power Density (S) E-Field, H-Field (mW/cm^2)	5 Averaging Time $\lvert E\rvert^2$, S (minutes)	or $\lvert H\rvert^2$ (minutes)
0.003 - 0.1	614	163	(100, 1 000 000)†	6	6
0.1 - 1.34	614	16.3/f	(100, 10 000/f^2)†	6	6
1.34 - 3.0	823.8/f	16.3/f	(180/f^2, 10 000/f^2)†	f^2/0.3	6
3.0 - 30	823.8/f	16.3/f	(180/f^2, 10 000/f^2)†	30	6
30 - 100	27.5	158.3/$f^{1.668}$	(0.2, 940 000/$f^{3.336}$)†	30	0.0636 $f^{1.337}$
100 - 300	27.5	0.0729	0.2	30	30
300 - 3 000			f/1 500	30	
3 000 - 15 000			f/1 500	90 000/f	
15 000 - 300 000			10	616 000/$f^{1.2}$	

Part B
Induced and Contact Radiofrequency Currents‡

Frequency Range	Maximum Current (mA) Through both feet	Through each Foot	Contact
0.003 - 0.1 MHz	900f	450f	450f
0.1 - 100 MHz	90	45	45

f=frequency in MHz

*The exposure values in terms of electric and magnetic field strengths are the values obtained by spatially averaging values over an area equivalent to the vertical cross-section of the human body (projected area).

†These plane-wave equivalent power density values, although not appropriate for near-field conditions, are commonly used as a convenient comparison with MPEs at higher frequency and are displayed on some instruments in use.

‡It should be noted that the current limits given above may not adequately protect against startle reactions caused by transient discharges when contacting an energized object. See text for additional comment.

(a) In uncontrolled environments, where individuals unfamiliar with the phenomenon of induced RF currents may have access, it is recommended that precautions be taken to limit induced currents to values not normally perceptible to individuals, as well as prevent the possibility of RF burns.

4.4 Relaxation of Power Density Limits for Partial Body Exposures. The following relaxation of power density limits is allowed for exposure of all parts of the body *except* the eyes and the testes.

Compliance with the MPE of Tables 1 and 2 is determined from spatial averages of power density or the mean squared electric and magnetic field strengths over an area equivalent to the vertical cross-section of the human body (projected area) at a distance no closer than 20 cm from any object. For exposures in controlled environments, the peak value of the mean squared field strength should not exceed 20 times the square of the allowed spatially averaged values (Table 1) at frequencies below 300 MHz, and should not exceed the equivalent power density of 20 mW/cm^2 at frequencies between 300 MHz and 6 GHz, 20 $(f/6)^{1/4}$ mW/cm^2 at frequencies between 6 and 96 GHz (f is in GHz), and 40 mW/cm^2 at frequencies above 96 GHz. Similarly, for exposures in uncontrolled environments, the peak value of the mean squared field strengths should not exceed 20 times the square of the allowed spatially averaged values (Table 2) at frequencies below 300 MHz, or the equivalent power density of 4 mW/cm^2 for f between 300 MHz and 6 GHz, $(f/1.5)$ mW/cm^2 for frequencies between 6 GHz and 30 GHz (f is in GHz), and 20 mW/cm^2 at frequencies above 30 GHz. At frequencies below 300 MHz, the equivalent maximum rms field strengths should not exceed 4.47[4] times the maximum allowed spatially averaged values of E and H shown in Tables 1 and 2 (see 6.10). The relaxation for partial-body exposure is summarized in Table 3.

Table 3
Relaxations for Partial Body Exposures

	Frequency in GHz	Peak Value of Mean Squared Field	Equivalent Power Density in mW/cm^2
Controlled Environment	$0.0001 \le f < 0.3$	$< 20\overline{E}^2$ or $20\overline{H}^{2*}$	
	$0.3 < f \le 6$		< 20
	$6 < f \le 96$		$< 20\,(f/6)^{1/4}$ ‡
	$96 < f \le 300$		40
Uncontrolled Environment	$0.0001 \le f < 0.3$	$< 20\overline{E}^2$ or $20\overline{H}^{2\dagger}$	
	$0.3 < f \le 6$		4
	$6 < f \le 30$		$f/1.5$ ‡
	$30 < f \le 300$		20

* $\overline{E}$ and $\overline{H}$ are the spatially averaged values from Table 1.
† $\overline{E}$ and $\overline{H}$ are the spatially averaged values from Table 2.
‡ f in GHz

5. Explanation

Exposure to electromagnetic fields in the resonance frequency range under consideration is but one of several sources of energy input to the human body. The MPE in a controlled environment results in energy deposition, averaged over the entire body mass for

[4] $(\sqrt{20})$