JERROLD T. BUSHBERG Ph.D., DABMP, DABSNM, FAAPM
♦HEALTH AND MEDICAL PHYSICS CONSULTING♦

7784 Oak Bay Circle Sacramento, CA 95831
(800) 760-8414–jbushberg@hampc.com

David Yarlagada
Crown Castle
890 Tasman Drive
Milpitas, CA 95035

January 28, 2013

Introduction

At your request, I have reviewed the technical specifications and calculated the maximum potential radiofrequency, (RF), power density from the proposed Crown Castle (CC) Dual Panel Distributed Antenna System (DAS) sites proposed for the Sunset and Richmond districts in San Francisco, CA. A DAS is a network of spatially separated antenna sites called "nodes" connected to a common source that provides wireless service within a geographic area. DAS antennae are typically installed near the top of light standards or on utility poles. The idea is to split the transmitted signal among several antenna sites, separated in space so as to provide coverage over the same area as a single antenna but with reduced total power and improved reliability. Thus a single antenna radiating at high power is replaced by a group (i.e., network) of low-power antennas to cover the same area. Some of the other advantages of DAS include the ability to provide service for multiple wireless carriers without the need to have separate antenna sites for each carrier at each location and the ability to place the antennae on existing vertical structures such as light or utility poles.

These proposed DAS nodes will utilize two panel antennae mounted on the cross arm of utility poles. The antenna specified is Kathrien model 840-10525 with a minimum azimuthal separation of 55 degrees. The maximum effective radiated power (EDP) for each antenna will be up to 160.4 watts at approximately 700 MHz; 30.8 watts at approximately 850 MHz and 52.0 watts at approximately 1,900 MHz. The distance from the antenna center to the ground will be at least 19 feet. A list of the proposed DAS node locations and an example of the site configuration are shown in attachment one. The antenna specification details are depicted in attachment two. This analysis represents the worst case RF exposure of any of the proposed utility pole mounted DAS node locations.

Calculation Methodology

Calculations at the level of the antenna were made in accordance with the cylindrical model recommendations for near-field analysis contained in the Federal Communications Commission, Office of Engineering and Technology Bulletin 65 (OET 65) entitled "Evaluating Compliance with FCC-Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields." RF exposure calculations at ground level were made using equation 10 from the same OET document. Several assumptions were made in order to provide the most conservative or "worst case" projections of power densities. Calculations were made assuming a minimum sector separation of 55 degrees and all channels were operating simultaneously at their maximum design effective radiated power. Attenuation (weakening) of the signal that would result from surrounding foliage or buildings was ignored. Buildings or other structures can reduce the signal strength by a factor of 10 (i.e., 10 dB) or more depending upon the construction material. In addition, for ground level calculations, the ground or other surfaces were considered to be perfect reflectors (which they are not) and the RF energy was assumed to overlap and interact constructively at all locations (which they would not) thereby resulting in the calculation of the maximum potential exposure. In fact, the accumulations of all these very conservative assumptions, will significantly overestimate the actual exposures that would typically be expected from such a facility. However, this method is a prudent approach that errs on the side of safety.

RF Safety Standards

The two most widely recognized standards for protection against RF field exposure are those published by the American National Standards Institute (ANSI) C95.1 and the National Council on Radiation Protection and measurement (NCRP) report #86. The NCRP is a private, congressionally chartered institution with the charge to provide expert analysis of a variety of issues (especially health and safety recommendations) on radiations of all forms. The scientific analyses of the NCRP are held in high esteem in the scientific and regulatory community both nationally and internationally. In fact, the vast majority of the radiological health regulations currently in existence can trace their origin, in some way, to the recommendations of the NCRP.

All RF exposure standards are frequency-specific, in recognition of the differential absorption of RF energy as a function of frequency. The most restrictive exposure levels in the standards are associated with those frequencies that are most readily absorbed in humans. Maximum absorption occurs at approximately 80 MHz in adults. The NCRP maximum allowable continuous occupational exposure at this frequency is 1,000 $\mu W/cm^2$. This compares to 2,933 $\mu W/cm^2$ at cellular frequencies and 5,000 $\mu W/cm^2$ at PCS frequencies that are absorbed much less efficiently than exposures in the VHF TV band.

The traditional NCRP philosophy of providing a higher standard of protection for members of the general population compared to occupationally exposed individuals, prompted a two-tiered safety standard by which levels of allowable exposure were substantially reduced for "uncontrolled " (e.g., public) and continuous exposures. This measure was taken to account for the fact that workers in an industrial environment are typically exposed no more than eight hours a day while members of the general population in proximity to a source of RF radiation may be exposed continuously. This additional protection factor also provides a greater margin of safety for children, the infirmed, aged, or others who might be more sensitive to RF exposure. After several years of evaluating the national and international scientific and biomedical literature, the members of the NCRP scientific committee selected 931 publications in the peer-reviewed scientific literature on which to base their recommendations. The current NCRP recommendations limit continuous public exposure at cellular frequencies (e.g., ~820MHz) to 550 $\mu W/cm^2$ and to 1,000 $\mu W/cm^2$ at PCS frequencies (~1,900 MHz).

The 1992 ANSI standard was developed by Scientific Coordinating Committee 28 (SCC 28) under the auspices of the Institute of Electrical and Electronic Engineers (IEEE). This standard, entitled "IEEE Standards for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz" (IEEE C95.1-1991), was issued in April 1992 and subsequently adopted by ANSI. A revision of this standard (C95.1-2005) was completed in October 2005 by SCC 39 the IEEE International Committee on Electromagnetic Safety. Their recommendations are similar to the NCRP recommendations for the maximum permissible exposure (MPE) to the public at PCS frequencies (950 $\mu W/cm^2$ for continuous exposure at 1,900 MHz) and incorporate the convention of providing for a greater margin of safety for public as compared with occupational exposure. Higher whole body exposures are allowed for brief periods provided that no 30 minute time-weighted average exposure exceeds these aforementioned limits.

On August 9, 1996, the Federal Communications Commission (FCC) established a RF exposure standard that is a hybrid of the current ANSI and NCRP standards. The maximum permissible exposure values used to assess environmental exposures are those of the NCRP (i.e., maximum public continuous exposure at cellular and PCS frequencies of 550 $\mu W/cm^2$ and 1,000 $\mu W/cm^2$ respectively). The FCC issued these standards in order to address its responsibilities under the National Environmental Policy Act (NEPA) to consider whether its actions will "significantly affect the quality of the human environment." In as far as there was no other standard issued by a federal agency such as the Environmental Protection Agency (EPA), the FCC utilized their rulemaking procedure to consider which standards should be adopted. The FCC received thousands of pages of comments over a three-year review period from a variety of sources including the public, academia, federal health and safety agencies (e.g., EPA & FDA) and the telecommunications industry. The FCC gave special consideration to the recommendations by the federal health agencies because of their special responsibility for protecting the public health and safety. In fact, the MPE values in the FCC standard are those recommended by EPA and FDA. The FCC standard incorporates various elements of the 1992 ANSI and NCRP standards which were chosen because they are widely accepted and technically supportable. There are a variety of other exposure guidelines and standards set by other national and international organizations and governments, most of which are similar to the current ANSI/IEEE or NCRP standard, figure one.

The FCC standards "Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation" (Report and Order FCC 96-326) adopted the ANSI/IEEE definitions for controlled and uncontrolled environments. In order to use the higher exposure levels associated with a controlled environment, RF exposures must be occupationally related (e.g., wireless company RF technicians) and they must be aware of and have sufficient knowledge to control their exposure. All other environmental areas are considered uncontrolled (e.g., public) for which the stricter (i.e., lower) environmental exposure limits apply. All carriers were required to be in compliance with the new FCC RF exposure standards for new telecommunications facilities by October 15, 1997. These standards applied retroactively for existing telecommunications facilities on September 1, 2000.

The task for the physical, biological, and medical scientists that evaluate health implications of the RF data base has been to identify those RF field conditions that can produce harmful biological effects. No panel of experts can guarantee safe levels of exposure because safety is a null concept, and negatives are not susceptible to proof. What a dispassionate scientific assessment can offer is the presumption of safety when RF-field conditions do not give rise to a demonstrable harmful effect.

Summary & Conclusions

All CC utility pole DAS nodes listed in attachment one, operating with the characteristics as specified above and observing an eight foot (public) and four foot (occupational) exclusion zone directly in front of and at the same elevation as the antenna, will be in full compliance with FCC RF public and occupational safety exposure standards. These transmitters, by design and operation, are low-power devices. Even under maximal exposure conditions in which both the antennae are transmitting at their greatest design basis ERP, the maximum exposure at the elevation of the antenna will not result in RF exposures in excess of the FCC public RF safety standard at eight or more feet from the surface of the antennae, (see appendix A-1). The maximum RF exposure at ground level will not be in excess of 11.7% of, (i.e., 8.5 times lower than), the FCC public safety standard, (see appendix A-2).

A chart of the electromagnetic spectrum and a comparison of RF power densities from various common sources is presented in figures two and three respectively in order to place exposures from DAS wireless systems in perspective. RF exposure in the neighborhood served by this and other DAS sites are very low due to three main factors. First, as previously stated, DAS is a relatively low-power technology. The maximum power into the antenna will be less than 31.4 watts. In addition, DAS sites utilize directional antennae that focus the RF energy toward the horizon, (i.e., parallel with the ground at the level of the antenna), thus only a very small percentage of the RF energy is emitted directly down toward the ground. This is similar to a lighthouse beacon that sends the majority of its light out toward the horizon with very little reaching the base of the lighthouse or people living nearby. Finally, as shown on the graph in appendix A-2, as one gets farther away from the site, the change in RF exposure intensity becomes more uniform with distance. Eventually there is a very rapid and consistent decrease in exposure with distance. Like all forms of electromagnetic energy, including light, the decrease in exposure at this point is proportional to the square of the increased distance. Thus, if the exposure at this point was 1% of the public exposure standard and one simply moved 10 times further away, (all other conditions being the same), the exposure would be 10^2 or 100 times less than before (i.e., 0.01% of the public exposure standard).

It is also important to realize that the FCC maximum allowable exposures are not set at a threshold between safety and known hazard but rather at 50 times below a level that the majority of the scientific community believes may pose a health risk to human populations. Thus, the previously mentioned maximum ground level exposure from these sites represents a "safety margin" from this threshold of potentially adverse health effects of more than 10,000 times.

Given the low levels of radiofrequency fields that would be generated from these CC directional antenna installations and given the evidence on RF biological effects in a large data base, there is no scientific basis to conclude that harmful effects will attend the utilization of this proposed wireless telecommunications facility. This conclusion is supported by a large number of scientists that have participated in standard-setting activities in the United States who are overwhelmingly agreed that RF radiation exposure below the FCC exposure limits has no demonstrably harmful effects on humans. A caution sign, containing appropriate contact information and indicating the stay back distance beyond which the RF exposures do not exceed the public and occupational maximum permissible exposure (MPE), should be placed near the antenna (see appendix A-3).

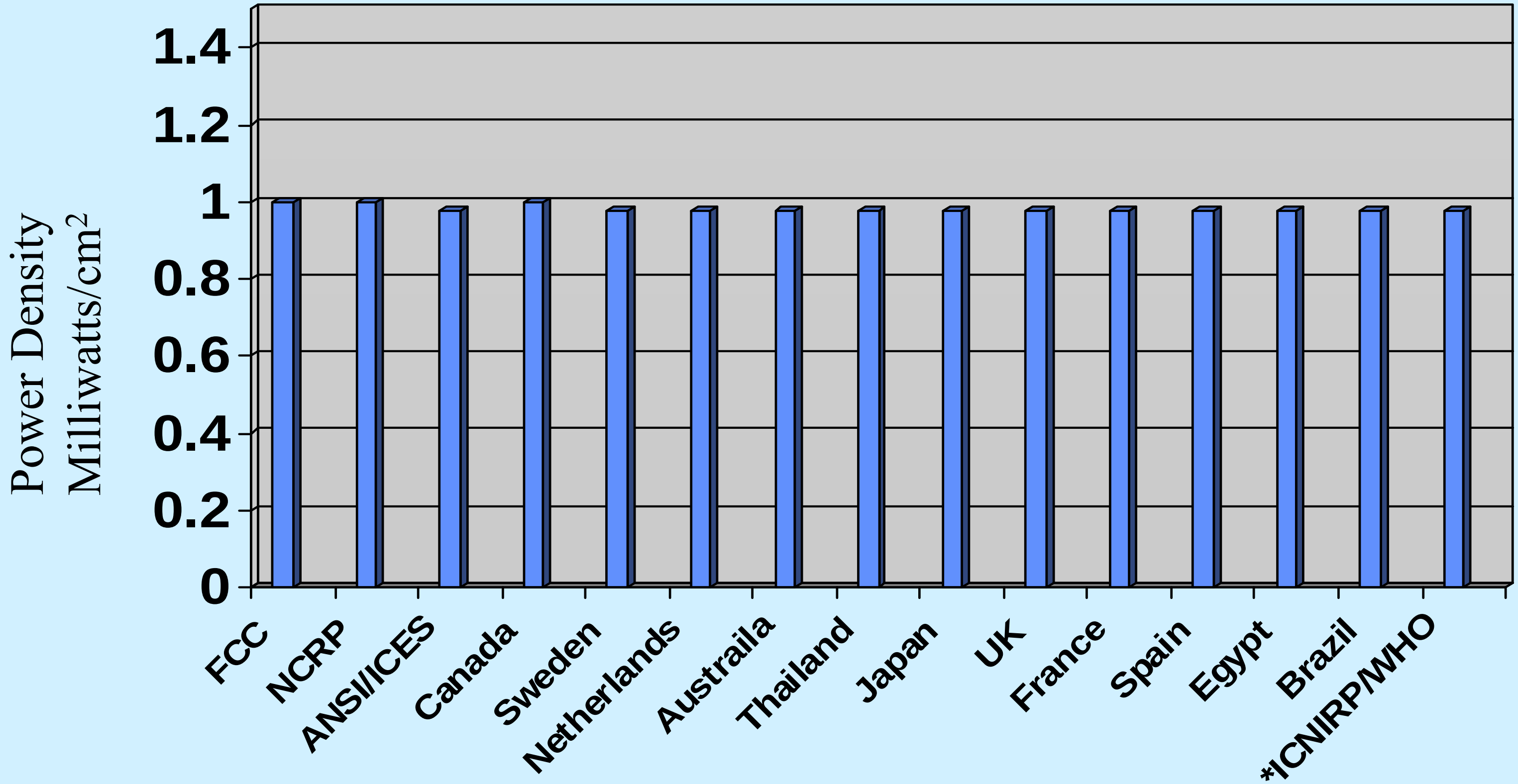
These findings are based on my professional evaluation of the scientific issues related to the health and safety of non-ionizing electromagnetic radiation and my analysis of the technical specification as provided by CC. The opinions expressed herein are based on my professional judgement and are not intended to necessarily represent the views of any other organization or institution. Please contact me if you require any additional information.

Sincerely,

Jerrold T. Bushberg Ph.D., DABMP, DABSNM
Diplomate, American Board of Medical Physics (DABMP)
Diplomate, American Board of Science in Nuclear Medicine (DABSNM)
Fellow, American Association of Physicists in Medicine (FAAPM)

Enclosures: Figures 1-3; Attachment 1,2; Appendices A1-A3 and Statement of Experience.

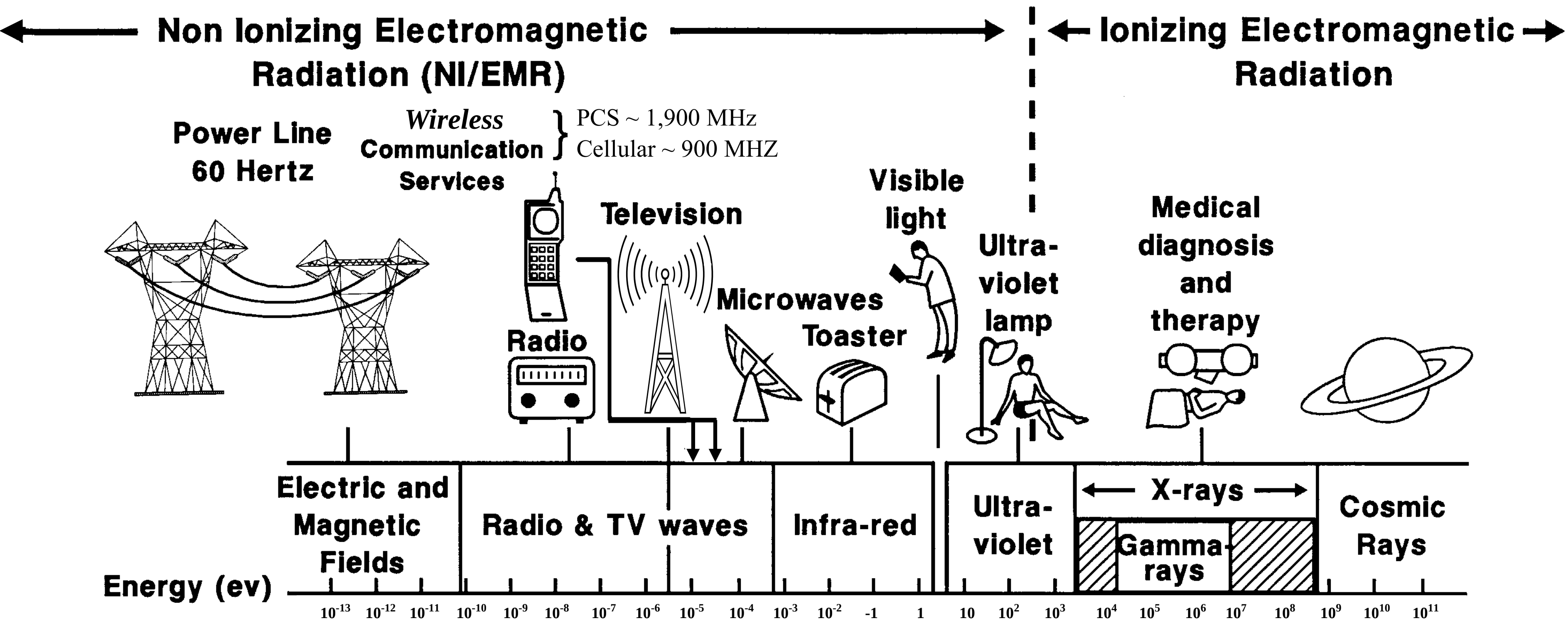
National and International Public RF Exposure Standards (DAS @ 1,950 MHz)



***International Commission on Non-Ionizing Radiation Protection (ICNIRP) Public Safety Exposure Standard. ICNIRP standard recommended by the World Health Organization (WHO). Members of the ICNIRP Scientific Committee were from:**

- **Australia**
- **Finland**
- **France**
- **Germany**
- **Hungary**
- **Italy**
- **Sweden**
- **Japan**
- **United Kingdom**
- **United States**

Figure 1



The Electromagnetic Spectrum

Figure 2

Typical Exposure from Various Radio Frequency / Microwave Sources

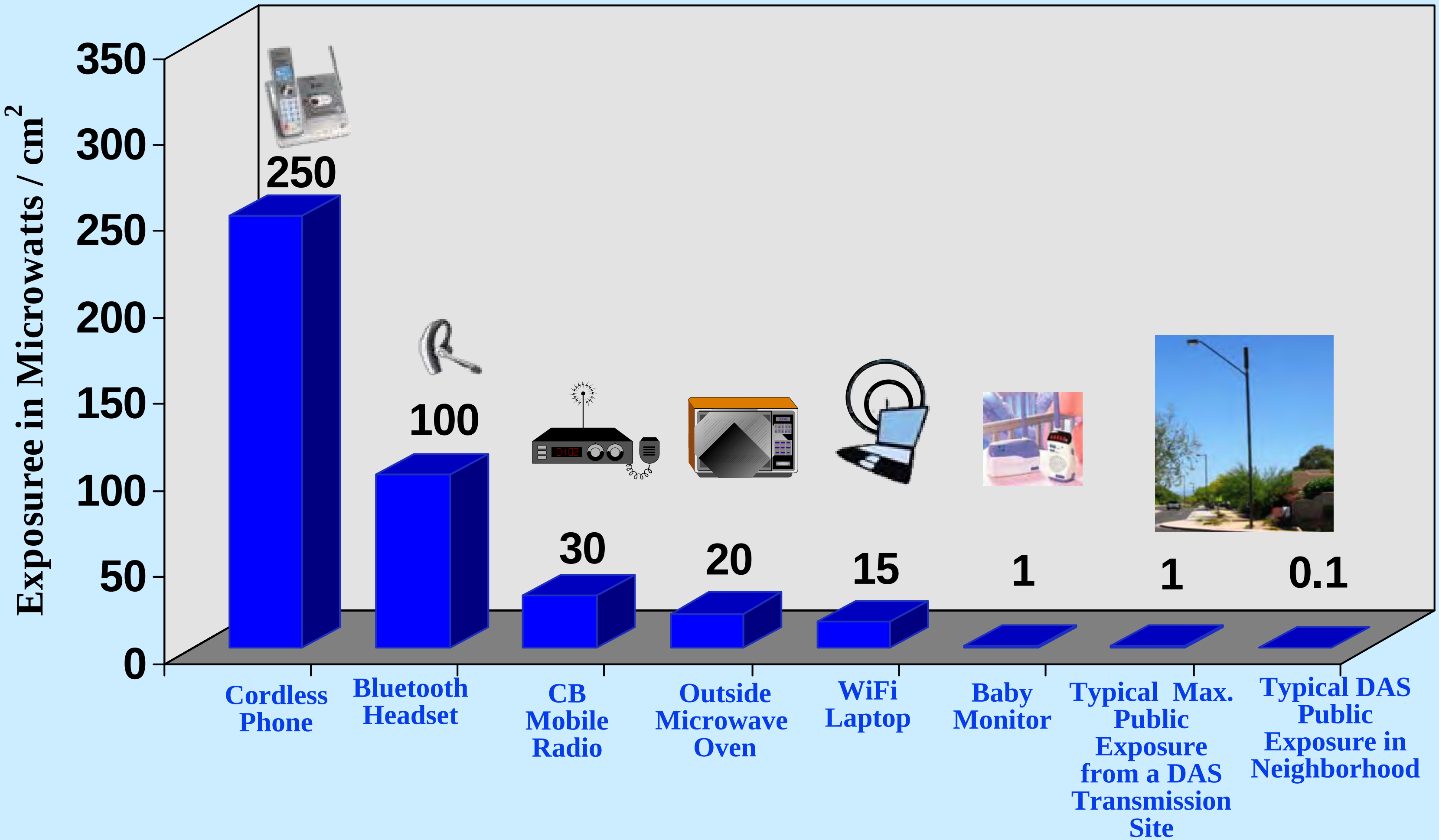


Figure 3

Attachment 1

List of Proposed Utility Pole Dual Panel Antenna DAS Node Locations and Example of DAS Dual Panel Antenna Mounted to Utility Pole

CROWN CASTLE

RF Approval for DAS Project

Customer: Verizon
Project Name: Sunset District

28-Aug-12

Host Site Locations

Proposed Host Item #	Proposed Host Site ID	# Sectors Required	# of Racks required	# remotes served from host	Currently Leased?	Latitude (decimal) NAD 83	Longitude (decimal) NAD 83	Street Address	Jurisdiction
1	**SF 24TH/PACHECO (CA0668)**	**3**	**1**	**17**	**Yes**	**37.747500**	**-122.475000**	**2145 19th Ave**	**San Francisco**

Remote Site Locations

Proposed Remote Site Item #	Proposed Remote Location(s) or Site ID	Pole Number	# Carriers per Sector PCS/Cell/LTE	PCS /CELL Usable EIRP per Carrier (dBm)	LTE /LTE MIMO Usable EIRP per Carrier (dBm)	Proposed Antenna Rad Center (AGL)	Number of Required Antennas at Site	Azimuth for Antenna #1	Azimuth for Antenna #2	Latitude (decimal) NAD 83	Longitude (decimal) NAD 83	Street Address	Jurisdiction	Antenna Type
1	SF DAS 1	P145	3/8/1	35.8 / 29.2	29 / 29	25'	2	200	290	37.76264	-122.50083	4000 IRVING ST	San Francisco	Kathrein Scala 840 10525
2	SF DAS 2	P111	3/8/1	35.8 / 29.2	29 / 29	25'	2	245	300	37.75737	-122.49291	1599 34TH AVE	San Francisco	Kathrein Scala 840 10525
3	SF DAS 3	P71	3/8/1	35.8 / 29.2	29 / 29	24'	2	90	270	37.75361	-122.48841	2301 NORIEGA ST	San Francisco	Kathrein Scala 840 10525
4	SF DAS 4	P58	3/8/1	35.8 / 29.2	29 / 29	28'	2	90	270	37.75021	-122.48582	2400 PACHECO ST	San Francisco	Kathrein Scala 840 10525
5	SF DAS 5	P216	3/8/1	35.8 / 29.2	29 / 29	27'	2	95	260	37.74342	-122.48548	2355 28TH AVE	San Francisco	Kathrein Scala 840 10525
6	SF DAS 6	P245A	3/8/1	35.8 / 29.2	29 / 29	25'	2	90	270	37.73908	-122.47963	1185 VICENTE ST	San Francisco	Kathrein Scala 840 10525
7	SF DAS 7	P470	3/8/1	35.8 / 29.2	29 / 29	27'	2	170	345	37.74310	-122.49607	2350 38TH AVE	San Francisco	Kathrein Scala 840 10525
8	SF DAS 8	P312	3/8/1	35.8 / 29.2	29 / 29	23'	2	80	280	37.74294	-122.50159	2343 43RD AVE	San Francisco	Kathrein Scala 840 10525
9	SF DAS 9	P351	3/8/1	35.8 / 29.2	29 / 29	25'	2	90	270	37.73824	-122.50231	3300 VICENTE ST	San Francisco	Kathrein Scala 840 10525
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
11	SF DAS 17	P264A	3/8/1	35.8 / 29.2	29 / 29	23'	2	90	270	37.73841	-122.49360	2445 VICENTE ST	San Francisco	Kathrein Scala 840 10525
12	SF DAS 18	P328	3/8/1	35.8 / 29.2	29 / 29	24'	2	5	145	37.74656	-122.50397	2143 45TH AVE	San Francisco	Kathrein Scala 840 10525
13	SF DAS A1a	P145	3/8/1	35.8 / 29.2	29 / 29	26'	2	0	135	37.75852	-122.50466	4045 KIRKHAM ST	San Francisco	Kathrein Scala 840 10525
14	SF DAS A1b	P402A	3/8/1	35.8 / 29.2	29 / 29	27'	2	0	160	37.75932	-122.50917	1450 LA PLAYA ST	San Francisco	Kathrein Scala 840 10525
15	SF DAS A2	P99	3/8/1	35.8 / 29.2	29 / 29	26'	2	90	270	37.75328	-122.50068	3436 NORIEGA ST	San Francisco	Kathrein Scala 840 10525
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
17	SF DAS A7	P711	3/8/1	35.8 / 29.2	29 / 29	25'	2	90	270	37.74956	-122.50084	1994 42ND AVE	San Francisco	Kathrein Scala 840 10525

By signing below, the undersigned duly authorized representative of Verizon Wireless hereby confirms that:

1. The drive test results and expected coverage from the node locations set forth above satisfy the coverage objectives and are acceptable; and accordingly
2. This network design meets or exceeds the design objectives stated in the agreement for this project.

Customer Approval:	
Date:	

CROWN CASTLE

RF Approval for DAS Project

Customer: **Verizon**
Project Name: **Richmond District** ***10-Aug-12***

Host Site Locations

Proposed Host Item #	Proposed Host Site ID	# Sectors Required	# of Racks required	# remotes served from host	Currently Leased?	Latitude (decimal) NAD 83	Longitude (decimal) NAD 83	Street Address	Jurisdiction
1	**GOLDEN GATE (CA0138)**	**1**	**2**	**7**	**Yes**	**37.782800**	**-122.505000**	**4150 Clement St.**	**San Francisco**

Remote Site Locations

Proposed Remote Site Item #	Proposed Remote Location(s) or Site ID	Pole Number	# Carriers per Sector PCS/Cell/LTE	PCS /CELL Usable EIRP per Carrier (dBm)	LTE /LTE MIMO Usable EIRP per Carrier (dBm)	Number of Required Antennas at Site	Azimuth for Antenna #1	Azimuth for Antenna #2	Latitude (decimal) NAD 83	Longitude (decimal) NAD 83	Street Address	Jurisdiction	Antenna Type
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	SF DAS 12	P72A	3/8/1	35.5 / 29.2	29 / 29	2	0	90	37.77517	-122.50816	4605 BALBOA ST	San Francisco	Kathrein Scala 840 10525
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
4	SF DAS 14	P62A	3/8/1	35.5 / 29.2	29 / 29	2	90	240	37.77379	-122.50051	3900 CABRILLO ST	San Francisco	Kathrein Scala 840 10525
5	SF DAS 15	P51	3/8/1	35.5 / 29.2	29 / 29	2	60	180	37.77558	-122.50174	4000 BALBOA ST	San Francisco	Kathrein Scala 840 10525
6	SF DAS 16	P100	3/8/1	35.5 / 29.2	29 / 29	2	110	230	37.77303	-122.50902	800 48TH AVE	San Francisco	Kathrein Scala 840 10525
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

By signing below, the undersigned duly authorized representative of Verizon Wireless hereby confirms that:

1. The drive test results and expected coverage from the node locations set forth above satisfy the coverage objectives and are acceptable; and accordingly
2. This network design meets or exceeds the design objectives stated in the agreement for this project.

Customer Approval:	
Date:	

NOTE:

A COPY OF ALL REQUIRED PERMITS MUST BE PRESENT DURING ANY WORK ON THIS LOCATION AND PERFORMING WORK AT THIS LOCATION INDICATES THAT THE CONTRACTOR HAS READ AND COMPLIED WITH THE REQUIREMENTS STATED IN THE PERMITS

SIGNATURE:

SAN FRANCISCO
NODE SF DAS 15
4000 BALBOA ST.
SAN FRANCISCO, 94121

Call Before you Dig!

Know what's **below.**
Call before you dig.
Call 811 Before you Dig!

VICINITY MAP

ALL WORK AND MATERIALS SHALL BE PERFORMED AND INSTALLED IN ACCORDANCE WITH THE CURRENT EDITIONS OF THE FOLLOWING CODES AS ADOPTED BY THE LOCAL GOVERNING AUTHORITIES. NOTHING IN THESE PLANS IS TO BE CONSTRUED TO PERMIT WORK NOT CONFORMING TO THE AREAS GOVERNING CODES.

1. STATE ADMINISTRATIVE CODE
2. STATE BUILDING CODE
3. ANSI/EIA-222-F LIFE SAFETY CODE NFPA-101-1990
4. STATE MECHANICAL CODE

CODE COMPLIANCE

PROPERTY INFORMATION

CUSTOMER:	CROWN CASTLE
PROJECT:	RICHMOND
NODE:	NODE SF DAS 15
LATITUDE:	37.77558
LONGITUDE:	-122.50174
STREET ADDRESS:	4000 BALBOA ST.
CITY, STATE:	SAN FRANCISCO, 94121
POLE# / TYPE:	P101/ UTILITY POLE
RAD CENTER / ANTENNA HEIGHT:	30'-9" TO RAD CENTER
ANTENNA TYPE:	(2) DIRECTIONAL
AZIMUTH FOR ANTENNA:	60°,180°
POWER TO POLE:	EXISTING SECONDARY
POLE ACCESS:	STREET SIDE
POLE LOCATION & DESCRIPTION:	N/W C/O BALBOA ST. AND 41ST AVE.

PROJECT SUMMARY

SHEET	DESCRIPTION	REV.
1	TITLE SHEET	0
2	UTILITY POLE EQUIPMENT PROFILES	0
3	UTILITY POLE EQUIPMENT TYPICALS	0

SHEET INDEX

THE PROJECT CONSISTS OF THE INSTALLATION AND OPERATION OF WIRELESS EQUIPMENT AND ANTENNAS FOR CROWN CASTLE ON EXISTING WOOD UTILITY POLES.

PROJECT DESCRIPTION

INSTALL NEW WIRELESS EQUIPMENT AND ANTENNAS AND ALL ASSOCIATED BRACKETS IN ACCORDANCE TO CONSTRUCTION SPECIFICATIONS, REARRANGE ANY EXISTING FACILITIES IN ACCORDANCE TO GOVERNING CONSTRUCTION GUIDELINES.

PROJECT SCOPE

DO NOT SCALE DRAWINGS

CONTRACTOR SHALL VERIFY ALL PLANS AND EXISTING DIMENSIONS AND CONDITIONS ON THE JOB SITE AND SHALL IMMEDIATELY NOTIFY THE ARCHITECT IN WRITING OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK OR BE RESPONSIBLE FOR SAME.

GENERAL CONTRACTOR NOTES

890 TASMAN DRIVE
MILPITAS, CA. 95035-7439
PHONE: (408) 954-1580

PROJECT INFORMATION:

SAN FRANCISCO
NODE SF DAS 15
4000 BALBOA ST.
SAN FRANCISCO, 94121

CURRENT ISSUE DATE:

1/11/13

PERMIT SUBMISSION:

REV.	DATE:	DESCRIPTION:	BY:

PLANS PREPARED BY:

HP COMMUNICATIONS INC.
13341 Temescal Cyn. Rd.
Corona, CA. 92883
PHONE: (951) 471-1919

PLANS APPROVED BY:

REP:

COMMENTS:

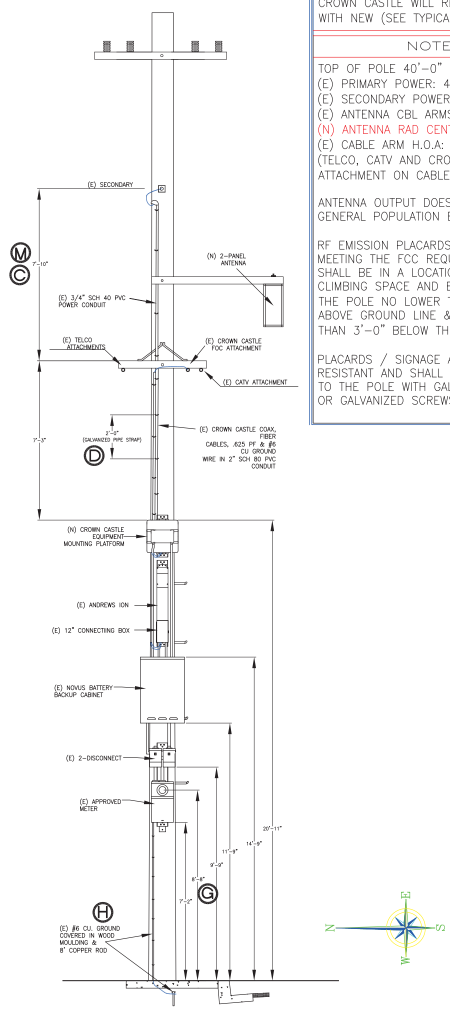
SHEET TITLE:

CROWN CASTLE
POLE PROFILE NODE SF DAS 15

SHEET NUMBER: 1

REVISION: 0

AZIMUTH	DOWNTILT
60°	N/A
180°	N/A



MAKE READY

N/A

NEW CONSTRUCTION

CONSTRUCTION:
CROWN CASTLE TO ATTACH (N) EQUIPMENT ABOVE (E) RADIO PLATFORM.
CROWN CASTLE WILL REPLACE (E) ANTENNAS WITH NEW (SEE TYPICAL SHEET).

NOTES:

TOP OF POLE 40'-0"
(E) PRIMARY POWER: 41'-11"
(E) SECONDARY POWER: 36'-0"
(E) ANTENNA CBL ARMS: 32'-0"
(N) ANTENNA RAD CENTER: 30'-9"
(E) CABLE ARM H.O.A: 28'-2"
(TELCO, CATV AND CROWNCASTLE ATTACHMENT ON CABLE ARM)

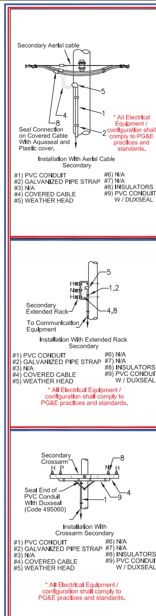
ANTENNA OUTPUT DOES NOT EXCEED GENERAL POPULATION EXPOSURE LIMITS.

RF EMISSION PLACARDS / SIGNAGE MEETING THE FCC REQUIREMENTS SHALL BE LOCATED IN A LOCATION VISIBLE FROM CLIMBING SPACE AND BE AFFIXED TO THE POLE NO LOWER THAN 9'-0" ABOVE GROUND LINE & NO HIGHER THAN 3'-0" BELOW THE ANTENNA.

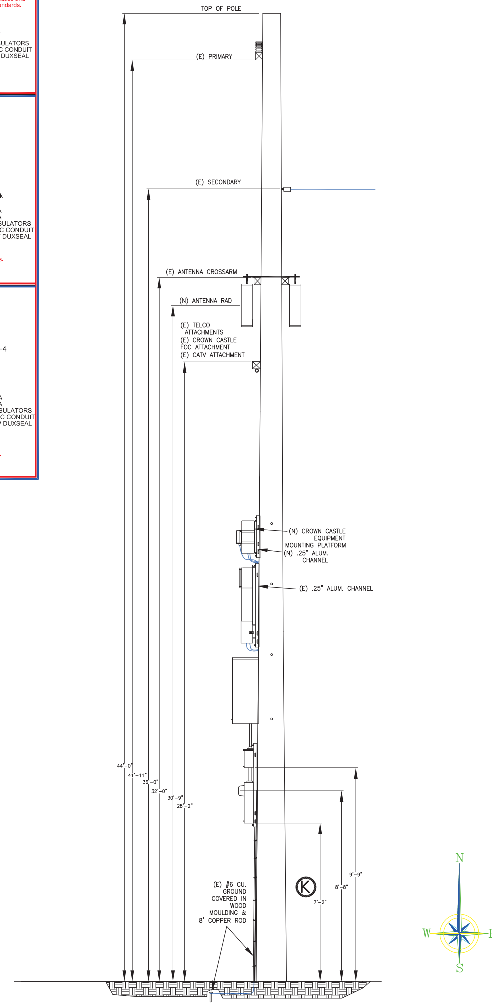
PLACARDS / SIGNAGE ARE UVA RESISTANT AND SHALL BE ATTACHED TO THE POLE WITH GALVANIZED NAILS OR GALVANIZED SCREWS.

- (A) – 72" MIN. CLEARANCE BETWEEN SECONDARY POWER AND CLOSEST LEVEL OF ANTENNA ASSEMBLY.
- (B) – POLE TOP EXTENSION UPPER AND LOWER BRACKET STEPS ARE TO BE INSTALLED WITH THE POLE TOP EXTENSION BRACKET ASSEMBLY. STEPS ARE NOT TO BE INSTALLED ON WOOD EXTENSION BAYONET.
- (C) – 72" MIN CLEARANCE REQ'D.
- (D) – 24" SPACING MAX. (GALVANIZED PIPE STRAP)
- (E) – 72" MIN. TO SECONDARY LEVEL.
- (F) – 12" MIN. SPACING FOR EQUIP TO CURB.
- (G) – 15' MIN. (MAY BE REDUCED TO 9' WHEN NOT EXPOSED TO TRAFFIC).
- (H) – GROUND INSTALLED BY COMM COMPANY (INCLUDES 8' COPPER ROD).
- (I) – 24" MIN. FROM CENTER OF POLE
- (J) – 24" MIN. CLEARANCE REQ'D.
- (K) – 7' MIN. / 8' MAX. REQ'D.
- (L) – 4" MIN. CLEARANCE BETWEEN EQUIPMENT AND POLE.
- (M) – PROTECTIVE COVERING MUST EXTEND A MINIMUM OF 3'-0" BEYOND ENERGIZED 0-750 VOLTS.
- (N) – POLE STEPS TO BE INSTALLED FROM 8'-6" ABOVE GRADE TO NEXTG ATTACHMENT.

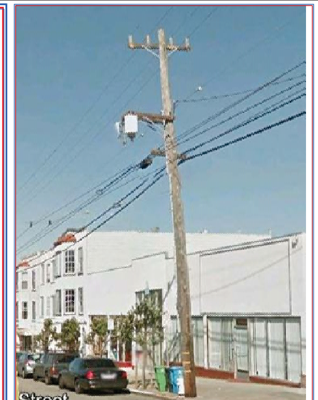
SCALE: 3/8"=1' | UTILITY POLE DETAIL | POLE# P101 | LOOKING EAST | A



AZIMUTH	DOWNTILT
60°	N/A
180°	N/A

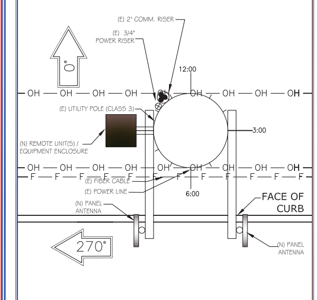


SCALE: 3/8"=1' | UTILITY POLE DETAIL | POLE# P101 | LOOKING NORTH | B



SCALE: N.T.S. | SITE POLE PICTURE | C

POLE WILL BE STEPPED IN ACCORDANCE TO G095 STANDARDS IN RESPECT TO CLIMBING SPACE.
REMOTE EQUIPMENT @ 3:00
1-2" CROWN CASTLE RISER @ 4:00
1-3/4" POWER RISER @ 4:00



POLE# P101

SCALE: N.T.S. | RISER POLE DETAIL | D

SCALE: N.T.S. | POWER SUPPLY ENCLOSURE | E

CROWN CASTLE
890 TASMAN DRIVE
MILPITAS, CA. 95035-7439
PHONE: (408) 954-1580

PROJECT INFORMATION:

SAN FRANCISCO
NODE SF DAS 15
4000 BALBOA ST.
SAN FRANCISCO, 94121

CURRENT ISSUE DATE:
1/11/13

PERMIT SUBMISSION:

REV.	DATE:	DESCRIPTION:	BY:

PLANS PREPARED BY:

HP COMMUNICATIONS INC.
13341 Temescal Cyn. Rd.
Corona, CA. 92883
PHONE: (951) 471-1919

PLANS APPROVED BY:

CROWN CASTLE

REP:

COMMENTS:

Call Before you Dig!
811
Know what's below.
Call before you dig.
Call 811 Before you Dig!

SHEET TITLE:

CROWN CASTLE
POLE PROFILE NODE SF DAS 15

SHEET NUMBER: 2
REVISION: 0

UTILITY POLE EQUIPMENT PROFILES

ION–M19P
ANDREW ION–19P IS A MULTI–BAND MULTI–OPERATOR REMOTE UNIT WITH VARIOUS EXTENSION UNITS.
IT IS USED IN CONJUNCTION WITH A MASTER UNIT IN THE ION OPTICAL DISTRIBUTION SYSTEM.
THIS SYSTEM TRANSPORTS MULTIPLE FREQUENCY BANDS SIMULTANEOUSLY (1900 MHZ AND 1700/2100 MHZ),
PROVIDING A COST–EFFECTIVE SOLUTION FOR DISTRIBUTING CAPACITY FROM ONE OR MORE BASE STATIONS.

ELECTRICAL
POWER SUPPLY
MAINS POWER, VAC 85 TO 264
115 OR 230
POWER CONSUMPTION, WATTS 350
OPTICAL
CONNECTORS E2000/APC 8°
OPTICAL RETURN LOSS, DB. 45 MINIMUM
FIBER TYPE, MM SINGLE MODE E9/125
OPTICAL LINK BUDGET, DB 0 TO 10
COMPOSITE INPUT POWER
@ OTRX MASTER SIDE, DBM.
1900MHZ +3 COMPOSITE
1700/2100 MHZ +5 COMPOSITE
INTERFACE
BTS SIDE
NUMBER OF CONNECTORS
1900MHZ 4
1700/2100 MHZ 4
SYSTEM OPTIMIZED FOR BTS POWER, DBM
33
43
ANTENNA PORT
CONNECTOR N FEMALE
OUTPUT POWER SEE BAND SPECIFICATION
1900 MHZ
FREQUENCY RANGE, MHZ
UPLINK 1850 TO 1915
DOWNLINK 1930 TO 1995
OUTPUT POWER PER CARRIER*, DBM

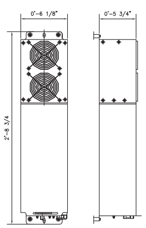
NUMBER OF CARRIERS	1	2	4	8
GSM	43	40	37	34
TOMA/ EDGE	43	40	37	34
CDMA/EV–DO	43	40	37	34
WCDMA/HSDPA	43	40	37	34

SPURIOUS EMISSION <–13 DBM. / 1MHZ
DL OUTPUT TOLERANCE OVER FREQUENCY, DB +1
DL OUTPUT TOLERANCE OVER TEMPERATURE, DB +0.5

INPUT ICP
ICP3 OPTIMIZED –12
NOISE FIGURE OPTIMIZED –18
NOISE FIGURE, DB
ICP3 OPTIMIZED 11
NOISE FIGURE OPTIMIZED 6
1700/2100 MHZ (IN EXTENSION UNIT)
FREQUENCY RANGE, MHZ
UPLINK 1710 TO 1755
DOWNLINK 2110 TO P1455
OUTPUT POWER PER CARRIER*, DBM

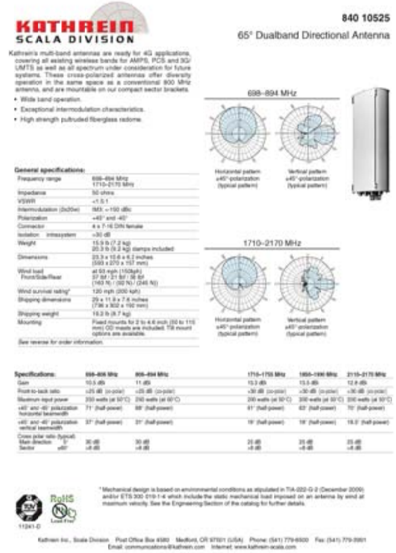
CDMA/EV–DO	WCDMA/UMTS/HSDPA
+43	+43 @ 1 CARRIER
+40	+40 @ 2 CARRIERS
+37	+37 @ 4 CARRIERS
+34	+34 @ 8 CARRIERS

SPURIOUS EMISSION <– 13 DBM / 1 MHZ
ADJACENT CHANNEL POWER, DBC –48
DL OUTPUT TOLERANCE OVER FREQ., DB +1
DL OUTPUT TOLERANCE OVER TEMP, DB +0.5
INPUT ICP3, DBM
ICP3 OPTIMIZED –12
NOISE FIGURED OPTIMIZED –18
* APPLICABLE TO SINGLE MODULATION MODE ONLY
** WITH ACTIVE COOLING

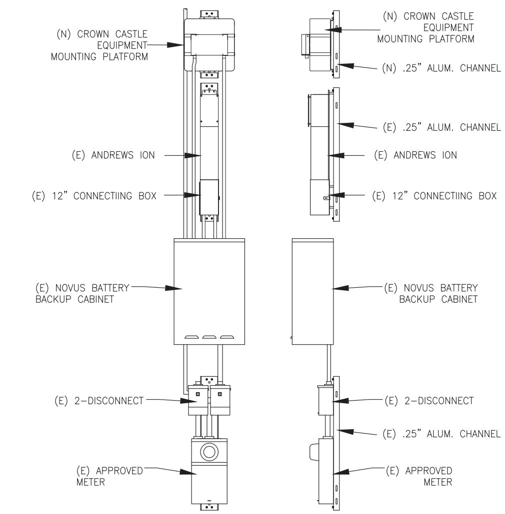


ION–M19P MULTI–BAND, MULTI–OPERATOR REMOTE OPTICAL SYSTEM

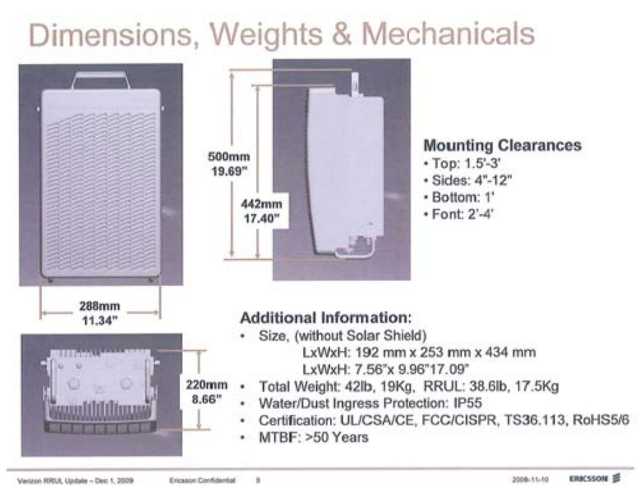
SCALE: N.T.S. REPEATER EQUIPMENT SPECIFICATIONS #1 A



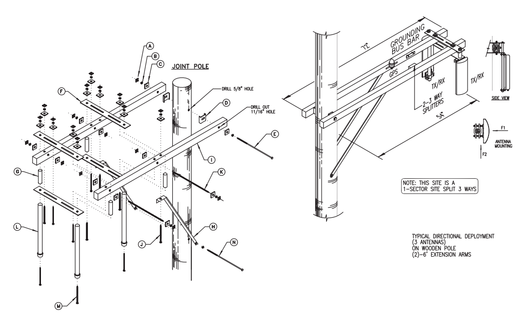
SCALE: N.T.S. ANTENNA SPECIFICATIONS B



SCALE: N.T.S. REPEATER EQUIPMENT AND MOUNTING CHASSIS CONFIGURATION C

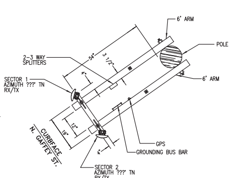


SCALE: N.T.S. REPEATER EQUIPMENT SPECIFICATIONS #2 D

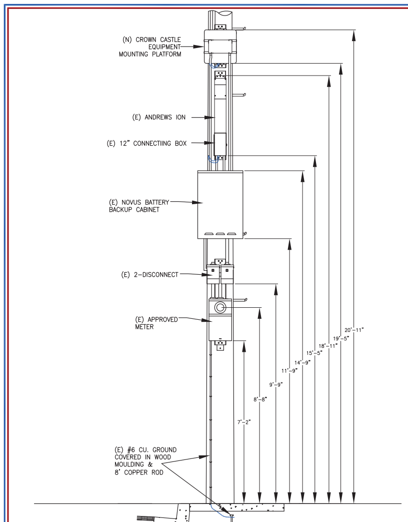


ITEM	DESCRIPTION	DIMENSIONS	CAT NO.	QTY.
A	SQUARE NUT	5/8"	J8563/JOSLYN	21
B	DOUBLE COIL LOCK WASHER	5/8"	J177/JOSLYN	20
C	FLAT SQUARE WASHERS	2 1/4" x 5/8"x 3/16"	J1074/JOSLYN	24
D	POLE GAINS	4" x 4"x SLOT SIZE 2 11/16"	DAT6599G001/McGRAW	2
E	MACHINE BOLT ✱	24" x 5/8"	J8824 (E)/JOSLYN	1
F	ANTENNA MOUNTING PLATE ✱	32" x 4" x 1/4"	PRE–FAB.	4
G	GALV. STEEL SPACERS	3/4" x 4 1/2"	PRE–FAB.	4
H	ANGLE BRACES & ALLEY ARM BRACES	42" x 1 3/4" x 3/16"	J1442/JOSLYN	2
I	TYPE 72 GA–WOOD ARM	3 1/2" x 4 1/2" x 72"	BROOKS	2
J	MACHINE BOLT	6" x 5/8"	J8806/JOSLYN	6
K	DOUBLE ARMING BOLT ✱	5/8" x 26"	J8876/JOSLYN	2
L	GALV. STEEL PIPE W/END CAP ✱	1 1/4" x 8" MIN. – 48" MAX.	PRE–FAB	3
M	MACHINE BOLT ✱	5/8" x 16" MIN. – 56" MAX.	CUSTOM/JOSLYN	4
N	MACHINE BOLT ✱	16" x 5/8"	J8816/JOSLYN	1
✱	DIMENSIONS VARY BASED UPON POLE/ANTENNA SIZE			

ARM ASSEMBLY



SCALE: N.T.S. ANTENNA MOUNTING CONFIGURATIONS E



SCALE: N.T.S. REPEATER EQUIPMENT AND MOUNTING CHASSIS CONFIGURATION F

UTILITY POLE EQUIPMENT TYPICALS

CROWN CASTLE
890 TASMAN DRIVE
MILPITAS, CA. 95035–7439
PHONE: (408) 954–1580

PROJECT INFORMATION:
SAN FRANCISCO
NODE SF DAS 15
4000 BALBOA ST.
SAN FRANCISCO, 94121

CURRENT ISSUE DATE:
1/11/13

PERMIT SUBMISSION:

REV.:	DATE:	DESCRIPTION:	BY:

PLANS PREPARED BY:
HP COMMUNICATIONS INC.
13341 Temescal Cyn. Rd.
Corona, CA. 92883
PHONE: (951) 471–1919

PLANS APPROVED BY:
CROWN CASTLE
REP:

COMMENTS:

SHEET TITLE:
CROWN CASTLE
POLE PROFILE NODE SF DAS 15

SHEET NUMBER: 3
REVISION: 0

Attachment 2

Antenna Specifications

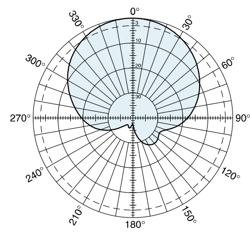
Preliminary **840 10525**

65° Dualband Directional Antenna

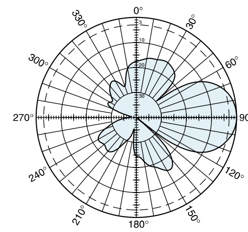
Kathrein's dual band antennas are ready for 3G applications, covering all existing wireless bands as well as all spectrum under consideration for future systems, LTE, PCS and 3G/UMTS. These cross-polarized antennas offer diversity operation in the same space as a conventional 700 MHz antenna, and are mountable on our compact sector brackets

- Wide band operation.
- Exceptional intermodulation characteristics.
- Various gain, beamwidth and downtilt ranges.
- High strength pultruded fiberglass radome.

698–894 MHz

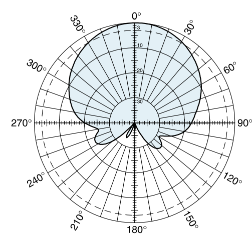


Horizontal pattern
±45°-polarization
(typical pattern)

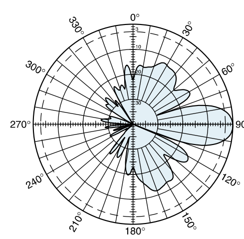


Vertical pattern
±45°-polarization
(typical pattern)

1710–2170 MHz



Horizontal pattern
±45°-polarization
(typical pattern)



Vertical pattern
±45°-polarization
(typical pattern)

General specifications:

Frequency range	698–894 MHz 1710–2170 MHz
Impedance	50 ohms
VSWR	<1.5:1
Intermodulation (2x20w)	IM3: <-150 dBc
Polarization	+45° and -45°
Connector	4 x 7-16 DIN female
Isolation intrasystem	>30 dB
Weight	15.9 lb (7.2 kg)
Dimensions	22.8 x 10.3 x 5.5 inches (579 x 262 x 139 mm)
Wind load Front/Side/Rear	at 93 mph (150kph) 23 lbf / 18 lbf / 41 lbf (100 N) / (80 N) / (180 N)
Wind survival rating*	120 mph (200 kph)
Shipping dimensions	29 x 11.9 x 7.6 inches (736 x 302 x 192 mm)
Shipping weight	19.2 lb (8.7 kg)
Mounting	Fixed and tilt mount options are available for 2 to 4.6 inch (50 to 115 mm) OD masts.

See reverse for order information.

Specifications:

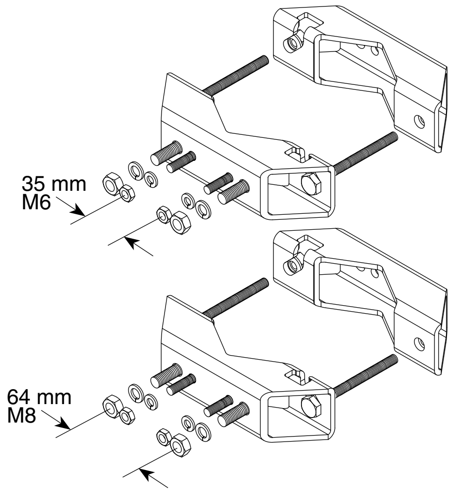
Specifications:	698–806 MHz	824–894 MHz	1710–1755 MHz	1850–1990 MHz	2110–2170 MHz
Gain	10.5 dBi	11 dBi	12.5 dBi	13.3 dBi	13.6 dBi
Front-to-back ratio	>25 dB (co-polar)	>25 dB (co-polar)	>27 dB (co-polar)	>27 dB (co-polar)	>27 dB (co-polar)
Maximum input power	250 watts (at 50°C)	250 watts (at 50°C)	200 watts (at 50°C)	200 watts (at 50°C)	200 watts (at 50°C)
+45° and -45° polarization horizontal beamwidth	72° (half-power)	66° (half-power)	64° (half-power)	64° (half-power)	60° (half-power)
+45° and -45° polarization vertical beamwidth	37° (half-power)	34° (half-power)	19° (half-power)	18.5° (half-power)	18° (half-power)
Cross polar ratio Main direction 0° Sector ±60°	 30 dB (typical) >10 dB	 25 dB (typical) >10 dB	 25 dB (typical) >8 dB	 25 dB (typical) >8 dB	 25 dB (typical) >8 dB

* Mechanical design is based on environmental conditions as stipulated in TIA-222-G-2 (December 2009) and/or ETS 300 019-1-4 which include the static mechanical load imposed on an antenna by wind at maximum velocity. See the Engineering Section of the catalog for further details.

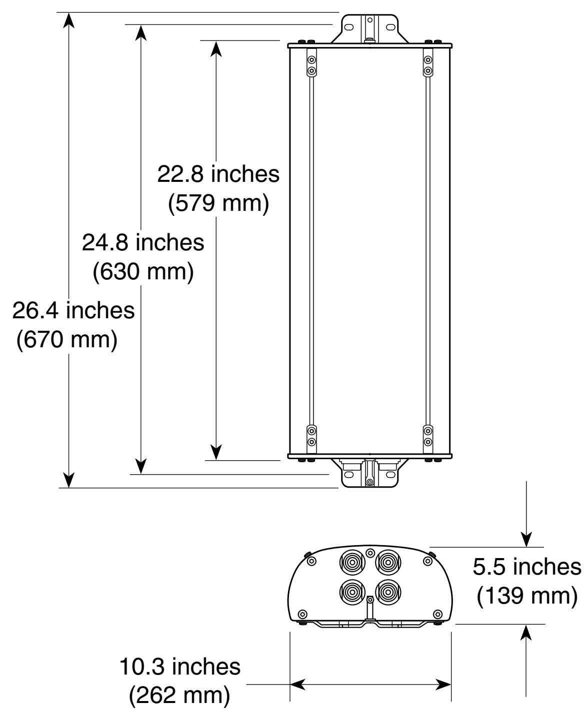
11241-FRO/a

Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

65° Dualband Directional Antenna



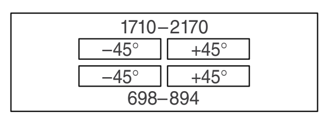
2 x 738 546 Mounting Kit



Profile PA2

Mounting Options:

Model	Description
2 x 738 546	Mounting Kit for 2 to 4.6 inch (50 to 115 mm) OD mast.
850 10013	Tilt Kit for use with the 2 x 738 546 mounting kit 0–34 degrees downtilt angle.



Order Information:

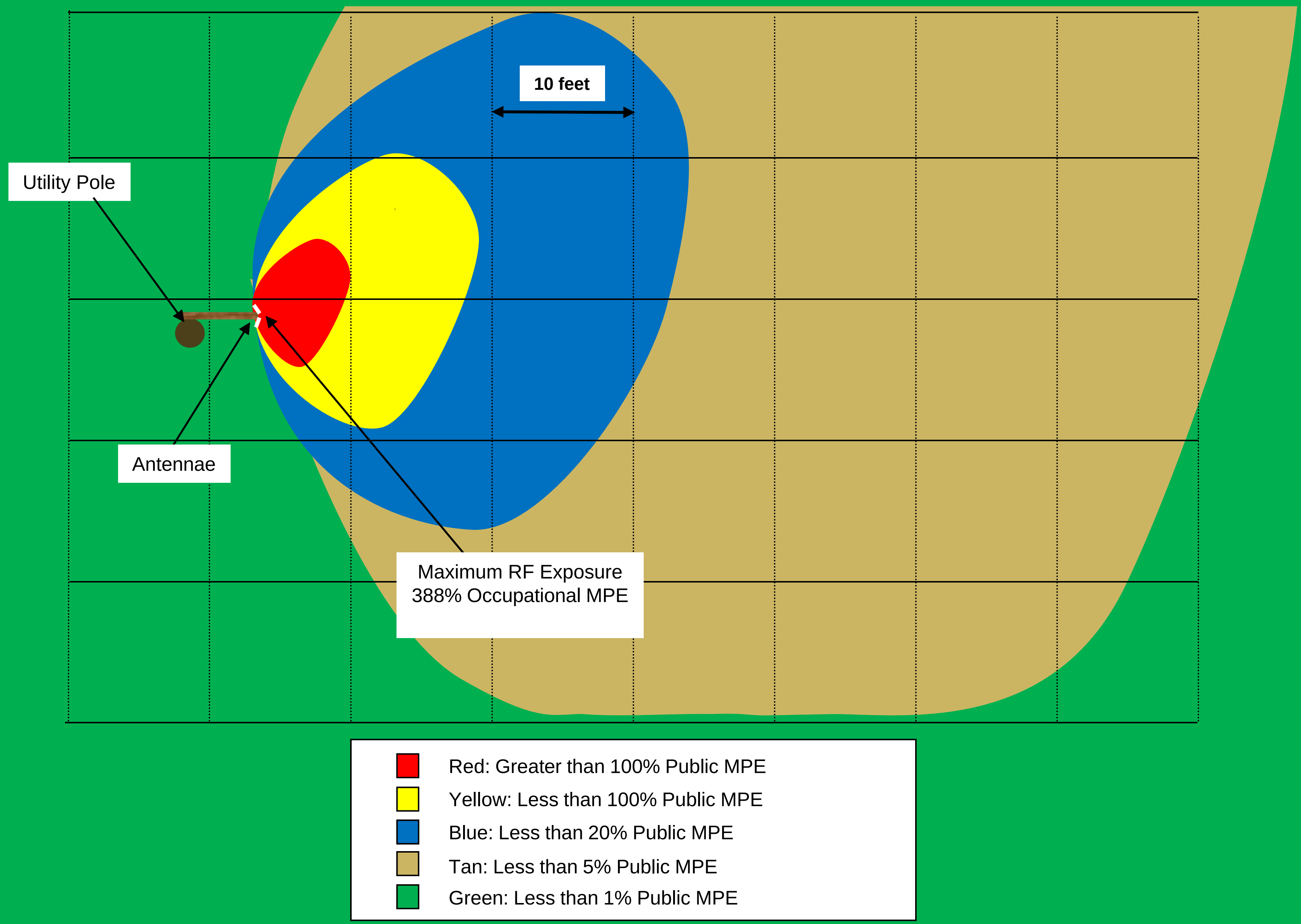
Model	Description
840 10525	Antenna with 7-16 DIN connectors

Kathrein Inc., Scala Division Post Office Box 4580 Medford, OR 97501 (USA) Phone: (541) 779-6500 Fax: (541) 779-3991
Email: communications@kathrein.com Internet: www.kathrein-scala.com

Appendix A-1

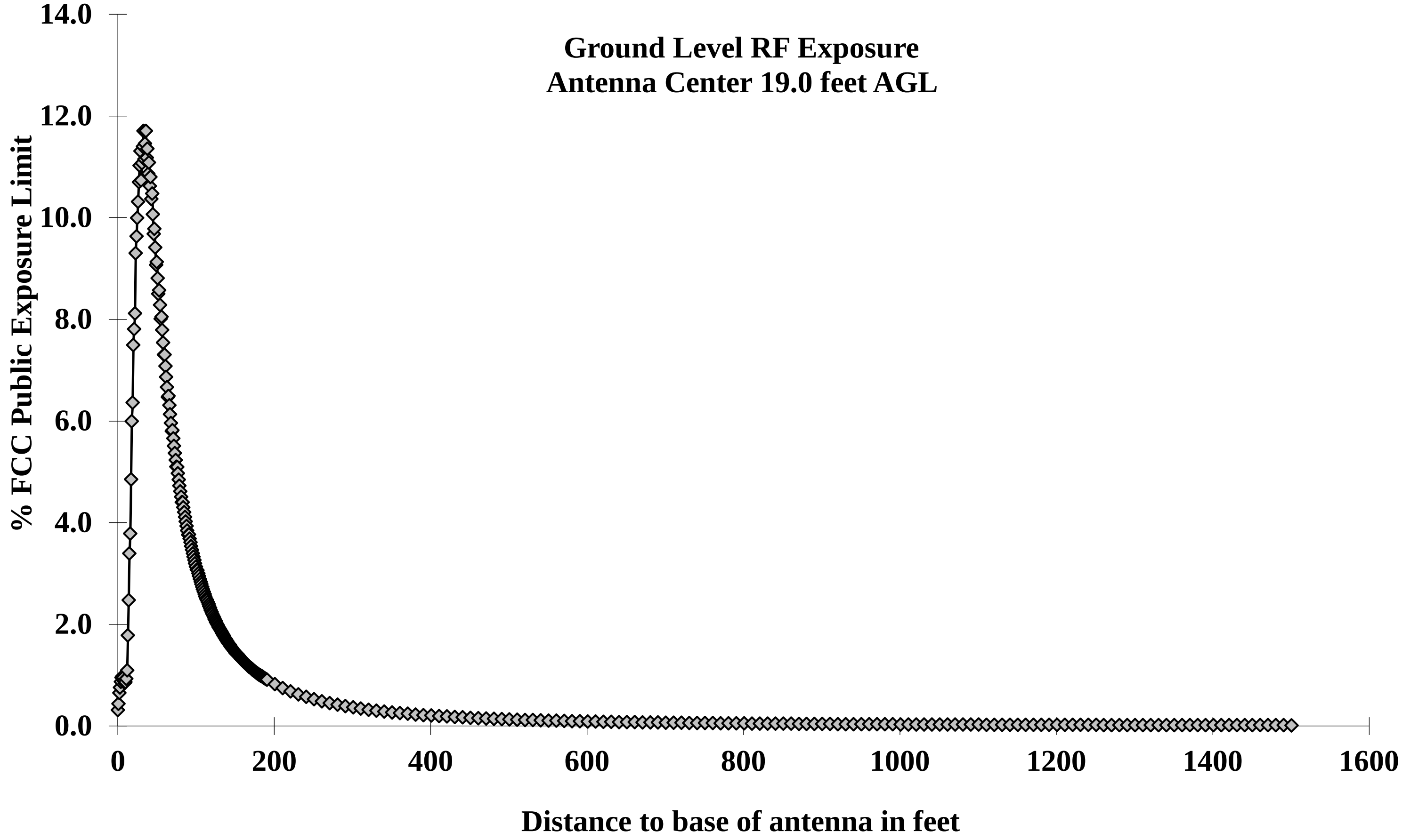
RF EXPOSURE AT ANTENNA LEVEL

RF EXPOSURE AT ELEVATION OF ANTENNA
PERCENTAGE OF FCC MAXIMUM PUBLIC & OCCUPATIONAL EXPOSURE (MPE) LIMIT



Appendix A-2

RF EXPOSURE AT GROUND LEVEL


Ground Level RF Exposure
Antenna Center 19.0 feet AGL
% FCC Public Exposure Limit
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
0
200
400
600
800
1000
1200
1400
1600
Distance to base of antenna in feet

Appendix A-3

RF CAUTION SIGN

CAUTION

The radio frequency (RF) emissions at this site have been evaluated for potential RF exposure to personnel who may need to work near these antennae.

RF EXPOSURE AT 8 and 4 FEET OR CLOSER TO THE FACE OF THE ANTENNA *MAY EXCEED* THE FCC PUBLIC AND OCCUPATIONAL EXPOSURE LIMITS RESPECTIVELY. OBEY ALL SITE RF SAFETY GUIDELINES. ONLY QUALIFIED WORKERS THAT HAVE RF SAFETY TRAINING MAY WORK NEAR THIS 4 FOOT EXCLUSION ZONE. ANYONE NEEDING TO WORK INSIDE THE EXCLUSION ZONE SHOULD CALL ____________________ FOR INSTRUCTIONS PRIOR TO COMMENCING WORK. REFER TO SITE LOCATION AS ____________________

Reference: Federal Communications Commission (FCC) Public Exposure Standard. OET Bulletin-65, Edition 97-01, August 1997.

STATEMENT OF EXPERIENCE

Jerrold Talmadge Bushberg, Ph.D., DABMP, DABSNM, FAAPM
(800) 760-8414 jbushberg@hampc.com

Dr. Jerrold Bushberg has performed health and safety analysis for RF & ELF transmissions systems since 1978 and is an expert in both health physics and medical physics. The scientific discipline of Health Physics is devoted to radiation protection, which, among other things, involves providing analysis of radiation exposure conditions, biological effects research, regulations and standards as well as recommendations regarding the use and safety of ionizing and non-ionizing radiation. In addition, Dr. Bushberg has extensive experience and lectures on several related topics including medical physics, radiation protection, (ionizing and non-ionizing), radiation biology, the science of risk assessment and effective risk communication in the public sector.

Dr. Bushberg's doctoral dissertation at Purdue University was on various aspects of the biological effects of microwave radiation. He has maintained a strong professional involvement in this subject and has served as consultant or appeared as an expert witness on this subject to a wide variety of organizations/institutions including, local governments, school districts, city planning departments, telecommunications companies, the California Public Utilities Commission, the California Council on Science and Technology, national news organizations, and the U.S. Congress. In addition, his consultation services have included detailed computer based modeling of RF exposures as well as on-site safety inspections. Dr. Bushberg has performed RF & ELF environmental field measurements and recommend appropriate mitigation measures for numerous transmission facilities in order to assure compliance with FCC and other safety regulations and standards. The consultation services provided by Dr. Bushberg are based on his professional judgement as an independent scientist, however they are not intended to necessarily represent the views of any other organization.

Dr. Bushberg is a member of the main scientific body of International Committee on Electromagnetic Safety (ICES) which reviews and evaluates the scientific literature on the biological effects of nonionizing electromagnetic radiation and establishes exposure standards. He also serves on the ICES Risk Assessment Working Group that is responsible for evaluating and characterizing the risks of nonionizing electromagnetic radiation. Dr.Bushberg was appointed and is serving as a member of the main scientific council of the National Council on Radiation Protection and Measurements (NCRP). He is also the Senior Scientific Vice-President of the NCRP and chairman of the NCRP Board of Directors. Dr. Bushberg has served as chair of the NCRP committee on Radiation Protection in Medicine and he continues to serve as a member of this committee as well as the NCRP scientific advisory committee on Non-ionizing Radiation Safety. The NCRP is the nation's preeminent scientific radiation protection organization, chartered by Congress to evaluate and provide expert consultation on a wide variety of radiological health issues. The current FCC RF exposure safety standards are based, in large part, on the recommendations of the NCRP. Dr. Bushberg was elected to the International Engineering in Medicine and Biology Society Committee on Man and Radiation (COMAR) which has as its primary area of responsibility the examination and interpreting the biological effects of non-ionizing electromagnetic energy and presenting its findings in an authoritative and professional manner. Dr. Bushberg also served for several years as a member of a six person U.S. expert delegation to the international scientific community on Scientific and Technical Issues for Mobile Communication Systems established by the FCC and the FDA Center for Devices and Radiological Health.

Dr. Bushberg is a full member of the Bioelectromagnetics Society, the Health Physics Society and the Radiation Research Society. Dr. Bushberg received both a Masters of Science and Ph.D. from the Department of Bionucleonics at Purdue University. Dr. Bushberg is a fellow of the American Association of Physicists in Medicine and is certified by several national professional boards with specific sub-specialty certification in radiation protection and medical physics. Prior to coming to California, Dr. Bushberg was on the faculty of Yale University School of Medicine.