AGENDA
COMMITTEE OF THE WHOLE
SPECIAL MEETING
November 20, 2018
2200 Harnish Drive
Village Board Room
- AGENDA -
7:30 P.M.

Trustee Jasper – Chairperson
Trustee Brehmer
Trustee Glogowski
Trustee Steigert
Trustee Sosine
Trustee Spella
President Schmitt

1. **Roll Call – Establish Quorum**
2. **Public Comment – Audience Participation** (*Persons wishing to address the Committee on an item on this agenda must register with the Chair prior to roll call.*)
3. **Community Development**
   A. Consider a Special Use Permit for Clocktower Cupcakes located on S. Harrison Street
4. **General Administration**
   A. Consider Certain Items as Surplus
   B. Consider a Site Access Agreement with Chicago SMSA/Verizon for the Jacobs Water Tower
   C. Consider Increasing the Number of Liquor Licenses in Class A and Class A-1
5. **Public Works & Safety**
   A. Consider an Agreement with Nilco, Inc. of Woodstock for Downtown Snow Removal
   B. Consider an Agreement with Langton Group of Woodstock for Cul-de-sac and Eyebrow Snow Removal
   C. Consider an Amendment to Appendix B, 6A.28-C, Manual Meter Reading Fee
   D. Consider an Agreement with Sebert Landscaping for 2019 Landscaping Services
6. **Executive Session**
7. **Other Business**
8. **Adjournment**

# VILLAGE OF ALGONQUIN

*COMMUNITY DEVELOPMENT DEPARTMENT*

**– M E M O R A N D U M –**

DATE: November 20, 2018

TO: Committee of the Whole

FROM: Benjamin A. Mason, AICP, Senior Planner

SUBJECT: **Case No. 2018-15. 123 S. Harrison – Special Use Permit**

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Introduction

Mr. Ken and Donna Stratton have submitted a petition for Special Use Permit for a residential dwelling use on a portion of the ground floor of the building at 123 S. Harrison Street. The property is located in the village's Old Town District just south of Cornish Park and attached please find a map of the location.

The subject property is zoned B-1 Business, Limited Retail and consists of an 1890s Victorian era home. The house has been occupied by businesses in the past, however most recently it has been used as a single-family residence.

**123 S. Harrison Street**

The new owners propose to establish a "live/work" use of the property, whereby they would operate Clock Tower Cupcakes Shoppe in the front half of the home's main floor, and occupy the rear half of the ground floor as well as upper story for their own private residence.

Attached please find a floor plan submitted by the petitioner for their proposed use of the home's main floor. There will be separate entrances to the retail (pink) and residential portions (blue). The large rectangular room at the rear of the first floor is the home's residential kitchen. The petitioner is proposing to add a commercial kitchen and public bathroom toward the front to accommodate their retail operations.

Staff Comments

Current zoning regulations for commercial-zoned property downtown allow "by-right" a residential dwelling unit on the second floor of a structure. A Special Use Permit in this case is therefore only required to use the rear half of the building's ground floor as part of the residential dwelling. Since the property will once again be occupied by a business tenant, consistent with the property's underlying zoning designation, Staff supports the request for a Special Use Permit to allow for residential use of the rear half of the first floor. Attached please find a summary of the business operations provided by the petitioner.

Planning and Zoning Recommendation

On November 12, 2018 the Planning and Zoning Commission considered the petition and unanimously recommended approval (6-0) of the request for the Special Use Permit for residential use of the first floor of the B-1, Business zoned property at 123 S. Harrison Street.

Recommendation

Staff concurs with the Planning and Zoning Commission and recommends approval of the Special Use Permit, subject to the following conditions:

1. Terms of the Special Use Permit shall follow the village's Zoning Code, whereby, any special use that has been discontinued for a period of six consecutive months shall be considered terminated. Should the Special Use approval be terminated, residential use of the ground floor shall not be re-established in the future unless the Village Board grants a new special use permit request.

2. The petitioner shall apply for all necessary building and sign permits through the Community Development Department prior to opening the business.

3. Any exterior improvements to the structure shall be required to following the village's Preservation Code guidelines and obtain a Certificate of Appropriateness.

Attachments

1. P&Z Minutes
2. Property Map
3. Floor Plan
4. Business Plan

DRAFT

**VILLAGE OF ALGONQUIN**
**PLANNING AND ZONING COMMISSION**
**Meeting Minutes**
**William J. Ganek Municipal Center-Board Room**
**November 12, 2018**
**7:30 p.m.**

***AGENDA ITEM 1***: Roll Call to Establish a Quorum
Present: Chairperson Patrician, Commissioners Hoferle, Szpekowski, Postelnick, Laipert, and Sturznickel.

Absent: Neuhalfen

Staff Members Present: Ben Mason, Senior Planner

***AGENDA ITEM 2***: Approval of Minutes from the August 13, 2018 Meeting.
A motion by Commissioner Sturznickel to approve the August 13, 2018 minutes as presented was seconded by Commissioner Szpekowski and a voice vote noted all ayes. The motion carried.

***AGENDA ITEM 3***: Public Comment
There was no one wishing to make any public comment.

***AGENDA ITEM 4***: Request for a Special Use Permit
**Case No. 2018-15 Clock Tower Cupcakes, 123 S. Harrison Street**
Petitioner: Ken and Donna Stratton, property owner

**OPEN PUBLIC HEARING AND ESTABLISH QUORUM**
Mr. Mason called roll to verify a quorum. Present: Commissioners Hoferle, Szpekowski, Postelnick, Laipert, Sturznickel and Chairperson Patrician. Absent: Neuhalfen. Mason announced a quorum was present. Chairperson Patrician opened the public hearing and asked for petitioner comments.

**PETITIONER COMMENTS**
Chairperson Patrician verified that proper notice of the meeting had been posted. Chairperson Patrician swore in the petitioners, Ken and Donna Stratton, property owner at 123 S. Harrison Street. The couple purchased the property to live upstairs in the historic Victorian era home as well as operate their business Clock Tower Cupcakes on the first floor. Due to the layout of the home's floor plan, the petitioner is requesting use of the rear portion of the ground floor which has the house's kitchen and other living space, for an extension of their private residence upstairs.

Chairperson Patrician then asked for Staff Comments.

**STAFF COMMENTS**
Mason reviewed his staff report for the Commission. The property is located downtown and zoned B-1, Business. Residential use is allowed on the second floor of the property by-right, however the petitioner is required to obtain a Special Use Permit to occupy a portion of the ground floor for their private residence. Staff supports the request, as the proposed bakery business is permitted in the B-1 district and

will be located at the front of the home facing out toward Harrison Street. Residential use of the ground floor will be limited to the rear of the first floor, and fulfill the petitioner's desire to establish a live/work arrangement in a historic home downtown.

**COMMISSION QUESTIONS/COMMENTS**
Chairperson Patrician inquired if there were any Commissioner questions or comments.

Commissioner Laipert asked if the Special Use Permit would expire if the petitioners sold the property in the future, to which Staff clarified yes it would continue to remain in effect provided the new owners establish a similar live/work use within six (6) months.

Commissioner Sturznickel asked how the petitioners plan to advertise their business, to which they stated through a variety of social media outlets, participating in local events and a sign on their property.

Commissioner Hoferle asked if any special ventilation equipment will be required for the bakery, to which Mr. Stratton stated it would likely not be necessary as their commercial kitchen will probably consist of simply two large ovens and a freezer.

Chairperson Patrician suggested a pedestrian crosswalk be added on S. Harrison Street to connect the property to public parking on the west side of the street.

**PUBLIC COMMENT**
Chairperson Patrician called for public comments.

There was no one wishing to make any public comment.

**CLOSE PUBLIC COMMENT**

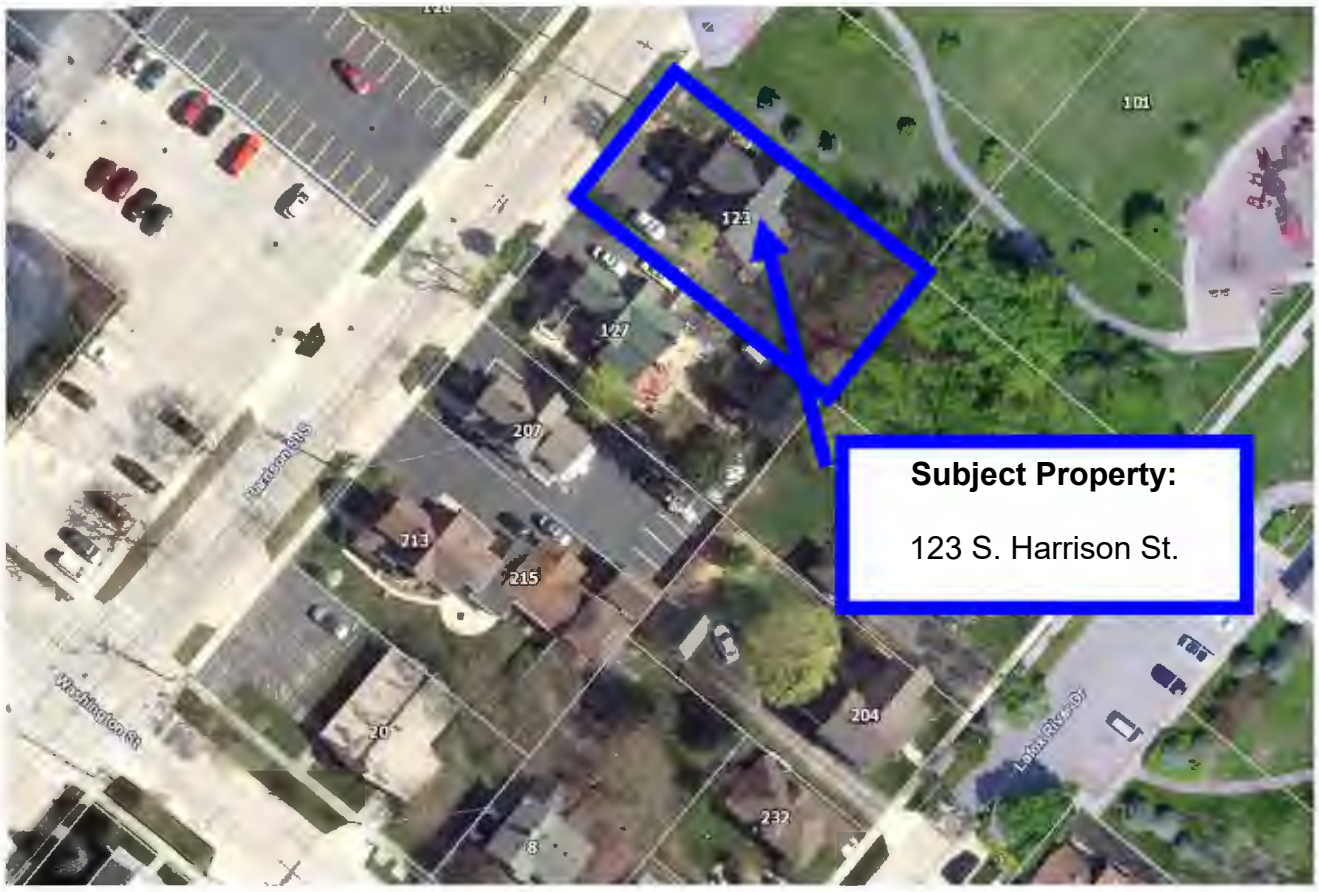
**COMMISSION MOTION ON PETITION**
Chairperson Patrician entertained a motion to approve the request for Special Use Permit for residential use of the first floor of the B-1, Business zoned property at 123 S. Harrison Street. Commissioner Postelnick moved and Commissioner Sturznickel seconded a motion to recommend approval of the request consistent with the petition submitted by the petitioner, the findings of fact listed in the November 12, 2018 Community Development memorandum and the conditions recommended by staff.

The Roll Call noted the following: Ayes: Commissioners Laipert, Szpekowski, Postelnick, Sturznickel, Hoferle and Chairperson Patrician. Nays: None. Absent: Neuhalfen. Motion carried 6-0.

***AGENDA ITEM 5:*** New/Old Business
Staff gave a brief update on the status of Main Street construction and ongoing renovation work at Algonquin Town Center.

***AGENDA ITEM 6***: Adjournment
A motion to adjourn the meeting was seconded and a voice vote noted all ayes. The motion carried and the meeting was adjourned at 8:05p.m.

# Property in Question Map



Clock Tower Cupcakes Shoppe
123 S. Harrison St.
Algonquin, IL 60102

# General Business Overview

Planning to offer cupcakes (a variety of flavors), crumb cupcakes, and cinnamon roll cupcakes as well as beverages; coffee, tea, and water.

We aim to attract customers after dining, morning commuters, park patrons, visitors of downtown, and people who place orders on the website.

Anticipating foot traffic to be greater during the warmer months, our hours of operation will vary during different seasons. Our initial plan is;

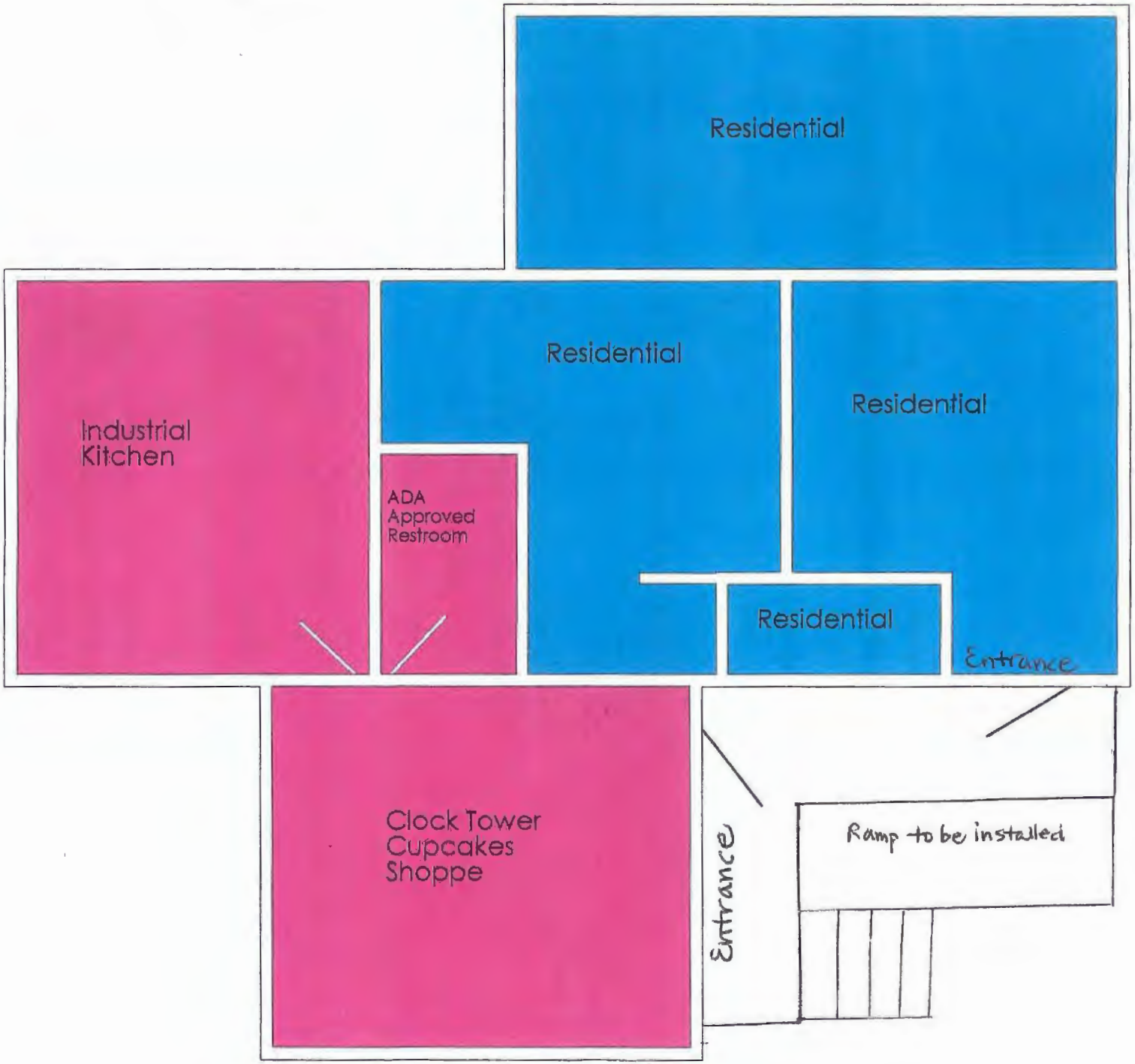
Spring/Summer - 7:30 am - 8:30 pm Tuesday-Thursday
7:30 am - 9:30 pm Friday-Saturday
8:30 am - 5:30 Sunday
Closed Monday

Possible Fall/Winter hours - Weekends 8:00 am - 6:00 pm

We will open for special order pick ups of online orders and by appointment for wedding tastings and consultations.

We would be open with extended hours during Algonquin's special events such as Christmas tree lighting, Founder's Day, etc.

123 S. Harrison St., Algonquin



# VILLAGE OF ALGONQUIN

*GENERAL SERVICES ADMINISTRATION*

**– M E M O R A N D U M –**

DATE: November 13, 2018

TO: Tim Schloneger, Village Manager

FROM: Kevin Crook, Chief Innovation Officer

SUBJECT: *Computer Equipment Surplus*

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Attached (1) please find a copy of the devices that are requested to be declared surplus. The list of surplus items represents used equipment from the Village of Algonquin. All items contained on the list are beyond their useful service life and will be recycled to clean up storage areas.

Staff recommends the declaration of surplus for said devices.

FY19 IT Surplus (Nov 14 2018)

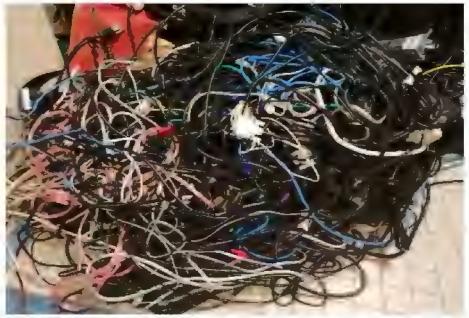
| Category | Count |
|---|---|
| Monitors | 43 |
| Desktop | 28 |
| Laptop | 26 |
| Printers | 10 |

| Type | Make | Model | S/N |
|---|---|---|---|
| ??? | Martin Yale | 1501X0 | 56852 |
| ASA | Cisco | 5505 | JMX1218Z10C |
| Desktop | HP | dc7900 | 2UA9240YSR |
| Desktop | HP | dc7900 | 2UA9240YSZ |
| Desktop | HP | dc7900 | 2UA9240YT3 |
| Desktop | Lenovo | m91p | MJHCGFP |
| Desktop | Lenovo | m91p | MJTFH3T |
| Desktop | Lenovo | m91p | MJTHBP6 |
| Desktop | Lenovo | m91p | MJTGNH0 |
| Desktop | Lenovo | m91p | MJTHBP4 |
| Desktop | Lenovo | m91p | MJTGTB7 |
| Desktop | Lenovo | m91p | MJTGNG4 |
| Desktop | Lenovo | m91p | MJTGTA9 |
| Desktop | Lenovo | m91p | MJTFHR9 |
| Desktop | Lenovo | m91p | MJWZTD5 |
| Desktop | Lenovo | m91p | MJTGTB9 |
| Desktop | VarTech Systems | VTPC1709 | VNC130402001 |
| Desktop | Lenovo | m91p | MJTGNH3 |
| Desktop | Lenovo | m93p | MJNVVZY |
| Desktop | Lenovo | m93p | MJNVVZW |
| Desktop | Lenovo | m93p | MJNVWAE |
| Desktop | HP | DC7800 | 2UA82719V8 |
| Desktop | HP | DC7800 | 2UA82719V5 |
| Desktop | HP | DC7900 | 2UA9240YSX |
| Desktop | HP | DC7800 | 2UA82791V9 |
| Desktop | HP | DC7800 | 2UA82719V7 |
| Desktop | HP | DC5750M | MXM650004B |
| Desktop | HP | DC7900 | 2UA9240YT0 |
| Desktop | HP | DC7900 | 2UA9240YT1 |
| Desktop | HP | DC7900 | 2UA9240YST |
| Laptop | Lenovo | T61p | L3F2828 |
| Laptop | Lenovo | T61p | L3F2826 |
| Laptop | Lenovo | T61p | L3F2831 |
| Laptop | Lenovo | T60 | L3BP412 |
| Laptop | Lenovo | T60P | L3-F2833 |
| Laptop | Lenovo | T60P | L3-F2825 |
| Laptop | Dell | PP04X | 50540C1 |
| Laptop | Lenovo | T60P | L3-ABN5T |
| Laptop | Dell | 92L90093 | 2W3YF41 |
| Laptop | Lenovo | T60P | L3-ABN5W |
| Laptop | Lenovo | T60P | L3-F2827 |
| Monitor | HP | RA373A | CN492001JC |
| Monitor | Dell | 1907FPC | CN-0CC299-64180-649-05AS |
| Monitor | Dell | 2007WFPB | MX-0HF730-46634-76L-64CL |
| Monitor | Dell | RA373A | CN49080676 |

| | | | |
|---|---|---|---|
| Monitor | Dell | 1907FPC | CN-0CC299-64180-641-8TPL |
| Monitor | Dell | 1905FP | CN-0T6116-71618-4AT-ACWS |
| Monitor | Dell | 622-HB1 | V1H6784 |
| Monitor | Dell | 1907FPC | CN-0CC299-64180-64P-0JGS |
| Monitor | Dell | 1704FPVT | CN-0J664271618-550-AHPD |
| Monitor | Dell | 1907FPC | CN-0CJ319-72872-6A4-457L |
| Monitor | Dell | 1707FPT | CN-0CC280-71618-6BH-ADUH |
| Monitor | Dell | 2007WFPB | CN-0CC299-64180-64J-4J9S |
| Monitor | Dell | 1800FP | MX-07R477-48323-34N-0G5W |
| Monitor | Dell | 6622-HB1 | V1H6786 |
| Monitor | LG | L17MS-0 | 406MXPH1A328 |
| Monitor | HP | RA373A | CN492001PT |
| Monitor | HP | RA373A | CNG8210BHW |
| Monitor | HP | L2045W | CNT717S0N4 |
| Monitor | Dell | 1704FPVS | MX-0H6304-47605-55I-ALVP |
| Monitor | Dell | 1907FPC | CN-0T6116-71618-54M-AG7W |
| Monitor | Sony | SDM-S73 | 3258235 |
| Monitor | Dell | 1800FP | MX-07R477-48323-34N-0G5N |
| Monitor | Dell | 2007WFPB | MX-0HF730-46634-76L-641L |
| Monitor | HP | RA373A | CN492001JH |
| Monitor | Dell | 1704FPVS | MX-0H6304-47605-55I-ALU1 |
| Monitor | Dell | 2009WR | CN-0KM509-71618-834-AXFU |
| Monitor | Dell | 6622-HB1 | MX-05F108-47605-33V-CVN3 |
| Monitor | Dell | 1704FPTT | CN-0Y4299-71618-54G-AA69 |
| Monitor | Dell | 1704FPTT | CN-0Y4299-71618-56M-AA9E |
| Monitor | Dell | 2007WFPB | MX-0HF730-46634-76L-63UL |
| Monitor | HP | RA373A | CN492001PW |
| Monitor | Dell | 1704FPVS | MX-0H6304-47605-55I-ALSJ |
| Monitor | Dell | 1907FPC | CN-0T6116-71618-5AN-AE49 |
| Monitor | Dell | 1907FPC | CN-0CC299-64180-64J-4J6S |
| Monitor | Dell | 1907FPC | CN-0CC299-64180-64P-0JGS |
| Monitor | Dell | 1907FPC | CN-0CC299-64180-64P-050S |
| Monitor | Dell | 1907FPC | CN-0CC299-64180-64I-1P9S |
| Monitor | HP | RA373A | CN492001P8 |
| Monitor | Dell | 2001FP | CN-0C0646-46633-49R-0THL |
| Monitor | Dell | 1504FP | MX-05F108-47605-34P-C9WA |
| Monitor | Dell | 1800FP | MX-07R477-48323-34N-0G61 |
| Monitor | Dell | 1905FP | CN-0T6116-71618-4A8-AE23 |
| Monitor | Dell | 1905FP | CN-0T6116-71618-54M-AG0D |
| Phone | Nortel | M7100 | NNTM09098BWW |
| Printer | Ricoh | MP 161SPF | M0169500070 |
| Printer | HP | E3E03A | TH6AS611DZ |
| Printer | HP | CE461A | VNB3L03954 |
| Printer | HP | Q5409A | CNRXL95502 |
| Printer | Fargo | DTC300FD | A502033 |
| Printer | HP | C5871A | SG86I1V2BC |

| | | | |
|---|---|---|---|
| Printer | HP | C8969A | MY74R9R00W |
| Printer | HP | J4093A | SG01903250 |
| Printer | HP | C9016A | TH56R120VV |
| Printer | HP | CB092A | MY9C2417C |
| Server | Dell | EMS | CKR9P91 |
| Server | Dell | SC1425 | 7951J71 |
| Switch | Dlink | DSS-5+ | B205338027475 |
| Switch | Linksys | SD208 | REG10G620329 |
| Toughbook | Panasonic | CF-29 | 5IKYA59405 |
| Toughbook | Panasonic | CF-30 | 7GKYA50081 |
| Toughbook | Panasonic | CF-29 | 5IKYA59406 |
| Toughbook | Panasonic | CF-30 | 7GKYA49785 |
| Toughbook | Panasonic | CF-29 | 6DKYA28842 |
| Toughbook | Panasonic | CF-29 | 5IKYA59408 |
| Toughbook | Panasonic | CF-29 | 5IKYA59409 |
| Toughbook | Panasonic | CF-19 | 1AKSA27770 |
| Toughbook | Panasonic | CF-19 | 8DKSA47087 |
| Toughbook | Panasonic | CF-18 | 6GKYA18716 |
| Toughbook | Panasonic | CF-19 | 2DKSA45202 |
| Toughbook | Panasonic | CF-19 | 7GKSA64643 |
| Toughbook | Panasonic | CF-19 | 7GKSA64605 |
| Toughbook | Panasonic | CF-19 | 7GKSA64605 |
| Toughbook | Panasonic | CF-19 | 7GKSA64601 |
| UPS | APC | SC420 | 5S1311TI5760 |

Cables



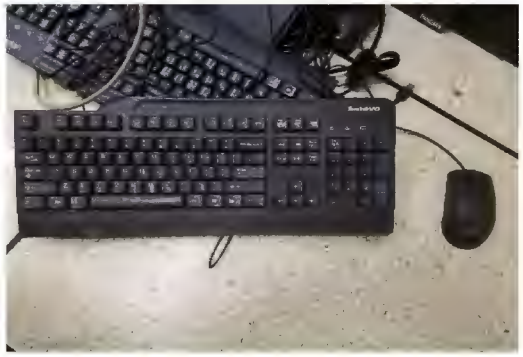
Workstations

Laptops

Ruggedized Laptops

Monitors

Keyboards/Mice



Servers

Printers

# VILLAGE OF ALGONQUIN

*GENERAL SERVICES ADMINISTRATION*

**– M E M O R A N D U M –**

DATE: November 11, 2018

TO: Tim Schloneger, Village Manager

FROM: Kevin Crook, Chief Innovation Officer

SUBJECT: *Chicago SMSA/Verizon Site Access Agreement – Jacobs Water Tower*

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Attached (1) please find a copy of the proposed Site Access Agreement (SAA) between the Village of Algonquin and Chicago SMSA/Verizon for grounds access to perform a site investigation at the Jacobs Water Tower (2600 Bunker Hill Road).

The primary purpose for this agreement is for Verizon to conduct a Site Investigation at the property as Verizon is interested in collocating cellular equipment on Jacobs Tower. This activity is required prior to proceeding forward with a Site Lease Agreement (SLA). Verizon will have until May 2019 to conduct its tests on the site.

***Village staff recommends Village Board approval of this agreement***

If you concur, please forward to the Committee of the Whole for their consideration at their next meeting. Please do not hesitate to contact me with any questions.

# SITE ACCESS AGREEMENT

This Site Access Agreement (this **"Agreement"**) is executed by Chicago SMSA Limited Partnership d/b/a Verizon Wireless (the "**Licensee**"), with a business address of 180 Washington Valley Road, Bedminster, NJ 07921, and the Village of Algonquin, an Illinois municipality, (the **"Licensor"**) whose mailing address is 2200 Harnish Drive, Algonquin, Illinois 60102.

## BACKGROUND

With respect to a portion of the real property (the **"Property"**) located at 2600 Bunker Hill Rd., Algonquin, County of McHenry, Illinois 60102, as more fully described in **Exhibit A**, attached, Licensee wishes to have access to the Property for an environmental investigation relative to the potential placement, maintenance and use of a communications facility and appurtenant uses, and the Licensor has agreed to grant to Licensee and other persons described herein, a license, to enter upon the Property to conduct activities to help Licensee assess the suitability of the Property for its intended use. These activities may include, among other things, environmental inspection, testing and sampling activities ("Site Investigations") at the Property.

The purpose of this Agreement is to enter into a site access license governing the Site Investigations that may be conducted by Licensee's authorized agents, contractors, consultants and employees.

Licensee and Licensor agree as follows:

1. **Authority to Grant a License.** Licensor represents that it has the authority to grant the access allowed by this Agreement and that there is no need to obtain the approval or consent of any other party. The Licensor hereby grants a temporary, nonexclusive license to Licensee to conduct the Site Investigation that will automatically expire on May 1, 2019.

2. **Access to Property and Licensor's Consent.** Licensor grants to Licensee and its agents, advisors, employees, consultants, representatives, and independent contractors, including environmental contractors and consultants hired directly or indirectly by Licensee (collectively, the **"Licensee Representatives"**), this temporary, nonexclusive license for ingress to, egress from, and access under, above, and through, the Property for the purpose of performing the Site Investigation. The Site Investigation may include, but is not necessarily limited to, activities intended to (1) review environmental, safety and health conditions;(2) conduct radio tests, including the placing of radio broadcast/receive equipment on the Property for necessary periods; (3) conduct physical, structural and geotechnical testing; and (4) perform boundary and other surveys. These activities may, among other things, include the collection and testing of samples of soil, water, building materials and other substances. Without limiting the generality of the foregoing, the Licensee Representatives may drill into the soil, remove reasonable amounts of soil, install and sample monitoring wells, so long as such wells are removed upon the expiration of this license and perform other tests, actions, evaluations, procedures, and treatments to complete its investigations. The Licensee Representatives shall undertake all activities on the Property in compliance with all applicable laws and shall use commercially reasonable efforts to minimize the extent and duration of any interference with Licensor's business operations on the Property. The

cost of all such activities shall be the responsibility of Licensee (or the Licensee Representatives as arranged between the Licensee Representative and the Licensee) and not Licensor.

3. **Advance Notice.** Licensee or Licensee Representatives shall give Licensor at least twenty-four (24) hours advance notice, either orally (by telephone or in person) or by electronic message of a planned activity that can reasonably be expected to require invasive activities into the Property's subsurface, including notice of the areas of the Property that are expected to be materially affected by any sampling, monitoring, installation, or similar action. Licensee Representatives shall cooperate with Licensor to schedule the activities so as to minimize the extent and duration of any interference with Licensor's operations.

4. **Installation, Sampling, and Removal.** Licensor shall cooperate with the Licensee Representatives regarding all installation, monitoring, sampling, removal and related activities that Licensee Representatives desire to conduct on the Property. Licensor shall cooperate in locating buried utilities and improvements on the Property at the request of Licensee Representative and shall assist the Licensee Representatives in avoiding impacts to such buried or concealed features. At the Licensor's specific request, Licensee Representatives shall use commercially reasonable efforts to schedule its activities to avoid times of peak business activity on the Property. Licensor authorizes Licensee Representatives to obstruct temporarily, but for a reasonable period of time, access to, or use of, limited areas of the Property to conduct Site Investigations. Licensee Representatives may use any electrical or other utility outlets or connections on the Property to conduct its activities. Licensee Representatives shall split all samples with Licensor upon Licensor's request, so long as Licensor pays for any and all additional costs incurred by the Licensee Representatives in this regard. After completing the activities contemplated by this Agreement, Licensee or Licensee Representatives shall remove their equipment and restore any part of the Property that was affected by its activities to a condition that is reasonably similar to the condition of the Property at the time immediately preceding the commencement of said activities.

5. **Indemnification.**
(a) Licensee shall indemnify and hold harmless Licensor for any penalties, damages or costs that result from the negligence or willful misconduct, misrepresentation or breach of warranty in this agreement by Licensee or Licensee representatives.

(b) Licensee shall indemnify and hold harmless Licensor for any penalties, damages, claims, actions or costs that result from Licensee's or Licensee's Representatives' presence or activities on the Property, except to the extent caused by the negligence or willful misconduct of Licensor. Notwithstanding the foregoing, Licensee shall not be responsible for any environmental or industrial hygiene condition that existed on the Property before the execution of this Agreement, or that otherwise does not result from the activities of Licensee. For the avoidance of doubt, Licensee shall not become liable or responsible for any condition simply because Licensee discovers it while conducting the testing permitted by this Agreement or reports it to any appropriate agency in accordance with law.

(c) The site access granted to the Licensee and/or Licensee Representatives pursuant to this Agreement extends to any repair or restoration work required to remediate any damage to the Property that is indemnified pursuant to this Section.

6. In the event that, as a result of Licensee and/or Licensee Representatives' Site Investigations or any other activities relative to the environmental condition of Property, it is determined that there is a reporting obligation regarding the Property, the Village shall be responsible for any such reporting, alone, and neither Licensee or any Licensee Representative shall undertake any such reporting of any kind, unless the Village refuses to do so and Licensee or Licensee Representative is required to do so by law. Licensee shall cause every Licensee Representative that it utilizes relative to the Site Investigations to be added as a signatory to this Agreement such that each Licensee Representative is bound to this provision.

7. **Waiver; Modification; Severability.** An extension, amendment, modification, cancellation, or termination of this Agreement will be valid and effective only if it is in writing and signed by each party to this Agreement, except as provided otherwise in this Agreement. In addition, a waiver of any duty, obligation, or responsibility of a party under this Agreement will be valid and effective only if it is evidenced by a writing signed by, or on behalf of, the party against whom the waiver or discharge is sought to be enforced. Whenever possible, each provision of this Agreement should be construed and interpreted so that it is valid and enforceable under applicable law. However, if a provision of this Agreement is held by a court of competent jurisdiction to be invalid or unenforceable, that provision will be deemed severable from the remaining provisions of this Agreement and will not affect the validity, interpretation, or effect of the other provisions of this Agreement or the application of that provision to other circumstances in which it is valid and enforceable.

8. **Assignment; Third Party Beneficiaries.** Neither the entry of this Agreement or any action taken by Licensee hereunder shall create any third party beneficiary or third party beneficiary rights.

9. **Legal Matters.** The validity, construction, enforcement, and interpretation of this Agreement are governed by the laws of the State where the Property is located and the federal laws of the United States of America.

10. **Notices.** Except for oral notices specifically authorized in this agreement, notices permitted by this Agreement will be valid only if such notice is in writing, delivered personally or by e-mail, telecopy, commercial courier, or first class, postage prepaid, United States mail (whether or not certified or registered and regardless of whether a return receipt is requested or received by the sender), and addressed by the sender to the intended recipient at its address set forth in the first paragraph of this Agreement, or to such other address as the intended recipient may designate by notice given to the sender in accordance with this section. A validly given notice, consent, demand, request, or approval will be effective on the earlier of its receipt, if delivered personally or by e-mail, telecopy, or commercial courier, or the third day after it is postmarked by the United States Postal Service, if delivered by first class, postage prepaid, United States mail. Each party promptly shall notify the other of any change in its mailing address or telephone contact number stated in this Agreement.

11. **Complete Agreement; Survival.** This Agreement records the entire understanding between the parties regarding the subjects addressed in it and supersedes any previous or contemporaneous agreement, understanding, or representation, oral or written, by either of them.

12. **Execution and Effectiveness.** The parties may execute this Agreement in counterparts. Each executed counterpart will constitute an original document, and all executed counterparts, together, will constitute the same agreement. This Agreement will become effective upon the last signatory's delivery of the fully executed document to the other party, and the last signatory shall fill in the EXECUTED date below prior to such delivery.

**EXECUTED:** _____, 20____.

**LICENSOR:**

**The Village of Algonquin**

By: _____

Name: _____

Title: _____

Date: _____

**LICENSEE:**

**Chicago SMSA Limited Partnership,**
**d/b/a Verizon Wireless,**
**By Cellco Partnership, Its General Partner**

By: _____

Name: _____

Title: _____

Date: _____

The undersigned "Licensee Representative" has reviewed this Agreement and hereby agrees to comply with all obligations pertaining to, and imposed on, Licensee Representatives contained herein.

Agreed to and accepted by:
**EnviroBusiness, Inc.**

By: _____

Name: _____

Its Authorized Agent

Date: _____

# EXHIBIT A
## LEGAL DESCRIPTION

**ALL THAT PARCEL OF LAND IN MCHENRY COUNTY, STATE OF ILLINOIS, AS MORE FULLY DESCRIBED IN DEED DOC # 94R-042872, ID# 19-30-476-003, BEING KNOWN AND DESIGNATED AS FOLLOWS:**

**THAT PART OF LOT 6 IN EAGLE COMMERCIAL CENTER, BEING A RESUBDIVISION OF LOT 3 IN KAPER'S WEST SUBDIVISION OF PART OF THE EAST HALF OF THE SOUTHEAST QUARTER OF SECTION 30, TOWNSHIP 43 NORTH, RANGE 8 EAST OF THE THIRD PRINCIPAL MERIDIAN, ACCORDING TO THE PLAT THEREOF RECORDED NOVEMBER 4, 1993 AS DOCUMENT NO. 93R67593, DESCRIBED AS FOLLOWS: BEGINNING AT THE SOUTHWEST CORNER OF SAID SUBDIVISION; THENCE NORTH 00 DEGREE, 07 MINUTES, 37 SECONDS WEST ALONG THE WEST LINE OF SAID SUBDIVISION, 201.00 FEET; THENCE NORTH 89 DEGREES, 20 MINUTES, 24 SECONDS EAST, 150.00 FEET; THENCE SOUTH 00 DEGREES, 07 MINUTES, 37 SECONDS EAST, 138.77 FEET; THENCE ALONG A CURVE TO THE LEFT, HAVING A CHORD BEARING OF SOUTH 72 DEGREES, 46 MINUTES, 55 SECONDS EAST AND A RADIUS OF 333.00 FEET, AN ARC DISTANCE OF 107.50 FEET; THENCE ALONG A CURVE TO THE LEFT, HAVING A CHORD BEARING OF SOUTH 77 DEGREES, 05 MINUTES, 48 SECONDS EAST AND A RADIUS OF 267.00 FEET , AN ARC DISTANCE OF 126.41 FEET TO A POINT ON THE SOUTH LINE OF SAID SUBDIVISION; THENCE SOUTH 89 DEGREES, 20 MINUTES, 24 SECONDS WEST, ALONG SAID SOUTH LINE, 374.19 FEET, TO THE PLACE OF BEGINNING, IN MCHENRY COUNTY, ILLINOIS.**

VILLAGE OF ALGONQUIN
MEMORANDUM

DATE: November 15, 2018

TO: Committee of the Whole

FROM: Michelle Weber

SUBJECT: Liquor Code Amendment

In accordance with an ordinance passed in 2013 limiting the number of allowable liquor licenses in all classes to the number of licenses issued at that time, the attached proposed ordinance increases the number of available Class A and Class A-1 liquor licenses by one each. These changes are the result of requests from:

- Bull's Eye Pub & Eatery, LLC, 229 S. Main Street, Algonquin, a new restaurant opening soon in our downtown area. This license will allow them to serve alcohol for consumption on premises, and shall permit the sale of alcohol for consumption off premises.
- Burrito Inc., Burrito Parrilla Mexicana, 2321 W. Algonquin Road, Algonquin, a new restaurant opening in the former Fradillio's building. This license will allow them to serve alcohol for consumption on premises.

Staff recommends that the change in the number of available licenses be approved.

Attachment

# ORDINANCE NO. 2018-O-XX

***An Ordinance Amending Chapter 33, Liquor Control and Liquor Licensing, of the Algonquin Municipal Code***

WHEREAS, the Village of Algonquin, McHenry and Kane Counties, Illinois, is a home rule municipality as contemplated under Article VII, Section 6, of the Constitution of the State of Illinois, and the passage of this Ordinance constitutes an exercise of the Village's home rule powers and functions as granted in the Constitution of the State of Illinois.

NOW, THEREFORE, BE IT ORDAINED by the President and Board of Trustees of the VILLAGE OF ALGONQUIN, McHenry and Kane Counties, Illinois, as follows:

SECTION 1: Section 33.07-B, Paragraphs 1 and 2 Number of Licenses Issued, of the Algonquin Municipal Code shall be amended as follows:

1. Four Class A Licenses at any one time.
2. Twenty-Five Class A-1 Licenses at one time.

SECTION 2: If any section, paragraph, subdivision, clause, sentence or provision of this Ordinance shall be adjudged by any Court of competent jurisdiction to be invalid, such judgment shall not affect, impair, invalidate or nullify the remainder thereof, which remainder shall remain and continue in full force and effect.

SECTION 3: All ordinances or parts of ordinances in conflict herewith are hereby repealed to the extent of such conflict.

SECTION 4: This Ordinance shall be in full force and effect December 5, 2018, approval and publication in pamphlet form (which publication is hereby authorized) as provided by law.

Voting Aye:
Voting Nay:
Abstain:
Absent:

APPROVED:

(SEAL)

_____
Village President John C. Schmitt

ATTEST: _____
Village Clerk Gerald S. Kautz

Passed:
Approved:
Published:

# VILLAGE OF ALGONQUIN

*PUBLIC WORKS DEPARTMENT*

**– M E M O R A N D U M –**

DATE: November 16, 2018

TO: Bob Mitchard, Public Works Director

FROM: Steven R. Ludwig, General Services Superintendent

SUBJECT: Snow Plowing Bid Recommendation

---

Public Works General Services received bids for contracted snow removal for two different work activities this week. One bid is for snow removal in various cul-de-sacs and eyebrows located throughout town, and the other is for snow removal for streets, walks, and parking areas throughout the downtown area. The bid numbers requested reflect the costs expected for an average season. The reality of each season may require significantly more or less costs, dependent upon the amount of snowfall received. The bids received are as follows:

**Cul-de-sacs and Eyebrows**

| | |
|---|---|
| Greve Construction, Inc.: | $151,050 |
| Langton Group: | $123,844.56 – Award Recommended |
| Nilco, Inc.: | Non-responsible bid. |

**Downtown**

| | |
|---|---|
| Greve Construction, Inc.: | $235,600 |
| Nilco, Inc.: | $111,735 – Award Recommended |
| Snow Systems: | $259,810 |

I have reviewed the references for each of the lowest responsible bids and find them to be acceptable. Therefore, I recommend award of the following bids:

| **Cul-de-sacs and Eyebrow Snow Removal** | **The Langton Group of Woodstock, IL.** |
|---|---|
| 1-5 inches of snow clearing: | $5,897.36/per cycle |
| 5-9 inches of snow clearing: | $8,846.04/per cycle |
| Seasonal Estimate: | $123,844.56 |

| **Downtown Snow Removal** | **Nilco, Inc. of Woodstock, IL.** |
|---|---|
| 1-5 inches of snow clearing: | $5,395.00/per cycle |
| 5-9 inches of snow clearing: | $7,950.00/per cycle |
| Seasonal Estimate: | $111,735.00 |

I look forward to your response.

# NOTICE TO BIDDERS
# FOR
# 2018-19 Snow Removal Downtown

The Village of Algonquin is now accepting sealed bid proposals for **2018-19 Snow Removal Downtown**. Bids will be accepted until 11 a.m. CST on Tuesday, November 13, 2018 at the William J. Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois, 60102 c/o Deputy Village Clerk.

## Time and Place of Bid Opening

Notice is hereby given that the Village of Algonquin, Illinois, will receive sealed bids at the William J. Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois 60102 until 11 a.m. CST on November 13, 2018 for **2018-19 Snow Removal Downtown**, at which time the bids will be publicly opened and read. Bid will be awarded to the lowest responsible bidder determined in the exclusive discretion of the Village Board of Trustees.

## Description of Work

Each bid includes a separate scope of work, similar in effort. The bid involves clearing snow and applying ice control to areas throughout our downtown including roadways, parking areas, sidewalks, and walkways.

## Availability of Contract Documents

Electronic copies of for 2018-19 Snow Removal Downtown Bid Specifications, and Contract Documents may be obtained for free online at www.algonquin.org *(at top of page click on "Business" & select "Bids & RFP's", the project will be listed near the bottom of the page).* A compact disc of the information may also be obtained at the Village of Algonquin, Office of the Village Clerk, Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois 60102 upon receipt of a $10.00 non-refundable deposit. If mailing is requested an additional $5.00 deposit will be required.

## Bid Security

A proposal guaranty in the proper amount, as specified in BLRS Special Provision for Bidding Requirements and Conditions for Contract Proposals, will be required. Bid Bonds will be allowed as a proposal guaranty. Accompanying this proposal is either a bid bon if allowed, on Department form BLR 12230 or as a proposal guaranty check, complying with the specifications, made payable to the Village of Algonquin. The amount of the check is 5% of the Bid amount.

## Submission Format

Bids shall be made on the forms furnished by the Village and shall be submitted no later than the specified closing time in an opaque sealed envelope addressed to: Village of Algonquin, attention: Deputy Clerk, 2200 Harnish Drive, Algonquin, IL 60102. Envelopes should be clearly marked, "**Sealed Bid 2018-19 Snow Removal Downtown**". The bids will be opened at this location and read aloud. The Village of Algonquin reserves the right to reject any or all parts thereof, or waive any formality or technical errors, and to make the award in the best interest of the Village.

**Public Works**

This contract calls for the construction of a "public works," within the meaning of the Illinois Prevailing Wage Act, 821 ILCS 130/.01 et seq. ("the Act"). The Act requires contractors and subcontractors to pay laborers, workers and mechanics performing services on public works projects no less than current "prevailing rate of wages" (hourly cash wages plus amount for fringe benefits) in the county where the work is performed. The Illinois Department of Labor publishes the prevailing wage rates on its website http://www.state.il.us/agency/idol/rates/rates.HTM. The Illinois Department of Labor revises the prevailing wage rates and the contractor/subcontractor has an obligation to check the Illinois Department of Labor website for revisions to prevailing wage rates. For information regarding current prevailing wage rates, please refer to the Illinois Department of Labor's website. All contractors and subcontractors rendering services under this contract must comply with all requirements of the Act, including by not limited to, all wage requirements and notice and record keeping duties." Each bidder shall adopt a written sexual harassment policy in compliance with ILCS 5/2-105 (1992). Bidder agrees to comply with Substance Abuse Prevention on Public Works Projects Act, 820 ILCS265/1 et seq. (2008). As required by the Act, the Bidder agrees to file with the Village, prior to commencing work, its written substance abuse prevention program. It is the responsibility of the vendor/contractor/subcontractor to comply with all applicable provisions of FOIA. The regulations of the State of Illinois Freedom of Information Act (FOIA) 5 ILCS 140, apply to all records of the vendor/contractor/subcontractor pertaining to this authorization or contract. When requested by the Village of Algonquin, the vendor/contractor is required to provide all records requested within no more than three (3) business days, at no cost to the Village of Algonquin.

**Questions**

All questions regarding this project should be directed to Steve Ludwig at steveludwig@algonquin.org or (847) 658-2754 ext. 4411

By: Tim Schloneger, Village Manager

# Village of Algonquin
# Standard Conditions

**Contract Documents**: Any drawings, plans, standard conditions, supplemental additional conditions, specifications, bid notice, bid sheet, and addendum, if any, as specified herein shall form the "Contract Documents." For the purpose of this bid, the word "Village" shall refer to the Village of Algonquin, and the word "Bidder" shall refer to any person, company, or entity submitting a bid. Any work shown or described in one of the documents shall be construed as if described in all the documents.

**Interpretation of Contract Documents**: Each request for interpretation of the Contract Documents shall be made in writing addressed to Steve Ludwig, General Services Superintendent, Village of Algonquin, 110 Meyer Drive, Algonquin, IL 60102 (steveludwig@algonquin.org) and shall be received at least (5) business days prior to the scheduled bid opening date. Interpretations and supplemental instructions will be in the form of written addenda to the Contract Documents.

**Electronic Bid Documents**: Electronic copies of the 2018-19 Snow Removal - Downtown Bid Specifications, and Contract Documents may be obtained for free online at www.algonquin.org (at top of page click on "Business" & select "Bids & RFP's", the project will be listed near the bottom of the page). A compact disc of the information may also be obtained at the Village of Algonquin, Office of the Village Clerk, Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois 60102 upon receipt of a $10.00 non-refundable deposit. If mailing is requested an additional $5.00 deposit will be required.

**Submittal of Bid**: Bids must be submitted to the Office of the Village Clerk, 2200 Harnish Dr. Algonquin, IL. 60102, no later than 11 a.m. on Tuesday, November 13, 2018. Bids arriving after the specified time will not be accepted. Mailed bids which are delivered after the specified hour will not be accepted regardless of postmarked time on the envelope. Bidders should carefully consider all bid delivery options (US Postal Service, UPS, Federal Express, private delivery service, etc.) and select a method that will successfully deliver their bid by the required time and date. Bids shall be submitted in **sealed envelopes** carrying the following information: Bidder's name, address, and subject matter as indicated in the specification, and designated date and time of the bid opening.

**Withdrawal of Bid**: Bidders may withdraw or cancel their bid, in written form, at any time prior to the advertised bid opening time.

**Bidder's Qualifications**: No award will be made to any Bidder who cannot satisfy to the Village that they have sufficient ability and experience in this class of work, as well as sufficient capital and equipment to do the job and complete the work successfully within the time named (i.e. responsible). The Village's decision or judgment on these matters shall be final, conclusive, and

binding. The Village may make such investigations as it deems necessary. The Bidder shall furnish to the Village, under oath if so required, all information and data the Village may request for the purpose of investigation.

**Preparation of Bid**: The Bidder's submittal shall include the completed *Bid Sheet* found in the Contract Documents. The Village will strictly hold the Bidder to the terms of the bid. The bid must be executed by a person having the legal right and authority to bind the Bidder.

**Compliance with Laws**: The Bidder shall at all times observe and conform to all laws, ordinances, and regulations of the Federal, State, and local governments, which may in any manner affect the preparation of bids or the performance of the contract.

**Alternate to Bids**: Any reference in these specifications to manufacturer's name, trade name, or catalog number (unless otherwise specified) is intended as a standard only. The Village's written decision of approval or disapproval of a proposal substitution shall be final.

Alternate bids will be considered only if received at the time stated for receipt of the bids. Submit alternate bids in a sealed envelope and identify the envelope as required for all bids, except that the phrase **Alternate Bid** shall be used. Bidders are cautioned that, if an alternate bid(s) involves an increase in the *Bid Sum*, the *Bid Deposit*, **if required**, shall be ample or be increased to cover the alternate *Bid Sum* or the entire bid may be rejected.

**Form of Contract**: The form of contract between the Village and the successful Bidder will be a purchase order referencing the bid specifications and the bid submitted by the successful Bidder.

**Freedom of Information Act (FOIA)**: The Village is required by Public Act 96-542 to comply with freedom of information requests (FOIA) within five (5) business days of a record request. All contractors used by the village may be in possession of records covered by this act and therefore will be required to provide the village with those records upon request and within the time frame of the Act.

**Bid Review**: The Village reserves the right to reject any or all bids and/or to waive any irregularities or disregard any informality in the bids and bidding when, in its opinion, the best interest of the Village will be served by such action. Furthermore, the Village reserves the right to award each item to a different Bidder, or all items to a single Bidder unless otherwise noted on the *Bid Sheet*. The Village may determine as follows: 1) an equal or alternative is a satisfactory substitute; 2) an early delivery date is entitled to more consideration than price; 3) an early delivery date is to be disregarded because of the reputation of the Bidder for not meeting delivery dates; 4) a Bidder is not a responsible Bidder; and 5) what exceptions or deviations from written specifications will be accepted.

No bid will be accepted from, or contract awarded to any person, firm, or corporation that is in arrears or is in default to the Village upon any debt or contract, or that is a defaulter, as surety or

otherwise, upon any obligation to the Village, or had failed to perform faithfully any previous contract with the Village.

**Delivery**: Where applicable, all materials shipped to the Village must be shipped F.O.B. delivered to a designated location, Algonquin, Illinois. If the delivery is made by truck, arrangements must be made in advance by the Bidder, with concurrence by the Village, for receipt of the materials. The materials must be delivered where directed. Truck deliveries will be accepted at the Public Works Facility between 7:30 a.m. and 4:00 p.m. and at all other Village locations 8:00 a.m. and 5:00 p.m., weekdays only.

**Inspections**: The Village shall have the right to inspect any materials, components, equipment, supplies, services, or completed work specified herein. Any of said items not complying with these specifications are subject to rejection at the option of the Village. Any items rejected shall be removed from the premises of the Village and/or replaced at the entire expense of the successful Bidder.

# A. General Supplemental Additional Conditions

**Scope of Work**: The Bidder shall supply all required supervision, skilled labor, transportation, new materials, apparatus, and tools necessary for the entire and proper completion of the work. The Bidder shall supply, maintain, and remove all equipment for the performance of the work and be responsible for the safe, proper, and lawful construction, maintenance, and use of the same. This work shall be completed to the satisfaction of the Village. The Bidder shall provide adequate protection of the job site to protect the general public from any injury as a result of the job. The Bidder shall provide all safeguards and suitable barricades to protect public and adjacent property. The Village is not responsible for site safety. The Bidder is solely and exclusively responsible for construction means, methods, technologies, and site safety.

**Licensing and Permits**: The successful Bidder and their subcontractor(s) must be licensed with the Village and shall obtain all required building permits prior to the start of any work. The Village will waive applicable Village permit fees for the specific contract. Permit application forms and license forms may be obtained from the Community Development Department at the Ganek Municipal Center, 2200 Harnish Drive, Algonquin, IL.

**Period of Unemployment**: Public Act 30 ILCS 570 Employment of Illinois Workers on Public Works Act must be adhered to in entirety by the awarded contractor. This act requires the use of Illinois workers on Public Works projects during periods of excess unemployment, which means any month immediately following 2 consecutive calendar months during which the level of unemployment in the State of Illinois has exceeded 5% as measured by the United States Bureau of Labor Statistics in its monthly publication of employment and unemployment figures.

**Toxic Substance**: Prior to delivery of any material which is caustic, corrosive, flammable, or dangerous to handle, the supplier will provide written directions as to methods of handling such products, as well as the antidote or neutralizing material required for its first aid. (Safety Data Sheet).

**Guarantees and Warranties**: All guarantees and warranties required shall be furnished by the Bidder and shall be delivered to the Village before final payment on the contract is issued.

**Termination of Contract**: The Village reserves the right to terminate in whole or any part of this contract, upon written notice to the Bidder, in the event of default by the Bidder. Default is defined as failure of the Bidder to perform any of the provisions of this contract or failure to make sufficient progress so as to endanger performance of this contract in accordance with its terms. In the event of default and termination, the Village may procure, upon such terms and in such a manner as the Village may deem appropriate, supplies, or services similar to those terminated.

The Bidder shall be liable for any excess costs for such supplies or service unless evidence is submitted to the Village that, in the sole opinion of the Village, clearly proves that failure to

perform the contract was due to causes beyond the control and without the fault or negligence of the Bidder.

**Hold Harmless Agreement (Contractual Liability)**: The Bidder agrees to indemnify and save harmless the Village, including its elected or appointed officials, employees, and agents against any and all claims, loss, damage, injury, liability, and court costs and attorney's fees incident thereto, including any claims made by employees of the Bidder or any of their subcontractors, as well as all other persons, resulting directly or indirectly from the work covered by this contract or the equipment used in connection therewith. It is understood that this agreement shall apply to any and all such claims whether resulting from the negligence or the intentional acts of the Bidder, or otherwise. With the single exception of any claim, damage, loss, or expense arising solely out of professional services performed by the Village, its agents, or employees, including: 1) the preparation of maps, plans, opinions, reports, surveys, designs, or specifications, and 2) supervisory, inspection, or engineering services.

**Insurance**: The Bidder will provide certificates of insurance evidencing the following types and limits of insurance. The certificates of insurance will specifically address each of the requirements noted below. Each insurance company shall be acceptable to the Village. The General Liability coverage shall name the Village of Algonquin as additional insured. All insurance noted below is primary and in no event will be considered contributory to any insurance purchased by the Village. All insurance noted below will not be canceled, reduced, or materially changed without providing the Village thirty (30) days advance notice, via certified mail.

A. **Comprehensive General Liability** including Products Liability/Completed Operations insurance, in an amount not less than $1,000,000/occurrence, $2,000,000/policy limit, including Broad Form Contractual Liability insurance, in an amount not less than $1,000,000/occurrence, $2,000,000/policy limit, subject to the terms and conditions of the policy. A copy of the policy may be required.
B. **Automobile Liability** insurance, in an amount not less than $1,000,000 combined single limit. Said insurance is to be extended to cover hired and non-owned vehicles.
C. **Umbrella or Excess Liability** coverage, the Contractor shall provide evidence of Umbrella or Excess Liability coverage of $2,000,000.
D. **Workers' Compensation** is to be provided as required by statute, by an insurance company licensed to write worker's compensation in the State of Illinois. Employer's Liability, in an amount not less than $500,000 each accident, $500,000 disease – policy limit, and $500,000 disease – each employee.
E. **Insurance Rating –** All insurance policies required by this contract shall be underwritten by insurance companies with a minimum A.M. Best rating of A: VII.
F. A certificate of insurance is required as evidence of coverage, with the Village of Algonquin named as an additional insured. The certificate will include an "Additional Insured Endorsement". The same full insurance coverage provided to the named insured, whether it is the contractor or a sub-contractor, shall be provided to the Village without

any limitations or endorsements that might limit or exclude coverage. If insurance is canceled for any reason whatsoever the Village will be given not less than thirty (30) days prior written notice.

Any and all deductibles or other forms of retention are the responsibility of the Contractor. All deductibles or other forms of retention are subject to the approval of the Village. Contractor will disclose to the Village in writing the amounts of any deductible or self-insured retentions on the insurance required under this contract.

Contractor waives any right of subrogation it may have or later acquire against the Village.

*Special Requirement: If the Bidder is an architectural firm or engineering firm, said Bidder shall file a certificate of insurance for professional liability, errors and omissions coverage subject to final acceptance by the Village of said coverage.

The Bidder shall not commence work under this contract until they have obtained all insurance required under this section and such insurance has been approved by the Village, nor shall Bidder allow any subcontractor to commence work on their subcontract until the same insurance has been obtained by the subcontractor. The Bidder and their subcontractor(s) shall maintain all insurance required under paragraphs A through D of this Section for not less than one (1) year after completion of this contract.

## B. Construction Supplemental Additional Conditions

**Failure to Execute**: Failure to execute the contract shall, at the option of the Village, constitute a breach of the agreement made by acceptance of the bid, and the Village shall be entitled to forfeiture of the certified check, bank draft, or Bid Bond accompanying the bid that is required, not as a penalty, but as liquidated damages. In the event of failure of a Bidder to whom an award of contract has been made, to execute the contract and furnish a Performance Bond within ten (10) days after notification of award, such award may be nullified and an award may be made to the next lowest responsive and responsible Bidder approved by the Village.

**Bid Security**: Each bid shall be accompanied by a bid security in the amount of 5% of the total amount bid (Total cost of operations 1& 2 as noted on the bid sheet). Bid security shall be in the form of a certified check or cashier's check, drawn on a responsible bank doing business in the United States and made payable to the Village of Algonquin, or an original Bid Bond (may NOT be a copy or facsimile) by a surety company which is satisfactory to the Village and is qualified to do business in Illinois. Bids not accompanied by a bid security will be rejected. The bid security of the unsuccessful Bidders (if in the form of a certified check or cashier's check) will be returned after the contract is awarded, or earlier, if the Village does not deem it necessary to retain the Bid Security. The bid security of the accepted Bidder, (if in the form of a certified check or cashier's check) will be returned either upon execution of a contract and submittal of a performance bond, if required by the specifications or, where no performance bond is required, when, in the Village's estimation, the contract has been satisfactorily completed. When the bid security is submitted in the form of a bid bond, the bond will become null and void following the award of contract and the Village's receipt of the Performance Bond and Labor and Material Payment Bond, if required by the specifications. Should the Bidder fail to fulfill the contract as set forth, the bid security shall become payable to the Village as liquidated damages.

**Performance Security**: 5% retainage on each invoice per specifications.

**Waiver of Lien**: Where applicable, a Waiver of Lien and Contractor's Affidavit must be submitted by the Bidder, verifying that all subcontractors and material invoices have been paid prior to the Village approving final payment.

# Village of Algonquin
# Snow Removal: Historic District
# Detailed Specifications

**Intent:** The intent of this Bid is to enter into a contract with a qualified contractor to provide the specified snow and ice removal services for our historic district areas located in the Village of Algonquin (hereafter "Village"), including any additional work that may need to be added during the contract year. Bidders will be required to demonstrate their capability through references or by means acceptable to the Village.

This contract will be administered and direction given to the contractor by the Public Works Director or his authorized representative.

**Term of Contract:** The initial term of this contract shall begin on November 1, 2018 and shall be in affect through April 30, 2019. The Village, however, reserves the right to terminate the same at any time by giving a thirty (30) day notice in writing to the contractor. In the event of such cancellation, the contractor shall be entitled to receive payment for services and work performed, and materials, supplies, and equipment furnished under the terms of the contract prior to the effective date of such cancellation, but will not be entitled to receive any damages on account of such cancellation or any further payment whatsoever.

The Village may wish to extend this contract, upon mutual agreement, with two (2) one-year extensions, with the first extension going from May 1, 2019 to April 30, 2020; and the second extension going from May 1, 2020 to April 30, 2021, upon written notice of the Village of its intention to exercise this option.

A one (1) time economic adjustment for labor, materials, supplies, and equipment costs may be negotiated for each one (1) year extension to the contract after the initial one (1) year contract period. This economic adjustment may not exceed the published Chicago Area Consumer Price Index (CPI) for the previous 12 month period. The initial contract places no obligation on the Village to appropriate funds beyond the initial term of the contract and contract extensions are dependent upon sufficient funds being appropriated each fiscal year by the Village for this work.

Due to budget constraints, the Village reserves the right to add or delete from the bid as required. No adjustments in bid prices or additional compensation will be made for decreases in the quantities or services from the bid.

**Scope of Work:** The scope of work consists of furnishing all labor and snow removal equipment to maintain traffic and pedestrian flow in all designated snow removal locations at all times which will include 24-hour service on weekends, Saturdays, Sundays, and Holidays.

Holidays are defined as Thanksgiving Day, Christmas Day and New Year's Day.

The contractor shall provide snow removal on all sites listed on Attachment A. The contractor may be called upon to haul snow from these areas when conditions warrant the removal and hauling of snow.

**Qualification of Bidder:** As evidence of experience and work performance, the bidder must supply with their bid a reference list of previous municipal snow removal experience, and present an anticipated contractual workload, which will verify the bidder's qualifications to perform under the terms of this contract.

**Equipment:** The bidder shall submit with their bid a list of company labor and equipment, including minimum staffing number (persons), equipment types and model numbers, and plow sizes, available for specific assignment to this job.

Please also list additional equipment available in the event of a heavy snowfall (such as graders, end loaders (include bucket capacity), dump trucks, etc.

Proof of possession of all required equipment, and proof of insurance coverage, is required prior to award of contract. Submittals shall indicate whether the equipment is owned, leased, or financed. Should the equipment be leased, submittals shall include a copy of the lease agreement. All equipment must be available for use throughout the term of the contract, as need is determined by the Village.

**Bid may be considered "Non-Responsive" if these requirements are not fulfilled.**

**Protection of Public and Private Property:** The contractor shall exercise all necessary caution to protect all public and private property from injury or damage caused by the contractor's operations.

The contractor shall assume responsibility for all damage to property (including curbs, parkway trees, grass area, utilities, mailboxes, trash cans, benches, and driveways) caused by equipment used for removal of snow. **All damage shall be the responsibility of the contractor to repair.** A complete list of snow removal locations are included in this document as Attachments A.

Any practice obviously hazardous in the opinion of the Public Works Director, or his designee, shall be immediately discontinued by the contractor upon receipt of either written or verbal notice to discontinue such practice. The Village is not responsible for site safety. The contractor is solely and exclusively responsible for site safety.

**All brick paver areas (roadways, parking areas, and sidewalks) shall be serviced with equipment that utilizes a rubber blade for contact with the surface, or shall be accomplished with small hand operated equipment such as walk behind snow throwers. The expense for repairs for any damages caused by failure to adhere to this requirement will be fully borne by the contractor.**

**Accidents:** In the event of accidents of any kind, the contractor shall immediately notify the Director, or his designee, and the Police Department, to secure an accident report, and shall provide

a full accounting of all details of the accident. The contractor shall furnish the Village with copies of all reports of such accidents.

**Prosecution of Work:** The proper timing and use of equipment is essential in maintaining the continuous, expeditious, and safe operation of snow removal. Consequently, it is imperative that all equipment be in good operating condition at all times so as to ensure maximum working efficiency and prevent unnecessary failures. Time is of the essence in arriving at the scene to commence snow removal efforts. To ensure uninterrupted snow removal operations, callouts shall be answered promptly, and extraordinary effort shall be exerted by the contractor to render service.

The contractor shall prosecute the work in the following manner:

A. The contractor shall at all times maintain a force of qualified personnel sufficient to perform the work required and described herein. The force of qualified personnel shall be sufficient to respond to emergency calls which may be received at any time. Manpower must be activated and equipment operational at the site within one hour after notification by the Village.

B. The contractor shall submit, in writing, the name, address and telephone number of the person in its organization to whom instructions may be given by the Director, or his designee, on a 24 hour per day basis. One designated supervisor in the contractor's organization shall be on the job site and available at all times during snow plowing operations.

C. The Public Works General Services Division will notify the contractor whenever a storm warning from the Village's weather forecasting service is received stating that a plowable amount of snow (1 inch or more) is forecast. The contractor shall respond by mobilizing all personnel and equipment within a maximum of 1 hour after being notified by the General Services Division.

D. It shall be the responsibility of the contractor to notify the General Services Division manager when all team members are present and working their assignments, and at the full completion of each operation. A form to verify hours worked and equipment used will be provided by the Village and will be signed by both the contractor and the appropriate Village representative as a prerequisite for payment.

E. After finishing one complete clearing pass cycle through the snow removal locations, the contractor may be told to start a second complete clearing cycle immediately and to continue snow removal operations depending on weather conditions. The contractor shall be prepared to continue operations, or start up activities again whenever snow accumulates to a depth of 1 inch or more on the paved area.

F. Snow removal is accomplished by plowing the snow to the curb in the designated cul-de-sacs. Care shall be taken so that no residential driveways or public sidewalk crossing shall be blocked by an amount of snow greater than the windrow of snow through the throat of the cul-de-sac. There is to be no excessive mounting of snow at the corners higher than the normal windrow. The snow shall be carried out to the curb line of the streets.

G. Snow removal in the historic district shall include all designated roadways, parking areas, and sidewalks.

1. Extreme care shall be taken to prevent damage to right of way features (pavers, benches, trash cans, curbs, trees, planters, signs, light poles, etc.)
2. All brick paver areas (roadways, parking areas, and sidewalks) shall be serviced with equipment that utilizes a rubber blade for contact with the surface, or shall be accomplished with small hand operated equipment such as walk behind snow throwers.
3. Roadways shall be cleared of snow completely from curb to curb.
4. Care shall be taken so that no residential driveways or public sidewalk crossing shall be blocked by an amount of snow greater than the windrow of the average roadway profile.
5. There is to be no excessive mounting of snow at the corners higher than the normal windrow.
6. Snow shall be completely removed from all noted parking areas and hauled to a designated staging location for later removal by the Village.
7. Snow shall be removed completely from all noted walkways.
8. No snow shall be blown, placed, or moved upon any planter bed, tree pit, or other area containing plants.
9. Walkways (particularly on Main St. between Washington St. and Algonquin Rd.) where there is no parkway turf area shall have snow and hauled to a designated staging location for later removal by the Village.
10. Roadways and non-brick paver parking areas shall be treated with deicing materials by the Village during the event at the request of the contractor (typically upon substantial completion of removal operations).
11. Brick paver roadway and parking areas, walking surfaces, including sidewalks and ADA ramps, shall be lightly and completely treated with deicing materials provided by the contractor. Deicing material shall be calcium magnesium acetate or urea, as approved by the Village.

**Type of Operation:** Depending on snowfall conditions, the following snow removal operations will be initiated at all snow removal locations:

- **Operation #1:** For an accumulation **in excess of 1 inch and less than 5 inches** of snow, the contractor shall provide sufficient equipment to remove snow from all designated areas whenever called upon. Sufficient equipment shall be provided to complete the entire designated area in a maximum of **12 hours** after the clearing operation has begun.

- **Operation #2:** For an accumulation **in excess of 5 inches and less than 9 inches** of snow, the contractor shall provide sufficient equipment to remove snow from all designated areas whenever called upon. Sufficient equipment shall be provided to complete the entire designated area in a maximum of **12 hours** after the clearing operation has begun.

- **Operation #3:** For an accumulation **in excess of 9 inches or more** of snow, the contractor shall provide sufficient equipment to remove snow from all designated areas whenever

called upon. Sufficient equipment shall be provided to complete the entire designated area in a maximum of **18 hours** after the clearing operation has begun.

Depth of snow accumulation is measured at the time each plowing operation commences. It is not the total accumulation of snow at the end of the storm.

If stored snow within the cul-de-sacs reaches an undesirable height as determined by the Village, the contractor may be required to load and haul snow to a designated location and will be paid in accordance with the hourly equipment rental rates noted on the Bid Sheet for Operation #3.

**Method of Payment:** All charges for snow removal will start when equipment begins operation in the designated cul-de-sacs and end when the operation is complete. No separate charge for transportation of equipment, downtime, repair or maintenance to or from the site, will be allowed.

The contractor shall be paid on the basis of number of complete clearing passes of all snow and ice locations for Operations #1 and #2 as described in Type of Operation above. Supervision shall be included in the cost per clearing pass.

The contractor shall be paid an hourly rate basis for Operation #3. The contractor shall submit an hourly cost for each piece of equipment on the equipment list (the hourly rate should include the cost of the operator) in the space provided on the Bid Sheet. Supervision, equipment operators and labor shall be included in all hourly rates.

**Exceptions:** Any exceptions to these specifications shall be noted on the Exceptions Sheet and included with the bid submittal.

**Liquidated Damages:** Time is of the essence to the contract. Should the contractor fail to complete the work within the specified time stipulated in the contract, or within such extended time as may have been allowed, the contractor shall be liable and shall pay to the Village the amount shown in the following schedule of deduction. Costs are incurred not as a penalty, but as liquidated damages, for each hour of overrun in the contract time or such extended time as may have been allowed. The liquidated damages for failure to complete the contact on time are approximate, due to the impracticality of calculating and proving actual delay costs. This schedule of deductions establishes the cost of delay to account for administration, engineering, inspection, and supervision during periods of extended and delayed performance. The costs of delay represented by the schedule are understood to be a fair and reasonable estimate of the costs that will be borne by the Village during extended and delayed performance by the contractor of the work. The liquidated damage amount specified will accrue and be assessed until completion of the total physical work of the contract even though the work may be substantially complete. The Village will deduct these liquidated damages from any monies due or to become due to the Contractor from the Village.

Deduction for each hour of overrun in contract time: $750/hour

# Bid Sheet

The undersigned, having examined the specifications and all conditions affecting the specified project, offer to furnish all services, labor, and incidentals specified for the price below.

The undersigned bidder certifies that they are not barred from bidding on this contract as a result of a conviction for the violation of state laws prohibiting bid rigging or bid rotating, (720ILCS 5/33E-1, et seq.) and is not delinquent in nay taxes to the Illinois Department of Revenue (65ILCS 5/11-42.1-1).

It is understood that the Village reserves the right to reject any and all bids ad to waive any irregularities and that the prices contained herein will remain valid for a period of not less than sixty (60) days.

**Company Name:** _____

**Operation #1 Complete Clearing**
**Excess of 1 inch and less than 5 inches of snow accumulation**

**1.** Cost per 1 complete clearing of all locations (lump sum): $_____

**2.** Estimate of 15 events times the lump sum cost above: $_____

**Operation #2 Complete Clearing**
**Excess of 5 inches and less than 9 inches of snow accumulation**

**3.** Cost per 1 complete clearing of all locations (lump sum): $_____

**4.** Estimate of 4 events times the lump sum cost above: $_____

**Total Cost of Operations #1 & 2** (add lines 2 and 4 above) $_____

**Operation #3 Complete Clearing**
**Hourly Equipment Rate**
**9 inches or more of snow accumulation Loading/Hauling**

****NOTE hourly rate includes equipment, operator and labor costs****

| | |
|---|---|
| Skid Steer Loader | $_____ per hour |
| 4x4 Pick Up Truck | $_____ per hour |
| Dump Truck w/Plow (min. 25,000 GVW) | $_____ per hour |
| Dump Truck Only (min. 25,000 GVW) | $_____ per hour |
| 4WD End Loader Rubber tired (min. 76HP/1.5CY bucket or plow) | $_____ per hour |
| Semi-Trailer Truck | $_____ per hour |
| Gradall (if necessary) | $_____ per hour |

Is required equipment owned, leased or financed? _____Owned _____Leased _____Financed

If leased, have you included a copy of your lease agreement? _____Yes _____No

If it is the contractor's intention to utilize a subcontractor(s) to fulfill the requirements of this contract, the Village must be advised of the subcontractor's company name, address, telephone and fax numbers, and a contact person's name at eth time of the bid submittal.

Will you be utilizing a subcontractor? _____Yes _____No

If yes, have you included all required information with your bid submittal? _____Yes _____No

I hereby certify that the item(s) proposed is/are in accordance with the specifications as noted and that the prices quoted are not subject to change; and that _____ (company name) is not barred by law from submitting a bid to the Village for the project contemplated herein because of a conviction for prior violations of either Illinois Compiles Statues, 720 ILCS 5/33E-3 (Bid Rigging) or 720 ILCS 5/33-4 (Bid Rotating); and that

_____ (company name) is not delinquent in payment of any taxes to the Illinois Department of Revenue in accordance with 65 ILCS 5/11-42.1; and that

_____ (company name) provides a drug free workplace pursuant to 30 ILCS 580/1, et seq; and that

_____ (company name) certifies they have a substance-abuse program and provide drug testing in accordance with 820 ILCS 130/11G, Public Act 095-0635; and that

_____ (company name) is in compliance with the Illinois Human Rights Act 775 ILCS 5/1.101, et seq. including establishment and maintenance of sexual harassment policies and program.

_____ _____
Bidder's company name Signed name

_____ _____
Street address Print name and title

_____ _____
City State Zip Code e-mail address

_____ _____
Phone number Fax number

Date: _____

# Exception Sheet

**Exceptions:** Any exception must be clearly noted on the Exception Sheet. Failure to do so may be reason for rejection of the bid. It is not our intention to prohibit any potential Bidder from bidding by virtue of the specifications, but to describe the material(s) and service(s) actually required. The Village reserves the right to accept or reject any or all exceptions.

**Exceptions Sheet must be enclosed with the Bid Sheet.**

Bidder's exceptions are:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

# Attachment A Downtown

**Parking Areas & Parks**

- ☐ Towne Park Lot (West end of Washington St.)
- ☐ Historic Village Hall
- ☐ Municipal Lot
- ☐ Cornish Park
- ☐ Riverfront Park

**Streets (Including On-Street Parking Areas**

- ☐ Main St. (Algonquin Rd. South to Route 31)
- ☐ Harrison St. (from Washington St. to North End of Riverfront Park)
- ☐ Washington St. (from Towne Park to South Harrison St.)
- ☐ Edward St. (from Main St. to North Harrison St.)
- ☐ Front St. (from Main St. to North Harrison St.)
- ☐ Jefferson St. (from Towne Park to Railroad St.)
- ☐ Railroad St.

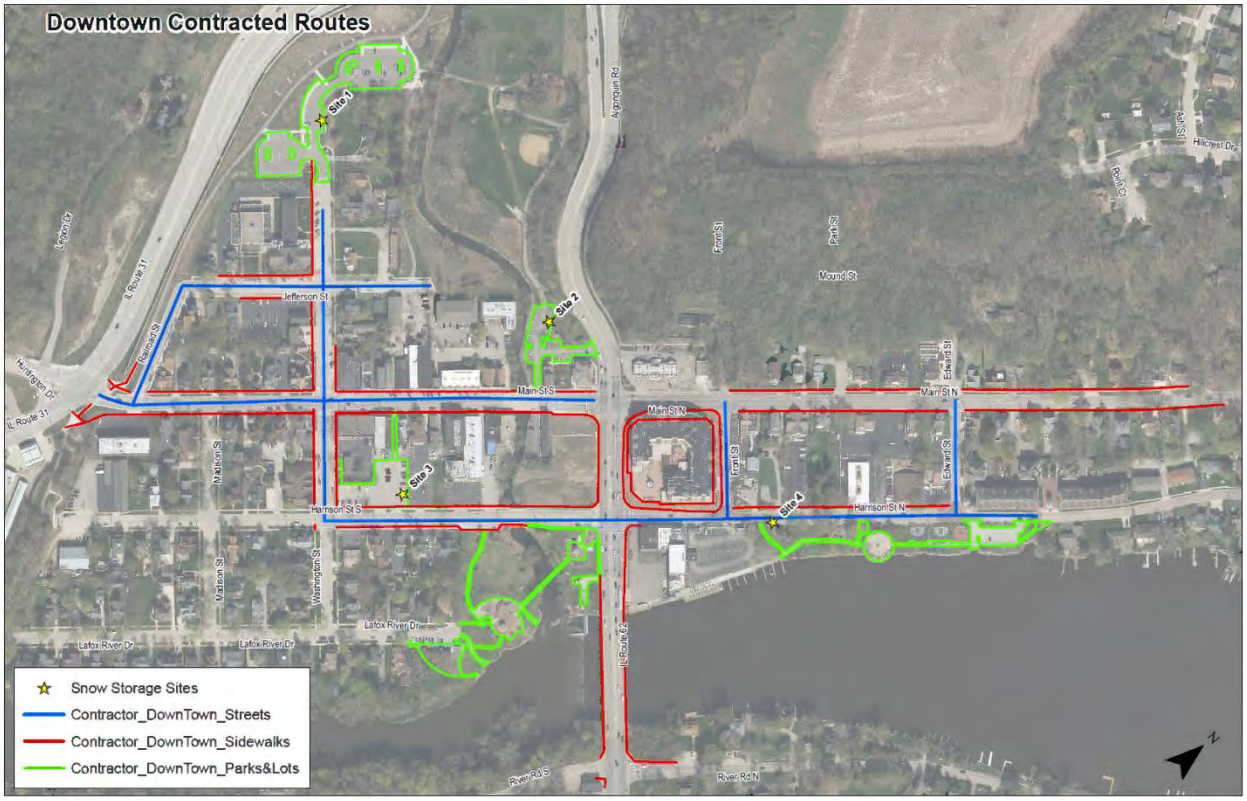
**Sidewalks**

- ☐ Main St. (Both sides from Route 31 South end to last homes on North Main St.)
- ☐ Harrison St. (Both sides from Washington St. to North End of Riverfront Park)
- ☐ Washington St. (from Towne Park to South Harrison St.)

☐ Algonquin Rd. from Main St. to River Rd. (Include N. River Rd west side from 62 to first prop

☐ Front St. (South side from Main St. to North Harrison St.)

☐ Jefferson St. (from Harrison St. to the ends of the church properties, both sides)



## Bid Sheet

The undersigned, having examined the specifications and all conditions affecting the specified project, offer to furnish all services, labor, and incidentals specified for the price below.

The undersigned bidder certifies that they are not barred from bidding on this contract as a result of a conviction for the violation of state laws prohibiting bid rigging or bid rotating, (720ILCS 5/33E-1, et seq.) and is not delinquent in nay taxes to the Illinois Department of Revenue (65ILCS 5/11-42.1-1).

It is understood that the Village reserves the right to reject any and all bids ad to waive any irregularities and that the prices contained herein will remain valid for a period of not less than sixty (60) days.

**Company Name:** NILCO INC.

**Operation #1 Complete Clearing**
**Excess of 1 inch and less than 5 inches of snow accumulation**

1. Cost per 1 complete clearing of all locations (lump sum): $ 5,395.00
2. Estimate of 15 events times the lump sum cost above: $ 79,935.00

**Operation #2 Complete Clearing**
**Excess of 5 inches and less than 9 inches of snow accumulation**

3. Cost per 1 complete clearing of all locations (lump sum): $ 7,950.00
4. Estimate of 4 events times the lump sum cost above: $ 31,800.00

**Total Cost of Operations #1 & 2** (add lines 2 and 4 above) $ 111,735.00

If it is the contractor's intention to utilize a subcontractor(s) to fulfill the requirements of this contract, the Village must be advised of the subcontractor's company name, address, telephone and fax numbers, and a contact person's name at eth time of the bid submittal.

Will you be utilizing a subcontractor? _____Yes __X__No

If yes, have you included all required information with your bid submittal? _____Yes _____No

I hereby certify that the item(s) proposed is/are in accordance with the specifications as noted and that the prices quoted are not subject to change; and that _____ (company name) is not barred by law from submitting a bid to the Village for the project contemplated herein because of a conviction for prior violations of either Illinois Compiles Statues, 720 ILCS 5/33E-3 (Bid Rigging) or 720 ILCS 5/33-4 (Bid Rotating); and that

NILCO, INC. (company name) is not delinquent in payment of any taxes to the Illinois Department of Revenue in accordance with 65 ILCS 5/11-42.1; and that

NILCO, INC (company name) provides a drug free workplace pursuant to 30 ILCS 580/1, et seq; and that

NILCO, INC (company name) certifies they have a substance-abuse program and provide drug testing in accordance with 820 ILCS 130/11G, Public Act 095-0635; and that

NILCO, INC (company name) is in compliance with the Illinois Human Rights Act 775 ILCS 5/1.101, et seq. including establishment and maintenance of sexual harassment policies and program.

NILCO INC
Bidder's company name

Signed name

13503 RT. 176
Street address

BRENT JOHNSON PRESIDENT
Print name and title

WOODSTOCK IL 60098
City State Zip Code

Brent@nilcoinc.com
e-mail address

815-206-3625 EXT. 22
Phone number

815-206-3619
Fax number

Date: 11/12/18

**Operation #3 Complete Clearing**
**Hourly Equipment Rate**
**9 inches or more of snow accumulation Loading/Hauling**

****NOTE hourly rate includes equipment, operator and labor costs****

| | | |
|---|---|---|
| Skid Steer Loader | $ 85 | per hour |
| 4x4 Pick Up Truck | $ 80 | per hour |
| Dump Truck w/Plow (min. 25,000 GVW) | $ 115 | per hour |
| Dump Truck Only (min. 25,000 GVW) | $ 115 | per hour |
| 4WD End Loader Rubber tired (min. 76HP/1.5CY bucket or plow) | $ 385 | per hour |
| Semi-Trailer Truck | $ 155 | per hour |
| Gradall (if necessary) | $ NA | per hour |

Is required equipment owned, leased or financed? X Owned _____Leased _____Financed

If leased, have you included a copy of your lease agreement? _____Yes _____No

# Exception Sheet

**Exceptions:** Any exception must be clearly noted on the Exception Sheet. Failure to do so may be reason for rejection of the bid. It is not our intention to prohibit any potential Bidder from bidding by virtue of the specifications, but to describe the material(s) and service(s) actually required. The Village reserves the right to accept or reject any or all exceptions.

**Exceptions Sheet must be enclosed with the Bid Sheet.**

Bidder's exceptions are:

## Attachment A Downtown

**Parking Areas & Parks**

- [ ] Towne Park Lot (West end of Washington St.)
- [ ] Historic Village Hall
- [ ] Municipal Lot
- [ ] Cornish Park
- [ ] Riverfront Park

**Streets (Including On-Street Parking Areas**

- [ ] Main St. (Algonquin Rd. South to Route 31)
- [ ] Harrison St. (from Washington St. to North End of Riverfront Park)
- [ ] Washington St. (from Towne Park to South Harrison St.)
- [ ] Edward St. (from Main St. to North Harrison St.)
- [ ] Front St. (from Main St. to North Harrison St.)
- [ ] Jefferson St. (from Towne Park to Railroad St.)
- [ ] Railroad St.

**Sidewalks**

- [ ] Main St. (Both sides from Route 31 South end to last homes on North Main St.)
- [ ] Harrison St. (Both sides from Washington St. to North End of Riverfront Park)
- [ ] Washington St. (from Towne Park to South Harrison St.)

☐ Algonquin Rd. from Main St. to River Rd. (Include N. River Rd west side from 62 to first prop

☐ Front St. (South side from Main St. to North Harrison St.)

☐ Jefferson St. (from Harrison St. to the ends of the church properties, both sides)

# NOTICE TO BIDDERS
# FOR
# 2018-19 Snow Removal of Cul-De-Sacs and Eyebrows

The Village of Algonquin is now accepting sealed bid proposals for **2018-19 Snow Removal of Cul-De-Sacs and Eyebrows** Bids will be accepted until 11 a.m. CST on Tuesday, November 13, 2018 at the William J. Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois, 60102 c/o Deputy Village Clerk.

## Time and Place of Bid Opening

Notice is hereby given that the Village of Algonquin, Illinois, will receive sealed bids at the William J. Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois 60102 until 11 a.m. CST on November 13, 2018 for **2018-19 Snow Removal of Cul-De-Sacs and Eyebrows**, at which time the bids will be publicly opened and read. Bid will be awarded to the lowest responsible bidder determined in the exclusive discretion of the Village Board of Trustees.

## Description of Work

Each bid includes a separate scope of work, similar in effort. The bid includes the clearing of snow from cul-de-sacs and eyebrows throughout the Village.

## Availability of Contract Documents

Electronic copies of for **2018-19 Snow Removal of Cul-De-Sacs and Eyebrows** Bid Specifications, and Contract Documents may be obtained for free online at www.algonquin.org *(at top of page click on "Business" & select "Bids & RFP's", the project will be listed near the bottom of the page).* A compact disc of the information may also be obtained at the Village of Algonquin, Office of the Village Clerk, Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois 60102 upon receipt of a $10.00 non-refundable deposit. If mailing is requested an additional $5.00 deposit will be required.

## Bid Security

A proposal guaranty in the proper amount, as specified in BLRS Special Provision for Bidding Requirements and Conditions for Contract Proposals, will be required. Bid Bonds will be allowed as a proposal guaranty. Accompanying this proposal is either a bid bon if allowed, on Department form BLR 12230 or as a proposal guaranty check, complying with the specifications, made payable to the Village of Algonquin. The amount of the check is 5% of the Bid amount.

## Submission Format

Bids shall be made on the forms furnished by the Village and shall be submitted no later than the specified closing time in an opaque sealed envelope addressed to: Village of Algonquin, attention: Deputy Clerk, 2200 Harnish Drive, Algonquin, IL 60102. Envelopes should be clearly marked, "**Sealed Bid – 2018-19 Snow Removal – Cul-De-Sacs and Eyebrows**". The bids will be opened at this location and read aloud. The Village of Algonquin reserves the right to reject any or all parts thereof, or waive any formality or technical errors, and to make the award in the best interest of the Village.

**Public Works**

This contract calls for the construction of a "public works," within the meaning of the Illinois Prevailing Wage Act, 821 ILCS 130/.01 et seq. ("the Act"). The Act requires contractors and subcontractors to pay laborers, workers and mechanics performing services on public works projects no less than current "prevailing rate of wages" (hourly cash wages plus amount for fringe benefits) in the county where the work is performed. The Illinois Department of Labor publishes the prevailing wage rates on its website http://www.state.il.us/agency/idol/rates/rates.HTM. The Illinois Department of Labor revises the prevailing wage rates and the contractor/subcontractor has an obligation to check the Illinois Department of Labor website for revisions to prevailing wage rates. For information regarding current prevailing wage rates, please refer to the Illinois Department of Labor's website. All contractors and subcontractors rendering services under this contract must comply with all requirements of the Act, including by not limited to, all wage requirements and notice and record keeping duties." Each bidder shall adopt a written sexual harassment policy in compliance with ILCS 5/2-105 (1992). Bidder agrees to comply with Substance Abuse Prevention on Public Works Projects Act, 820 ILCS265/1 et seq. (2008). As required by the Act, the Bidder agrees to file with the Village, prior to commencing work, its written substance abuse prevention program. It is the responsibility of the vendor/contractor/subcontractor to comply with all applicable provisions of FOIA. The regulations of the State of Illinois Freedom of Information Act (FOIA) 5 ILCS 140, apply to all records of the vendor/contractor/subcontractor pertaining to this authorization or contract. When requested by the Village of Algonquin, the vendor/contractor is required to provide all records requested within no more than three (3) business days, at no cost to the Village of Algonquin.

**Questions**

All questions regarding this project should be directed to Steve Ludwig at steveludwig@algonquin.org or (847) 658-2754 ext. 4411

By: Tim Schloneger, Village Manager

# Village of Algonquin
# Standard Conditions

**Contract Documents**: Any drawings, plans, standard conditions, supplemental additional conditions, specifications, bid notice, bid sheet, and addendum, if any, as specified herein shall form the "Contract Documents." For the purpose of this bid, the word "Village" shall refer to the Village of Algonquin, and the word "Bidder" shall refer to any person, company, or entity submitting a bid. Any work shown or described in one of the documents shall be construed as if described in all the documents.

**Interpretation of Contract Documents**: Each request for interpretation of the Contract Documents shall be made in writing addressed to Steve Ludwig, General Services Superintendent, Village of Algonquin, 110 Meyer Drive, Algonquin, IL 60102 (steveludwig@algonquin.org) and shall be received at least (5) business days prior to the scheduled bid opening date. Interpretations and supplemental instructions will be in the form of written addenda to the Contract Documents.

**Electronic Bid Documents**: Electronic copies of the 2018-19 Snow Removal - Cul-de-sacs and Eyebrows Bid Specifications, and Contract Documents may be obtained for free online at www.algonquin.org (at top of page click on "Business" & select "Bids & RFP's", the project will be listed near the bottom of the page). A compact disc of the information may also be obtained at the Village of Algonquin, Office of the Village Clerk, Ganek Municipal Center, 2200 Harnish Drive, Algonquin, Illinois 60102 upon receipt of a $10.00 non-refundable deposit. If mailing is requested an additional $5.00 deposit will be required.

**Submittal of Bid**: Bids must be submitted to the Office of the Village Clerk, 2200 Harnish Dr. Algonquin, IL. 60102, no later than 11 a.m. on Tuesday, November 13, 2018. Bids arriving after the specified time will not be accepted. Mailed bids which are delivered after the specified hour will not be accepted regardless of postmarked time on the envelope. Bidders should carefully consider all bid delivery options (US Postal Service, UPS, Federal Express, private delivery service, etc.) and select a method that will successfully deliver their bid by the required time and date. Bids shall be submitted in **sealed envelopes** carrying the following information: Bidder's name, address, and subject matter as indicated in the specification, and designated date and time of the bid opening.

**Withdrawal of Bid**: Bidders may withdraw or cancel their bid, in written form, at any time prior to the advertised bid opening time.

**Bidder's Qualifications**: No award will be made to any Bidder who cannot satisfy to the Village that they have sufficient ability and experience in this class of work, as well as sufficient capital and equipment to do the job and complete the work successfully within the time named (i.e. responsible). The Village's decision or judgment on these matters shall be final, conclusive, and binding. The Village may make such investigations as it deems necessary. The Bidder shall furnish to the Village, under oath if so required, all information and data the Village may request for the purpose of investigation.

**Preparation of Bid**: The Bidder's submittal shall include the completed *Bid Sheet* found in the Contract Documents. The Village will strictly hold the Bidder to the terms of the bid. The bid must be executed by a person having the legal right and authority to bind the Bidder.

**Compliance with Laws**: The Bidder shall at all times observe and conform to all laws, ordinances, and regulations of the Federal, State, and local governments, which may in any manner affect the preparation of bids or the performance of the contract.

**Alternate to Bids**: Any reference in these specifications to manufacturer's name, trade name, or catalog number (unless otherwise specified) is intended as a standard only. The Village's written decision of approval or disapproval of a proposal substitution shall be final.

Alternate bids will be considered only if received at the time stated for receipt of the bids. Submit alternate bids in a sealed envelope and identify the envelope as required for all bids, except that the phrase **Alternate Bid** shall be used. Bidders are cautioned that, if an alternate bid(s) involves an increase in the *Bid Sum*, the *Bid Deposit*, **if required**, shall be ample or be increased to cover the alternate *Bid Sum* or the entire bid may be rejected.

**Form of Contract**: The form of contract between the Village and the successful Bidder will be a purchase order referencing the bid specifications and the bid submitted by the successful Bidder.

**Freedom of Information Act (FOIA)**: The Village is required by Public Act 96-542 to comply with freedom of information requests (FOIA) within five (5) business days of a record request. All contractors used by the village may be in possession of records covered by this act and therefore will be required to provide the village with those records upon request and within the time frame of the Act.

**Bid Review**: The Village reserves the right to reject any or all bids and/or to waive any irregularities or disregard any informality in the bids and bidding when, in its opinion, the best interest of the Village will be served by such action. Furthermore, the Village reserves the right to award each item to a different Bidder, or all items to a single Bidder unless otherwise noted on the *Bid Sheet*. The Village may determine as follows: 1) an equal or alternative is a satisfactory substitute; 2) an early delivery date is entitled to more consideration than price; 3) an early delivery date is to be disregarded because of the reputation of the Bidder for not meeting delivery dates; 4) a Bidder is not a responsible Bidder; and 5) what exceptions or deviations from written specifications will be accepted.

No bid will be accepted from, or contract awarded to any person, firm, or corporation that is in arrears or is in default to the Village upon any debt or contract, or that is a defaulter, as surety or otherwise, upon any obligation to the Village, or had failed to perform faithfully any previous contract with the Village.

**Delivery**: Where applicable, all materials shipped to the Village must be shipped F.O.B. delivered to a designated location, Algonquin, Illinois. If the delivery is made by truck, arrangements must be made in advance by the Bidder, with concurrence by the Village, for receipt of the materials. The materials must be delivered where directed. Truck deliveries will be accepted at the Public Works Facility between 7:30 a.m. and 4:00 p.m. and at all other Village locations 8:00 a.m. and 5:00 p.m., weekdays only.

**Inspections**: The Village shall have the right to inspect any materials, components, equipment, supplies, services, or completed work specified herein. Any of said items not complying with these specifications are subject to rejection at the option of the Village. Any items rejected shall be removed from the premises of the Village and/or replaced at the entire expense of the successful Bidder.

# A. General Supplemental Additional Conditions

**Scope of Work**: The Bidder shall supply all required supervision, skilled labor, transportation, new materials, apparatus, and tools necessary for the entire and proper completion of the work. The Bidder shall supply, maintain, and remove all equipment for the performance of the work and be responsible for the safe, proper, and lawful construction, maintenance, and use of the same. This work shall be completed to the satisfaction of the Village. The Bidder shall provide adequate protection of the job site to protect the general public from any injury as a result of the job. The Bidder shall provide all safeguards and suitable barricades to protect public and adjacent property. The Village is not responsible for site safety. The Bidder is solely and exclusively responsible for construction means, methods, technologies, and site safety.

**Licensing and Permits**: The successful Bidder and their subcontractor(s) must be licensed with the Village and shall obtain all required building permits prior to the start of any work. The Village will waive applicable Village permit fees for the specific contract. Permit application forms and license forms may be obtained from the Community Development Department at the Ganek Municipal Center, 2200 Harnish Drive, Algonquin, IL.

**Period of Unemployment**: Public Act 30 ILCS 570 Employment of Illinois Workers on Public Works Act must be adhered to in entirety by the awarded contractor. This act requires the use of Illinois workers on Public Works projects during periods of excess unemployment, which means any month immediately following 2 consecutive calendar months during which the level of unemployment in the State of Illinois has exceeded 5% as measured by the United States Bureau of Labor Statistics in its monthly publication of employment and unemployment figures.

**Toxic Substance**: Prior to delivery of any material which is caustic, corrosive, flammable, or dangerous to handle, the supplier will provide written directions as to methods of handling such products, as well as the antidote or neutralizing material required for its first aid. (Safety Data Sheet).

**Guarantees and Warranties**: All guarantees and warranties required shall be furnished by the Bidder and shall be delivered to the Village before final payment on the contract is issued.

**Termination of Contract**: The Village reserves the right to terminate in whole or any part of this contract, upon written notice to the Bidder, in the event of default by the Bidder. Default is defined as failure of the Bidder to perform any of the provisions of this contract or failure to make sufficient progress so as to endanger performance of this contract in accordance with its terms. In the event of default and termination, the Village may procure, upon such terms and in such a manner as the Village may deem appropriate, supplies, or services similar to those terminated.

The Bidder shall be liable for any excess costs for such supplies or service unless evidence is submitted to the Village that, in the sole opinion of the Village, clearly proves that failure to perform the contract was due to causes beyond the control and without the fault or negligence of the Bidder.

**Hold Harmless Agreement (Contractual Liability)**: The Bidder agrees to indemnify and save harmless the Village, including its elected or appointed officials, employees, and agents against any and all claims, loss, damage, injury, liability, and court costs and attorney's fees incident thereto, including any claims made by employees of the Bidder or any of their subcontractors, as well as all other persons, resulting directly or indirectly from the work covered by this contract or the equipment used in connection therewith. It is understood that this agreement shall apply to any and all such claims whether resulting from the negligence or the intentional acts of the Bidder, or otherwise. With the single exception of any claim, damage, loss, or expense arising solely out of professional services performed by the Village, its agents, or employees, including: 1) the preparation of maps, plans, opinions, reports, surveys, designs, or specifications, and 2) supervisory, inspection, or engineering services.

**Insurance**: The Bidder will provide certificates of insurance evidencing the following types and limits of insurance. The certificates of insurance will specifically address each of the requirements noted below. Each insurance company shall be acceptable to the Village. The General Liability coverage shall name the Village of Algonquin as additional insured. All insurance noted below is primary and in no event will be considered contributory to any insurance purchased by the Village. All insurance noted below will not be canceled, reduced, or materially changed without providing the Village thirty (30) days advance notice, via certified mail.

A. **Comprehensive General Liability** including Products Liability/Completed Operations insurance, in an amount not less than $1,000,000/occurrence, $2,000,000/policy limit, including Broad Form Contractual Liability insurance, in an amount not less than $1,000,000/occurrence, $2,000,000/policy limit, subject to the terms and conditions of the policy. A copy of the policy may be required.
B. **Automobile Liability** insurance, in an amount not less than $1,000,000 combined single limit. Said insurance is to be extended to cover hired and non-owned vehicles.
C. **Umbrella or Excess Liability** coverage, the Contractor shall provide evidence of Umbrella or Excess Liability coverage of $2,000,000.
D. **Workers' Compensation** is to be provided as required by statute, by an insurance company licensed to write worker's compensation in the State of Illinois. Employer's Liability, in an amount not less than $500,000 each accident, $500,000 disease – policy limit, and $500,000 disease – each employee.
E. **Insurance Rating –** All insurance policies required by this contract shall be underwritten by insurance companies with a minimum A.M. Best rating of A: VII.
F. A certificate of insurance is required as evidence of coverage, with the Village of Algonquin named as an additional insured. The certificate will include an "Additional Insured Endorsement". The same full insurance coverage provided to the named insured, whether it is the contractor or a sub-contractor, shall be provided to the Village without any limitations or endorsements that might limit or exclude coverage. If insurance is canceled for any reason whatsoever the Village will be given not less than thirty (30) days prior written notice.

Any and all deductibles or other forms of retention are the responsibility of the Contractor. All deductibles or other forms of retention are subject to the approval of the Village. Contractor will disclose to the Village in writing the amounts of any deductible or self-insured retentions on the insurance required under this contract.

Contractor waives any right of subrogation it may have or later acquire against the Village.

*Special Requirement: If the Bidder is an architectural firm or engineering firm, said Bidder shall file a certificate of insurance for professional liability, errors and omissions coverage subject to final acceptance by the Village of said coverage.

The Bidder shall not commence work under this contract until they have obtained all insurance required under this section and such insurance has been approved by the Village, nor shall Bidder allow any subcontractor to commence work on their subcontract until the same insurance has been obtained by the subcontractor. The Bidder and their subcontractor(s) shall maintain all insurance required under paragraphs A through D of this Section for not less than one (1) year after completion of this contract.

## B. Construction Supplemental Additional Conditions

**Failure to Execute**: Failure to execute the contract shall, at the option of the Village, constitute a breach of the agreement made by acceptance of the bid, and the Village shall be entitled to forfeiture of the certified check, bank draft, or Bid Bond accompanying the bid that is required, not as a penalty, but as liquidated damages. In the event of failure of a Bidder to whom an award of contract has been made, to execute the contract and furnish a Performance Bond within ten (10) days after notification of award, such award may be nullified and an award may be made to the next lowest responsive and responsible Bidder approved by the Village.

**Bid Security**: Each bid shall be accompanied by a bid security in the amount of 5% of the total amount bid (Total cost of operations 1& 2 as noted on the bid sheet). Bid security shall be in the form of a certified check or cashier's check, drawn on a responsible bank doing business in the United States and made payable to the Village of Algonquin, or an original Bid Bond (may NOT be a copy or facsimile) by a surety company which is satisfactory to the Village and is qualified to do business in Illinois. Bids not accompanied by a bid security will be rejected. The bid security of the unsuccessful Bidders (if in the form of a certified check or cashier's check) will be returned after the contract is awarded, or earlier, if the Village does not deem it necessary to retain the Bid Security. The bid security of the accepted Bidder, (if in the form of a certified check or cashier's check) will be returned either upon execution of a contract and submittal of a performance bond, if required by the specifications or, where no performance bond is required, when, in the Village's estimation, the contract has been satisfactorily completed. When the bid security is submitted in the form of a bid bond, the bond will become null and void following the award of contract and the Village's receipt of the Performance Bond and Labor and Material Payment Bond, if required by the specifications. Should the Bidder fail to fulfill the contract as set forth, the bid security shall become payable to the Village as liquidated damages.

**Performance Security**: 5% retainage on each invoice per specifications.

**Waiver of Lien**: Where applicable, a Waiver of Lien and Contractor's Affidavit must be submitted by the Bidder, verifying that all subcontractors and material invoices have been paid prior to the Village approving final payment.

# Village of Algonquin
# Snow Removal: Cul-de-Sacs & Eyebrows

**Intent:** The intent of this Bid is to enter into a contract with a qualified contractor to provide the specified snow and ice removal services for cul-de-sacs, eyebrows, and historic district areas located in the Village of Algonquin (hereafter "Village"), including any additional work that may need to be added during the contract year. Bidders will be required to demonstrate their capability through references or by means acceptable to the Village.

This contract will be administered and direction given to the contractor by the Public Works Director or his authorized representative.

**Term of Contract:** The initial term of this contract shall begin on November 1, 2018 and shall be in affect through April 30, 2019. The Village, however, reserves the right to terminate the same at any time by giving a thirty (30) day notice in writing to the contractor. In the event of such cancellation, the contractor shall be entitled to receive payment for services and work performed, and materials, supplies, and equipment furnished under the terms of the contract prior to the effective date of such cancellation, but will not be entitled to receive any damages on account of such cancellation or any further payment whatsoever.

The Village may wish to extend this contract, upon mutual agreement, with two (2) one-year extensions, with the first extension going from May 1, 2019 to April 30, 2020; and the second extension going from May 1, 2020 to April 30, 2021, upon written notice of the Village of its intention to exercise this option.

A one (1) time economic adjustment for labor, materials, supplies, and equipment costs may be negotiated for each one (1) year extension to the contract after the initial one (1) year contract period. This economic adjustment may not exceed the published Chicago Area Consumer Price Index (CPI) for the previous 12 month period. The initial contract places no obligation on the Village to appropriate funds beyond the initial term of the contract and contract extensions are dependent upon sufficient funds being appropriated each fiscal year by the Village for this work.

Due to budget constraints, the Village reserves the right to add or delete from the bid as required. No adjustments in bid prices or additional compensation will be made for decreases in the quantities or services from the bid.

**Scope of Work:** The scope of work consists of furnishing all labor and snow removal equipment to maintain traffic and pedestrian flow in all designated snow removal locations at all times which will include 24-hour service on weekends, Saturdays, Sundays, and Holidays.

Holidays are defined as Thanksgiving Day, Christmas Day and New Year's Day.

The contractor shall provide snow removal on all sites listed on Attachment A. The contractor may be called upon to haul snow from these areas when conditions warrant the removal and hauling of snow.

**Qualification of Bidder:** As evidence of experience and work performance, the bidder must supply with their bid a reference list of previous municipal snow removal experience, and present an anticipated contractual workload, which will verify the bidder's qualifications to perform under the terms of this contract.

**Equipment:** The bidder shall submit with their bid a list of company labor and equipment, including minimum staffing number (persons), equipment types and model numbers, and plow sizes, available for specific assignment to this job.

Please also list additional equipment available in the event of a heavy snowfall (such as graders, end loaders (include bucket capacity), dump trucks, etc.

Proof of possession of all required equipment, and proof of insurance coverage, is required prior to award of contract. Submittals shall indicate whether the equipment is owned, leased, or financed. Should the equipment be leased, submittals shall include a copy of the lease agreement. All equipment must be available for use throughout the term of the contract, as need is determined by the Village.

**Bid may be considered "Non-Responsive" if these requirements are not fulfilled.**

**Protection of Public and Private Property:** The contractor shall exercise all necessary caution to protect all public and private property from injury or damage caused by the contractor's operations.

The contractor shall assume responsibility for all damage to property (including curbs, parkway trees, grass area, utilities, mailboxes, trash cans, benches, and driveways) caused by equipment used for removal of snow. **All damage shall be the responsibility of the contractor to repair.** A complete list of snow removal locations are included in this document as Attachments A.

Any practice obviously hazardous in the opinion of the Public Works Director, or his designee, shall be immediately discontinued by the contractor upon receipt of either written or verbal notice to discontinue such practice. The Village is not responsible for site safety. The contractor is solely and exclusively responsible for site safety.

**Accidents:** In the event of accidents of any kind, the contractor shall immediately notify the Director, or his designee, and the Police Department, to secure an accident report, and shall provide a full accounting of all details of the accident. The contractor shall furnish the Village with copies of all reports of such accidents.

**Prosecution of Work:** The proper timing and use of equipment is essential in maintaining the continuous, expeditious, and safe operation of snow removal. Consequently, it is imperative that all equipment be in good operating condition at all times so as to ensure maximum working efficiency and prevent unnecessary failures. Time is of the essence in arriving at the scene to commence snow removal efforts. To ensure uninterrupted snow removal operations, callouts shall be answered promptly, and extraordinary effort shall be exerted by the contractor to render service.

The contractor shall prosecute the work in the following manner:

A. The contractor shall at all times maintain a force of qualified personnel sufficient to perform the work required and described herein. The force of qualified personnel shall be sufficient to respond to emergency calls which may be received at any time. Manpower must be activated and equipment operational at the site within one hour after notification by the Village.

B. The contractor shall submit, in writing, the name, address and telephone number of the person in its organization to whom instructions may be given by the Director, or his designee, on a 24 hour per day basis. One designated supervisor in the contractor's organization shall be on the job site and available at all times during snow plowing operations.

C. The Public Works General Services Division will notify the contractor whenever a storm warning from the Village's weather forecasting service is received stating that a plowable amount of snow (1 inch or more) is forecast. The contractor shall respond by mobilizing all personnel and equipment within a maximum of 1 hour after being notified by the General Services Division.

D. It shall be the responsibility of the contractor to notify the General Services Division manager when all team members are present and working their assignments, and at the full completion of each operation. A form to verify hours worked and equipment used will be provided by the Village and will be signed by both the contractor and the appropriate Village representative as a prerequisite for payment.

E. After finishing one complete clearing pass cycle through the snow removal locations, the contractor may be told to start a second complete clearing cycle immediately and to continue snow removal operations depending on weather conditions. The contractor shall be prepared to continue operations, or start up activities again whenever snow accumulates to a depth of 1 inch or more on the paved area.

F. Snow removal is accomplished by plowing the snow to the curb in the designated cul-de-sacs. Care shall be taken so that no residential driveways or public sidewalk crossing shall be blocked by an amount of snow greater than the windrow of snow through the throat of the cul-de-sac. There is to be no excessive mounting of snow at the corners higher than the normal windrow. The snow shall be carried out to the curb line of the streets.

**Type of Operation:** Depending on snowfall conditions, the following snow removal operations will be initiated at all snow removal locations:

- **Operation #1:** For an accumulation **in excess of 1 inch and less than 5 inches** of snow, the contractor shall provide sufficient equipment to remove snow from all designated areas whenever called upon. Sufficient equipment shall be provided to complete the entire designated area in a maximum of **12 hours** after the clearing operation has begun.

- **Operation #2:** For an accumulation **in excess of 5 inches and less than 9 inches** of snow, the contractor shall provide sufficient equipment to remove snow from all designated areas whenever called upon. Sufficient equipment shall be provided to complete the entire designated area in a maximum of **12 hours** after the clearing operation has begun.

- **Operation #3:** For an accumulation **in excess of 9 inches or more** of snow, the contractor shall provide sufficient equipment to remove snow from all designated areas whenever called upon. Sufficient equipment shall be provided to complete the entire designated area in a maximum of **18 hours** after the clearing operation has begun.

Depth of snow accumulation is measured at the time each plowing operation commences. It is not the total accumulation of snow at the end of the storm.

If stored snow within the cul-de-sacs reaches an undesirable height as determined by the Village, the contractor may be required to load and haul snow to a designated location and will be paid in accordance with the hourly equipment rental rates noted on the Bid Sheet for Operation #3.

**Method of Payment:** All charges for snow removal will start when equipment begins operation in the designated cul-de-sacs and end when the operation is complete. No separate charge for transportation of equipment, downtime, repair or maintenance to or from the site, will be allowed.

The contractor shall be paid on the basis of number of complete clearing passes of all snow and ice locations for Operations #1 and #2 as described in Type of Operation above. Supervision shall be included in the cost per clearing pass.

The contractor shall be paid an hourly rate basis for Operation #3. The contractor shall submit an hourly cost for each piece of equipment on the equipment list (the hourly rate should include the cost of the operator) in the space provided on the Bid Sheet. Supervision, equipment operators and labor shall be included in all hourly rates.

**Exceptions:** Any exceptions to these specifications shall be noted on the Exceptions Sheet and included with the bid submittal.

**Liquidated Damages:** Time is of the essence to the contract. Should the contractor fail to complete the work within the specified time stipulated in the contract, or within such extended time as may have been allowed, the contractor shall be liable and shall pay to the Village the amount shown in the following schedule of deduction. Costs are incurred not as a penalty, but as liquidated damages, for each hour of overrun in the contract time or such extended time as may have been allowed. The liquidated damages for failure to complete the contact on time are approximate, due to the impracticality of calculating and proving actual delay costs. This schedule of deductions establishes the cost of delay to account for administration, engineering, inspection, and supervision during periods of extended and delayed performance. The costs of delay represented by the schedule are understood to be a fair and reasonable estimate of the costs that will be borne by the Village during extended and delayed performance by the contractor of the work. The liquidated damage amount specified will accrue and be assessed until completion of the total physical work of the contract even though the work may be substantially complete. The Village will deduct these liquidated damages from any monies due or to become due to the Contractor from the Village.

Deduction for each hour of overrun in contract time: $750/hour

# Bid Sheet

The undersigned, having examined the specifications and all conditions affecting the specified project, offer to furnish all services, labor, and incidentals specified for the price below.

The undersigned bidder certifies that they are not barred from bidding on this contract as a result of a conviction for the violation of state laws prohibiting bid rigging or bid rotating, (720ILCS 5/33E-1, et seq.) and is not delinquent in nay taxes to the Illinois Department of Revenue (65ILCS 5/11-42.1-1).

It is understood that the Village reserves the right to reject any and all bids ad to waive any irregularities and that the prices contained herein will remain valid for a period of not less than sixty (60) days.

**Company Name:** _____

**Operation #1 Complete Clearing**
**Excess of 1 inch and less than 5 inches of snow accumulation**

**1.** Cost per 1 complete clearing of all locations (lump sum): $_____

**2.** Estimate of 15 events times the lump sum cost above: $_____

**Operation #2 Complete Clearing**
**Excess of 5 inches and less than 9 inches of snow accumulation**

**3.** Cost per 1 complete clearing of all locations (lump sum): $_____

**4.** Estimate of 4 events times the lump sum cost above: $_____

**Total Cost of Operations #1 & 2** (add lines 2 and 4 above) $_____

**Operation #3 Complete Clearing**
**Hourly Equipment Rate**
**9 inches or more of snow accumulation Loading/Hauling**

****NOTE hourly rate includes equipment, operator and labor costs****

| | |
|---|---|
| Skid Steer Loader | $_____ per hour |
| 4x4 Pick Up Truck | $_____ per hour |
| Dump Truck w/Plow (min. 25,000 GVW) | $_____ per hour |
| Dump Truck Only (min. 25,000 GVW) | $_____ per hour |
| 4WD End Loader Rubber tired (min. 76HP/1.5CY bucket or plow) | $_____ per hour |
| Semi-Trailer Truck | $_____ per hour |
| Gradall (if necessary) | $_____ per hour |

Is required equipment owned, leased or financed? _____Owned _____Leased _____Financed

If leased, have you included a copy of your lease agreement? _____Yes _____No

If it is the contractor's intention to utilize a subcontractor(s) to fulfill the requirements of this contract, the Village must be advised of the subcontractor's company name, address, telephone and fax numbers, and a contact person's name at eth time of the bid submittal.

Will you be utilizing a subcontractor? _____Yes _____No

If yes, have you included all required information with your bid submittal? _____Yes _____No

I hereby certify that the item(s) proposed is/are in accordance with the specifications as noted and that the prices quoted are not subject to change; and that _____ (company name) is not barred by law from submitting a bid to the Village for the project contemplated herein because of a conviction for prior violations of either Illinois Compiles Statues, 720 ILCS 5/33E-3 (Bid Rigging) or 720 ILCS 5/33-4 (Bid Rotating); and that

_____ (company name) is not delinquent in payment of any taxes to the Illinois Department of Revenue in accordance with 65 ILCS 5/11-42.1; and that

_____ (company name) provides a drug free workplace pursuant to 30 ILCS 580/1, et seq; and that

_____ (company name) certifies they have a substance-abuse program and provide drug testing in accordance with 820 ILCS 130/11G, Public Act 095-0635; and that

_____ (company name) is in compliance with the Illinois Human Rights Act 775 ILCS 5/1.101, et seq. including establishment and maintenance of sexual harassment policies and program.

_____ Bidder's company name

_____ Signed name

_____ Street address

_____ Print name and title

_____ City State Zip Code

_____ e-mail address

_____ Phone number

_____ Fax number

Date: _____

# Exception Sheet

**Exceptions:** Any exception must be clearly noted on the Exception Sheet. Failure to do so may be reason for rejection of the bid. It is not our intention to prohibit any potential Bidder from bidding by virtue of the specifications, but to describe the material(s) and service(s) actually required. The Village reserves the right to accept or reject any or all exceptions.

**Exceptions Sheet must be enclosed with the Bid Sheet.**

Bidder's exceptions are:

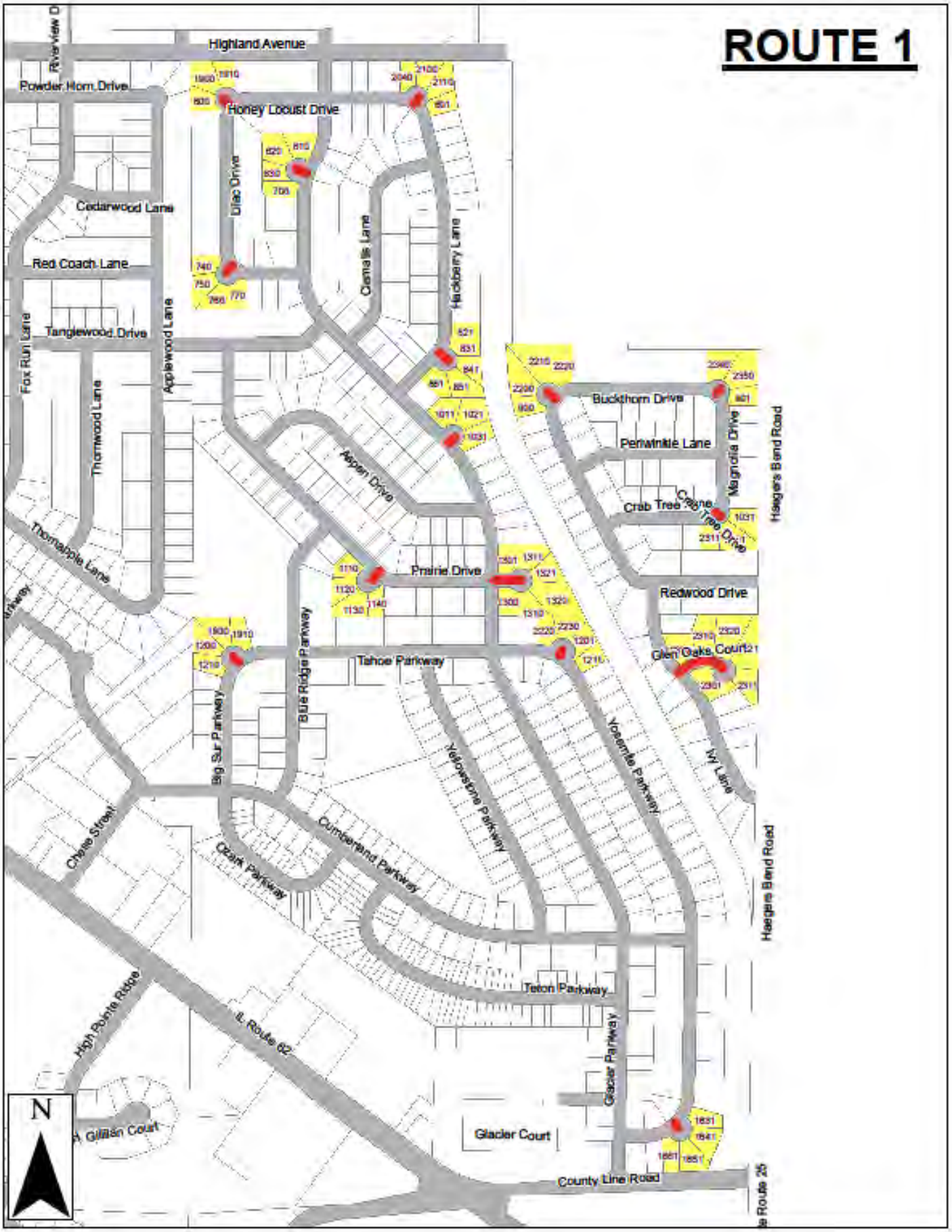
# Attachment A1

**Cul-de-Sacs**

- [ ] Glen Oaks Ct
- [ ] Prairie Ct

**Eyebrows**

- [ ] Glacier Parkway (610-630)
- [ ] Glacier Parkway (1011-1031)
- [ ] Hackberry Lane (831-861)
- [ ] Prairie Drive (1110-1140)
- [ ] Big Sur & Tahoe Parkway
- [ ] Yosemite & Tahoe Parkway
- [ ] Honey Locust & Lilac Drive
- [ ] Honey Locust & Hackberry
- [ ] Lilac & Lilac Drive
- [ ] Yosemite Parkway (1631-1661)
- [ ] Buckthorn & Redwood
- [ ] Buckthorn & Magnolia
- [ ] Crabtree & Magnolia


ROUTE 1
Highland Avenue
Powder Horn Drive
Honey Locust Drive
Lilac Drive
Cedarwood Lane
Red Coach Lane
Tanglewood Drive
Fox Run Lane
Thornwood Lane
Applewood Lane
Osmalis Lane
Hackberry Lane
Aspen Drive
Thornapple Lane
Prairie Drive
Buckthorn Drive
Periwinkle Lane
Crab Tree Drive
Magnolia Drive
Redwood Drive
Glen Oaks Court
Tahoe Parkway
Blue Ridge Parkway
Big Sur Parkway
Yellowstone Parkway
Yosemite Parkway
Cumberland Parkway
Ozark Parkway
Chase Street
Teton Parkway
Glacier Parkway
Glacier Court
High Pointe Ridge
Gillian Court
IL Route 62
County Line Road
Haegers Bend Road
W Lane
N

# Attachment A2

**Cul-de-Sacs**

- [ ] Kingsbury Ct.
- [ ] Plymouth Ct.
- [ ] Prairie Ct.
- [ ] Ballard Ct.
- [ ] Perry Dr. Ct.
- [ ] Longwood Ct.
- [ ] Tanglewood Ct.
- [ ] Cornell Ln.
- [ ] Olin Ct.
- [ ] Pickwick Ct.

**Eyebrows**

- [ ] Cumberland
- [ ] Cumberland
- [ ] Perry & Ballard
- [ ] Old Oak Circle (550 - 605)
- [ ] Longwood Dr. (600 - 630)
- [ ] Longwood Dr. (800 - 830)
- [ ] Powder Horn & Timberwood
- [ ] Powder Horn & Applewood


ROUTE 2
North Harrison Street
North River Road
North River Road
Echo Woods Drive
Riverview Drive
Tanglewood Court
Highland Avenue
Powder Horn Drive
Claymont Court
Wood Drive
Longwood Court
Kingsbury Court
Old Oak Circle
Timberwood Lane
Maplewood Lane
Cedarwood Lane
Old Mill Lane
Red Coach Lane
Colin Court
Pickwick Court
Oxford Court
Pinehurst Court
Countryside Drive
Tanglewood Drive
Fox Run Lane
Thornwood Lane
Applewood Lane
Perry Drive
Ballard Drive
Wesley Lane
Golf Lane
Wesley Lane
Cumberland Parkway
Thornapple Lane
Eastgate Drive
Webster Court
Woodview Lane
Ridge Street
Webster Street
Longwood Drive
Sunset Lane
Hickory Lane
Walnut Lane
Woodview Lane
Sandbloom Road
Sunrise Lane
Alice Lane
Washtenaw Lane
Ryan Parkway
IL Route 62
Chase Street
Ponte Ridge
N

# Attachment A5

**Cul-de-Sacs**

| | |
|---|---|
| | Filip Dr. |
| | Twisted Oak Ct. |
| | Surrey Ct. |
| | Harper Ct. X2 |
| | Hampton Ct. |
| | Hillside Ct. |
| | Braewood Dr. X2 |
| | Spruce Tree Ln |
| | Brandywine Cir. |

**Eyebrows**

| | |
|---|---|
| | Gaslight Drive |


ROUTE 5
Parkview Terrace North
Parkview Terrace West
Parkview Terrace East
Fairmont Court
Somerset Court
Applewood Court
Cherrywood Court
Saddlebrook Circle
Sandpiper Court
Eagle Ridge Lane
Parkview Terrace South
Victoria Court
Windy Knoll Drive
Hanson Road
Mayfair Lane
West Surrey Lane
Terrace Drive
Lexington Court
Yorktown Drive
Yorktown Court
Harper Court
Twisted Oak Court
Surrey Court
Surrey Lane
Zange Drive
Harper Drive
Edgewood Drive
Kingston Place
Devonshire Road
Brighton Lane
Brandywine Circle
Hampton Court
Springhill Drive
Green Pasture Lane
Cardinal Drive
Meadow Drive
Hillside View Drive
Merrill Avenue
Hillside Court
Rustic Lane
Gaslight Drive
Spruce Tree Lane
South Drive
Beach Drive
Hemps Road
Wilbrandt Street
Fox River Drive
Railroad Drive
Flip Road
Willow Street
Jayne Street
Center Drive
Scenic Drive
Short Street
West End Drive
Pleasant View Drive
Lafox River Drive
Division Street
South Harper Drive
Railroad Street
Legion Drive
Washington Street
Jefferson Street
Madison Street
Circle Drive
Shore Drive
Juniper Circle
Evergreen Court
Huntington Court
Concord Court
Concord Court
Huntington Drive
Mulberry Court
Orchard Court
Chestnut Court
Forest Circle
Butterfield Drive
Brentwood Court
Clearview Court
Holly Lane
Huntington Drive
Sandpebble Circle
Sandpebble Court
Lunkstorm Lane
N

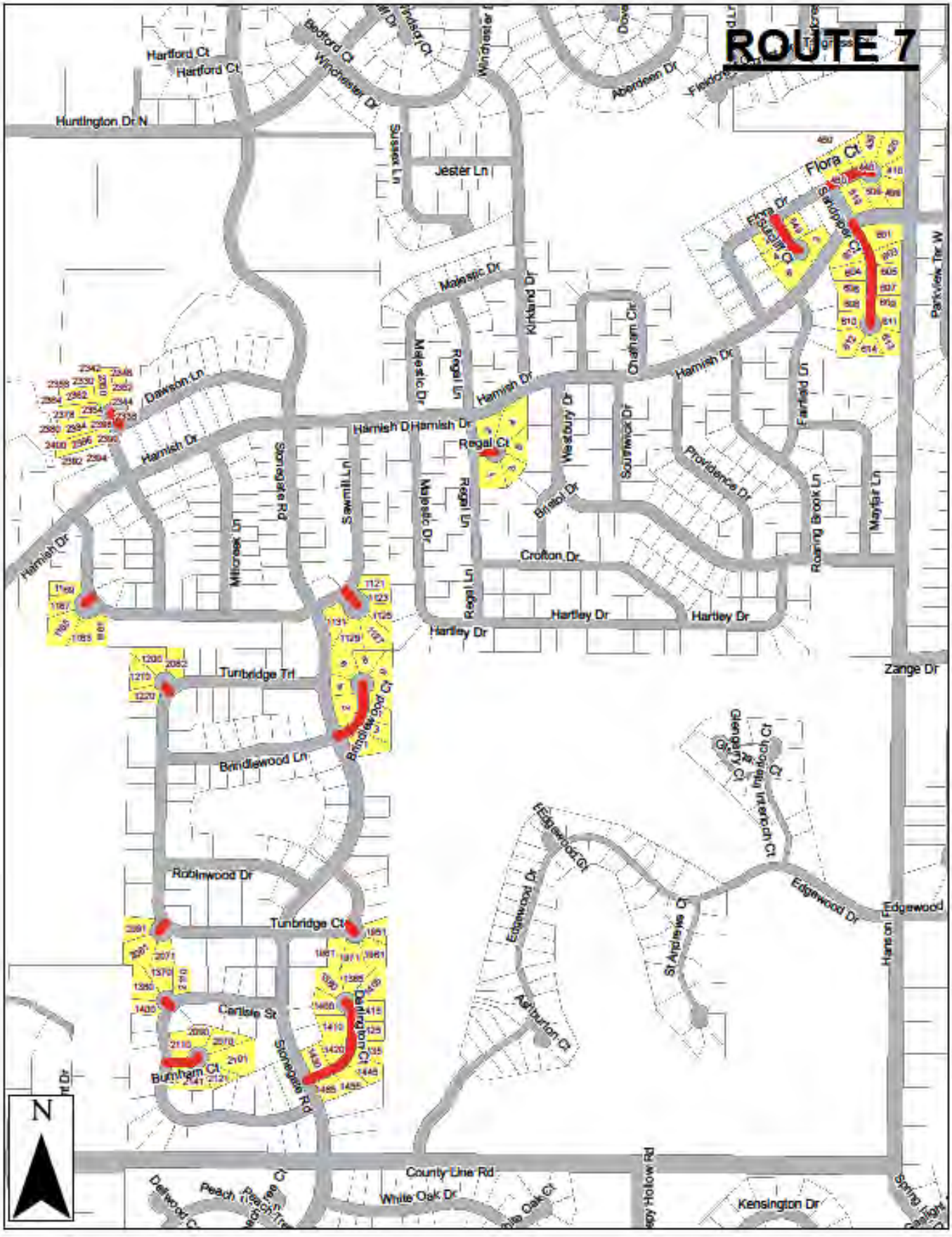
# Attachment A7

**Cul-de-Sacs**

- ☐ Sutcliff Ct.
- ☐ Flora Dr. (Ct.)
- ☐ Sandpiper Ct.
- ☐ Regal Ct.
- ☐ Brindlewood Ct.
- ☐ Darlington Ct.
- ☐ Burnham Ct.
- ☐ Tunbridge Ct.

**Eyebrows**

- ☐ Carlisle St.
- ☐ Tunbridge Tr.
- ☐ Tunbridge Tr.
- ☐ Sawmill Ln
- ☐ Sawmill Ln
- ☐ Dawson Mill Ln


ROUTE 7
Hartford Ct
Hartford Ct
Bedford Ct
Winchester Dr
Huntington Dr N
Sussex Ln
Jester Ln
Aberdeen Dr
Flora Ct
Flora Dr
Parkview Trl W
Majestic Dr
Kirkland Dr
Chatham Cir
Hamish Dr
Fairfield Ln
Dawson Ln
Regal Ln
Regal Ct
Westbury Dr
Southwick Dr
Providence Dr
Bristol Dr
Roaring Brook Ln
Mayfair Ln
Crofton Dr
Hartley Dr
Millcreek Ln
Stonegate Rd
Sawmill Ln
Zange Dr
Tunbridge Trl
Bridlewood Ct
Bridlewood Ln
Robinwood Dr
Tunbridge Ct
Carlisle St
Burnham Ct
Edgewood Ct
Edgewood Dr
Ashburton Ct
St Andrews Ct
Church Hill Ln
Glenbarry Ct
Hanson Edgewood
County Line Rd
White Oak Dr
Kensington Dr
N

# Attachment A8

**Cul-de-Sacs**

| | |
|---|---|
| | Farmhill Ct. |
| | Tallgrass Ct. |
| | Fieldcrest Ct. |
| | Barrington Ct. |
| | Sussex Ln. |
| | Lake Drive Ct. |
| | Rochester Ct. |
| | Cardiff Ct. |
| | Hartford Ct. |
| | Portsmith Ct. |
| | Salford Ct. |
| | Oakleaf Ct. |
| | Preston Ct. |
| | Falcon Ridge Ct. |
| | Bedford Ct. |
| | Dover Ct. |
| | Windsor Ct. |

**Eyebrows**

| | |
|---|---|
| | Farmhill Dr. |
| | Oakleaf Cir. |
| | Arquilla Dr. |
| | Lake Drive South |

# ROUTE 8


Crystal Lake Rd
Algonquin Rd
Algonquin R
Hilltop
Lake Drive S
Lake Drive Ct
Falcon Ridge Ct
Barrington Ct
Oakleaf Ct
Oakleaf Rd S
Safford Ct
Preston St
Preston Ct
Aberdeen Dr
Farmhill Dr
Arquilla Dr
Stonegate Rd
Rochester Ct
Safford Dr
Buckingham Dr
Portsmith Ct
Cardiff Dr
Cardiff Ct
Hartford Ct
Bedford Ct
Winchester Dr
Windsor Ct
Huntington Dr N
Dover Ct
Beamwood Ln
Fieldcrest Dr
Tallgrass Ct
Fieldcrest Ct
Hanson Rd
Jester Ln
Sussex Ct
Flora Ct
Flora Dr
Sandpiper Ct
Hamish Dr
Majestic Dr
Kirkland Dr
Regal Ln
Regal Ct
Chatham Ct
Providence Dr
Stirling Brook Ln
Fairfield Ln
Mayfair Ln
Westbury Dr
Southwick Dr
Stonegate Rd
Sawmill Ln
Parkview Ter W
N

# Attachment A9

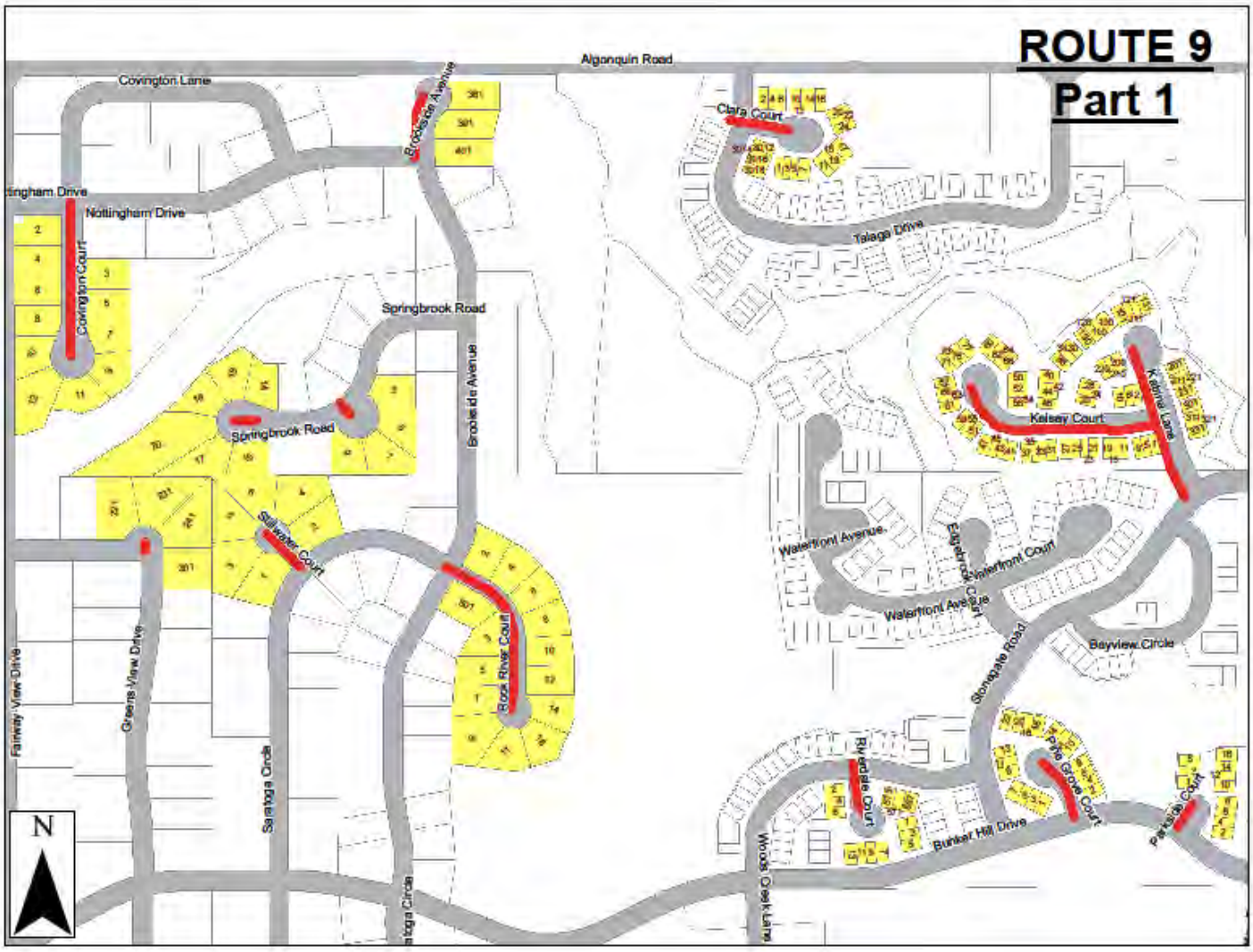
**Cul-de-Sacs**

- ☐ Woods Creek Ct.
- ☐ Millbrook Ct.
- ☐ Christie Ct.
- ☐ Amber Ct.
- ☐ Loren Ct.
- ☐ Covington Ct.
- ☐ Pine Grove Ct.
- ☐ Parkside Ct.
- ☐ Stillwater Ct.
- ☐ Riverdale Ct.
- ☐ Eineke Ct.
- ☐ Springbrook Rd. Ct.
- ☐ Brookside Ave. Ct.
- ☐ Rock River Ct.
- ☐ Clara Ct.
- ☐ Katrina Ln.
- ☐ Kelsey Ct.

**Eyebrows**

- [ ] Loren Ln.
- [ ] Springbrook Rd.
- [ ] Greensview Dr.

# ROUTE 9
# Part 1




ROUTE 9
Part 2
Woods Creek Ln
Woods Creek Ct
Golden Eagle Dr
Sherman Rd
Harnish Dr
Harnish Dr
Eineke Ct
Access Road
Savannah Ln
Eineke Blvd
Becky Lynn Ln
Millbrook Dr
Pond View Dr
Lenora Ln
Eineke Blvd
Eichbach Ct
Williamsburg
County Line Rd
Millbrook Ct
Loren Ct
Loren Ln
Loren Ln
Millbrook Dr
Access Road
Matthew Dr
Boyer Rd
Amber Trace Ct
Millbrook Dr
Commons Dr
Christie Ct
Christie Dr
Wendt St
N

# Attachment A10

**Cul-de-Sacs**

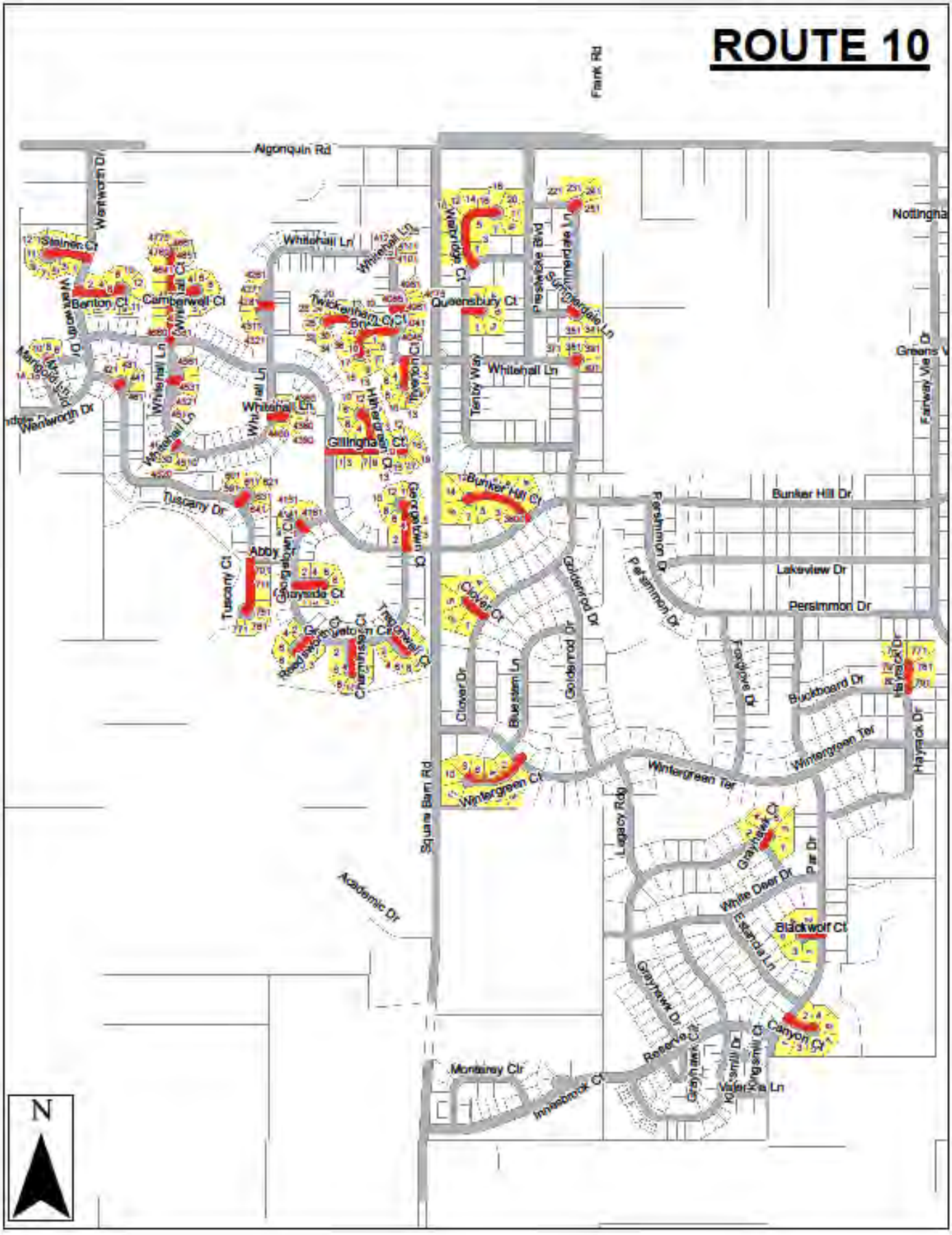
| | |
|---|---|
| | Hayrack Dr. (Ct.) |
| | Grayhawk Ct. |
| | Black Wolf Ct. |
| | Canyon Ct. |
| | Bunker Hill Ct. |
| | Clover Ct. |
| | Walbridge Ct. |
| | Queensbury Ct. |
| | Georgetown Ct. |
| | Tiverton Ct. |
| | Brixton Ct. |
| | Twickingham Ct. |
| | Gillingham Ct. |
| | Hithergreen Ct. |
| | Camberwell Ct. |
| | White Hall Ct. |
| | Quayside Ct. |
| | Reedsworth Ct. |

| | |
|---|---|
| | Charminster Ct. |
| | Tregonwell Ct. |
| | Steiner Ct. |
| | Benton Ct. |
| | Tuscany Dr. Ct. |
| | Wintergreen Ct. |

**Eyebrows**

| | |
|---|---|
| | Summerdale Ln. |
| | Summerdale Ln. |
| | Georgetown Cir. |
| | Whitehall & Clover Dr. |
| | Whitehall Dr. |
| | Whitehall Dr. |
| | Whitehall Dr. |
| | Whitehall Dr. |
| | Whitehall Dr. |
| | Whitehall Dr. |
| | Tuscany Dr. |
| | Tuscany Dr. |
| | Marigold Ln. |

# ROUTE 10


Algonquin Rd
Frank Rd
Wentworth Dr
Whitehall Ln
Stainer Ct
Barton Ct
Camberwell Ct
Twickenham Ct
Gillingham Ct
Thornton Ct
Queensbury Ct
Pleshette Blvd
Summerdale Ln
Tenby Way
Bunker Hill Ct
Bunker Hill Dr
Persimmon Dr
Lakeview Dr
Tuscany Dr
Tuscany Ct
Abby
Georgetown Ct
Grayslake Ct
Clover Ct
Clover Dr
Bluestem Ln
Goldenrod Dr
Fairlove Rd
Buckboard Dr
Wintergreen Ter
Wintergreen Ct
Square Barn Rd
Legacy Rdg
Academic Dr
Par Dr
White Deer Dr
Blackwolf Ct
Canyon Ct
Montaray Cir
Innsbrook Ct
Valley Ridge Ln
N

## Bid Sheet

The undersigned, having examined the specifications and all conditions affecting the specified project, offer to furnish all services, labor, and incidentals specified for the price below.

The undersigned bidder certifies that they are not barred from bidding on this contract as a result of a conviction for the violation of state laws prohibiting bid rigging or bid rotating, (720ILCS 5/33E-1, et seq.) and is not delinquent in nay taxes to the Illinois Department of Revenue (65ILCS 5/11-42.1-1).

It is understood that the Village reserves the right to reject any and all bids ad to waive any irregularities and that the prices contained herein will remain valid for a period of not less than sixty (60) days.

**Company Name:** Langton Group

**Operation #1 Complete Clearing**
**Excess of 1 inch and less than 5 inches of snow accumulation**

1. Cost per 1 complete clearing of all locations (lump sum): $ 5,897.36
2. Estimate of 15 events times the lump sum cost above: $ 88,460.40

**Operation #2 Complete Clearing**
**Excess of 5 inches and less than 9 inches of snow accumulation**

3. Cost per 1 complete clearing of all locations (lump sum): $ 8,846.04
4. Estimate of 4 events times the lump sum cost above: $ 35,384.16

**Total Cost of Operations #1 & 2** (add lines 2 and 4 above) $ 123,844.56

**Operation #3 Complete Clearing**
**Hourly Equipment Rate**
**9 inches or more of snow accumulation Loading/Hauling**

****NOTE hourly rate includes equipment, operator and labor costs****

| | | |
|---|---|---|
| Skid Steer Loader | $ 110.00 | per hour |
| 4x4 Pick Up Truck | $ 110.00 | per hour |
| Dump Truck w/Plow (min. 25,000 GVW) | $ 150.00 | per hour |
| Dump Truck Only (min. 25,000 GVW) | $ 150.00 | per hour |
| 4WD End Loader Rubber tired (min. 76HP/1.5CY bucket or plow) | $ 200.00 | per hour |
| Semi-Trailer Truck | $ 225.00 | per hour |
| Gradall (if necessary) | $ Exception 1.37 | per hour |

Is required equipment owned, leased or financed? X Owned ____Leased ____Financed

If leased, have you included a copy of your lease agreement? ____Yes ____No

If it is the contractor's intention to utilize a subcontractor(s) to fulfill the requirements of this contract, the Village must be advised of the subcontractor's company name, address, telephone and fax numbers, and a contact person's name at eth time of the bid submittal.

Will you be utilizing a subcontractor? _____Yes __X__No

If yes, have you included all required information with your bid submittal? _____Yes _____No

I hereby certify that the item(s) proposed is/are in accordance with the specifications as noted and that the prices quoted are not subject to change; and that Langton Group (company name) is not barred by law from submitting a bid to the Village for the project contemplated herein because of a conviction for prior violations of either Illinois Compiles Statues, 720 ILCS 5/33E-3 (Bid Rigging) or 720 ILCS 5/33-4 (Bid Rotating); and that

Langton Group (company name) is not delinquent in payment of any taxes to the Illinois Department of Revenue in accordance with 65 ILCS 5/11-42.1; and that

Langton Group (company name) provides a drug free workplace pursuant to 30 ILCS 580/1, et seq; and that

Langton Group (company name) certifies they have a substance-abuse program and provide drug testing in accordance with 820 ILCS 130/11G, Public Act 095-0635; and that

Langton Group (company name) is in compliance with the Illinois Human Rights Act 775 ILCS 5/1.101, et seq. including establishment and maintenance of sexual harassment policies and program.

Langton Group
Bidder's company name

Signed name

4510 Dean ST.
Street address

Kyle Cook Sales Consultant
Print name and title

Woodstock IL 60098
City State Zip Code

langtongroup@att.net
e-mail address

815-338-2630
Phone number

815-338-2634
Fax number

Date: 11-6-18

## Exception Sheet

**Exceptions:** Any exception must be clearly noted on the Exception Sheet. Failure to do so may be reason for rejection of the bid. It is not our intention to prohibit any potential Bidder from bidding by virtue of the specifications, but to describe the material(s) and service(s) actually required. The Village reserves the right to accept or reject any or all exceptions.

**Exceptions Sheet must be enclosed with the Bid Sheet.**

Bidder's exceptions are:

Replace Gradall with Front end loader to load Snow

Auto-Owners Insurance
Life Home Car Business

**Bond Number** BD150238

## BID BOND

KNOW ALL BY THESE PRESENTS, that we, LANGTON SNOW SOLUTIONS DBA LANGTON GROUP of 4510 DEAN ST WOODSTOCK, IL 60098-7503 (hereinafter called the Principal), as Principal, and Auto-Owners Insurance Company (hereinafter called the Surety), as Surety, are held and firmly bound unto VILLAGE OF ALGONQUIN 2200 HARNISH DR, ALGONQUIN IL 60102-5995 (hereinafter called the Obligee), in the penal sum of Five Percent of bid Dollars (5% of Attached bid) for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that WHEREAS, the Principal has submitted or is about to submit a proposal to the Obligee on a contract for SNOW REMOVAL FOR VILLAGE OF ALGONQUIN

NOW, THEREFORE, if the said Contract be timely awarded to the Principal and the Principal shall, within such time as may be specified, enter into the Contract in writing, and give bond, if bond is required, with surety acceptable to the Obligee for the faithful performance of the said Contract, then this obligation shall be void; otherwise to remain in full force and effect.

Signed and sealed this 6TH day of NOVEMBER, 2018.

Kyle Cook
Witness

Principal

Title

Auto-Owners Insurance Company

AUTO-OWNERS INSURANCE CORPORATE SEAL LANSING, MICHIGAN

Susan E. Theisen
Susan E. Theisen Witness

Paul D. Oppenlander
Paul D. Oppenlander Attorney-in-Fact

Print Date: **11/06/2018** Print Time: **04:54:55 PM**

Auto-Owners Insurance
Life Home Car Business

**Bond Number** BD150238

## ACKNOWLEDGEMENT BY SURETY

STATE OF MICHIGAN

County of Eaton

On this 6TH day of NOVEMBER, 2018, before me personally appeared Paul D. Oppenlander, known to me to be the Attorney-in-Fact of Auto-Owners Insurance Company, the corporation that executed the within instrument, and acknowledged to me that such corporation executed the same.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal, at my office in the aforesaid County, the day and year in this certificate first above written.

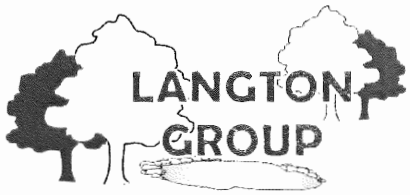
SUSAN E. THEISEN
NOTARY PUBLIC
COUNTY OF KENT
My Commission Expires
MARCH 10, 2022
Acting in the
County of
STATE OF MICHIGAN

Susan E. Theisen

Susan E. Theisen
Notary Public in the State of Michigan
County of Kent

**SUSAN E. THEISEN**
**NOTARY PUBLIC-STATE OF MICHIGAN**
**COUNTY OF KENT**
**My Commission Expires March 10, 2022**
**Acting in the County of** Eaton

Print Date: **11/06/2018** Print Time: **04:54:55 PM**




Full Service Landscape and Construction
815-338-2630

# References

City: Wonderlake
Contact: Chuck Bissel
Phone: 815-321-3020

City: Oswego
Contact: Aaron Grosskopf
Phone: 630-264-4587

Company: SweetWater HOA
Contact: Jim Barron
Address: 1805 Havens Rd. Woodstock, IL 60098
Phone: 815-575-1124

School District: 200 (Woodstock)
Contact: Ken Roiland
Address: 227 W Judd St, Woodstock, IL 60098
Phone: 815-338-8200

School District: 47 (Crystal Lake)
Contact: Sean Smith
Address: 300 Commerce Dr. Crystal Lake, IL 60014
Phone: 815-378-1320

School District: 155 (Crystal Lake)
Contact: Jeff Daurer
Address: 1 S. Virginia Rd. Crystal Lake, IL 60014
Phone: 815-455-8500 ext. 1056

# VILLAGE OF ALGONQUIN

*PUBLIC WORKS DEPARTMENT*

**– M E M O R A N D U M –**

DATE: *November 16, 2018*

TO: *Tim Schloneger, Committee of the Whole*

FROM: *Jason Schutz, Utilities Superintendent*

SUBJECT: Municipal Code, Appendix B – Manual meter reading fee

---

As we are in the midst of our water meter change out program, some residents are skeptical of having a smart meter in their home due to radio frequencies (RF). Additional literature is included with this packet and is available upon request to the public. I am anticipating that some residents will opt out of this program, therefore requesting to change our *Manual meter reading fee* from *$7.00* that is currently in the Municipal Code, Appendix B, 6A.28-C to *$25.00*. This change would bring us to our current operational / labor rates to perform this additional service.

Our calculations are based off from 30 minutes per manual read. Meters vehicle cost to operate is $6.74 per half hour and loaded cost of employee is $26.85 per half hour, which is more than proposing for.

# SmartPoint 510M

## Non-Pit Set Module

The SmartPoint® 510M Non-Pit Set Module is a radio transceiver that provides water utilities inbound and outbound access to water measurement and ancillary device diagnostics via radio signal. The SmartPoint 510M Module is designed for non-submersible/non-pit installations.

BENEFITS:

- Easily receives input from either walk-by/drive-by or fixed-base collection device
- Controls both deployment and lifetime operation costs
- Compact installation that saves time, space and money - without reducing system performance
- Delivers a fast, efficient, reliable connection at minimal cost
- Minimizes new infrastructure investment
- Enables effective leak detection

### TouchCoupler Design

The SmartPoint 510M Module utilizes TouchCoupler, the patented Sensus inductive coupling communication platform, to interface with the encoded meter. With TouchCoupler, the SmartPoint 510M Module can connect to the meter using existing two-wire AMR installations instead of requiring utilities to access the home to install a new three-wire system. This results in a fast, efficient and reliable connection at minimal cost.

### Operation

With its migratable, two-way communication ability, the M-Series SmartPoint functions as a walk-by/drive-by endpoint, fixed-base endpoint, or combination of the two. This flexibility increases utility data collection capabilities and streamlines operations. The SmartPoint 510M Module receives input from the meter register and remotely sends data to a walk-by/drive-by or fixed-base collection device. The SmartPoint 510M Module easily migrates from walk-by/drive-by to fixed base by simply installing a Base Station.

In walk-by/drive-by mode, the SmartPoint 510M Module collects data and awaits an activation signal from the Vehicle Gateway Basestation (VGB) or Hand-Held Device (HHD). Upon signal receipt, it transmits readings, the meter identification number and any alarms.

As a fixed-base endpoint, the SmartPoint 510M Module interacts with one or more strategically placed Base Stations located in the utility service area. Top of the hour readings and other diagnostics are instantly forwarded to the Regional Network Interface (RNI)™ at time of transmission. The FlexNet® communication network provides unmatched reliability by using expansive tower receiver coverage of metering end points, data/message redundancy, failover backup provisions and operation on FCC primary use (unshared) RF spectrum.

SENSUS
a xylem brand

# SmartPoint 510M

## Non-Pit Set Module

### Powerful Transmission, Flexible Platform

The SmartPoint® 510M Non-Pit Set Module offers several advantages that control both deployment and lifetime operation costs. Its powerful, industry leading two watt transmitter broadcasts over large distances and minimizes collection infrastructure. And after the SmartPoint 510M Module is installed, its migratable, two-way system platform can be updated without requiring personnel to visit each meter and/or inconveniencing customers.

### Additional SmartPoint 510M Module Features

The SmartPoint 510M Module obtains hourly readings and can monitor continuous flow over a programmable period of time, alerting the utility to leak conditions. In addition, the SmartPoint 510M Module stores up to 840 consumption intervals (35 days of hourly consumption), providing the utility with the ability to extract detailed usage profiles for consumer information and dispute resolution. The SmartPoint 510M Module also incorporates a two-port design, allowing the utility to connect multiple registers and ancillary devices (such as acoustic monitoring) to a single SmartPoint. This results in a compact installation that saves time, space and money – without reducing system performance.

### Specifications

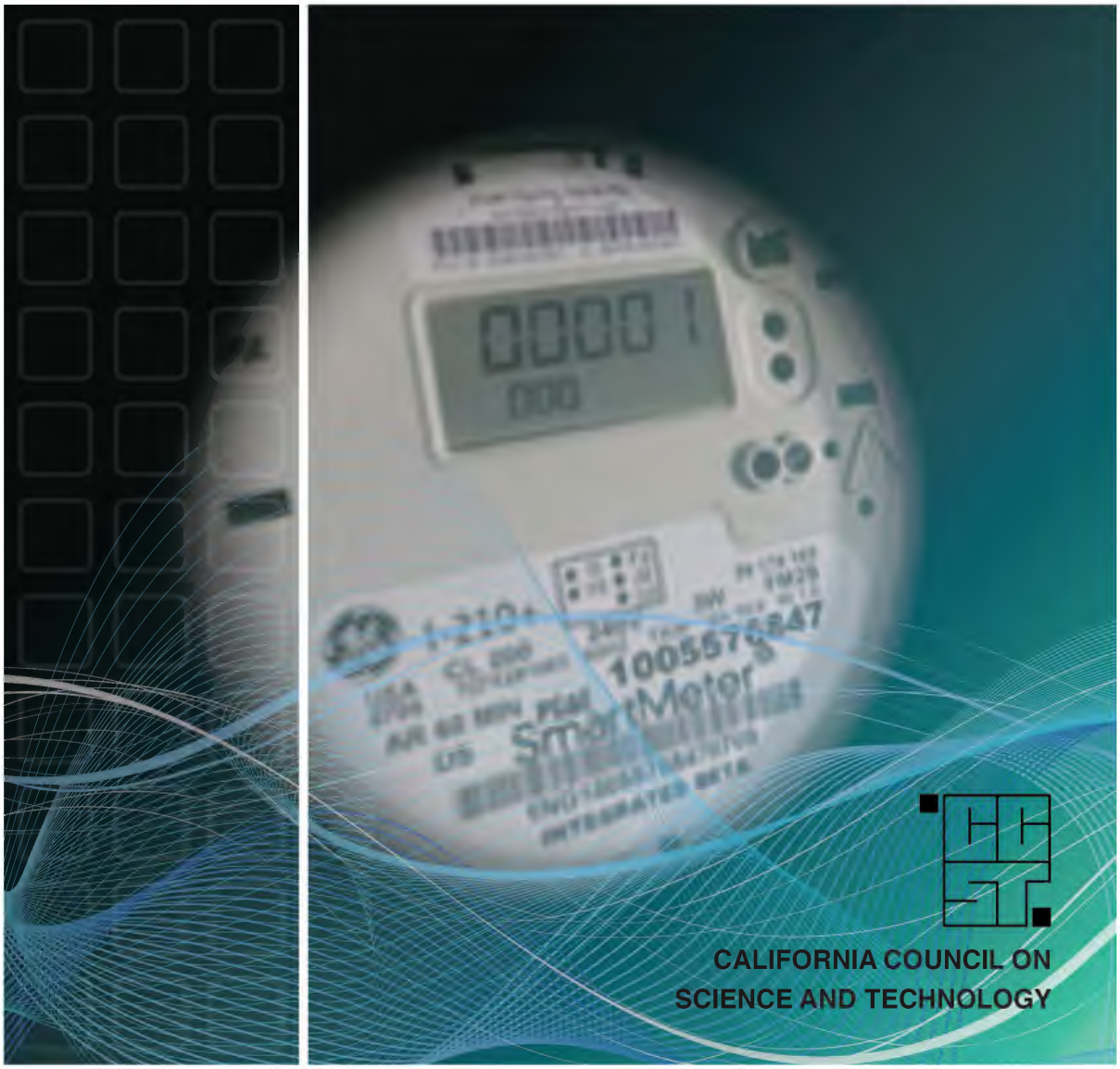
| | |
|---|---|
| Service | Wall mounted (non-pit/non-submersible) installation interfacing the utility meter to the Sensus FlexNet system. |
| Physical characteristics | Width: 5 9/16" x Height: 5 1/2" x Depth: 3" |
| Weight | 1.13 lbs/18.08 oz |
| Color | Tan |
| Frequency range | 900 – 950 MHz, 8000 channels X 6.25 kHz steps |
| Modulation | Proprietary Narrow Band |
| Memory | Non-Volatile |
| Power | Lithium Thionyl Chloride batteries |
| Approvals | US: FCC CFR 47: Part 24D, Part 101C, Part 15<br>Licensed operation<br>Canada: Industry Canada (IC) RSS-134, RSS-119 |
| Operating temperature | - 22° F to +185° F<br>- 30° C to + 85° C |
| Options | Dual or single port availability; TouchCoupler only, wired only |
| Installation environment | The 510M is designed for side-of-home applications where it is not subject to submergence. |
| Compatibility | TouchCoupler and Wired Version: Sensus Encoder Registers, Badger ADE water registers, Master Meter AccuLinx, and Hersey Translator (approved TR/PL Lead)<br><br>Wired Version Only: Elster Encoder (Sensus protocol), Neptune ARB VI (ProRead), Hersey Translator, Zenner PMN Nitro 01, McCrometer flowcom FC100-00M, and Kamstrup flowIQ 2100<br><br>Refer to the 510M/520M SmartPoint® Module Water Meter and Ancillaries Compatibility Quick Guide for the latest compatibility information. |
| Warranty | 20 years – Based on six transmissions per day.<br>Refer to Sensus G-500 for warranty. |

SENSUS
a xylem brand

8601 Six Forks Rd, Ste 700
Raleigh, NC 27615
1-800-638-3748
sensus.com

# HEALTH IMPACTS OF RADIO FREQUENCY EXPOSURE FROM SMART METERS

APRIL 2011 - FINAL REPORT




CALIFORNIA COUNCIL ON
SCIENCE AND TECHNOLOGY

**ACKNOWLEDGMENTS**
We would like to thank the many people who provided input and feedback towards the completion of this report. Without the insightful feedback that these individuals generously provided, this report could not have been completed. We would like to give special thanks to the California Smart Grid Center, College of Engineering and Computer Science at the California State University, Sacramento and to the University of California's Center for Information Technology Research in the Interest of Society (CITRIS).

This report was conducted with the oversight of a CCST Smart Meter Project Team, whose members include: Rollin Richmond (Chair), Emir Macari, Patrick Mantey, Paul Wright, Ryan McCarthy, Jane Long, David Winickoff, and Larry Papay. We also thank J.D. Stack for his technical contributions and Lora Lee Martin for the overall coordination of this report response. We express gratitude to CCST's members and colleagues for their many contributions to the report. Comments on the January 2011 draft of this report were solicited from the public. Many very thoughtful and informed comments were received. All public comments were reviewed and taken into consideration as this final report was completed.

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Health Impacts of Radio Frequency Exposure From Smart Meters
April 2011
ISBN-13: 978-1-930117-42-6

CCST is a non-profit organization established in 1988 at the request of the California State Government and sponsored by the major public and private postsecondary institutions of California and affiliate federal laboratories in conjunction with leading private-sector firms. CCST's mission is to improve science and technology policy and application in California by proposing programs, conducting analyses, and recommending public policies and initiatives that will maintain California's technological leadership and a vigorous economy.

Note: The California Council on Science and Technology (CCST) has made every reasonable effort to assure the accuracy of the information in this publication. However, the contents of this publication are subject to changes, omissions, and errors, and CCST does not accept responsibility for any inaccuracies that may occur.

For questions or comments on this publication contact:
California Council on Science and Technology
1130 K Street, Suite 280
Sacramento, California 95814
(916) 492-0996
ccst@ccst.us

**Table of Contents**

**Letter from CCST**

With rapidly emerging and evolving technologies, lawmakers at times find themselves pressed to make policy decisions on complex technologies. Smart meters are one such technology.

Smart meters are being deployed in many places in the world in an effort to create a new generation of utility service based on the concepts of a smart grid, one that is agile, efficient and cost effective.

The electricity crisis of 2000 and 2001 helped force the issue here in California, lending significant urgency to the need for better management of power generation and distribution. In 2006, the California Public Utilities Commission authorized the Pacific Gas and Electric Company to implement a relatively new technology, smart meters, to gather much more precise information about power usage throughout the state. The process of installing the meters throughout the state is still underway.

As with any new technology, there are unknowns involved. Smart meters generally work by transmitting information wirelessly. Some people have expressed concerns about the health effects of wireless signals, particularly as they become virtually ubiquitous. These concerns have recently been brought to the attention of state legislators, with some local municipalities opting to ban further installation of the meters in their communities.

We are pleased that Assembly Members Huffman and Monning have turned to CCST for input on this issue. It is CCST's charge to offer independent expert advice to the state government and to recommend solutions to science and technology-related policy issues. In this case, we have assembled a succinct but comprehensive overview of what is known about human exposure to wireless signals and the efficacy of the FCC safety standards for these signals. To do so, we assembled a project team that consulted with over two dozen experts and sifted through over a hundred articles and reports, providing a thorough, unbiased overview in a relatively rapid manner.

In situations where public sentiment urges policy makers to make policy decisions with potentially long-term consequences, access to the best information possible is critical. This is the role that CCST was created to fulfill.

Susan Hackwood
Executive Director, CCST

Rollin Richmond
Project Team Chair, CCST

**Health Impacts of Radio Frequency from Smart Meters**
**Response to Assembly Members Huffman and Monning**

California Council on Science and Technology
April 2011

## KEY REPORT FINDINGS

1. Wireless smart meters, when installed and properly maintained, result in much smaller levels of radio frequency (RF) exposure than many existing common household electronic devices, particularly cell phones and microwave ovens.
2. The current FCC standard provides an adequate factor of safety against *known thermally* induced health impacts of existing common household electronic devices and smart meters.
3. To date, scientific studies have not identified or confirmed negative health effects from *potential non-thermal* impacts of RF emissions such as those produced by existing common household electronic devices and smart meters.
4. Not enough is currently known about potential non-thermal impacts of radio frequency emissions to identify or recommend additional standards for such impacts

## OTHER CONSIDERATIONS

Smart electricity meters are a key enabling technology for a "smart grid" that is expected to become increasingly clean, efficient, reliable, and safe at a potentially lower cost to the consumer. The CCST Smart Meter Project Team offers the following for further consideration by policy makers, regulators and the utilities. We appreciate that each of these considerations would likely require a cost/benefit analysis. However, we feel they should be considered as the overall cumulative exposure to RF emissions in our environment continues to expand.

1. As wireless technologies of all types increase in usage, it will be important to: (a) continue to quantitatively assess the levels of RF emissions from common household devices and smart meters to which the public may be exposed; and (b) continue to investigate potential thermal and non-thermal impacts of such RF emissions on human health.
2. Consumers should be provided with clearly understood information about the radiofrequency emissions of all devices that emit RF including smart meters. Such information should include intensity of output, duration and frequency of output, and, in the cases of the smart meter, pattern of sending and receiving transmissions to and from all sources.
3. The California Public Utilities Commission should consider doing an independent review of the deployment of smart meters to determine if they are installed and operating consistent with the information provided to the consumer.
4. Consideration could be given to alternative smart meter configurations (such as wired) in those cases where wireless meters continue to be concern to consumers.

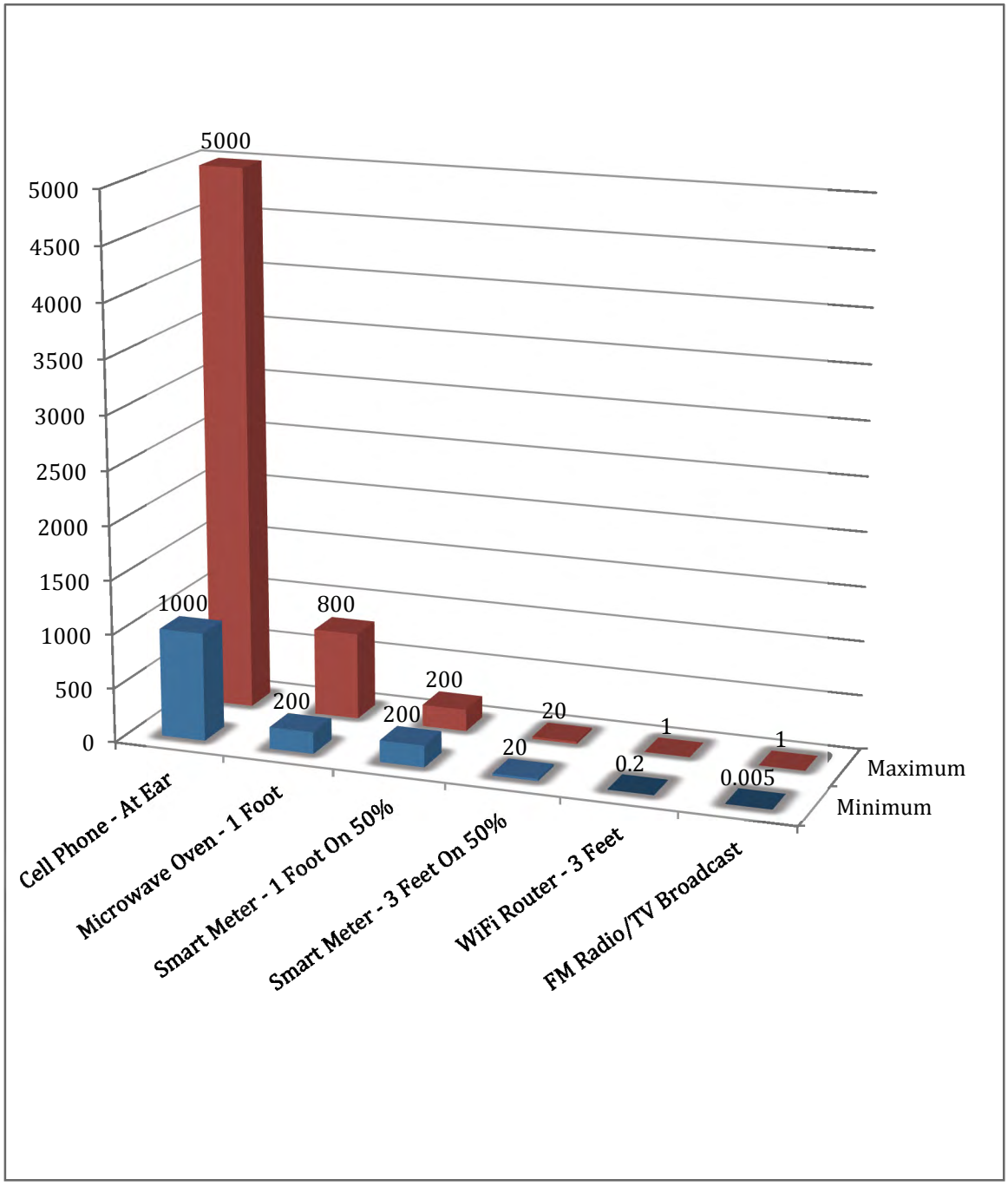


**Figure 1. Instantaneous Radio Frequency Power Density Levels of Common Devices (in microWatts/cm$^2$)**
About this figure**:** This figure was developed by the CCST project team**.** Quantities for different distances calculated using Inverse Square Law. Assumes distances in far-field, where power density reduces as the square of the distance from the source. Smart meter power scaled to obtain output for 50% duty cycle. The source for the various starting measurements came from Electric Power Research Institute (EPRI), Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model (February 2011)

**Legislative Request**

On July 30, 2010, California Assembly Member Jared Huffman wrote to the California Council on Science and Technology (CCST) to request that the Council perform an "independent, science-based study…[that] would help policy makers and the general public resolve the debate over whether smart meters present a significant risk of adverse health effects." California Assembly Member Bill Monning signed onto the request with his own letter to CCST on September 15, 2010. The City of Mill Valley also sent a letter on September 20th supporting Assembly Member Huffman's request for the study.

**Approach**

Reflecting the requests of the Assembly Members, CCST agreed to compile and assess the evidence available to address:

> **1. Whether Federal Communications Commission (FCC) standards for smart meters are sufficiently protective of public health, taking into account current exposure levels to radiofrequency and electromagnetic fields.**
>
> **2. Whether additional technology-specific standards are needed for smart meters and other devices that are commonly found in and around homes, to ensure adequate protection from adverse health effects.**

CCST convened a Smart Meter Project Team composed of CCST Council and Board members supplemented with additional experts in relevant fields (see Appendix A for Project Team members). The Project Team identified and reviewed over 100 publications and postings about smart meters and other devices in the same range of emissions, including research related to cell phone RF emissions, and contacted over two dozen experts in radio and electromagnetic emissions and related fields to seek their opinion on the two identified issues.

It is important to note that CCST has not undertaken primary research of its own to address these issues. This response is limited to soliciting input from technical experts and to reviewing and evaluating available information from past and current research about health impacts of RF emitted from electric appliances generally, and smart meters specifically. This report has been extensively reviewed by the Project Team, experts in related fields, and has been subject to the CCST peer review process (see Appendix B). It has also been made available to the public for comment.

**Two Types of Radio Frequency Effects: Thermal and Non-thermal**

Household electronic devices, such as cellular and cordless telephones, microwave ovens, wireless routers, and wireless smart meters produce RF emissions. Exposure to RF emissions may lead to thermal and non-thermal effects. Thermal effects on humans have been extensively studied and appear to be well understood. The Federal Communications Commission (FCC) has established guidelines to protect public health from known hazards associated with the thermal impacts of RF: tissue heating from absorbing energy associated with radiofrequency emissions. Non-thermal effects, however, including cumulative or prolonged exposure to lower levels of RF emissions, are not well understood. Some studies have suggested non-thermal effects may include fatigue, headache, irritability, or even cancer. *But these findings have not been scientifically established, and the mechanisms that might lead to non-thermal effects remain uncertain.* Additional research and monitoring is needed to better identify and understand potential non-thermal effects.

**Findings**

Given the body of existing, *generally accepted scientific knowledge* regarding smart meters and similar electronic devices, CCST finds that:

1. **The FCC standard provides an adequate factor of safety against known RF induced health impacts of smart meters and other electronic devices in the same range of RF emissions.**
   The potential for behavioral disruption from increased body tissue temperatures is the only biological health impact that has been consistently demonstrated and scientifically proven to result from absorbing RF within the band of the electromagnetic spectrum (EMF) that smart meters use. The Federal Communications Commission (FCC) has set a limit on the Standard Absorption Rate (SAR) from electronic devices, which is well below the level that has been demonstrated to affect behavior in laboratory animals. Smart meters, including those being installed by Pacific Gas and Electric Company (PG&E) in the Assembly Members' districts, if installed according to the manufacturers instructions and consistent with the FCC certification, emit RF that is a very small fraction of the exposure level established as safe by the FCC guidelines.

   FCC staff has recently confirmed that it "relied on the expert opinions of EPA, NCRP, and others to conclude that the RF exposure limits it adopted were adequately protective of human health from all known adverse effects, regardless of whether these effects were thermal or athermal in origin".[1]

   The FCC guidelines provide a significant factor of safety against known RF impacts that occur at the power levels and within the RF band used by smart meters. Given current

[1] Statement provide by Robert Weller regarding FCC regulations on February 3, 2011. Robert Weller, Chief, Technical Analysis Branch, Office of Engineering and Technology, Federal Communications Commission.

scientific knowledge, the FCC guideline provides a more than adequate margin of safety against known RF effects.

2. **At this time there is no clear evidence that additional standards are needed to protect the public from smart meters or other common household electronic devices.** Neither the relevant scientific literature nor our expert consultations support that there is a causal relationship between RF emissions and non-thermal human health impacts. Nor does the relevant evidence convincingly describe mechanisms for such impacts, although more research is needed to better understand and verify these potential mechanisms. Given the absence of evidence supporting a real hazard, the benefits of elevating existing standards are highly speculative. Further, there is not an existing basis from which to understand what types of standards could be helpful or appropriate**.** Without a clearer understanding of the biological mechanisms involved identifying additional standards or evaluating the relative costs and benefits of those standards cannot be determined at this time.

   Given the existing significant scientific uncertainty around non-thermal effects, there is currently no generally accepted definitive, evidence-based indication that additional standards are needed. Because of the lack of generally accepted evidence, there is also not an existing basis from which to understand what types of standards could be helpful or appropriate**.** Without a clearer understanding of the biological mechanisms involved identifying additional standards or evaluating the relative costs and benefits of those standards cannot be determined at this time.

   CCST notes that in some of the studies reviewed, contributors have raised emerging questions from some in the medical and biological fields about the potential for biological impacts other than the thermal impact that the FCC guidelines address. A report of the National Academies identifies research needs and gaps and recommended areas of research to be undertaken to further understanding of long-term exposure to RF emissions from communication devices, particularly from non-thermal mechanisms.[2] In our increasingly wireless society, smart meters account for a very small portion of RF emissions to which we are exposed. Concerns about human health impacts of RF emissions from smart meters should be considered in this broader context.

[2] National Research Council (2008) *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication,* The National Academies Press, Washington, D.C.

THE SCIENTIFIC METHOD

"Scientifically established", "generally accepted scientific knowledge" and other such references throughout this document are referencing information obtained through the scientific method. A scientific method consists of the collection of data through observation and experimentation, and the formulation and testing of hypotheses. These steps must be repeatable in order to predict future results. Scientific inquiry is generally intended to be as objective as possible, to reduce biased interpretations of results. Another basic expectation is to document, archive and share all data and methodology so they are available for careful scrutiny by other scientists, giving them the opportunity to verify results by attempting to reproduce them. This practice, called full disclosure, also allows statistical measures of the reliability of these data to be established.

INTERPRETING THE SCIENTIFIC LITERATURE

In our review of the relevant scientific evidence, we privileged those studies that had as many of the following indicia of scientific reliability as possible: (1) Empirical testing; (2) Peer review and publication; (3) The use of accepted standards and controls; (4) Degree to which the finding is generally accepted by a relevant scientific community. These criteria of scientific reliability are broadly based on the standards of expert testimony and evidence in the US Federal Courts.

Health concerns surrounding RF from smart meters are similar to those from many other devices that we use in our daily lives, including cordless and cellular telephones, microwave ovens, wireless routers, hair dryers, and wireless-enabled laptop computers. As detailed in the report, a comparison of electromagnetic frequencies from smart meters and other devices shows that the exposure level is very low.

***Standards of Proof or Certainty in Public Health***

In this report, scientific evidence is the primary consideration. Upon consulting with the California Department of Public Health, it is noted that using scientific evidence to shape public policy is always challenging. The standards for declaring certainty within a scientific discipline, which are based on the results of statistical testing, may be unrealistic or inappropriate for making public policy decisions, particularly those with potential impacts on population health. Statistical tests usually rely on the convention of whether the results of a given study are sufficient to reject the null hypothesis of no effect (i.e., of a given exposure). This is effectively a standard of 95% certainty, analogous to the legal standard of proof "beyond a reasonable doubt."

In public health, five factors are generally considered when reviewing scientific evidence for policy decisions related to specified exposures:

1. Severity of potential effect(s): e.g., cancer or serious birth defects would be considered more severe than skin irritation;
2. Number of people with potential exposure;
3. Levels of likely and possible exposures;
4. Degree of certainty of the specific effect(s) at different exposure levels; certainty just above 50% might be characterized as "more likely than not."
5. Cost to mitigate potential effect(s), typically considered in light of the other factors.

Policy makers constantly weigh these factors consciously or unconsciously as they interact with stakeholders to craft good public policy. In one situation, they might consider high-cost mitigations for high-severity effects with high-certainty evidence. In another situation with high-severity effects and "more likely than not" certainty of those effects, they might choose low-cost mitigations. This report did not extend beyond the scientific evidence realm with which we were charged leaving those issues to the policy makers to whom this report has been delivered.

**What are Smart Meters?**

Smart meters measure attributes of electricity, natural gas, or water as delivered to consumers and transmit that information (e.g., usage) digitally to utility companies. Some smart meters are also designed to transmit real-time information to the consumer. These smart meters replace traditional, analog meters and meter readers with an automated process that is expected to reduce operating costs for utilities, and potentially, costs for customers (see Figure 2). Each of California's major electricity utilities has begun deploying smart meter infrastructure.

a. Analog Meter b. Digital Meter

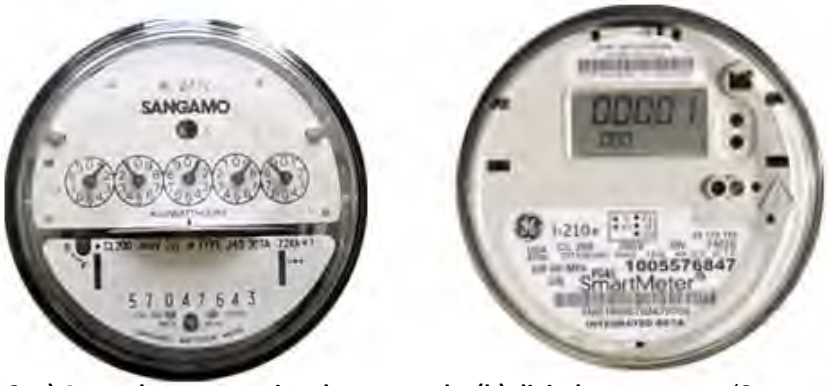


**Figure 2. a) An analog, conventional meter and a (b) digital smart meter** (Source: PG&E)

There are many kinds of smart meters manufactured by a variety of companies. The meter, including sensors and the housing or casing, may be manufactured by one company while the communications device (installed within the meter) is manufactured by another. Depending upon the internal communications device employed, meters are configured to operate in a wired or in wireless environment. The smart meters used by PG&E are made by General Electric and Landis + Gyr and use a wireless communications technology from Silver Spring Networks. Each of these PG&E meters has two transmitters to provide two different communications of data from these meters.[3] The first provides for the "automatic meter reading" (AMR) function of the meter (and for more detailed and real time monitoring of the characteristics of the

[3] Tell, R. (2008) "Supplemental Report on An Analysis of Radiofrequency Fields Associated with Operation of the PG&E Smart Meter Program Upgrade System," Prepared for Pacific Gas & Electric Company, Richard Tell Associates, Inc., October 27.

electrical energy delivered to the consumer) and sends this data to an access point, where it is collected along with data from many other customers and transmitted to PG&E using a wireless area network (WAN) (similar to the way cell phone communication works).

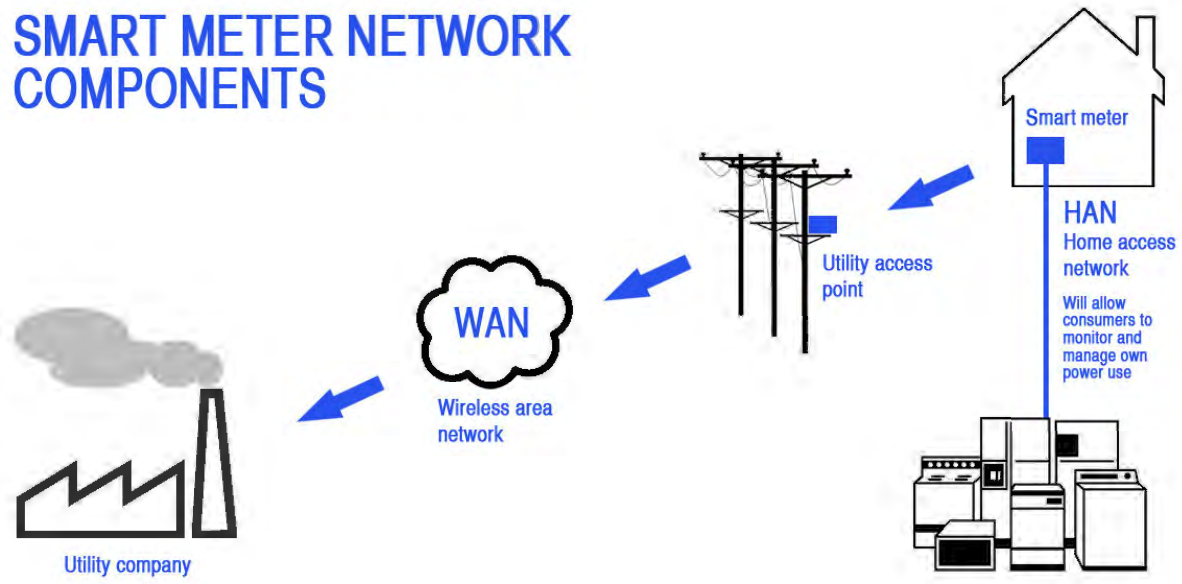


**Figure 3. Simplified depiction of Smart Meter system network. Arrows show the use of radiofrequency (RF) signals for automated meter reading, communications among electric power meters, relays, access points, the company's enterprise management systems. The future home access network will operate within the house.**

Smart meters have evolved from automatic meter reading (AMR; i.e., replacing meter readers) to a real time monitoring of power as delivered to the consumer by the utility company. CCST obtained from PG&E the Richard Tell Associates report, which describes the operation of the smart meter from the 2008 perspective of AMR, not a fully deployed real time smart grid. The Richard Tell Associates reports describe the use of the smart meter radios being deployed by PG&E as licensed by the FCC for a maximum power output of 1 W (watt) and within the 902-928 MHz (mega-hertz) frequency band. In its initial deployment, PG&E reports that it will configure the radios to transmit data from the meter to the access point once every four hours, for about 50 milliseconds at a time.[4] Accounting for this, the current duty cycles of the smart meter transmitter (that is, the percent of time that the meter operates) would then typically be 1 percent, or in some cases where the meter is frequently used as a relay, as much as 2-4 percent. *This means that the typical smart meter in this initial (AMR) use would not transmit any RF signal at least 96-98 percent of the time.*

It is important to note that any one smart meter is part of a broader "mesh" network and may act as a relay among other smart meters and utility access points. In addition, when the smart

[4] Tell, R. (2008) "Supplemental Report on An Analysis of Radiofrequency Fields Associated with Operation of the PG&E Smart Meter Program Upgrade System," Prepared for Pacific Gas & Electric Company, Richard Tell Associates, Inc., October 27. http://www.pge.com/includes/docs/pdfs/shared/edusafety/systemworks/rfsafety/rf_fields_supplemental_report_2008.pdf)

grid is fully functional the smart meters would be expected to be transmitting much more than once every four hours, providing data in near real-time, which will result in a much higher duty cycle. For purposes of this report we include a hypothetical scenario where the smart meter is transmitting 50 percent of the time (i.e., transmitting half the time and receiving half the time). Even in this 50% duty cycle situation the power output would be well below the FCC limits.

Smart meters are designed to transmit data to a utility access point that is usually 25 feet above ground, on utility or light poles. These access points are designed to transmit data from up to 5,000 smart meters to the utility company. Access points have a similar AMR transmitter as smart meters, as well as an additional *AirCard,* which communicates with utilities and is similar to wireless cards used in laptop computers. *AirCard*s typically operate at 0.25-1 W, in the 800-900 MHz or 1.9 GHz range.

In some cases, data is moved through the mesh network, relaying the data through other meters to the utility access point. This may occur when the topography or built environment interferes with the transmission of data from a smart meter to the access point. In these cases, the relaying of data may occur between one smart meter and another before the signal is sent to the utility access point (e.g., hops along a set of meters). Additionally, some non-meter data relays will also exist in the system to connect some smart meters to utility access points.

*Many smart meters, including those from PG&E, also have a second transmitter that, at some future point in time, will allow customers to enable a home access network (HAN). The HAN will allow increased consumer monitoring of electricity use and communication among appliances and the future smart grid. This functionality is important to achieve the full potential of the smart grid. This second internal transmitter, for delivery of smart meter data to the consumer, reportedly will operate at a rated power of 0.223W, at frequency of about 2.4 GHz (again, similar to that of cell phones and wireless phones). The actual duty cycle of this transmitter will depend on the design and operation of the home area network.*

**Why are Smart Meters Being Installed Throughout California?**

It is anticipated, when fully operational, that smart electricity meters are a key enabling technology for a "smart grid" that is expected to become increasingly clean, efficient, reliable, and safe (see Figure 3) at a potential lower cost to the consumer. (Digital meters are also being used for reading of natural gas and water consumption). Smart electrical meters allow direct two-way communication between utilities and customers, which is expected to help end users adjust their demand to price changes that reflect the condition of the electricity grid. These end user adjustments can help to protect the overall reliability of the electricity grid, cut costs for utility customers, and improve the operation and efficiency of the electricity grid. The smart grid will enable grid operators to better balance electricity supply and demand in real-time, which becomes increasingly important as more intermittent wind and solar generation resources are added to the grid.

Figure 4 depicts the potential operation of a smart grid.

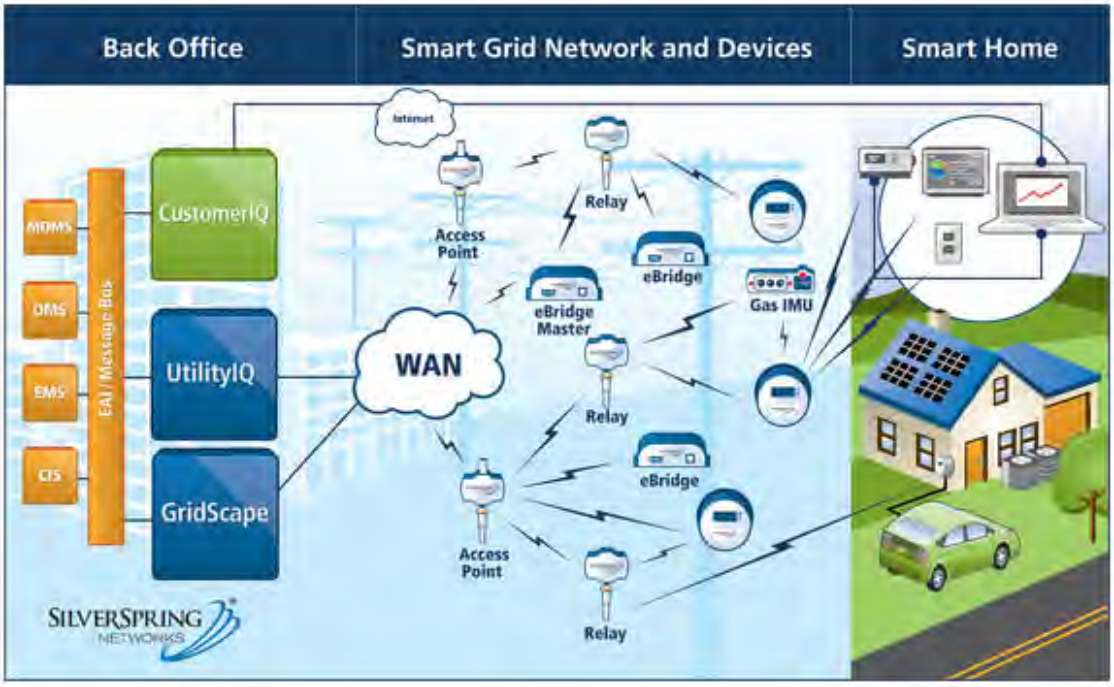


**Figure 4. Illustration of components of the PG&E Smart Meter Program Upgrade showing the use of radiofrequency (RF) signals for communications among electric power meters, relays, access points and, ultimately, the company's enterprise management systems. (Source Silver Spring Network[5])**

Smart meters will also allow utilities to communicate grid conditions to customers through price signals, so that consumers, via their HAN, can delay non-time sensitive demands (such as clothes drying) to a time when electricity is cheapest or has the most benefit to the reliability of the system. In some cases wireless signals interior to the structure will also be able to automatically adjust the heating and ventilation systems and to adjust heat or air conditioning units. This adaptation to price or reliability signals could reduce overall electricity costs for customers, improve the utilization of renewable and non-renewable power plants, and cut costs associated with adding intermittent wind and solar resources to the grid.

While such long-term value of smart meters will take years to fully realize, they are sufficiently promising that the federal government has required utilities to take steps to implement smart

[5] See http://www.silverspringnet.com/products/index.html for component descriptions. Network infrastructure includes the Silver Spring Access Points (APs) and Relays that forward data from endpoints across the utility's backhaul or WAN infrastructure into the back office.
The UtilityIQ application suite incorporates both utility applications such as Advanced Metering and Outage Detection as well as administrative programs for managing and upgrading the network. GridScape provides management for DA communications networks.
The CustomerIQ web portal enables utilities to directly communicate usage, pricing, and recommendations to consumers. Silver Spring works with each utility to customize the information portrayed and to import utility-specific information such as rate schedules.

grid networks, including the use of smart meters.[6] After review and authorization from the California Public Utilities Commission,[7] utilities in California have begun to install smart meters throughout the state. Some California utilities (such as Sacramento Municipal Utility District) have received significant federal funding for smart meter deployment from the American Recovery and Reinvestment Act (federal stimulus package). Many countries around the world are actively deploying smart meters as well. Digital smart meters are generally considered to be the fundamental technology required to enable widespread integration of information technology (IT) into the power grid (i.e., the smart grid). The following table (table 1) summarizes some potential societal benefits expected to result from the smart grid.

**Table 1: Smart Grid Benefits**

| **Consumers** | **Environment** |
|---|---|
| 1. Cost Savings Resulting from Energy Efficiency<br>2. Increased Consumer Choice and Convenience<br>3. More Transparent, Real-Time Information and Control for Consumers | 1. Widespread Deployment of Renewable Energy (Solar, Wind, Biofuels) and Electric Vehicles (EVs)<br>2. Reduced Need to Build More Fossil Fueled Power plants<br>3. Reduced Carbon Footprint and Other Pollutants (via Renewables, Energy Efficiency, Electric Vehicles) |
| **Utilities** | **Economy** |
| 1. Reduced Cost Due to Increased Efficiencies in Delivering Electricity and Reduction in Manpower to Read Meters.<br>2. Improved Reliability and More Timely Outage Response<br>3. Increased Customer Satisfaction Due to Cost Savings and Self-Control<br>*Source: California Smart Grid Center* | 1. Creates New Market for Goods and Services (i.e., New Companies, New Jobs)<br>2. Up-skilling Workforce to be Prepared for New Jobs<br>3. Reduced Dependence on Foreign Oil, Keeps Dollars at Home |

[6] The federal Energy Independence and Security Act of 2007 directs states to encourage utilities to initiate smart grid programs, allows recovery of smart grid investments through utility rates, and reimburses 20% of qualifying smart grid investments. The American Recovery and Reinvestment Act of 2009 provided $4.5 billion to develop smart grid infrastructure in the U.S. For more information, see: Congressional Research Service (2007) "Energy Independence and Security Act of 2007: A Summary of Major Provisions," CRS Report for Congress, Order Code RL34l294, December 21. (http://energy.senate.gov/public/_files/RL342941.pdf)

[7] California Public Utilities Commission decision on Application 07-12-009 (March 12, 2009). Decision on Pacific Gas and Electric Company's Proposed Upgrade to the Smartmeter Program.

**What Health Concerns are Associated with Smart Meters?**

Human health impacts from exposure to electromagnetic frequency (EMF) emissions vary depending on the frequency and power of the fields. Smart meters operate at low power and in the RF portion of the electromagnetic spectrum. At these levels, RF emissions from smart meters are unlikely to produce *thermal effects; however it is not scientifically confirmed whether or what the non-thermal effects* on living organisms, and potentially, human health might be. These same concerns over potential impacts should apply to all other electronic devices that operate with similar frequency and power levels, including cell phones, computers, cordless phones, televisions, and wireless routers. Any difference in health impacts from these devices is likely to be a result of differences in usage patterns among them.

***Thermal Effects***

Electromagnetic waves carry energy, and EMF absorbed by the body can increase the temperature of human tissue. The scientific consensus is that body temperatures must increase at least 1$^{o}$C to lead to potential biological impacts from the heat. The only scientifically verified effect that has been shown to occur in the power and frequency range that smart meters are designed to occupy is a disruption in animal feeding behavior at energy exposure levels of 4 W/kg and with an accompanying increase in body temperature of 1$^{o}$C or more.[8] The exposure levels from smart meters even at close range are far below this threshold. The FCC has set limits on power densities from electronic devices that are well below the level where demonstrated biological impacts occur, and the limits are tens or hundreds of times higher than likely exposure from smart meters.[9]

***Non-thermal Effects***

There are emerging questions in the medical and biological fields about potential harmful effects caused by non-thermal mechanisms of absorbed RF emissions. Complaints of health impacts from "electromagnetic stress" have been reported, with symptoms including fatigue, headache, and irritability. Some studies have suggested that RF absorption from mobile phones may disrupt communication between human cells, which may lead to other negatives impacts on human biology.[10,11] While concerns of brain cancer associated with mobile phone usage persist, there is currently no definitive evidence linking cell phone usage with increased

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[8] D'Andrea, J.A., Adair, E.R., and J.O. de Lorge (2003) Behavioral and cognitive effects of microwave exposure, *Bioelectromagnetics* Suppl 6, S39-62 (2003).

[9] Tell, R. (2008) "Supplemental Report on An Analysis of Radiofrequency Fields Associated with Operation of the PG&E Smart Meter Program Upgrade System," Prepared for Pacific Gas & Electric Company, Richard Tell Associates, Inc., October 27. (http://www.pge.com/includes/docs/pdfs/shared/edusafety/systemworks/rfsafety/rf_fields_supplemental_report_2008.pdf)

[10] Markova, E., Malmgren, L., and I.Y. Belyaev (2009) Microwaves from mobile phones inhibit 53PB1 focus formation in human stem cells stronger than in differentiated cells: Possible mechanistic link to cancer risk. Environmental Health Perspectives, doi:10.1289/ehp.0900781.

[11] Nittby, H., Grafstrom, G., Eberhardt, J.L., Malmgren, L., Brun, A., Persson B.R.R., and L.G. Salford (2008) Radiofrequency and Extremely Low-Frequency Electromagnetic Field Effects on the Blood-Brain Barrier Electromagnetic Biology and Medicine, 27: 103–126, 2008.

incidence of cancer.[12] But due to the recent nature of the technology, impacts of long-term exposure are not known. Ongoing scientific study is being conducted to understand non-thermal effects from long-term exposure to mobile phones and smart meters, etc., especially the cumulative impact from all RF emitting devices including that of a network of smart meters operating throughout a community.[13]

There currently is no conclusive scientific evidence pointing to a non-thermal cause-and-effect between human exposure to RF emissions and negative health impacts. For this reason, regulators and policy makers may be prudent to call for more research while continuing to base acceptable human RF exposure limits on currently proven scientific and engineering findings on known thermal effects, rather than on general concerns or speculation about possible unknown and as yet unproven non-thermal effects. Such questions will likely take considerable time to resolve. The data that are available strongly suggest that if there are non-thermal effects of RF absorption on human health, such effects are not so profound as to be easily discernable.

**FCC Guidelines**

In 1985, the FCC first established guidelines to limit human exposure and protect against thermal effects of absorbed RF emissions. The guidelines were based on those from the American National Standards Institute (ANSI) that were issued in 1982.[14] In 1996, the FCC modified its guidelines,[15] based on a rulemaking process that began in 1993 in response to a 1992 revision of the ANSI guidelines[16, 17] and findings by the National Council on Radiation Protection and Measurements (NCRP).[18] The 1996 guidelines are still in place today.

> In its rulemaking process to set SAR and MPE limits, the FCC relied on many federal health and safety agencies, including the U.S. Environmental Protection Agency and the Food and Drug Administration.

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[12] Ahlbom, A., Feychting, M., Green, A., Kheifets, L., Savitz, D. A., and A. J. Swerdlow (2009) Epidemiologic evidence on mobile phones and tumor risk: a review. *Epidemiology* 20, 639-52 (2009).

[13] National Research Council (2008) *Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication,* The National Academies Press, Washington, D.C. (http://www.nap.edu/catalog/12036.html)

[14] American National Standards Institute (1982) "American National Standard Radio Frequency Radiation Hazard Warning Symbol," ANSI C95.2-1982, Institute of Electrical and Electronics Engineers, Inc.

[15] FCC (1997) "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," OET Bulletin 65 (Edition 97-01), Federal Communications Commission, August. (http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf)

[16] American National Standards Institute (1992) "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1-1992 (previously issued as IEEE C95.1-1991), Institute of Electrical and Electronics Engineers, Inc.

[17] American National Standards Institute (1992) "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave," ANSI/IEEE C95.3-1992, Institute of Electrical and Electronics Engineers, Inc.

[18] NCRP (1986) "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86 (1986), National Council on Radiation Protection Measurements.

While the FCC guidelines appear to provide a large factor of safety against known thermal effects of exposure to radiofrequency, they do not necessarily protect against potential non-thermal effects, nor do they claim to.[19] Without additional understanding of these effects, there is inadequate basis to develop additional guidelines at this time.

The FCC guidelines measure exposure to RF emissions in two ways. Specific absorption rate (SAR) measures the rate of energy absorption and is measured in units of watts-per-kilogram of body weight (W/kg). It accounts for the thermal effects on human health associated with heating body tissue and is used as a limiting measurement for wireless devices, such as mobile phones, that are used in close proximity to human tissue.[20] The FCC limits, as well as the underlying ANSI and NCRP limits, are based on a SAR threshold of 4 W/kg. At the time of the FCC rulemaking, and still today, behavioral disruption in laboratory animals (including non-human primates) at this absorption rate is the only adverse health impact that has been clearly linked to RF at levels similar to those emitted by smart meters. This finding is supported in scientific literature[21, 22] and by the World Health Organization and many health agencies in Europe.[23, 24] The FCC limit of 1.6 W/kg provides a significant factor of safety against this threshold.

Limits on SAR provide the basis for another measurement of exposure, maximum permissible exposure (MPE). MPE limits average exposure over a given time period (usually 30 minutes for general exposure) from a device and is often used for exposure to stationary devices and where human exposure is likely to occur at a distance of more than 20 cm. It is measured in micro ($10^{-6}$) watts-per-square-centimeter ($\mu W/cm^2$), and accounts for the fact that the human body absorbs energy more efficiently at some radiofrequencies than others. The human body absorbs energy most efficiently in the range of 30-300 MHz, and the corresponding MPE limits for RF emissions in this range are consequently the most stringent. In the frequency bands where smart meters operate, including PG&E's, namely the 902-928 MHz band and 2.4 GHz range, the human body absorbs energy less efficiently, and the MPE limits are less restrictive.

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[19] The U.S. EPA confirmed this in a letter to The Electromagnetic Radiation Policy Institute, dated March 8, 2002. (http://www.emrpolicy.org/litigation/case_law/docs/noi_epa_response.pdf)

[20] FCC (2001) "Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions," Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), Federal Communications Commission, June. (http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65c.pdf)

[21] D'Andrea, J.A., Adair, E.R., and J.O. de Lorge (2003) Behavioral and cognitive effects of microwave exposure, *Bioelectromagnetics* Suppl 6, S39-62 (2003).

[22] Sheppard, A.R, Swicord, M. L., and Q. Balzano (2008) Quantitative evaluations of mechanisms of radiofrequency interactions with biological molecules and processes, *Health Phys* 95, 365-96 (2008).

[23] The World Health Organization has reviewed international guidelines for limiting radiofrequency exposure and scientific studies related to human health impacts and concludes that exposure below guideline limits don't appear to have health consequences. (http://www.who.int/peh-emf/standards/en/)

[24] Committee on Man and Radiation (COMAR) (2009) "Technical Information Statement: Expert reviews on potential health effects of radiofrequency electromagnetic fields and comments on The Bioinitiative Report," Health Physics 97(4):348-356 (2009).

The FCC limits on MPE are summarized in Figure 5.[25, 26] At 902 MHz, appropriate for operation of the AMR transmitter of the smart meter; the FCC limit is 601 µW/cm$^2$. At higher frequencies, the human body absorbs even less energy, and the threshold for the 2.4 GHz transmitter for home area network communications is consequently higher, 1000 µW/cm$^2$.

PG&E commissioned a 2008 study by Richard Tell Associates, "Supplemental Report on An Analysis of Radiofrequency Fields Associated with Operation of the PG&E Smart Meter Program Upgrade System." In this study of PG&E's proposed smart meter network it is noted that the FCC limits on MPE include a factor of safety, and the perceived hazardous exposure level is 50 times higher than the FCC limits.[27] The study estimates that the highest exposure from smart meters, if an individual were standing directly in front of and next to the meter, would be 8.8 µW/cm$^2$ transmitting at 2 to 4% of the time. The study notes that this is almost 70 times less than the FCC limit and 3,500 times less than the demonstrated hazard level. In all likelihood, individuals will be much farther away from smart meters and likely behind them, (within a structure) where power density will be much lower. The highest exposure from the entire smart meter system would occur immediately adjacent to an access point. It is very unlikely that an individual would be immediately adjacent to an access point, as they are normally located 25 feet above the ground on a telephone or electrical pole or other structure. The peak power density from an access point is estimated to be 24.4 µW/cm$^2$, or about 25 times less than the FCC limit. From the ground, exposure to power density from access points is estimated to be 15,000 times less than the FCC limit in great part due to the distance from the device.

The PG&E commissioned report by Richard Tell Associates is based only on an AMR duty cycle of transmitting data once every four hours which results in this very low estimated peak power. However, we are not aware of the justification for using averaging over a four-hour period. We do know the FCC[28] allows averaging of exposure over a designated period (30 minutes). To truly be a smart grid the data will be transmitted at a much more frequent rate than this. In this report we look at the worst-case scenario, a meter that is stuck in the "on" position, constantly relaying, at a 100% duty cycle. Even in this 100% scenario the RF emissions would be measurably below the FCC limits for thermal effects.

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[25] FCC (1997) "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," OET Bulletin 65 (Edition 97-01), Federal Communications Commission, August. (http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf)

[26] FCC (1999) "Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields," OET Bulletin 56 (Fourth Edition), Federal Communications Commission, August. (http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf)

[27] Tell, R. (2008) "Supplemental Report on An Analysis of Radiofrequency Fields Associated with Operation of the PG&E Smart Meter Program Upgrade System," Prepared for Pacific Gas & Electric Company, Richard Tell Associates, Inc., October 27. (http://www.pge.com/includes/docs/pdfs/shared/edusafety/systemworks/rfsafety/rf_fields_supplemental_report_2008.pdf)

[28] http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet56/oet56e4.pdf

**Power Density (and Exposure Level) Declines Rapidly with Distance**

The power density from smart meters, or other devices that emit RF, falls off dramatically with distance. Figure 6 illustrates this affect for an example smart meter. While the estimated maximum exposure level at 1 foot from the meter with a duty cycle of 50% is 180 µW/cm$^2$ (far below the FCC guidelines), at a distance of about 10 feet, the power-density exposure approaches zero.

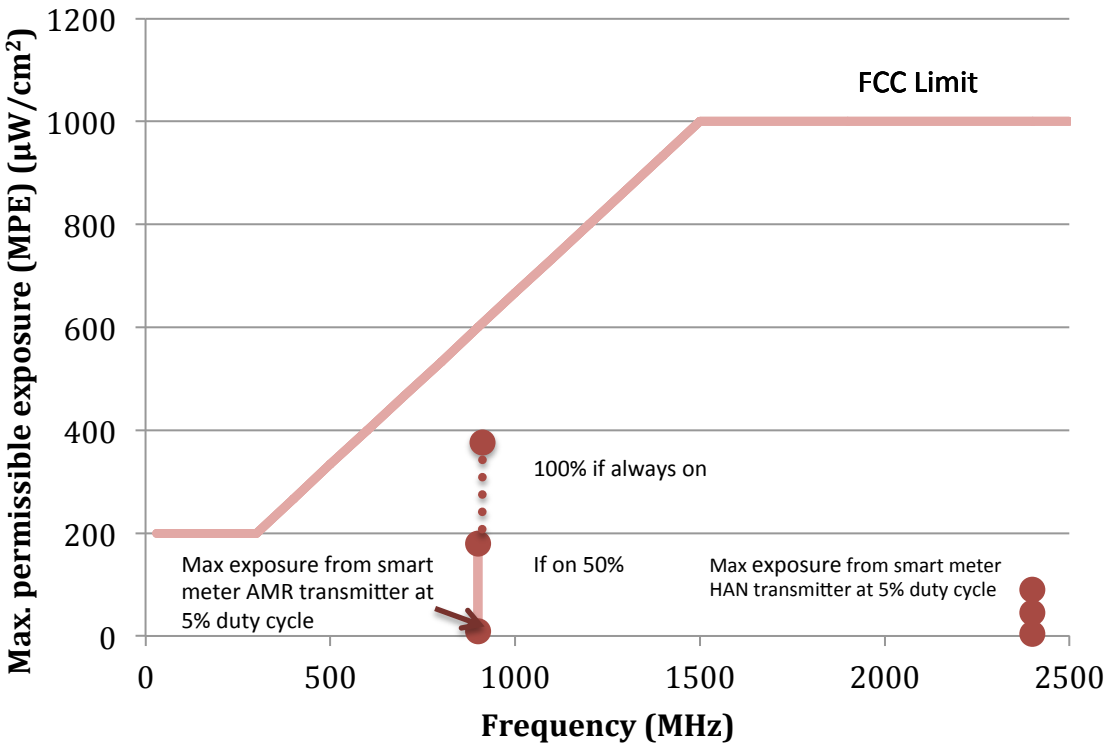


**Figure 5. FCC maximum permissible exposure limits on power density rise with frequency because the human body can safely absorb more energy at higher frequencies. The estimated maximum exposure from a 1-Watt AMR transmitter at 5% duty cycle (i.e., 72 minutes/day) and one-foot distance is 18 µW/cm$^2$, or 3% of the FCC limit. Even if a meter malfunctioned and was stuck in the always-on transmit mode (i.e., 100% duty cycle), exposure levels would be 60% of the FCC limit for an AMR transmitter. For a 250mW HAN transmitter at a 5% duty cycle, the level would be .45% of the FCC limit and 9% of the FCC limit if the transmitter were on 100%. Exposure figures derived from February 2011 Electric Power Research Institute (EPRI) field measurement study entitled "Radio Frequency Exposure Levels from Smart Meters: A Case Study of One Model".[29]**

[29] EPRI (2011) "Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model," Electric Power Research Institute, February 2011.

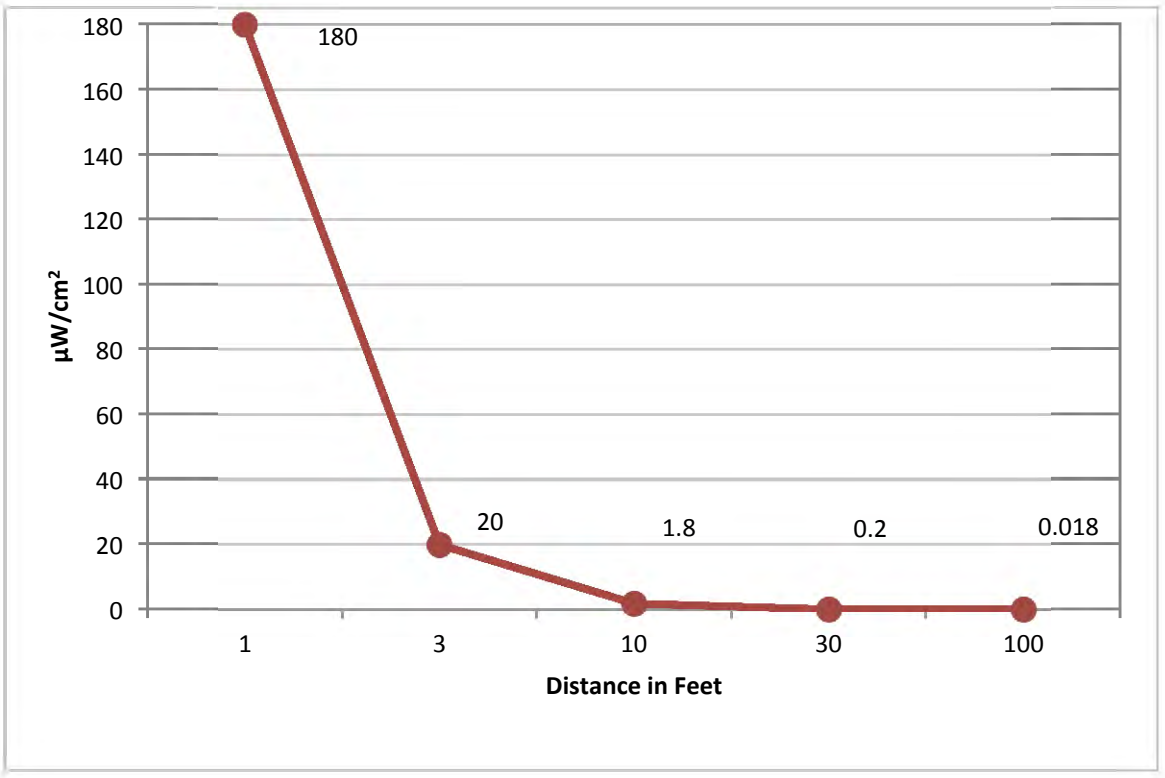


**Figure 6. Power density from a sample smart meter versus distance;[30] 1-Watt emitter at 50% duty cycle. Typical smart meter AMR transmitter power density declines rapidly with distance. The rapid drop of power density with distance (inverse-square law) is similar for various duty cycles and different sets of source data.**

## Comparison of Electromagnetic Frequencies from Smart Meters and Other Devices

Health concerns surrounding RF from smart meters are similar to those from many other devices that we use in our daily lives, including cordless and mobile telephones, microwave ovens, wireless routers, hair dryers, and wireless-enabled laptop computers.

In addition to slight differences in frequency and power levels, which affect human absorption of RF from these devices, the primary difference among them is how they are used. Cell phones, for example, are often used for many minutes at a time, several times over the course of a day, and held directly next to one's head.

For perspective, microwave ovens operate at a similar frequency as the HAN transmitter of smart meters (2.45 GHz), and the U.S. Food and Drug Administration has set limits on leakage levels that are five times higher (5,000 µW /cm$^2$) than the FCC limit for smart meters and other

[30] EPRI (20110) "Radio- Frequency Exposure Levels from Smart Meters; A Case Study of One Model, "" Electric Power Research Institute, February 2011.

devices operating at 2.4 GHz.[31] Wireless routers and Wi-Fi equipment produce radiofrequency fields of about 0.2 – 1.0 µW /cm$^2$.[32, 33, 34] People in metropolitan areas are exposed to radiofrequency from radio and television antennas, as well, although for most of the population, exposure is quite low, around 0.005 µW /cm$^2$.[35]

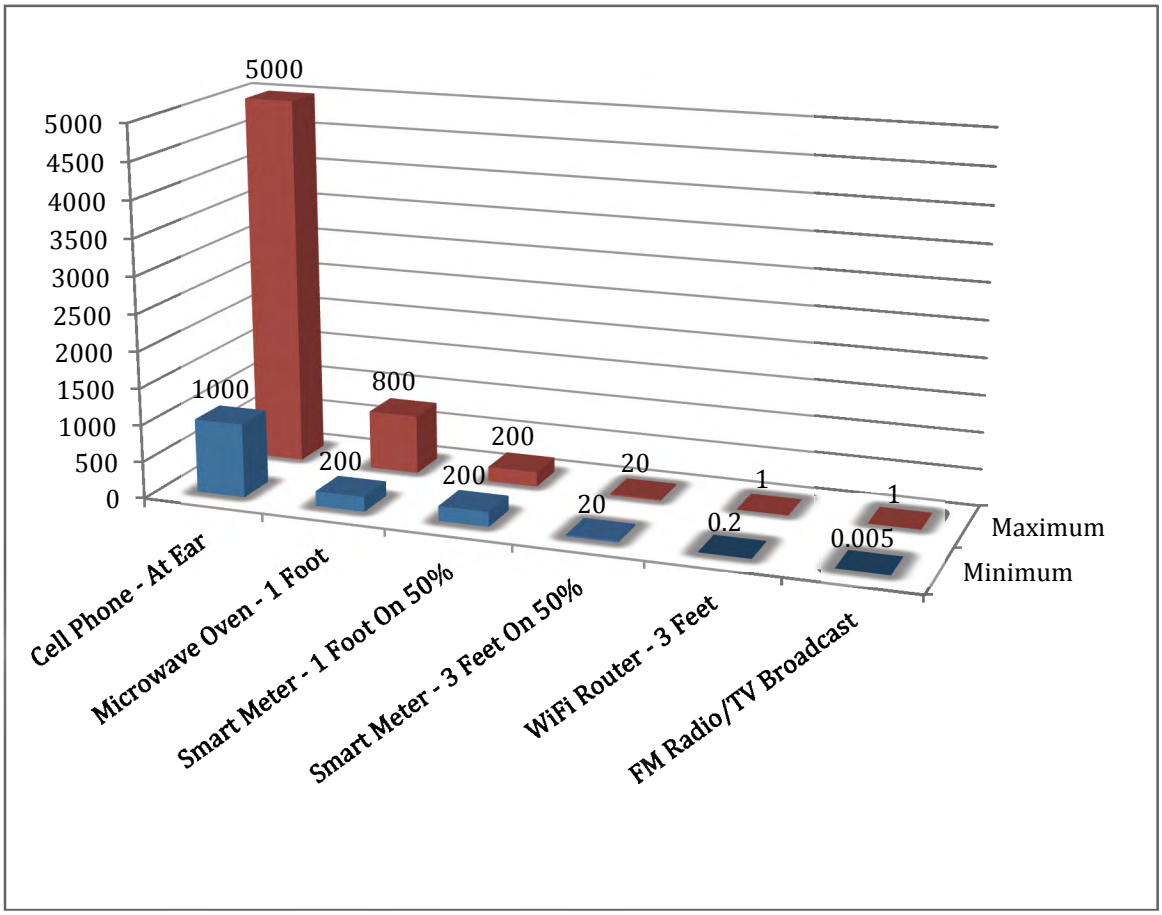


**Figure 7. Instantaneous Radio Frequency Power Density Levels of Common Devices (in microWatts/cm$^2$)**
About this figure**:** This figure was developed by the CCST project team**.** Quantities for different distances calculated using Inverse Square Law. Assumes distances in far-field, where power density reduces as the square of the distance from the source. Smart meter power scaled to obtain output for 50% duty cycle. The source for the various starting measurements came from Electric Power Research Institute (EPRI), Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model (February 2011)

[31] FDA, "Summary of the Electronic Product Radiation Control Provisions of the Federal Food, Drug, and Cosmetic Act," U.S. Food and Drug Administration. (http://www.fda.gov/Radiation-EmittingProducts/ElectronicProductRadiationControlProgram/LawsandRegulations/ucm118156.htm)
[32] EPRI (2011) "Radio-Frequency Exposure Levels from Smart Meters; A Case Study of One Model, "Electric Power Research Institute, February 2011.
[33] Foster, K.R. (2007) Radiofrequency exposure from wireless LANS utilizing WI-FFI technology. *Health Physics*, Vol. 92, No. 3, March, pp. 280-282.
[34] Schmidt, G. et al. (2007) Exposure of the general public due to wireless LAN applications in public Places, *Radiation Protection Dosimetry*, Vol. 123, No. 1, Epub June 11, pp. 48-52.
[35] EPA (1986) The Radiofrequency Radiation Environment: Environmental Exposure Levels and RF Radiation Emitting Sources, EPA 520/1-85-014, U.S. Environmental Protection Agency, July.

## Table 2: Radio-Frequency Levels from Various Sources

| Source | Frequency | Exposure Level ($mW/cm^2$) | Distance | Time | Spatial Characteristic |
|---|---|---|---|---|---|
| Mobile phone | 900 MHz, 1800 MHz | 1—5 | At ear | During call | Highly localized |
| Mobile phone base station | 900 MHz, 1800 MHz | 0.000005—0.002 | 10s to a few thousand feet | Constant | Relatively uniform |
| Microwave oven | 2450 MHz | ~50.05-0.2 | 2 inches2 feet | During use | Localized, non-uniform |
| Local area networks | 2.4—5 GHz | 0.0002—0.001<br>0.000005—0.0002 | 3 feet | Constant when nearby | Localized, non-uniform |
| Radio/TV broadcast | Wide spectrum | 0.001 (highest 1% of population)<br>0.000005 (50% of population) | Far from source (in most cases) | Constant | Relatively uniform |
| Smart meter | 900 MHz, 2400 MHz | 0.0001 (250 mW, 1% duty cycle)<br>0.002 (1 W, 5% duty cycle)<br>0.000009 (250 mW, 1% duty cycle)<br>0.0002 (1 W, 5% duty cycle) | 3 feet<br><br>10 feet | When in proximity during transmission | Localized, non-uniform |

Source: Electric Power Research Institute (EPRI), Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model (February 2011)

## What is Duty Cycle and How Does it Relate to RF Exposure?

Duty cycle refers to the fraction of time a device is transmitting. For instance, a duty cycle of 1% means the device transmits RF energy 1% of a given time period. One percent of the time in a day is equivalent to 14.4 minutes per day. *The duty cycle, or signal duration is an often-overlooked factor when comparing exposures from different kinds of devices (e.g., mobile phones, Wi-Fi routers, smart meters, microwave ovens, FM radio/TV broadcast signals).*

Duty cycles of various devices vary considerably. The duty cycle of AM/FM radio/TV broadcasts, are 100%; in other words, they are transmitting continuously. Mobile phones usage varies widely from user to user, of course. However, the national average use is about 450 minutes per month. This usage equates to a 1% duty cycle for the "average" user.

From information that CCST was able to obtain we understand that the smart meter transmitter being used by PG&E operates with a maximum power output of 1 W (watt) and within the 902-928 MHz (mega-hertz) frequency band. Each smart meter is part of a broader "mesh" network and may act as a relay between other smart meters and utility access points. The transmitter at each smart meter will be idle some of the time, with the percent of time idle (not transmitting) depending on the amount and schedule of data transmissions made from each meter, the relaying of data from other meters that an individual meter does, and the networking protocol (algorithm) that manages control and use of the communications paths in the mesh network.

Theoretically the transmit time could increase substantially beyond today's actual operation level if new applications and functionality are added to the meter's communication module in the future. For a hypothetical illustration (i.e., the meter transmits half the time and receives half the time), an upper end duty cycle would be 50%,. The table below compares the effect of different duty cycles against the FCC guidelines for human exposure limits.

| **Typical Smart Meter Operation With Repeater Activity** | **Scaled Hypothetical Maximum Use Case (i.e., always on)** |
|---|---|
| 5% Duty Cycle | 50% Duty Cycle |
| 72 minutes/day | 12 hours/day |
| 3% of FCC limit | 30% of FCC limit |

Source data on operating duty cycles (i.e., first column) from Electric Power Research Institute (EPRI) actual field testing of smart meters, as reported in *Radio-Frequency Exposure Levels from Smart Meters: A Case Study of One Model*, February 2011. Second column hypothetical maximum case derived through extrapolation of first column data. Both exposure levels at 1-foot distance.

*In summary, the duty cycles of smart meters in typical meter-read operation and added maximum-case repeater operation result in exposures that are 3% of the FCC exposure guidelines.* Even in a hypothetical extreme and unusual case of half-transmit and half-receive scenario the maximum exposure would be about 30% of the FCC limit, which provides a wide safety margin from known thermal effects of RF emissions.

**What About Exposure Levels from a Bank of Meters and from Just Behind the Wall of a Single Meter?**

In a February 2011 study Electric Power Research Institute (EPRI)[36] field tested exposure levels from a bank of 10 meters of 250 mW power level at one foot distance in order to simulate a bank of smart meters located at a multifamily building, such as an apartment house. The exposure level was equivalent to 8% of the FCC standard.

In the same study EPRI measured exposure of one meter from eight inches *behind* the meter panel box in order to simulate proximity on the opposite site of the meter wall. At 5% duty cycle it yielded an exposure of only 0.03% of the FCC standard. Even at 100% duty cycle (i.e., always transmitting), exposure at eight inches behind the meter was 0.6% of the FCC limit.

**Is the FCC Standard Sufficient to Protect Public Health?**

The FCC guidelines do provide a significant factor of safety against thermal impacts the only currently understood human health impact that occurs at the power level and within the frequency band that smart meters use. In addition to the factor of safety built into the guidelines, at worst, human exposure to RF from smart meter infrastructure operating at even 50% duty cycle will be significantly lower than the guidelines. While additional study is needed to understand potential non-thermal effects of exposure to RF and effects of cumulative and prolonged exposure to several devices emitting RF, given current scientific knowledge the FCC guideline provides an adequate margin of safety against known RF effects.

**Are Additional Technology-specific Standards Needed?**

FCC guidelines protect against thermal effects of RF exposure. Many non-thermal effects have been suggested, and additional research is needed to better understand and scientifically validate them.

Given the scientific uncertainty around non-thermal effects of all RF emitting equipment, at this time there is no clear indication of what, if any, additional standards might be needed. Neither is there a basis from which to understand what types of standards could be helpful or appropriate**.** Without a clear understanding of the biological mechanisms at play, the costs and benefits of additional standards for RF emitting devices including smart meters, cannot be determined at this time.

[36] EPRI (2010) "A perspective on radio-frequency exposure associated with residential automatic meter reading technology," Electric Power Research Institute, February, 2011.

**Public Information and Education**

It is important that consumers have clear and easily understood information about smart meter emissions as well as readily available access to clear, factual information and education on known effects of RF emissions at various field strengths and distances from an array of devices commonly found in our world.

Equipped with this information, people can make knowledgeable judgments about how to prudently minimize possible risks to themselves and their families by utilizing standards-compliant devices at known safe distances. Also, people will be better able to gauge relative field strengths of various RF sources in our everyday environment (e.g., mobile phones, electric blankets, clock radios, TV and radio, computers, smart meters, power lines, microwave ovens, etc.). An ongoing regularly updated source of unbiased information on the state of scientific research, both proven and as-yet-unproven causal effects being studied, if presented by an independent entity, would provide consumers a credible and transparent source from which to obtain facts about RF in our environment.

CCST is not currently aware of a single website with up-to-date consumer information which we are able to endorse as impartial.

**Alternatives to Wireless?**

Assembly Member Huffman has inquired about potential alternatives to wireless communication with smart meters. There are currently several other methods of transmitting data from some smart meters to the utility company. These methods include transmitting over a power line or wired through phone lines, fiber-optic or coaxial cable. Each method has tradeoffs among cost and performance (e.g., how much data can be carried, how far, how fast). The ability to have a transmission protocol alternative to wireless depends upon the type and configuration of the meter used. Some existing smart meters can be hard-wired, while others would have to be modified or replaced. The communications board plugs into a digital meter. The current PG&E meters use a SilverSpring communications board that only supports wireless protocol. SilverSpring or another vendor could provide an alternative communications means if such were warranted and cost effective. The related costs of an alternative approach would need to be factored into the decision making process related to different options.

If future research were to establish a causal relationship between RF emissions and negative human health impacts, industries and governments worldwide may be faced with difficult choices about practical alternatives to avoid and mitigate such effects. This would greatly affect the widespread use of mobile phones, cordless phones, Wi-Fi devices, smart meters, walkie-talkies, microwave ovens, and many other everyday appliances and devices emitting RF. If such a hypothetical scenario were to occur, smart meters could conceivably be adapted to non-wireless transmission of data. However, retrofitting millions of smart meters with hard-wired technology could be difficult and costly. Perhaps more importantly, retrofitting smart

meters would not address the significantly greater challenge presented by the billions of mobile phones in use globally.

**Key Factors to Consider When Evaluating Exposure to Radiofrequency from Smart Meters**

| | | |
|---|---|---|
| 1. Signal Frequency | Compare to devices in the 900 MHz band and 2.4 GHz band | Frequency similar to mobile phones, Wi-Fi, laptop computers, walkie-talkies, baby monitors, microwave ovens |
| 2. Signal Strength (or Power Density) | Microwatts/square centimeter ($\mu W/cm^2$) | Meter signal strength very small compared to other devices listed above |
| 3. Distance from Signal | Signal strength drops rapidly (doubling distance cuts power density by four) | Example:<br>1 ft. – 8.8 $\mu W/cm^2$<br>3 ft. – 1.0 $\mu W/cm^2$<br>10 ft. – 0.1 $\mu W/cm^2$ |
| 4. Signal Duration | - Extremely short amount of time (2.0-5.0%, max.)<br>- No RF signal 95-98% of the time (over 23 hours/day) | - Often overlooked factor when comparing devices.<br>- Short duration combined with weak signal strength yields tiny exposures |
| 5. Thermal Effects | - Scientific consensus on proven effects from heat at high RF levels | - FCC "margin-of-safety" limits 50 times lower than hazardous exposure level<br>- Typical meter operates at 70 times less than FCC limit and 3,500 times less than the demonstrated hazard level |
| 6. Non-thermal Effects | - Inconclusive research to date<br>- No established cause-and-effect pointing to negative health impacts | Continuing research needed |

**Conclusion**

The CCST Project Team, after carefully reviewing the available literature on the current state of science on health impacts of radiofrequency from smart meters and input from a wide array of subject matter experts, concludes that:

1. **The FCC standard provides a currently accepted factor of safety against known thermally induced health impacts of smart meters and other electronic devices in the same range of RF emissions. Exposure levels from smart meters are well below the thresholds for such effects.**

2. **There is no evidence that additional standards are needed to protect the public from smart meters.**

The topic of potential health impacts from RF exposure in general, including the small RF exposure levels of smart meters, continues to be of concern. This report has been developed to provide readers and consumers with factual, relevant information about the:

- Scientific basis underpinning current RF limits
- Need for further research into RF effects
- Relative nature of RF emissions from a wide array of devices commonly used throughout world (e.g., cellular and cordless phones, Wi-Fi devices, laptop computers, baby monitors, microwave ovens).

CCST encourages the ongoing development of unbiased sources of readily available and clear facts for public information and education. A web-based repository of written reports, frequently asked questions and answers, graphics, and video demonstrations would provide consumers with factual, relevant information with which to better understand RF effects in our environment.

## Appendix A – Letters Requesting CCST

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Assembly
California Legislature

JARED HUFFMAN
ASSEMBLYMEMBER, SIXTH DISTRICT

COMMITTEES
CHAIR, WATER, PARKS AND WILDLIFE
NATURAL RESOURCES
UTILITIES AND COMMERCE

SUBCOMMITTEE NO.3
ON RESOURCES

July 30, 2010

Karl Pister, Chair
Susan Hackwood, Executive Director
California Council on Science and Technology
1130 K Street, Suite 280
Sacramento, CA 95814-3965

Dear Chair Pister and Ms. Hackwood:

I am writing to request a study by the California Council on Science and Technology in response to the many concerns and questions that have been raised by constituents in my Assembly District including the Marin County Board of Supervisors, City of Sebastopol, City of Fairfax, and Marin Association of Realtors relating to potential negative health effects from SmartMeters, the electronic monitoring devices that Pacific Gas and Electric Company (PG&E) is installing statewide to continuously measure the electricity output from each household and business.

SmartMeters are currently being installed throughout the state under the authority of the California Public Utilities Commission (CPUC) pursuant to a series of decisions that span from 2006 through 2009. The authority for PG&E to deploy SmartMeters in its territory is embodied in two decisions: D.06-07-027 (the initial deployment) and D.09-03-026 (the upgrade). On the question of health effects of radiation from the devises, PG&E and CPUC maintain that electromagnetic fields emitted from these SmartMeters and the radio frequency power associated with the wireless radios fall within the Federal Communications Commission's (FCC) regulations, pointing out that SmartMeters emit fewer radio frequencies than the amount allowable for cellular telephones, microwave ovens, and wireless Internet Services.

Critics claim, among other things, that FCC standards are not sufficiently protective of public health and do not take into account the cumulative effect of radiation exposure from a growing number of sources and devices, including continuous exposure from some sources. For example, they cite a letter from the Radiation Protection Division of the Environmental Protection Agency (attached), they argue, ..."these standards were thermally based and do not apply to chronic, nonthermal exposure situations, ... and that … the current exposure guidelines are based on the effects resulting from whole-body heating, not exposure of and effect on critical organs including the brain and the eyes." Therefore, they argue the "safety" standards were not designed to protect the public from health problems under the circumstances which the meters are being used.

An independent, science-based study by the California Council on Science and Technology would help policy makers and the general public resolve the debate over whether SmartMeters present a significant risk of adverse health effects. Toward that end, I reqnest that the Council specifically determine whether FCC standards for SmartMeters are sufficiently protective of public health taking into account current exposure levels to radiofrequency and electromagnetic fields, and further to assess whether additional technology specific standards are needed for SmartMeters and other devises that are commonly found in and around homes, to ensure adequate protection from adverse health effects.

Thank you for your serious consideration of this important and time-sensitive request. Please do not hesitate to contact me if I can be of assistance going forward

Sincerely,

**JARED HUFFMAN**
Assemblymember, 6th District

COMMITTEES
CHAIR, HEALTH
ARTS, ENTERTAINMENT, SPORTS, TOURISM & INTERNET MEDIA
ENVIRONMENTAL SAFETY & TOXIC MATERIALS
JOINT LEGISLATIVE AUDIT COMMITTEE
JUDICIARY
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Assembly
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WILLIAM W. MONNING
ASSEMBLYMEMBER, TWENTY-SEVENTH DISTRICT

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(831) 649-2935

SANTA CLARA COUNTY DIRECT LINE
(408) 782-0647

September 15, 2010

Karl Pister, Chair
California Council on Science and Technology
1130 K Street, Suite 280
Sacramento, CA 95814-3965

Dear Chair Pister:

This letter is to formally request that I be included in the response from the California Council on Science and Technology (CCST) regarding the health safety evaluation of the new electronic metering devices, otherwise known as Smart Meters, currently being installed by Pacific Gas and Electric Company (PG&E) which will be available by October 15, 2010.

Numerous concerns and questions have been raised by PG&E customers throughout the state, as well as local government entities such as the County of Santa Cruz, the City of Capitola, City of Santa Cruz, City of Scotts Valley, and the City of Watsonville, relating to potential health effects of the radio frequency (RF) emitted from Smart Meters.

As you know, the federal Energy Independence and Security Act of 2007 required each state to initiate a smart grid system. In response to this federal mandate, the State of California enacted Senate Bill 17, Chapter 327, Statutes of 2009, granting the California Public Utilities Commission (CPUC) smart grid oversight authority. While the CPUC has authorized PG&E to install their current Smart Meter system, CPUC has not addressed the question of whether the RF emissions from Smart Meter devices have potential health impacts.

While PG&E maintains that Smart Meters comply with the Federal Communications Commission (FCC) safety standards, there is still public concern that the FCC standards do not sufficiently protect the public's health and do not take into account the cumulative effect of radiation exposure from the growing number of sources and devices emitting RF.

The scientific evaluation by the California Council on Science and Technology will help to inform both elected officials and the public about the safety of PG&E's Smart Meters and I appreciate the Council taking the time to assess this very important issue.

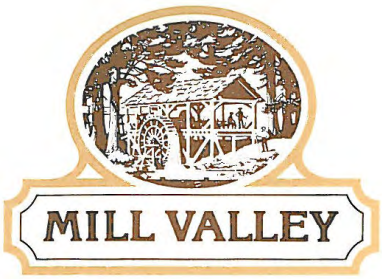
Thank you for your time and assistance on this issue.

Sincerely,

WILLIAM W. MONNING
Assemblymember, 27th District

WWM:rog

Printed on Recycled Paper






September 20, 2010

Karl Pister, Chair
Susan Hackwood, Executive Director
California Council on Science and Technology
1130 K Street, Suite 280
Sacramento, CA 95814-3965

Dear Chair Pistel and Ms. Hackwood:

On behalf of the Mill Valley City Council, I am writing to support Assemblymember Jared Huffman's request for a study by the California Council on Science and Technology (CCST) to specifically determine whether Federal Communications Commission (FCC) standards for Pacific Gas and Electric (PG&E) SmartMeters are sufficiently protective of public health.

This request is in response to the many concerns and questions that have been raised by Mill Valley residents relating to potential negative health effects from SmartMeters. Mill Valley residents have expressed their concerns that these devices, which are regulated by the California Public Utilities Commission (CPUC), emit levels of radiation that may be harmful to public health, especially with consideration to the long-term and cumulative impacts of the devices. The CPUC maintains that SmartMeters emit radiation well below the FCC-established safety standards, and have therefore not ordered PG&E to halt the installation of the advanced metering devices.

Critics argue that the safety standards determined by the FCC are not sufficient and specifically not designed to protect the public from health problems under the circumstances which the meters will be used. The FCC standards, they claim, do not take into consideration long-term and cumulative exposures to these devices.

The City of Mill Valley City Council therefore join Assemblymember Huffman in requesting the CCST undertake a study to specifically determine whether FCC standards for SmartMeters are sufficiently protective of public health, taking into account current exposure levels to radiofrequency and electromagnetic fields, and further to assess whether additional technology


City of Mill Valley, 26 Corte Madera Avenue, Mill Valley, California 94941 • 415-388-4033

specific standards are needed for SmartMeters and other devices that are commonly found in and around homes, to ensure adequate protection from adverse health effects.

Thank you for your consideration.

Sincerely,

Stephanie Moulton-Peters, Mayor
City of Mill Valley

Cc: Mill Valley City Council
Assemblymember Jared Huffman
Joshua Townsend, PG&E Public Affairs Manager
Marzia Zafar, CPUC Business and Community Outreach Division Manager

## Appendix B – Project Process

### CCST Smart Meter Project Approach

Assembly Member Huffman (Marin) (July 30, 2010 letter) and Assembly Member Monning (Santa Cruz) (September 17, 2010 letter) requested CCST's assistance in determining if there are health safety issues regarding the new SMART meters being installed by the utilities. In addition, the City of Mill Valley sent a letter to CCST (September, 2010) in support of Mr. Huffman's request. (Appendix A - letters)

The CCST Executive Committee appointed a Smart Meter Project Team that oversaw the development of a response on the issue (Appendix C):

- Rollin Richmond (Chair), President Humboldt State University, CSU
- Jane Long, Associate Director at Large, Global Security Directorate Fellow, Center for Global Security Research Lawrence Livermore National Laboratory
- Emir Macari, Dean of Engineering and Computer Science, California State University, Sacramento and Director of the California Smart Grid Center
- Patrick Mantey, Director, CITRIS @ Santa Cruz
- Ryan McCarthy, 2009 CCST Science and Technology Policy Fellow
- Larry Papay, CEO, PQR, LLC, mgmt consulting firm
- David Winickoff, Assistant Professor of Bioethics and Society, Department of Environmental Science, Policy and Management, UC Berkeley
- Paul Wright, Director, UC Center for Information Technology Research in the Interest of Society (CITRIS)

In addition to those on the project team, CCST approached over two dozen technical experts to contribute their opinion to inform CCST's response. The experts were referred from a variety of sources and were vetted by the Smart Meter Project Team. Efforts were made to include both biological and physical scientists and engineers to help provide broad context and perspective to the response. Many of the experts approached indicated they did not time to provide a written response however they provided references to additional experts and/or literature for review. A few experts identified were not asked to contribute due to affiliations that were felt to be a conflict of interest. Experts were asked to provide written comment on two issues, to provide referral to other experts, and to suggest literature that should be reviewed. Appendix D provides a list of those experts who provided written comment.

Smart Meter Project Team members and the experts providing written technical input completed a conflict of interest disclosure form to reveal any activities that could create the potential perception of a conflict.

In addition to written and oral input from technical experts, CCST identified relevant reports and other sources of information to inform the final report. This material can be found listed in Appendix E and on a CCST website: http://ccst.us/projects/smart/.

Peer Review: After the draft report was vetted in great detail by the Smart Meter Project Team, it was forwarded to the CCST Board and Council for peer review.

Public Comment: Comments on the January 2011 draft of this report were solicited from the public. The report was posted to the CCST website to allow the general public to easily comment. Many very thoughtful and informed comments were received. All public comments were reviewed and taken into consideration as this final report was completed.

## Appendix C – Project Team

The California Council on Science and Technology adheres to the highest standards to provide independent, objective, and respected work. Board and Council Members review all work that bears CCST's name. In addition, CCST seeks peer review from external technical experts. The request for rigorous peer review results in a protocol that ensures the specific issue being addressed is done so in a targeted way with results that are clear and sound.

In all, this report reflects the input and expertise of nearly 30 people in addition to the project team. Reviewers include experts from academia, industry, national laboratories, and non-profit organizations.

We wish to extend our sincere appreciation to the project team members who have helped produce this report. Their expertise and diligence has been invaluable, both in rigorously honing the accuracy and focus of the work and in ensuring that the perspectives of their respective areas of expertise and institutions were taken into account. Without the insightful feedback that these experts generously provided, this report could not have been completed.

**Rollin Richmond, Smart Meter Project Chair, CCST Board Member**
*President Humboldt State University, CSU*

Prior to Richmond's appointment at Humboldt State University in 2002, he had a distinguished career as a faculty member, researcher in evolutionary biology and academic administrator. Richmond received a Ph.D. in genetics from the Rockefeller University and a bachelor's degree in zoology from San Diego State University. Dr. Richmond's career has included: Chairperson of biology at Indiana University, founding Dean of the College of Arts and Sciences at the University of South Florida, Provost at the State University of New York at Stony Brook, and Provost and Professor of Zoology and Genetics at Iowa State University. He was named the sixth President of Humboldt State University in July of 2002. Dr. Richmond is a fellow of the American Association for the Advancement of Science and a member of Phi Beta Kappa. His research interests are in evolutionary genetics.

**Jane Long, CCST's California's Energy Future Project Co-Chair and CCST Sr. Fellow**
*Associate Director at Large, Global Security Directorate Fellow, Center for Global Security Research Lawrence Livermore National Laboratory*

Dr. Long is the Principal Associate Director at Large for Lawrence Livermore National Laboratory working on energy and climate. She is also a Fellow in the LLNL Center for Global Strategic Research. Her current interests are in reinvention of the energy system in light of climate change, national security issues, economic stress, and ecological breakdown. She holds a bachelor's degree in engineering from Brown University and Masters and Ph.D. from UC Berkeley.

**Patrick Mantey**

*Director, UC Center for Information Technology Research in the Interest of Society (CITRIS) @ Santa Cruz, University of California, Santa Cruz*

Mantey holds the Jack Baskin Chair in Computer Engineering and was the founding Dean of the Jack Baskin School of Engineering. He is now the director of CITRIS at UC Santa Cruz and of ITI, the Information Technologies Institute in the Baskin School of Engineering. In 1984, he joined the UCSC faculty to start the engineering programs, coming from IBM where he was a senior manager at IBM Almaden Research. His research interests include system architecture, design, and performance, simulation and modeling of complex systems, computer networks and multimedia, real-time data acquisition, and control systems. Mantey is a Fellow of the Institute of Electrical and Electronics Engineers. His current projects at CITRIS include the Residential Load Monitoring Project and work on power distribution system monitoring and reliability. Mantey received his B.S. (magna cum laude) from the University of Notre Dame, his M.S. from the University of Wisconsin-Madison, and his Ph.D. from Stanford University, all in electrical engineering. He is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

**Emir José Macari**

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Cindy Sage, MA, Department of Oncology, University Hospital, Orebro, Sweden and Co-Editor, BioInitiative Report

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- Smart Grid Information Clearinghouse (SGIC)
- stopsmartmeters.org

## Appendix F – Glossary

**Access point** - A term typically used to describe an electronic device that provides for wireless connectivity via a WAN to the Internet or a particular computer facility.

**Duty cycle** – A measure of the percentage or fraction of time that an RF device is in operation. A duty cycle of 100% corresponds to continuous operation (e.g., 24 hours/day). A duty cycle of 1% corresponds to a transmitter operating on average 1% of the time (e.g., 14.4 minutes/day).

**Electromagnetic field (EMF)** - A composition of both an electric field and a magnetic field that are related in a fixed way that can convey electromagnetic energy. Antennas produce electromagnetic fields when they are used to transmit signals.

**Far-field** - A distance which extends from about two wavelengths distance from the antenna to infinity, is the region in which the field acts as "normal" electromagnetic radiation. The power of this radiation decreases as the square of distance from the antenna. By contrast, the **near-field**, which is inside about one wavelength distance from the antenna, is a region in which there are effects from the currents and charges in the antenna, which do not behave like far-field radiation. These effects decrease in power far more quickly with distance, than does the far-field radiation power.

**Federal Communications Commission (FCC)** - The Federal Communications Commission (FCC) is an independent agency of the US Federal Government and is directly responsible to Congress. The FCC was established by the Communications Act of 1934 and is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. The FCC also allocates bands of frequencies for non-government communications services (the NTIA allocates government frequencies). The guidelines for human exposure to radio frequency electromagnetic fields as set by the FCC are contained in the Office of Engineering and Technology (OET) Bulletin 65, Edition 97-01 (August 1997). Additional information is contained in OET Bulletin 65 Supplement A (radio and television broadcast stations), Supplement B (amateur radio stations), and Supplement C (mobile and portable devices).

**Gigahertz (GHz)** - One billion Hertz, or one billion cycles per second, a measure of frequency.

**Hertz** - The unit for expressing frequency, one Hertz (Hz) equals one cycle per second.

**Maximum permissible exposure (MPE) limit**. An exposure limit or guideline for RF energy exposure published by a recognized consensus standards organization.

**Megahertz (MHz)** - One million Hertz, or one million cycles per second, a unit for expressing frequency.

**Mesh network** - A network providing a means for routing data, voice and instructions between nodes. A mesh network allows for continuous connections and reconfiguration around broken or blocked data paths by "hopping" from node to node until the destination is reached.

**Milliwatt per square centimeter ($mW/cm^2$)** - A measure of the power density flowing through an area of space, one thousandth ($10^{-3}$) of a watt passing through a square centimeter.

**Microwatt per square centimeter ($\mu W/cm^2$)** - A measure of the power density flowing through an area of space, one millionth ($10^{-6}$) of a watt passing through a square centimeter.

**Radiofrequency (RF)** - The RF spectrum is formally defined in terms of frequency as extending from 0 to 3000 GHz, the frequency range of interest is 3 kHz to 300 GHz.

**Repeater unit** - A device that can simultaneously receive a radio signal and retransmit the signal. Repeater units are used to extend the range of low power transmitters in a geographical area.

**Router** - An electronic computer device that is used to route and forward information, typically between various computers within a local area network or between different local area networks.

**Smart meter** - A digital device for measuring consumption, such as for electricity and natural gas, and sending the measurement to a utility company. Automated meter reading (AMR) meters send information one-way only. Automated meter infrastructure (AMI) meters are capable of two-way communications.

**Specific absorption rate (SAR)** - The incremental energy absorbed by a mass of a given density. SAR is expressed in units of watts per kilogram (or milliwatts per gram, mW/g).

**Transmitter** - An electronic device that produces RF energy that can be transmitted by an antenna. The transmitted energy is typically referred to a radio signal or RF field.

**Wide area network (WAN)** - A computer network that covers a broad area such as a whole community, town, or city. Commonly, WANs are implemented via a wireless connection using radio signals. High-speed Internet connections can be provided to customers by wireless WANs.

**Wi-Fi** - An name given to the wireless technology used in home networks, mobile phones, and other wireless electronic devices that employ the IEEE 802.11 technologies (a standard that defines specific characteristics of wireless local area networks).

**Appendix G – CCST 2011 BOARD MEMBERS**

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*Federal Communications Commission*
*Office of Engineering & Technology*

# Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

# OET Bulletin 65

**Edition 97-01**

**August 1997**

# Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields

OET BULLETIN 65
Edition 97-01

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***NOTE: Mention of commercial products does not constitute endorsement by the Federal Communications Commission or by the authors.***

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**Kwok Chan, Errol Chang, William Cross, Richard Engelman, Bruce Franca and Jay Jackson**

## TABLE OF CONTENTS

## *FIGURES*

# *INTRODUCTION*

This revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to radiofrequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance. ***However, it is not intended to establish mandatory procedures, and other methods and procedures may be acceptable if based on sound engineering practice.***

In 1996, the FCC adopted new guidelines and procedures for evaluating environmental effects of RF emissions. The new guidelines incorporate two tiers of exposure limits based on whether exposure occurs in an occupational or "controlled" situation or whether the general population is exposed or exposure is in an "uncontrolled" situation. In addition to guidelines for evaluating fixed transmitters, the FCC adopted new limits for evaluating exposure from mobile and portable devices, such as cellular telephones and personal communications devices. The FCC also revised its policy with respect to categorically excluding certain transmitters and services from requirements for routine evaluation for compliance with the guidelines.

This bulletin is a revision of the FCC's OST Bulletin 65, originally issued in 1985. Although certain technical information in the original bulletin is still valid, this revised version updates other information and provides additional guidance for evaluating compliance with the the new FCC policies and guidelines. The bulletin is organized into the following sections: Introduction, Definitions and Glossary, Background Information, Prediction Methods, Measuring RF Fields, Controlling Exposure to RF Fields, References and Appendices. Appendix A provides a summary of the new FCC guidelines and the requirements for routine evaluation. Additional information specifically for use in evaluating compliance for radio and television broadcast stations is included in a supplement to this bulletin (Supplement A). A supplement for the Amateur Radio Service will also be issued (Supplement B), and future supplements may be issued to provide additional information for other services. This bulletin and its supplements may be revised, as needed.

In general, the information contained in this bulletin is intended to enable an applicant to make a reasonably quick determination as to whether a proposed or existing facility is in compliance with the limits. In addition to calculations and the use of tables and figures, Section 4, dealing with controlling exposure, should be consulted to ensure compliance, especially with respect to occupational/controlled exposures. In some cases, such as multiple-emitter locations, measurements or a more detailed analysis may be required. In that regard, Section 3 on measuring RF fields provides basic information and references on measurement procedures and instrumentation.

For further information on any of the topics discussed in this bulletin, you may contact the FCC's RF safety group at: +1 202 418-2464. Questions and inquiries can also be e-mailed to: rfsafety@fcc.gov. The FCC's World Wide Web Site provides information on FCC decision documents and bulletins relevant to the RF safety issue. The address is: www.fcc.gov/oet/rfsafety.

## *DEFINITIONS AND GLOSSARY OF TERMS*

The following specific words and terms are used in this bulletin. These definitions are adapted from those included in the American National Standards Institute (ANSI) 1992 RF exposure standard [Reference 1], from NCRP Report No. 67 [Reference 19] and from the FCC's Rules (47 CFR § 2.1 and § 1.1310).

**Average (temporal) power.** The time-averaged rate of energy transfer.

**Averaging time.** The appropriate time period over which exposure is averaged for purposes of determining compliance with RF exposure limits (discussed in more detail in Section 1).

**Continuous exposure.** Exposure for durations exceeding the corresponding averaging time.

**Decibel (dB).** Ten times the logarithm to the base ten of the ratio of two power levels.

**Duty factor**. The ratio of pulse duration to the pulse period of a periodic pulse train. Also, may be a measure of the temporal transmission characteristic of an intermittently transmitting RF source such as a paging antenna by dividing average transmission duration by the average period for transmissions. A duty factor of 1.0 corresponds to continuous operation.

**Effective radiated power (ERP)** (in a given direction). The product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction.

**Equivalent Isotropically Radiated Power (EIRP).** The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

**Electric field strength (E)**. A field vector quantity that represents the force (**F**) on an infinitesimal unit positive test charge (**q**) at a point divided by that charge. Electric field strength is expressed in units of volts per meter (V/m).

**Energy density (electromagnetic field)**. The electromagnetic energy contained in an infinitesimal volume divided by that volume.

**Exposure**. Exposure occurs whenever and wherever a person is subjected to electric, magnetic or electromagnetic fields other than those originating from physiological processes in the body and other natural phenomena.

**Exposure, partial-body**. Partial-body exposure results when RF fields are substantially nonuniform over the body. Fields that are nonuniform over volumes comparable to the human body may occur due to highly directional sources, standing-waves, re-radiating sources or in the near field. See **RF "hot spot".**

**Far-field region**. That region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. In this region (also called the free space region), the field has a predominantly plane-wave character, i.e., locally uniform distribution of electric field strength and magnetic field strength in planes transverse to the direction of propagation.

**Gain (of an antenna).** The ratio, usually expressed in decibels, of the power required at the input of a loss-free reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength or the same power density at the same distance. When not specified otherwise, the gain refers to the direction of maximum radiation. Gain may be considered for a specified polarization. Gain may be referenced to an isotropic antenna (dBi) or a half-wave dipole (dBd).

**General population/uncontrolled exposure.** For FCC purposes, applies to human exposure to RF fields when the general public is exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public always fall under this category when exposure is not employment-related.

**Hertz (Hz).** The unit for expressing frequency, (***f***). One hertz equals one cycle per second.

**Magnetic field strength (H)**. A field vector that is equal to the magnetic flux density divided by the permeability of the medium. Magnetic field strength is expressed in units of amperes per meter (A/m).

**Maximum permissible exposure (MPE)**. The rms and peak electric and magnetic field strength, their squares, or the plane-wave equivalent power densities associated with these fields to which a person may be exposed without harmful effect and with an acceptable safety factor.

**Near-field region**. A region generally in proximity to an antenna or other radiating structure, in which the electric and magnetic fields do not have a substantially plane-wave character, but vary considerably from point to point. The near-field region is further subdivided into the reactive near-field region, which is closest to the radiating structure and that contains most or nearly all of the stored energy, and the radiating near-field region where the radiation field predominates over the reactive field, but lacks substantial plane-wave character and is complicated in structure. For most antennas, the outer boundary of the reactive near field region is commonly taken to exist at a distance of one-half wavelength from the antenna surface.

**Occupational/controlled exposure.** For FCC purposes, applies to human exposure to RF fields when persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see definition above), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Peak Envelope Power (PEP).** The average power supplied to the antenna transmission line by a radio transmitter during one radiofrequency cycle at the crest of the modulation envelope taken under normal operating conditions.

**Power density, average (temporal).** The instantaneous power density integrated over a source repetition period.

**Power density (S)**. Power per unit area normal to the direction of propagation, usually expressed in units of watts per square meter ($W/m^2$) or, for convenience, units such as milliwatts per square centimeter ($mW/cm^2$) or microwatts per square centimeter ($\mu W/cm^2$). For plane waves, power density, electric field strength (E) and magnetic field strength (H) are related by the impedance of free space, i.e., 377 ohms, as discussed in Section 1 of this bulletin. Although many survey instruments indicate power density units ("far-field equivalent" power density), the actual quantities measured are E or $E^2$ or H or $H^2$.

**Power density, peak**. The maximum instantaneous power density occurring when power is transmitted.

**Power density, plane-wave equivalent or far-field equivalent**. A commonly-used terms associated with any electromagnetic wave, equal in magnitude to the power density of a plane wave having the same electric (E) or magnetic (H) field strength.

**Radiofrequency (RF) spectrum**. Although the RF spectrum is formally defined in terms of frequency as extending from 0 to 3000 GHz, for purposes of the FCC's exposure guidelines, the frequency range of interest in 300 kHz to 100 GHz.

**Re-radiated field**. An electromagnetic field resulting from currents induced in a secondary, predominantly conducting, object by electromagnetic waves incident on that object from one or more primary radiating structures or antennas. Re-radiated fields are sometimes called "reflected" or more correctly "scattered fields." The scattering object is sometimes called a "re-radiator" or "secondary radiator".

**RF "hot spot."** A highly localized area of relatively more intense radio-frequency radiation that manifests itself in two principal ways:

(1) The presence of intense electric or magnetic fields immediately adjacent to conductive objects that are immersed in lower intensity ambient fields (often referred to as re-radiation), and

(2) Localized areas, not necessarily immediately close to conductive objects, in which there exists a concentration of RF fields caused by reflections and/or narrow beams produced by high-gain radiating antennas or other highly directional sources. In both cases, the fields are characterized by very rapid changes in field strength with distance. RF hot spots are normally associated with very nonuniform exposure of the body (partial body exposure). This is not to be confused with an actual thermal hot spot within the absorbing body.

**Root-mean-square (rms)**. The effective value, or the value associated with joule heating, of a periodic electromagnetic wave. The rms value is obtained by taking the square root of the mean of the squared value of a function.

**Scattered radiation**. An electromagnetic field resulting from currents induced in a secondary, conducting or dielectric object by electromagnetic waves incident on that object from one or more primary sources.

**Short-term exposure**. Exposure for durations less than the corresponding averaging time.

**Specific absorption rate (SAR)**. A measure of the rate of energy absorbed by (dissipated in) an incremental mass contained in a volume element of dielectric materials such as biological tissues. SAR is usually expressed in terms of watts per kilogram (W/kg) or milliwatts per gram (mW/g). Guidelines for human exposure to RF fields are based on SAR thresholds where adverse biological effects may occur. When the human body is exposed to an RF field, the SAR experienced is proportional to the squared value of the electric field strength induced in the body.

**Wavelength** ($\lambda$). The wavelength ($\lambda$) of an electromagnetic wave is related to the frequency ($f$) and velocity ($v$) by the expression $v = f\lambda$. In free space the velocity of an electromagnetic wave is equal to the speed of light, i.e., approximately $3 \times 10^8$ m/s.

# Section 1: BACKGROUND INFORMATION

## FCC Implementation of NEPA

The National Environmental Policy Act of 1969 (NEPA) requires agencies of the Federal Government to evaluate the effects of their actions on the quality of the human environment.[1] To meet its responsibilities under NEPA, the Commission has adopted requirements for evaluating the environmental impact of its actions.[2] One of several environmental factors addressed by these requirements is human exposure to RF energy emitted by FCC-regulated transmitters and facilities.

The FCC's Rules provide a list of various Commission actions which may have a significant effect on the environment. If FCC approval to construct or operate a facility would likely result in a significant environmental effect included in this list, the applicant for such a facility must submit an "Environmental Assessment" or "EA" of the environmental effect including information specified in the FCC Rules. It is the responsibility of the applicant to make an initial determination as to whether it is necessary to submit an EA.

If it is necessary for an applicant to submit an EA that document would be reviewed by FCC staff to determine whether the next step in the process, the preparation of an Environmental Impact Statement or "EIS," is necessary. An EIS is only prepared if there is a staff determination that the action in question will have a significant environmental effect. If an EIS is prepared, the ultimate decision as to approval of an application could require a full vote by the Commission, and consideration of the issues involved could be a lengthy process. Over the years since NEPA implementation, there have been relatively few EIS's filed with the Commission. This is because most environmental problems are resolved in the process well prior to EIS preparation, since this is in the best interest of all and avoids processing delays.

Many FCC application forms require that applicants indicate whether their proposed operation would constitute a significant environmental action under our NEPA procedures. When an applicant answers this question on an FCC form, in some cases documentation or an explanation of how an applicant determined that there would ***not*** be a significant environmental effect may be requested by the FCC operating bureau or office. This documentation may take the form of an environmental statement or engineering statement that accompanies the application. Such a statement is ***not*** an EA, since an EA is only submitted if there is evidence for a significant environmental effect. In the overwhelming number of cases, applicants attempt to mitigate any potential for a significant environmental effect before submission of either an environmental statement or an EA. This may involve informal

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[1] National Environmental Policy Act of 1969, 42 U.S.C. Section 4321, et seq.

[2] See 47 CFR § 1.1301, et seq.

consultation with FCC staff, either prior to the filing of an application or after an application has been filed, over possible means of avoiding or correcting an environmental problem.

## FCC Guidelines for Evaluating Exposure to RF Emissions

In 1985, the FCC first adopted guidelines to be used for evaluating human exposure to RF emissions.[3] The FCC revised and updated these guidelines on August 1, 1996, as a result of a rule-making proceeding initiated in 1993.[4] The new guidelines incorporate limits for Maximum Permissible Exposure (MPE) in terms of electric and magnetic field strength and power density for transmitters operating at frequencies between 300 kHz and 100 GHz. Limits are also specified for localized ("partial body") absorption that are used primarily for evaluating exposure due to transmitting devices such as hand-held portable telephones. Implementation of the new guidelines for mobile and portable devices became effective August 7, 1996. For other applicants and licensees a transition period was established before the new guidelines would apply.[5]

The FCC's MPE limits are based on exposure limits recommended by the National Council on Radiation Protection and Measurements (NCRP)[6] and, over a wide range of frequencies, the exposure limits developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI) to

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[3] *See Report and Order,* GEN Docket No. 79-144, 100 FCC 2d 543 (1985); and *Memorandum Opinion and Order,* 58 RR 2d 1128 (1985). The guidelines originally adopted by the FCC were the 1982 RF protection guides issued by the American National Standards Institute (ANSI).

[4] See *Report and Order*, ET Docket 93-62, FCC 96-326, adopted August 1, 1996, 61 Federal Register 41,006 (1996), 11 FCC Record 15,123 (1997). The FCC initiated this rule-making proceeding in 1993 in response to the 1992 revision by ANSI of its earlier guidelines for human exposure. The Commission responded to seventeen petitions for reconsideration filed in this docket in two separate Orders: *First Memorandum Opinion and Order,* FCC 96-487, adopted December 23, 1996, 62 Federal Register 3232 (1997), 11 FCC Record 17,512 (1997); and *Second Memorandum Opinion and Order and Notice of Proposed Rulemaking,* adopted August 25, 1997.

[5] This transition period was recently extended. With the exception of the Amateur Radio Service, the date now established for the end of the transition period is October 15, 1997. See *Second Memorandum Opinion and Order and Notice of Proposed Rule Making,* ET Docket 93-62, adopted August 25, 1997. Therefore, the new guidelines will apply to applications filed on or after this date. For the Amateur Service only, the new guidelines will apply to applications filed on or after January 1, 1998. In addition, the Commission has adopted a date certain of September 1, 2000, by which time all existing facilities and devices must be in compliance with the new guidelines (see *Second Memorandum Opinion and Order*).

[6] *See Reference 20*, "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86 (1986), National Council on Radiation Protection and Measurements (NCRP), Bethesda, MD. The NCRP is a non-profit corporation chartered by the U.S. Congress to develop information and recommendations concerning radiation protection.

replace the 1982 ANSI guidelines.[7] Limits for localized absorption are based on recommendations of both ANSI/IEEE and NCRP. The FCC's new guidelines are summarized in Appendix A.

In reaching its decision on adopting new guidelines the Commission carefully considered the large number of comments submitted in its rule-making proceeding, and particularly those submitted by the U.S. Environmental Protection Agency (EPA), the Food and Drug Administration (FDA) and other federal health and safety agencies. The new guidelines are based substantially on the recommendations of those agencies, and it is the Commission's belief that they represent a consensus view of the federal agencies responsible for matters relating to public safety and health.

The FCC's limits, and the NCRP and ANSI/IEEE limits on which they are based, are derived from exposure criteria quantified in terms of specific absorption rate (SAR).[8] The basis for these limits is a whole-body averaged SAR threshold level of 4 watts per kilogram (4 W/kg), as averaged over the entire mass of the body, above which expert organizations have determined that potentially hazardous exposures may occur. The new MPE limits are derived by incorporating safety factors that lead, in some cases, to limits that are more conservative than the limits originally adopted by the FCC in 1985. Where more conservative limits exist they do not arise from a fundamental change in the RF safety criteria for whole-body averaged SAR, but from a precautionary desire to protect subgroups of the general population who, potentially, may be more at risk.

The new FCC exposure limits are also based on data showing that the human body absorbs RF energy at some frequencies more efficiently than at others. As indicated by Table 1 in Appendix A, the most restrictive limits occur in the frequency range of 30-300 MHz where whole-body absorption of RF energy by human beings is most efficient. At other frequencies whole-body absorption is less efficient, and, consequently, the MPE limits are less restrictive.

MPE limits are defined in terms of power density (units of milliwatts per centimeter squared: $mW/cm^2$), electric field strength (units of volts per meter: V/m) and magnetic field strength (units of amperes per meter: A/m). In the far-field of a transmitting antenna, where the electric field vector (E), the magnetic field vector (H), and the direction of propagation

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[7] *See Reference 1*, ANSI/IEEE C95.1-1992, "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz." Copyright 1992, The Institute of Electrical and Electronics Engineers, Inc., New York, NY. The 1992 ANSI/IEEE exposure guidelines for field strength and power density are similar to those of NCRP Report No. 86 for most frequencies except those above 1.5 GHz.

[8] Specific absorption rate is a measure of the rate of energy absorption by the body. SAR limits are specified for both whole-body exposure and for partial-body or localized exposure (generally specified in terms of spatial peak values).

can be considered to be all mutually orthogonal ("plane-wave" conditions), these quantities are related by the following equation.[9]

$$S = \frac{E^2}{3770} = 37.7H^2 \qquad (1)$$

where: S = power density ($mW/cm^2$)
E = electric field strength (V/m)
H = magnetic field strength (A/m)

In the near-field of a transmitting antenna the term "far-field equivalent" or "plane-wave equivalent" power density is often used to indicate a quantity calculated by using the near-field values of $E^2$ or $H^2$ as if they were obtained in the far-field. As indicated in Table 1 of Appendix A, for near-field exposures the values of plane-wave equivalent power density are given in some cases for reference purposes only. These values are sometimes used as a convenient comparison with MPEs for higher frequencies and are displayed on some measuring instruments.

The FCC guidelines incorporate two separate tiers of exposure limits that are dependent on the situation in which the exposure takes place and/or the status of the individuals who are subject to exposure. The decision as to which tier applies in a given situation should be based on the application of the following definitions.

***Occupational/controlled*** exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure. Occupational/controlled exposure limits also apply where exposure is of a transient nature as a result of incidental passage through a location where exposure levels may be above general population/uncontrolled limits (see below), as long as the exposed person has been made fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means. As discussed later, the occupational/controlled exposure limits also apply to amateur radio operators and members of their immediate household.

***General population/uncontrolled*** exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment-related, for example, in the case of a telecommunications tower that exposes persons in a nearby residential area.

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[9] Note that this equation is written so that power density is expressed in units of $mW/cm^2$. The impedance of free space, 377 ohms, is used in deriving the equation.

For purposes of applying these definitions, awareness of the potential for RF exposure in a workplace or similar environment can be provided through specific training as part of an RF safety program. Warning signs and labels can also be used to establish such awareness as long as they provide information, in a prominent manner, on risk of potential exposure and instructions on methods to minimize such exposure risk.[10] However, warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to achieve the awareness necessary to qualify these devices as operating under the occupational/controlled category. In those situations the general population/uncontrolled exposure limits will apply.

A fundamental aspect of the exposure guidelines is that they apply to power densities or the squares of the electric and magnetic field strengths that are spatially averaged over the body dimensions. Spatially averaged RF field levels most accurately relate to estimating the whole-body averaged SAR that will result from the exposure and the MPEs specified in Table 1 of Appendix A are based on this concept. This means that local values of exposures that exceed the stated MPEs may not be related to non-compliance if the spatial average of RF fields over the body does not exceed the MPEs. Further discussion of spatial averaging as it relates to field measurements can be found in Section 3 of this bulletin and in the ANSI/IEEE and NCRP reference documents noted there.

Another feature of the exposure guidelines is that exposures, in terms of power density, $E^2$ or $H^2$, may be averaged over certain periods of time with the average not to exceed the limit for continuous exposure.[11] As shown in Table 1 of Appendix A, the averaging time for occupational/controlled exposures is 6 minutes, while the averaging time for general population/uncontrolled exposures is 30 minutes. It is important to note that for general population/uncontrolled exposures it is often not possible to control exposures to the extent that averaging times can be applied. In those situations, it is often necessary to assume continuous exposure.

As an illustration of the application of time-averaging to occupational/controlled exposure consider the following. The relevant interval for time-averaging for occupational/controlled exposures is six minutes. This means, for example, that during any given six-minute period a worker could be exposed to two times the applicable power density limit for three minutes as long as he or she were not exposed at all for the preceding or following three minutes. Similarly, a worker could be exposed at three times the limit for two minutes as long as no exposure occurs during the preceding or subsequent four minutes, and so forth.

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[10] For example, a sign warning of RF exposure risk and indicating that individuals should not remain in the area for more than a certain period of time could be acceptable. Reference [3] provides information on acceptable warning signs.

[11] Note that although the FCC did not explicitly adopt limits for ***peak*** power density, guidance on these types of exposures can be found in Section 4.4 of the ANSI/IEEE C95.1-1992 standard.

This concept can be generalized by considering Equation (2) that allows calculation of the allowable time(s) for exposure at [a] given power density level(s) during the appropriate time-averaging interval to meet the exposure criteria of Table 1 of Appendix A. The sum of the products of the exposure levels and the allowed times for exposure must equal the product of the appropriate MPE limit and the appropriate time-averaging interval.

$$\sum S_{exp} t_{exp} = S_{limit} t_{avg} \qquad (2)$$

where:
$S_{exp}$ = power density level of exposure ($mW/cm^2$)
$S_{limit}$ = appropriate power density MPE limit ($mW/cm^2$)
$t_{exp}$ = allowable time of exposure for $S_{exp}$
$t_{avg}$ = appropriate MPE averaging time

For the example given above, if the MPE limit is 1 $mW/cm^2$, then the right-hand side of the equation becomes 6 mW-min/$cm^2$ (1 $mW/cm^2$ X 6 min). Therefore, if an exposure level is determined to be 2 $mW/cm^2$, the allowed time for exposure at this level during any six-minute interval would be a total of 3 minutes, since the left side of the equation must equal 6 (2 $mW/cm^2$ X 3 min). Of course, many other combinations of exposure levels and times may be involved during a given time-averaging interval. However, as long as the sum of the products on the left side of the equation equals the right side, the ***average*** exposure will comply with the MPE limit. It is very important to remember that time-averaging applies to ***any*** interval of $t_{avg}$. Therefore, in the above example, consideration would have to be given to the exposure situation both before and after the allowed three-minute exposure. The time-averaging interval can be viewed as a "sliding" period of time, six minutes in this case.

Another important point to remember concerning the FCC's exposure guidelines is that they constitute ***exposure*** limits (not ***emission*** limits), and they are relevant only to locations that are ***accessible*** to workers or members of the public. Such access can be restricted or controlled by appropriate means such as the use of fences, warning signs, etc., as noted above. For the case of occupational/controlled exposure, procedures can be instituted for working in the vicinity of RF sources that will prevent exposures in excess of the guidelines. An example of such procedures would be restricting the time an individual could be near an RF source or requiring that work on or near such sources be performed while the transmitter is turned off or while power is appropriately reduced. In the case of broadcast antennas, the use of auxiliary antennas could prevent excessive exposures to personnel working on or near the main antenna site, depending on the separation between the main and auxiliary antennas. Section 4 of this bulletin should be consulted for further information on controlling exposure to comply with the FCC guidelines.

**Applicability of New Guidelines**

The FCC's environmental rules regarding RF exposure identify particular categories of existing and proposed transmitting facilities, operations and devices for which licensees and applicants are required to conduct an initial environmental evaluation, and prepare an Environmental Assessment if the evaluation indicates that the transmitting facility, operation or device exceeds or will exceed the FCC's RF exposure guidelines. For transmitting facilities, operations and devices not specifically identified, the Commission has determined, based on calculations, measurement data and other information, that such RF sources offer little potential for causing exposures in excess of the guidelines. Therefore, the Commission "categorically excluded" applicants and licensees from the requirement to perform routine, initial environmental evaluations of such sources to demonstrate compliance with our guidelines. However, the Commission still retains the authority to request that a licensee or an applicant conduct an environmental evaluation and, if appropriate, file environmental information pertaining to an otherwise categorically excluded RF source if it is determined that there is a possibility for significant environmental impact due to RF exposure.[12]

In that regard, all transmitting facilities and devices regulated by this Commission that are the subject of an FCC decision or action (e.g., grant of an application or response to a petition or inquiry) are expected to comply with the appropriate RF radiation exposure guidelines, or, if not, to file an Environmental Assessment (EA) for review under our NEPA procedures, if such is required. It is important to emphasize that the categorical exclusions are ***not*** exclusions from ***compliance*** but, rather, exclusions from performing routine evaluations to demonstrate compliance. Normally, the exclusion from performing a routine evaluation will be a sufficient basis for assuming compliance, unless an applicant or licensee is otherwise notified by the Commission or has reason to believe that the excluded transmitter or facility encompasses exceptional characteristics that could cause non-compliance.

It should also be stressed that even though a transmitting source or facility may not be categorically excluded from routine evaluation, no further environmental processing is required once it has been demonstrated that exposures are within the guidelines, as specified in Part 1 of our rules. These points have been the source of some confusion in the past among FCC licensees and applicants, some of whom have been under the impression that filing an EA is always required.

In adopting its new exposure guidelines, the Commission also adopted new rules indicating which transmitting facilities, operations and devices will be categorically excluded from performing routine, initial evaluations. The new exclusion criteria are based on such factors as type of service, antenna height, and operating power. The new criteria were adopted in an attempt to obtain greater consistency and scientific rigor in determining requirements for RF evaluation across the various FCC-regulated services.

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[12] *See* 47 CFR §§ 1.1307(c) and (d).

Routine environmental evaluation for RF exposure is required for transmitters, facilities or operations that are included in the categories listed in Table 2 of Appendix A or in FCC rule parts 2.1091 and 2.1093 (for portable and mobile devices). This requirement applies to some, but not necessarily all, transmitters, facilities or operations that are authorized under the following parts of our rules: 5, 15, 21 (Subpart K), 22 (Subpart E), 22 (Subpart H), 24, 25, 26, 27, 73, 74 (Subparts A, G, I, and L), 80 (ship earth stations), 90 (paging operations and Specialized Mobile Radio), 97 and 101 (Subpart L). Within a specific service category, conditions are listed in Table 2 of Appendix A to determine which transmitters will be subject to routine evaluation. These conditions are generally based on one or more of the following variables: (1) operating power, (2) location, (3) height above ground of the antenna and characteristics of the antenna or mode of transmission. In the case of Part 15 devices, only devices that transmit on millimeter wave frequencies and unlicensed Personal Communications Service (PCS) devices are covered, as noted in rule parts 2.1091 and 2.1093 (see section on mobile and portable devices of Appendix A).

Transmitters and facilities not included in the specified categories are excluded from routine evaluation for RF exposure. We believe that such transmitting facilities generally pose little or no risk for causing exposures in excess of the guidelines. However, as noted above, in exceptional cases the Commission may, on its own merit or as the result of a petition, require environmental evaluation of transmitters or facilities even though they are otherwise excluded from routine evaluation. Also, at multiple-transmitter sites applications for non-excluded transmitters should consider significant contributions of other co-located transmitters (see discussion of multiple-transmitter evaluation in Section 2).

If a transmitter operates using relatively high power, and there is a possibility that workers or the public could have access to the transmitter site, such as at a rooftop site, then routine evaluation is justified. In Table 2 of Appendix A, an attempt was made to identify situations in the various services where such conditions could prevail. In general, at rooftop transmitting sites evaluation will be required if power levels are above the values indicated in Table 2 of Appendix A. These power levels were chosen based on generally "worst-case" assumptions where the most stringent uncontrolled/general population MPE limit might be exceeded within several meters of transmitting antennas at these power levels. In the case of paging antennas, the likelihood that duty factors, although high, would not normally be expected to be 100% was also considered. Of course, if procedures are in place at a site to limit accessibility or otherwise control exposure so that the safety guidelines are met, then the site is in compliance and no further environmental processing is necessary under our rules.

Tower-mounted ("non-rooftop") antennas that are used for cellular telephone, PCS, and Specialized Mobile Radio (SMR) operations warrant a somewhat different approach for evaluation. While there is no evidence that typical installations in these services cause ground-level exposures in excess of the MPE limits, construction of these towers has been a topic of ongoing public controversy on environmental grounds, and we believe it necessary to ensure that there is no likelihood of excessive exposures from these antennas. Although we believe there is no need to require routine evaluation of towers where antennas are mounted high above the ground, out of an abundance of caution the FCC requires that tower-mounted

installations be evaluated if antennas are mounted lower than 10 meters above ground and the total power of all channels being used is over 1000 watts effective radiated power (ERP), or 2000 W ERP for broadband PCS.[13] These height and power combinations were chosen as thresholds recognizing that a theoretically "worst case" site could use many channels and several thousand watts of power. At such power levels a height of 10 meters above ground is not an unreasonable distance for which an evaluation generally would be advisable. For antennas mounted higher than 10 meters, measurement data for cellular facilities have indicated that ground-level power densities are typically hundreds to thousands of times below the new MPE limits.

In view of the expected proliferation of these towers in the future and possible use of multiple channels and power levels at these installations, and to ensure that tower installations are properly evaluated when appropriate, we have instituted these new requirements for this limited category of tower-mounted antennas in these services. For consistency we have instituted similar requirements for several other services that could use relatively high power levels with antennas mounted on towers lower than 10 meters above ground.

Paging systems operated under Part 22 (Subpart E) and Part 90 of our rules previously have been categorically exempted from routine RF evaluation requirements. However, the potential exists that the new, more restrictive limits may be exceeded in accessible areas by relatively high-powered paging transmitters with rooftop antennas.[14] These transmitters may operate with high duty factors in densely populated urban environments. The record and our own data indicate the need for ensuring appropriate evaluation of such facilities, especially at multiple transmitter sites. Accordingly, paging stations authorized under Part 22 (Subpart E) and Part 90 are also subject to routine environmental evaluation for RF exposure if an antenna is located on a rooftop and if its ERP exceeds 1000 watts.

**Mobile and Portable Devices**

As noted in Appendix A, mobile and portable transmitting devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services (PCS), the General Wireless Communications Service, the Wireless Communication Service, the Satellite Communications services, the Maritime Services (ship earth stations only) and Specialized Mobile Radio Service authorized, respectively, under Part 22 (Subpart H), Part 24, Part 25, Part 26, Part 27, Part 80, and Part 90 of the FCC's Rules are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use. Unlicensed PCS, NII and millimeter wave devices are also subject to routine environmental evaluation for RF exposure

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[13] For broadband PCS, 2000 W is used as a threshold, instead of 1000 W, since at these operating frequencies the exposure criteria are less restrictive by about a factor of two.

[14] For example, under Part 90, paging operations in the 929-930 MHz band may operate with power levels as high as 3500 W ERP.

prior to equipment authorization or use. All other mobile, portable, and unlicensed transmitting devices are normally categorically excluded from routine environmental evaluation for RF exposure (see Section 2 and Appendix A for further details).

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits given in Table 1 of Appendix A.

The FCC defines portable devices, for purposes of these requirements, as transmitters whose radiating structures are designed to be used within 20 centimeters of the body of the user. As explained later, in Section 2 and in Appendix A, portable devices are to be evaluated with respect to limits for specific absorption rate (SAR).

**Operations in the Amateur Radio Service**

In the FCC's recent *Report and Order*, certain amateur radio installations were made subject to routine evaluation for compliance with the FCC's RF exposure guidelines.[15] Also, amateur licensees will be expected to demonstrate their knowledge of the FCC guidelines through examinations. Applicants for new licenses and renewals also will be required to demonstrate that they have read and that they understand the applicable rules regarding RF exposure. Before causing or allowing an amateur station to transmit from any place where the operation of the station could cause human exposure to RF radiation levels in excess of the FCC guidelines amateur licensees are now required to take certain actions. A routine RF radiation evaluation is required if the transmitter power of the station exceeds the levels shown in Table 1 and specified in 47 CFR § 97.13(c)(1).[16] Otherwise the operation is categorically excluded from routine RF radiation evaluation, except as a result of a specific motion or petition as specified in Sections 1.1307(c) and (d) of the FCC's Rules, (see earlier discussion in Section 1 of this bulletin).

The Commission's *Report and Order* instituted a requirement that operator license examination question pools will include questions concerning RF safety at amateur stations. An additional five questions on RF safety will be required within each of three written examination elements. The Commission also adopted the proposal of the American Radio

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[15] *See* para. 160 of *Report and Order*, ET Dkt 93-62. *See also*, 47 CFR § 97.13, as amended.

[16] These levels were chosen to roughly parallel the frequency of the MPE limits of Table 1 in Appendix A. These levels were modified from the Commission's original decision establishing a flat 50 W power threshold for routine evaluation of amateur stations (*see Second Memorandum Opinion and Order*, ET Docket 93-62, FCC 97-303, adopted August 25, 1997).

**TABLE 1. Power thresholds for routine evaluation of amateur radio stations.**

| Wavelength Band | Transmitter Power (watts) |
|---|---|
| **MF** | |
| 160 m | 500 |
| **HF** | |
| 80 m | 500 |
| 75 m | 500 |
| 40 m | 500 |
| 30 m | 425 |
| 20 m | 225 |
| 17 m | 125 |
| 15 m | 100 |
| 12 m | 75 |
| 10 m | 50 |
| **VHF (all bands)** | 50 |
| **UHF** | |
| 70 cm | 70 |
| 33 cm | 150 |
| 23 cm | 200 |
| 13 cm | 250 |
| **SHF (all bands)** | 250 |
| **EHF (all bands)** | 250 |

Relay League (ARRL) that amateur operators should be required to certify, as part of their license application process, that they have read and understand our bulletins and the relevant FCC rules.

When routine evaluation of an amateur station indicates that exposure to RF fields could be in excess of the exposure limits specified by the FCC (see Appendix A), the licensee must take action to correct the problem and ensure compliance (see Section 4 of this bulletin on controlling exposure). Such actions could be in the form of modifying patterns of operation, relocating antennas, revising a station's technical parameters such as frequency, power or emission type or combinations of these and other remedies.

In complying with the Commission's *Report and Order*, amateur operators should follow a policy of systematic avoidance of excessive RF exposure. The Commission has said that it will continue to rely upon amateur operators, in constructing and operating their stations, to take steps to ensure that their stations comply with the MPE limits for both occupational/controlled and general public/uncontrolled situations, as appropriate. In that regard, amateur radio operators and members of their immediate household are considered to
be in a "controlled environment" and are subject to the occupational/controlled MPE limits. Neighbors who are not members of an amateur operator's household are considered to be members of the general public, since they cannot reasonably be expected to exercise control over their exposure. In those cases general population/uncontrolled exposure MPE limits will apply.

In order to qualify for use of the occupational/controlled exposure criteria, appropriate restrictions on access to high RF field areas must be maintained and educational instruction in RF safety must be provided to individuals who are members of the amateur operator's household. Persons who are not members of the amateur operator's household but who are present temporarily on an amateur operator's property may also be considered to fall under the occupational/controlled designation provided that appropriate information is provided them about RF exposure potential if transmitters are in operation and such persons are exposed in excess of the general population/uncontrolled limits.

Amateur radio facilities represent a special case for determining exposure, since there are many possible antenna types that could be designed and used for amateur stations. However, several relevant points can be made with respect to analyzing amateur radio antennas for potential exposure that should be helpful to amateur operators in performing evaluations.

First of all, the generic equations described in this bulletin can be used for analyzing fields due to almost all antennas, although the resulting estimates for power density may be overly-conservative in some cases. Nonetheless, for general radiators and for aperture antennas, if the user is knowledgeable about antenna gain, frequency, power and other relevant factors, the equations in this section can be used to estimate field strength and power density as described earlier. In addition, other resources are available to amateur radio operators for analyzing fields near their antennas. The ARRL Radio Amateur Handbook

contains an excellent section on analyzing amateur radio facilities for compliance with RF guidelines (Reference [4] ). Also, the FCC and the EPA conducted a study of several amateur radio stations in 1990 that provides a great deal of measurement data for many types of antennas commonly used by amateur operators (Reference [10] ).

Amateur radio organizations and licensees are encouraged to develop their own more detailed evaluation models and methods for typical antenna configurations and power/frequency combinations. The FCC is working with the amateur radio community to develop a supplement to this bulletin that will be designed specifically for evaluating amateur radio installations. For example, the supplement will contain information on projected minimum exclusion distances from typical amateur antenna installations. The supplement should be completed soon after release of this bulletin. Once the amateur radio supplement is released by the FCC it will be made available for downloading at the FCC's World Wide Web Site for "RF safety." Amateur radio applicants and licensees are encouraged to monitor the Web Site for release of the supplement. The address is: www.fcc.gov/oet/rfsafety. Information on availability of the supplement, as well as other RF-related questions, can be directed to the FCC's "RF Safety Program" at: (202) 418-2464 or to: rfsafety@fcc.gov.

## Section 2: PREDICTION METHODS

The material in this section is designed to provide assistance in determining whether a given facility would be in compliance with guidelines for human exposure to RF radiation. The calculational methods discussed below should be helpful in evaluating a particular exposure situation. However, for certain transmitting facilities, such as radio and television broadcast stations, a specific supplement to this bulletin has been developed containing information and compliance guidelines specific to those stations.[17] Therefore, applicants for radio and television broadcast facilities may wish to first consult this supplement that concentrates on AM radio, FM radio and television broadcast antennas. Applicants for many broadcast facilities should be able to determine whether a given facility would be in compliance with FCC guidelines by simply consulting the tables and figures in this supplement. However, in addition, with respect to occupational/controlled exposure, all applicants should consult Section 4 of this bulletin concerning controlling exposures that may occur during maintenance or other procedures carried out at broadcast and other telecommunications sites.

Applicants may consult the relevant sections below, which describe how to estimate field strength and power density levels from typical, general radiators as well as from aperture

[17] *Supplement A to* OET Bulletin 65, Version 97-01, *Additional Information for Radio and Television Broadcast Stations.* This supplement can be downloaded from the FCC's RF Safety World Wide Web Site: www.fcc.gov/oet/rfsafety. For further information contact the RF safety program at: +1 (202) 418-2464.

antennas such as microwave and satellite dish antennas. The general equations given below can be used for predicting field strength and power density in the vicinity of most antennas, including those used for paging and in the commercial mobile radio service (CMRS). They can also be used for making conservative predictions of RF fields in the vicinity of antennas used for amateur radio transmissions, as discussed earlier.

**Equations for Predicting RF Fields**

Calculations can be made to predict RF field strength and power density levels around typical RF sources. For example, in the case of a single radiating antenna, a prediction for power density in the far-field of the antenna can be made by use of the general Equations (3) or (4) below [for conversion to electric or magnetic field strength see Equation (1) in Section 1]. These equations are generally accurate in the far-field of an antenna but will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction.

$$S = \frac{PG}{4\pi R^2} \qquad (3)$$

where: S = power density (in appropriate units, e.g. $mW/cm^2$)
P = power input to the antenna (in appropriate units, e.g., mW)
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

***or:***

$$S = \frac{EIRP}{4\pi R^2} \qquad (4)$$

where: EIRP = equivalent (or effective) isotropically radiated power

When using these and other equations care must be taken to use the ***correct units*** for all variables. For example, in Equation (3), if power density in units of $mW/cm^2$ is desired then power should be expressed in milliwatts and distance in cm. Other units may be used, but care must be taken to use correct conversion factors when necessary. Also, it is important to note that the power gain factor, ***G***, in Equation (3) is normally ***numeric*** gain. Therefore,

when power gain is expressed in logarithmic terms, i.e., dB, a conversion is required using the relation:

$$G = 10^{\frac{dB}{10}}$$

For example, a logarithmic power gain of 14 dB is equal to a numeric gain of 25.12.

In some cases operating power may be expressed in terms of "effective radiated power" or "ERP" instead of EIRP. ERP is power referenced to a half-wave dipole radiator instead of to an isotropic radiator. Therefore, if ERP is given it is necessary to convert ERP into EIRP in order to use the above equations. This is easily done by multiplying the ERP by the factor of 1.64, which is the gain of a half-wave dipole relative to an isotropic radiator. For example, if ERP is used in Equation (4) the relation becomes:

$$S = \frac{EIRP}{4\pi R^2} = \frac{1.64\ ERP}{4\pi R^2} = \frac{0.41\ ERP}{\pi R^2} \qquad (5)$$

For a truly worst-case prediction of power density at or near a surface, such as at ground-level or on a rooftop, 100% reflection of incoming radiation can be assumed, resulting in a potential doubling of predicted field strength and a four-fold increase in (far-field equivalent) power density. In that case Equations (3) and (4) can be modified to:

$$S = \frac{(2)^2 PG}{4\pi R^2} = \frac{PG}{\pi R^2} = \frac{EIRP}{\pi R^2} \qquad (6)$$

In the case of FM radio and television broadcast antennas, the U.S. Environmental Protection Agency (EPA) has developed models for predicting ground-level field strength and power density [Reference 11]. The EPA model recommends a more realistic approximation for ground reflection by assuming a maximum 1.6-fold increase in field strength leading to an

increase in power density of 2.56 (1.6 X 1.6). Equation (4) can then be modified to:

$$S = \frac{2.56\ EIRP}{4\pi R^2} = \frac{0.64\ EIRP}{\pi R^2} \qquad (7)$$

If ERP is used in Equation (7), the relation becomes:

$$S = \frac{0.64\ EIRP}{\pi R^2} = \frac{(0.64)(1.64)\ ERP}{\pi R^2} = \frac{1.05\ ERP}{\pi R^2} \qquad (8)$$

It is sometimes convenient to use units of microwatts per centimeter squared ($\mu W/cm^2$) instead of $mW/cm^2$ in describing power density. The following simpler form of Equation (8) can be derived if power density, **S**, is to be expressed in units of $\mu W/cm^2$:

$$S = \frac{33.4\ ERP}{R^2} \qquad (9)$$

where: S = power density in $\mu W/cm^2$
ERP = power in watts
R = distance in meters

An example of the use of the above equations follows. A station is transmitting at a frequency of 100 MHz with a total nominal ERP (including all polarizations) of 10 kilowatts (10,000 watts) from a tower-mounted antenna. The height to the center of radiation is 50 meters above ground-level. Using the formulas above, what would be the calculated "worst-case" power density that could be expected at a point 2 meters above ground (approximate head level) and at a distance of 20 meters from the base of the tower? Note that this type of analysis ***does not*** take into account the vertical radiation pattern of the antenna, i.e., no information on directional characteristics of signal propagation is considered. Use of actual vertical radiation pattern data for the antenna would most likely significantly reduce ground-level exposure predictions from those calculated below (see later discussion), resulting in a more realistic estimate of the actual exposure levels.

From simple trigonometry the distance **R** can be calculated to be 52 meters [square root of: $(48)^2 + (20)^2$], assuming essentially flat terrain. Therefore, using Equation (9), the

calculated conservative "worst case" power density is:

$$S = \frac{33.4\ (10{,}000\ watts)}{(52\ m)^2} = about\ 124\ \mu W/cm^2$$

By consulting Table 1 of Appendix A it can be determined that the limit for general population/uncontrolled exposure at 100 MHz is 0.2 mW/cm$^2$ or 200 µW/cm$^2$. Therefore, this calculation shows that even under worst-case conditions this station would comply with the general population/uncontrolled limits, at least at a distance of 20 meters from the tower. Similar calculations could be made to ensure compliance at other locations, such as at the base of the tower where the shortest direct line distance, R, to the ground would occur.

**Relative Gain and Main-Beam Calculations**

The above-described equations can be used to calculate fields from a variety of radiating antennas, such as omni-directional radiators, dipole antennas and antennas incorporating directional arrays. However, in many cases the use of equations such as Equations (3) and (4) will result in an overly conservative "worst case" prediction of the field at a given point. Alternatively, if information concerning an antenna's vertical radiation pattern is known, a relative field factor (relative gain) derived from such a pattern can be incorporated into the calculations to arrive at a more accurate representation of the field at a given point of interest. For example, in the case of an antenna pointing toward the horizon, if the relative gain in the main beam is 1.0, then in other directions downward from horizontal the field may be significantly less than 1.0. Therefore, radiation from the antenna directly toward the ground may be significantly reduced from the omni-directional case and a more realistic prediction of the field can be obtained for the point of interest.

For example, in the calculation above, it can be shown from trigonometry that the depression angle below horizontal of the vector corresponding to the distance, R, is about 68°. For purposes of illustration, assume that the antenna in this example has its main beam pointed approximately toward the horizon and, at a depression angle of 68°, the field relative to the main beam (relative gain) is –6 dB (a factor of 0.5 in terms of field strength and 0.25 in terms of power density). In that case the calculation above can be modified giving a more

accurate representation of the power density at the ground-level point of interest, as follows.

$$S = \frac{33.4\ F^2\ ERP}{R^2} = \frac{33.4\ (0.5)^2\ (10{,}000\ watts)}{(52\ m)^2} = about\ 31\ \mu W/cm^2$$

where: F = the relative field factor (relative numeric gain)

In general, Equation (9) can be modified to:

$$S = \frac{33.4\ (F^2)\ ERP}{R^2} \qquad (10)$$

where: S = power density in $\mu W/cm^2$
F = relative field factor (relative numeric gain)
ERP = power in watts
R = distance in meters

When the point of interest where exposure may occur is in or near the main radiated beam of an antenna, Equation (3) or its derivatives can be used. In other words, the factor, F, in such cases would be assumed to be 1.0. Such cases occur when, for example, a nearby building or rooftop may be in the main beam of a radiator. For convenience in determining exposures in such situations, Equation (3) has been used to derive Figures 1 and 2. These figures allow a quick determination of the power density at a given distance from an antenna in its main beam for various levels of ERP.[18] Intermediate ERPs can be estimated by interpolation, or the next highest ERP level can be used as a worst case approximation.

Figure 1 assumes no reflection off of a surface. However, at a rooftop location where the main-beam may be directed parallel and essentially along or only slightly above the surface of the roof, there may be reflected waves that would contribute to exposure. Therefore, Figure 2 was derived for the latter case using the EPA-recommended reflection factor of $(1.6)^2 = 2.56$ (see earlier discussion), and the values shown are more conservative. When using Figures 1 or 2 a given situation should be considered on its own merits to determine which figure is more appropriate. For rooftop locations it is also important to note that exposures ***inside*** a building can be expected to be reduced by at least 10-20 dB due to attenuation caused by building materials in the walls and roof.

[18] To convert to EIRP use the relation: EIRP = ERP ***X*** 1.64.

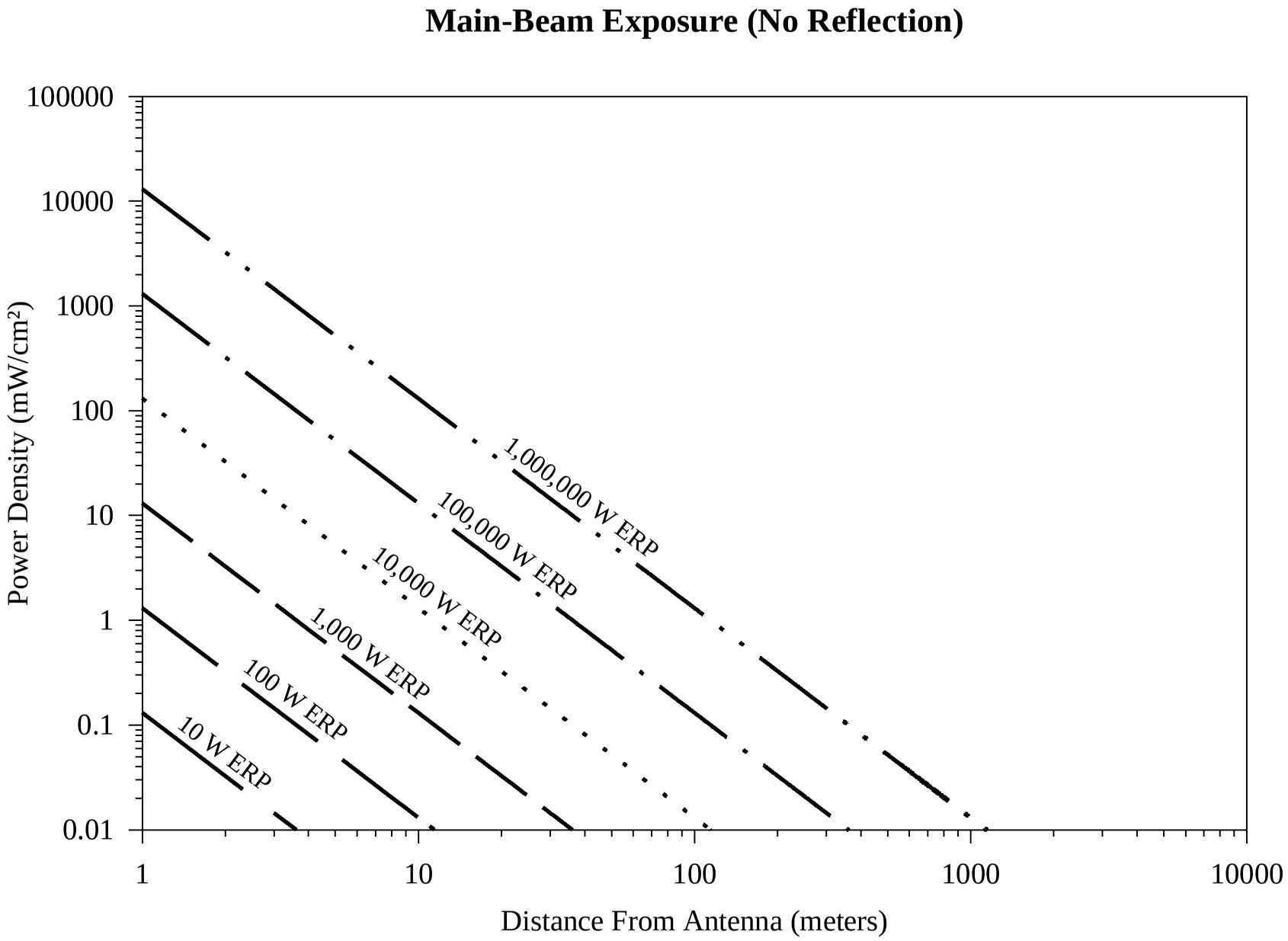


**FIGURE 1. Power Density vs. Distance (assumes no surface reflection).**

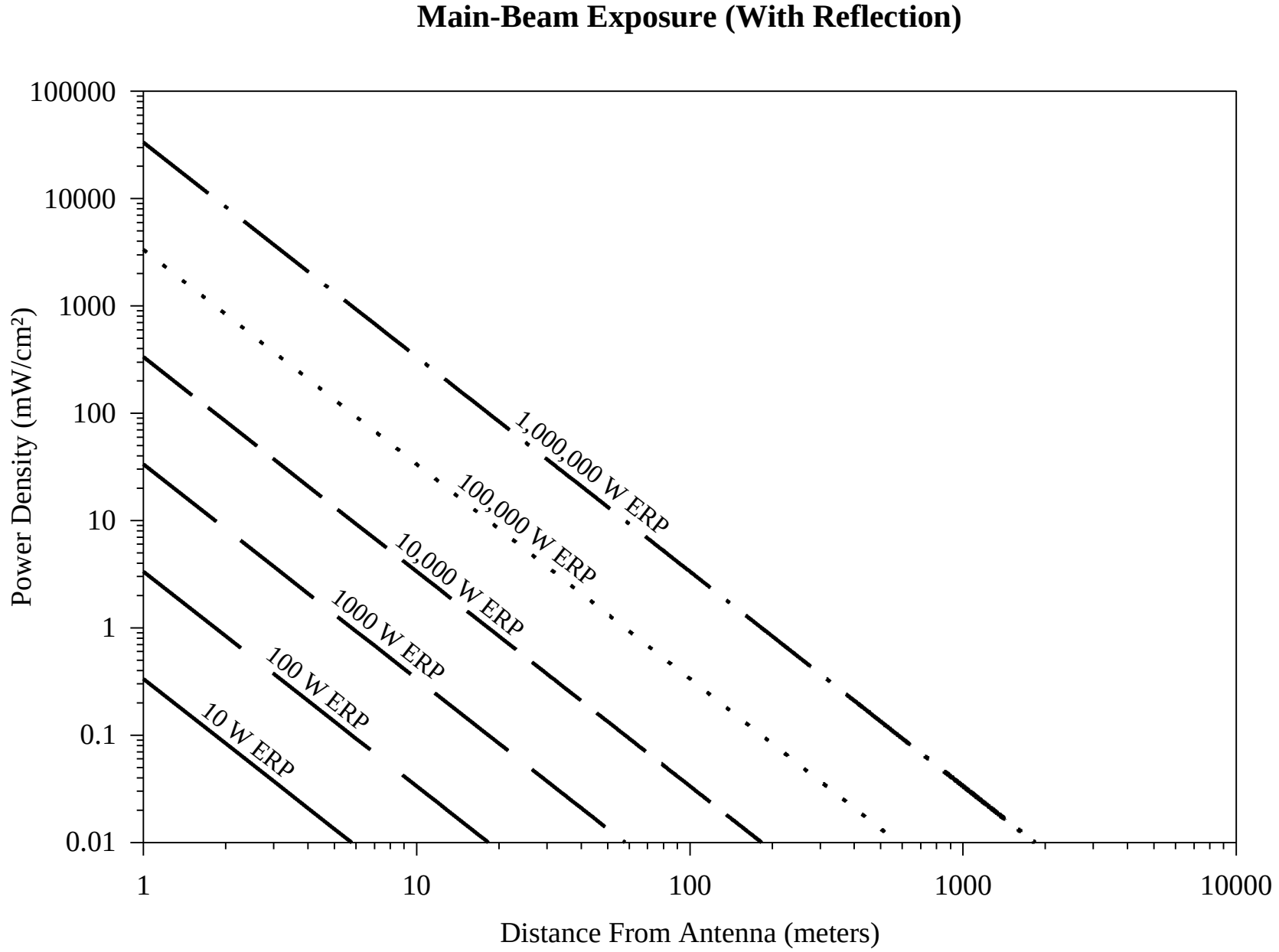


**FIGURE 2. Power Density vs. Distance (assumes surface reflection).**

**Aperture Antennas**

Aperture antennas include those used for such applications as satellite-earth stations, point-to-point microwave radio and various types of radar applications. Generally, these types of antennas have parabolic surfaces and many have circular cross sections. They are characterized by their high gain which results in the transmission of power in a well-defined collimated beam with little angular divergence. Systems using aperture antennas operate at microwave frequencies, i.e., generally above 900 MHz.

Those systems involved in telecommunications applications operate with power levels that depend on the distance between transmit and receive antennas, the number of channels required (bandwidth) and antenna gains of transmit and receive antennas. The antennas used typically have circular cross sections, where antenna diameter is an important characteristic that determines the antenna gain. With regard to some operations, such as satellite-earth station transmitting antennas, the combination of high transmitter power and large antenna diameter (high gain) produces regions of significant power density that may extend over relatively large distances in the main beam. Many "dish" type antennas used for satellite-earth station transmissions utilize the Cassegrain design in which power is fed to the antenna from a waveguide located at the center of the parabolic reflector. Radiation from this source is then incident on a small hyperbolic sub-reflector located between the power feed and the focal point of the antenna and is then reflected back to the main reflector resulting in the transmission of a collimated beam. An example of this is illustrated in Figure 3.

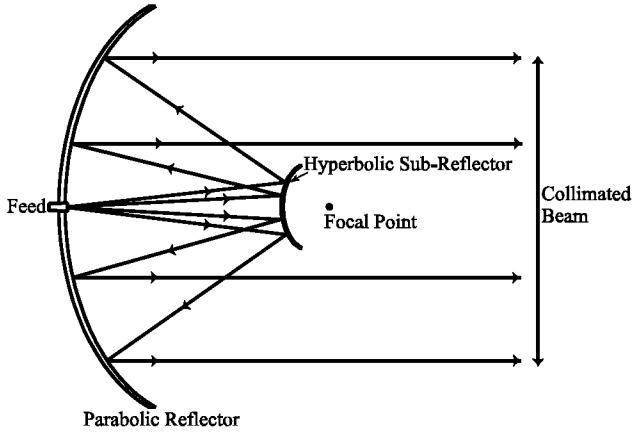


**FIGURE 3. Cassegrain Antenna**

Because of the highly directional nature of these and other aperture antennas, the likelihood of significant human exposure to RF radiation is considerably reduced. The power densities existing at locations where people may be typically exposed are substantially less

than on-axis power densities. Factors that must be taken into account in assessing the potential for exposure are main-beam orientation, antenna height above ground, location relative to where people live or work and the operational procedures followed at the facility.

Satellite-earth uplink stations have been analyzed and their emissions measured to determine methods to estimate potential environmental exposure levels. An empirical model has been developed, based on antenna theory and measurements, to evaluate potential environmental exposure from these systems [Reference 15]. In general, for parabolic aperture antennas with circular cross sections, the following information and equations from this model can be used in evaluating a specific system for potential environmental exposure. More detailed methods of analysis are also acceptable. For example, see References [18] and [21].

**Antenna Surface.** The maximum power density directly in front of an antenna (e.g., at the antenna surface) can be approximated by the following equation:

$$S_{surface} = \frac{4P}{A} \qquad (11)$$

where: $S_{surface}$ = maximum power density at the antenna surface
P = power fed to the antenna
A = physical area of the aperture antenna

**Near-Field Region.** In the near-field, or Fresnel region, of the main beam, the power density can reach a maximum before it begins to decrease with distance. The extent of the near-field can be described by the following equation (**D** and $\lambda$ in same units):

$$R_{nf} = \frac{D^2}{4\lambda} \qquad (12)$$

where: $R_{nf}$ = extent of near-field
D = maximum dimension of antenna (diameter if circular)
$\lambda$ = wavelength

The magnitude of the on-axis (main beam) power density varies according to location in the near-field. However, the maximum value of the near-field, on-axis, power density can

be expressed by the following equation:

$$S_{nf} = \frac{16\eta P}{\pi D^2} \qquad (13)$$

where: $S_{nf}$ = maximum near-field power density
$\eta$ = aperture efficiency, typically 0.5-0.75
P = power fed to the antenna
D = antenna diameter

Aperture efficiency can be estimated, or a reasonable approximation for circular apertures can be obtained from the ratio of the effective aperture area to the physical area as follows:

$$\eta = \frac{\left(\frac{G\lambda^2}{4\pi}\right)}{\left(\frac{\pi D^2}{4}\right)} \qquad (14)$$

where: $\eta$ = aperture efficiency for circular apertures
G = power gain in the direction of interest relative to an isotropic radiator
$\lambda$ = wavelength
D = antenna diameter

If the antenna gain is not known, it can be calculated from the following equation using the actual or estimated value for aperture efficiency:

$$G = \frac{4\pi\eta A}{\lambda^2} \qquad (15)$$

where: $\eta$ = aperture efficiency
G = power gain in the direction of interest relative to an isotropic radiator
$\lambda$ = wavelength
A = physical area of the antenna

**Transition Region.** Power density in the transition region decreases inversely with distance from the antenna, while power density in the far-field (Fraunhofer region) of the antenna decreases inversely with the ***square*** of the distance. For purposes of evaluating RF exposure, the distance to the beginning of the far-field region (farthest extent of the transition region) can be approximated by the following equation:

$$R_{ff} = \frac{0.6\ D^2}{\lambda} \qquad (16)$$

where: $R_{ff}$ = distance to beginning of far-field
D = antenna diameter
$\lambda$ = wavelength

The transition region will then be the region extending from $\mathbf{R_{nf}}$, calculated from Equation (12), to $\mathbf{R_{ff}}$. If the location of interest falls within this transition region, the on-axis

$$S_t = \frac{S_{nf}\ R_{nf}}{R} \qquad (17)$$

power density can be determined from the following equation:

where: $S_t$ = power density in the transition region
$S_{nf}$ = maximum power density for near-field calculated above
$R_{nf}$ = extent of near-field calculated above
R = distance to point of interest

**Far-Field Region.** The power density in the far-field or Fraunhofer region of the antenna pattern decreases inversely as the square of the distance. The power density in the far-field region of the radiation pattern can be estimated by the general equation discussed earlier:

$$S_{ff} = \frac{PG}{4\pi R^2} \qquad (18)$$

where: $S_{ff}$ = power density (on axis)
P = power fed to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the point of interest

In the far-field region, power is distributed in a series of maxima and minima as a function of the off-axis angle (defined by the antenna axis, the center of the antenna and the specific point of interest). For constant phase, or uniform illumination over the aperture, the main beam will be the location of the greatest of these maxima. The on-axis power densities calculated from the above formulas represent the maximum exposure levels that the system can produce. Off-axis power densities will be considerably less.

For off-axis calculations in the near-field and in the transition region it can be assumed that, if the point of interest is at least one antenna diameter removed from the center of the main beam, the power density at that point would be at least a factor of 100 (20 dB) less than the value calculated for the equivalent distance in the main beam (see Reference [15] ).

For practical estimation of RF fields in the off-axis vicinity of aperture antennas, use of the antenna radiation pattern envelope can be useful. For example, for the case of an earth station in the fixed-satellite service, the Commission's Rules specify maximum allowable gain for antenna sidelobes not within the plane of the geostationary satellite orbit, such as at ground level.[19] In such cases, the rules require that the gain of the antenna shall lie below the envelope defined by:

$$\mathbf{32 - \{25\log_{10}(\theta)\}\ dBi} \quad \textit{for} \quad \mathbf{1^o \leq \theta \leq 48^o}$$
$$\textit{and:} \quad \mathbf{-10\ dBi} \quad \textit{for} \quad \mathbf{48^o < \theta \leq 180^o}$$

Where: $\theta$ = the angle in degrees from the axis of the main lobe
**dBi** = dB relative to an isotropic radiator

Use of the gain obtained from these relationships in simple far-field calculations, such as Equation 18, will generally be sufficient for estimating RF field levels in the surrounding environment, since the apparent aperture of the antenna is typically very small compared to its frontal area.

**Special Antenna Models**

There are various antenna types for which other models and prediction methods could be useful for evaluating the potential for exposure. To discuss models for each of the numerous types of antennas in existence would be beyond the scope of this bulletin. However, some specific cases and applications will be mentioned. In addition, a model that

[19] See 47 CFR 25.209 (a)(2).

was developed for FM radio broadcast antennas is discussed in Supplement A to this bulletin.[20]

Prediction methods have been developed for certain specialized antennas used for paging, cellular radio and personal communications services (PCS). In 1995, a study was performed for the FCC by Richard Tell Associates, Inc., that included developing prediction methodology for RF fields in the vicinity of such antennas, particularly those that may be located on rooftops (see References [29] and also [22] ). In that study it was found that at distances close to these antennas a power density model based on inverse distance was more accurate than predictions based on the typical far-field equations such as Equations (3) and (4) above. In other words, in these equations the factor **R** could be substituted for the factor $\mathbf{R^2}$ for a more realistic approximation of the true power density close to the antennas. The distance over which this relation holds appears to vary with the antenna under study, but can extend for several meters according to the Tell study.

Tell has observed that the use of a cylindrical model can be useful in evaluating RF fields near vertical collinear dipole antennas similar to those used for cellular, PCS, paging and two-way radio communications.[21] This model can also be used in estimating near-field exposures adjacent to television and FM radio broadcast antennas where workers may be located during tower work. In general, this model is a more accurate predictor of exposure very close to an antenna where "far-field" equations, such as Equation 1, may significantly ***overpredict*** the RF environment. However, as one moves away from an antenna the cylindrical model becomes overly conservative and the far-field model becomes more accurate. The exact distance ("crossover point") where this occurs is not a simple value but depends on characteristics of the antenna such as aperture dimension and gain. One can determine this crossover point by calculating and plotting power densities using a far-field model and the cylindrical model described below and finding the distance where the predictions coincide.

For Tell's cylindrical model, spatially averaged plane-wave equivalent power densities parallel to the antenna may be estimated by dividing the net antenna input power by the surface area of an imaginary cylinder surrounding the length of the radiating antenna. While the actual power density will vary along the height of the antenna, the average value along its

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[20] *Additional Information for Radio and Television Broadcast Stations,* Supplement A to OET Bulletin 65, Version 97-01. This supplement will be made available for downloading from the FCC RF Safety Web Site: www.fcc.gov/oet/rfsafety. Otherwise contact the FCC RF Safety Program at: (202) 418-2464.

[21] Tell, Richard A. (1996). *EME Design and Operation Considerations for Wireless Antenna Sites.* Technical report prepared for the Cellular Telecommunications Industry Association, Washington, D.C. 20036.

length will closely follow the relation given by the following equation.

$$S = \frac{P_{net}}{2\pi Rh} \qquad (19)$$

where: S = power density
$P_{net}$ = net power input to the antenna
R = distance from the antenna
h = aperture height of the antenna

For sector-type antennas, power densities can be estimated by dividing the net input power by that portion of a cylindrical surface area corresponding to the angular beam width of the antenna. For example, for the case of a 120-degree azimuthal beam width, the surface area should correspond to 1/3 that of a full cylinder. This would increase the power density near the antenna by a factor of three over that for a purely omni-directional antenna. Mathematically, this can be represented by Equation (20) in which the angular beam width, $\theta_{BW}$, can be taken as the appropriate azimuthal "power dispersion" angle for a given reflector. For example, a conservative estimate could be obtained by using the 3 dB (half-power) azimuthal beam width for a given sectorized antenna.

$$S = \left(\frac{180}{\theta_{BW}}\right)\frac{P_{net}}{\pi Rh} \qquad (20)$$

where: S = power density
$P_{net}$ = net power input to the antenna
$\theta_{BW}$ = beam width of the antenna in degrees
R = distance from the antenna
h = aperture height of the antenna

Equation (20) can be used for any vertical collinear antenna, even omni-directional ones. For omni-directional antennas, $\theta_{BW}$ would be 360 degrees and Equation (20) reduces to the simpler Equation (19) above.

**Multiple-Transmitter Sites and Complex Environments**

It is common for multiple RF emitters to be co-located at a given site. Antennas are often clustered together at sites that may include a variety of RF sources such as radio and television broadcast towers, CMRS antennas and microwave antennas. The FCC's exposure guidelines are meant to apply to any exposure situation caused by transmitters regulated by

the FCC. Therefore, at multiple-transmitter sites, all significant contributions to the RF environment should be considered, not just those fields associated with one specific source. When there are multiple transmitters at a given site collection of pertinent technical information about them will be necessary to permit an analysis of the overall RF environment by calculation or computer modeling. However, if this is not practical a direct measurement survey may prove to be more expedient for assessing compliance (see Section 3 of this bulletin that deals with measurements for more information).

The rules adopted by the FCC specify that, in general, at multiple transmitter sites actions necessary to bring the area into compliance with the guidelines are the shared responsibility of all licensees whose transmitters produce field strengths or power density levels at the area in question in excess of 5% of the exposure limit (in terms of power density or the square of the electric or magnetic field strength) applicable to their particular transmitter.[22] When performing an evaluation for compliance with the FCC's RF guidelines ***all*** significant contributors to the ambient RF environment should be considered, including those otherwise excluded from performing routine RF evaluations, and applicants are expected to make a good-faith effort to consider these other transmitters. For purposes of such consideration, significance can be taken to mean ***any*** transmitter producing more than 5% of the applicable exposure limit (in terms of power density or the square of the electric or magnetic field strength) at accessible locations. The percentage contributions are then added to determine whether the limits are (or would be) exceeded. If the MPE limits are exceeded, then the responsible party or parties, as described below, must take action to either bring the area into compliance or submit an EA.

Applicants and licensees should be able to calculate, based on considerations of frequency, power and antenna characteristics the distance from their transmitter where their signal produces an RF field equal to, or greater than, the 5% threshold limit. The applicant or licensee then shares responsibility for compliance in any accessible area or areas within this 5% "contour" where the appropriate limits are found to be exceeded.

The following policy applies in the case of an application for a proposed transmitter, facility or modification (not otherwise excluded from performing a routine RF evaluation) that would ***cause non-compliance*** at an accessible area previously in compliance. In such a case, it is the responsibility of the applicant to either ensure compliance or submit an EA if emissions from the applicant's transmitter or facility would result in an exposure level at the non-complying area that exceeds 5% of the exposure limits applicable to that transmitter or facility in terms of power density or the square of the electric or magnetic field strength.

For a renewal applicant whose transmitter or facility (not otherwise excluded from routine evaluation) contributes to the RF environment at an accessible area ***not in compliance*** with the guidelines the following policy applies. The renewal applicant must submit an EA if emissions from the applicant's transmitter or facility, at the area in question, result in an exposure level that exceeds 5% of the exposure limits applicable to that particular transmitter

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[22] *See* 47 C.F.R. 1.1307(b)(3), as amended.

in terms of power density or the square of the electric or magnetic field strength. In other words, although the renewal applicant may only be responsible for a fraction of the total exposure (greater than 5%), the applicant (along with any other licensee undergoing renewal at the same time) will trigger the EA process, unless suitable corrective measures are taken to prevent non-compliance before preparation of an EA is necessary. In addition, in a renewal situation if a determination of non-compliance is made, other co-located transmitters contributing more than the 5% threshold level must share responsibility for compliance, regardless of whether they are categorically excluded from routine evaluation or submission of an EA.

Therefore, at multiple-transmitter sites the various responsibilities for evaluating the RF environment, taking actions to ensure compliance or submitting an EA may lie either with a newcomer to the site, with a renewal applicant (or applicants) or with all significant users, depending on the situation. In general, an applicant or licensee for a transmitter at a multiple-transmitter site should seek answers to the following questions in order to determine compliance responsibility.

**(1) New transmitter proposed for a multiple-transmitter site.**

- Is the transmitter in question already categorically excluded from routine evaluation?

- If ***yes***, routine evaluation of the application is not required.

- If ***not excluded***, is the site in question already in compliance with the FCC guidelines?

- If ***no,*** the applicant must submit an EA with its application notifying the Commission of the non-compying situation, unless measures are to be taken to ensure compliance. Compliance is the responsibility of licensees of all transmitters that contribute to non-complying area(s) in excess of the applicable 5% threshold at the existing site. If the existing site is subsequently brought into compliance ***without*** consideration of the new applicant then the next two questions below apply.

- If ***yes***, would the proposed transmitter cause non-compliance at the site in question?
- If ***yes***, the applicant must submit an EA (or submit a new EA in the situation described above) with its application notifying the Commission of the potentially non-complying situation, unless measures will be taken by the applicant to ensure compliance. In this situation, it is the responsibility of the applicant to ensure compliance, since the existing site is already in compliance.

- If ***no***, no further environmental evaluation is required and the applicant certifies compliance.

**(2) Renewal applicant at a multiple-transmitter site**

- Is the transmitter in question already categorically excluded from routine evaluation?

- If ***yes***, routine evaluation of the application is not required.

- If ***not excluded,*** is the site in question already in compliance with the FCC guidelines?

- If ***no***, the applicant must submit an EA with its application notifying the Commission of the non-compying situation, unless measures are taken to ensure compliance. Compliance is the responsibility of licensees of all transmitters that contribute to non-complying area(s) in excess of the applicable 5% threshold.

- If ***yes,*** no further environmental evaluation is necessary and the applicant certifies compliance.

The Commission expects its licensees and applicants to cooperate in resolving problems involving compliance at multiple-transmitter sites. Also, owners of transmitter sites are expected to allow applicants and licensees to take reasonable steps to comply with the FCC's requirements. When feasible, site owners should also encourage co-location and common solutions for controlling access to areas that may be out of compliance. In situations where disputes arise or where licensees cannot reach agreement on necessary compliance actions, a licensee or applicant should notify the FCC licensing bureau. The bureau may then determine whether appropriate FCC action is necessary to facilitate a resolution of the dispute.

The FCC's MPE limits vary with frequency. Therefore, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit (in terms of power density or square of the electric or magnetic field strength) incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100% in terms of percentage. For example, consider an antenna farm with radio and UHF television broadcast transmitters. At a given location that is accessible to the general public it is determined that FM radio station X contributes 100 $\mu W/cm^2$ to the total power density (which is 50% of the applicable 200 $\mu W/cm^2$ MPE limit for the FM frequency band). Also, assume that FM station Y contributes an additional 50 $\mu W/cm^2$ (25% of its limit) and that a nearby UHF-TV station operating on Channel 35 (center frequency = 599 MHz) contributes 200 $\mu W/cm^2$ at the same location (which is 50% of the applicable MPE limit for this frequency of 400 $\mu W/cm^2$). The sum of all of the percentage contributions then equals 125%, and the location is not in compliance with the MPE limits for the general public. Consequently, measures must be taken to bring the site into compliance such as restricting access to the area (see Section 4 of this bulletin on controlling exposure).

As noted above, in such situations it is the shared responsibility of site occupants to take whatever actions are necessary to bring a site into compliance. In the above case, the allocation of responsibility could be generally based on each station's percentage contribution to the overall power density at the problem location, although such a formula for allocating responsibility is not an FCC requirement, and other formulas may be used, as appropriate.

When attempting to predict field strength or power density levels at multiple transmitter sites the general equations discussed in this section of the bulletin can be used at many sites, depending on the complexity of the site. Individual contributions can often be determined at a given location using these prediction methods, and then power densities (or squares of field strength values) can be added together for the total predicted exposure level.
In addition, time-averaging of exposures may be possible, as explained in Section 1 of this bulletin. For sites involving radio and television broadcast stations, the methods described in Supplement A for broadcast stations can be used in some circumstances when a site is not overly complex. Also, for wireless communications sites, some organizations have developed commercially-available software for modeling sites for compliance purposes.[23]

When considering the contributions to field strength or power density from other RF sources, care should be taken to ensure that such variables as reflection and re-radiation are considered. In cases involving very complex sites predictions of RF fields may not be possible, and a measurement survey may be necessary (see Section 3 of this bulletin).

The following example illustrates a simple situation involving multiple antennas. The process for determining compliance for other situations can be similarly accomplished using the techniques described in this section and in Supplement A to this bulletin that deals with radio and television broadcast operations. However, as mentioned above, at very complex sites measurements may be necessary.

In the simple example shown in Figure 4 it is desired to determine the power density at a given location **X** meters from the base of a tower on which are mounted two antennas. One antenna is a CMRS antenna with several channels, and the other is an FM broadcast antenna. The system parameters that must be known are the total ERP for each antenna and the operating frequencies (to determine which MPE limits apply). The heights above ground level for each antenna, **H1** and **H2,** must be known in order to calculate the distances, **R1**and **R2**, from the antennas to the point of interest. The methods described in this section (and in Supplement A for FM antennas) can be used to determine the power density contributions of each antenna at the location of interest, and the percentage contributions (compared to the applicable MPE limit for that frequency) are added together as described above to determine if the location complies with the applicable exposure guidelines. If the location is accessible
to the public, the general/population limits apply. Otherwise occupational/controlled limits should be used.

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[23] For example, the following two U.S. companies have recently begun marketing such software: (1) Richard Tell Associates, Inc., telephone: (702) 645-3338; and (2) UniSite, telephone: (972) 348-7632.

Another type of complex environment is a site with multiple towers. The same general process may be used to determine compliance as described above, if appropriate. Distances from each transmitting antenna to the point of interest must be calculated, and RF levels should be calculated at the point of interest due to emissions from each transmitting antenna using the most accurate model. Limits, percentages and cumulative percent of the limit may then be determined in the same manner as for Figure 4. Figure 5 illustrates such a situation.

Another situation may involve a single antenna that creates significant RF levels at more than one type of location. Figure 6 illustrates such a situation where exposures on a rooftop as well as on the ground are possible. The same considerations apply here as before and can be applied to predict RF levels at the points of interest. As mentioned previously, with respect to rooftop environments, it is also important to remember that building attenuation can be expected to reduce fields inside of the building by approximately 10-20 dB.

Situations where tower climbing is involved may be complicated and may require reduction of power or shutting down of transmitters during maintenance tasks (also see Section 4 of this bulletin on controlling exposure). Climbing of AM towers involves exposure due to RF currents induced in the body of the climber, and guidelines are available for appropriate power reduction (see Supplement A, Section 1, dealing with AM broadcast stations). For FM, TV and other antennas that may be mounted on towers, the highest exposures will be experienced near the active elements of each antenna and may require shutting off or greatly reducing power when a worker passes near the elements.

The equations in this section can also be used to calculate worst-case RF levels either below or above antennas that are side-mounted on towers. In the example shown in Figure 7, a more complicated situation arises when a worker is climbing an AM tower on which are side-mounted two other antennas. In this case the safest and most conservative approach would be to consult Supplement A, Section 1, for the appropriate AM power level to use and then to ensure that the transmitters for the other antennas are shut down when the climber passes near each side-mounted antenna's elements.

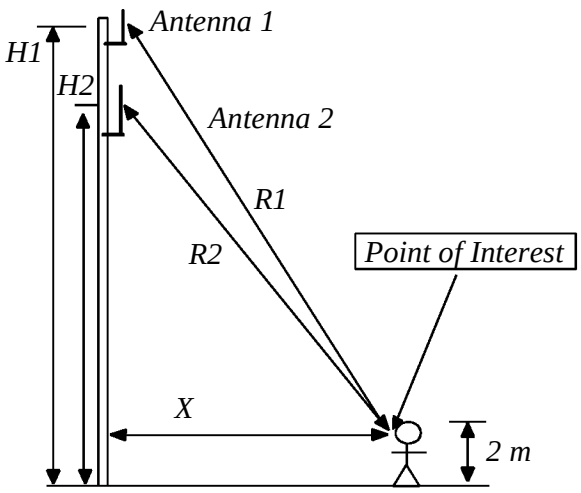


**Figure 4. Single tower, co-located antennas, ground-level exposure (at 2 m).**

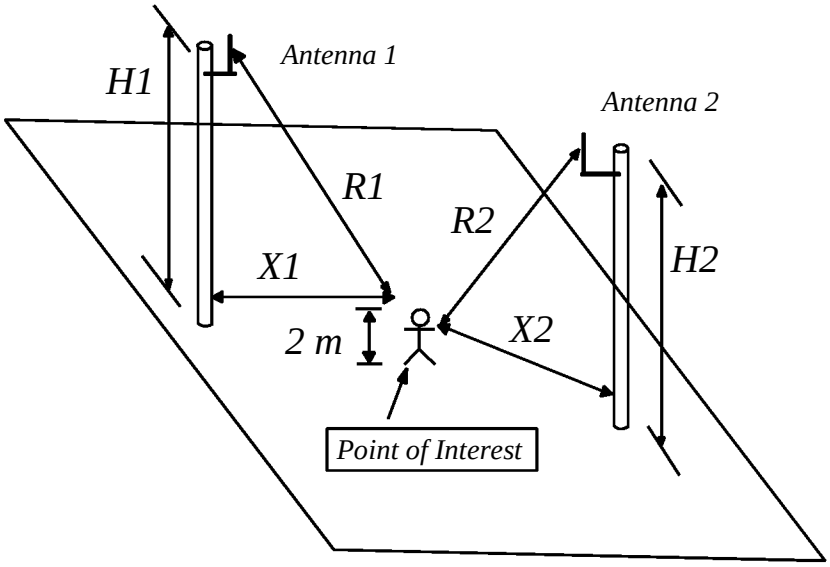


**FIGURE 5. Antennas on multiple towers contributing to RF field at point of interest.**

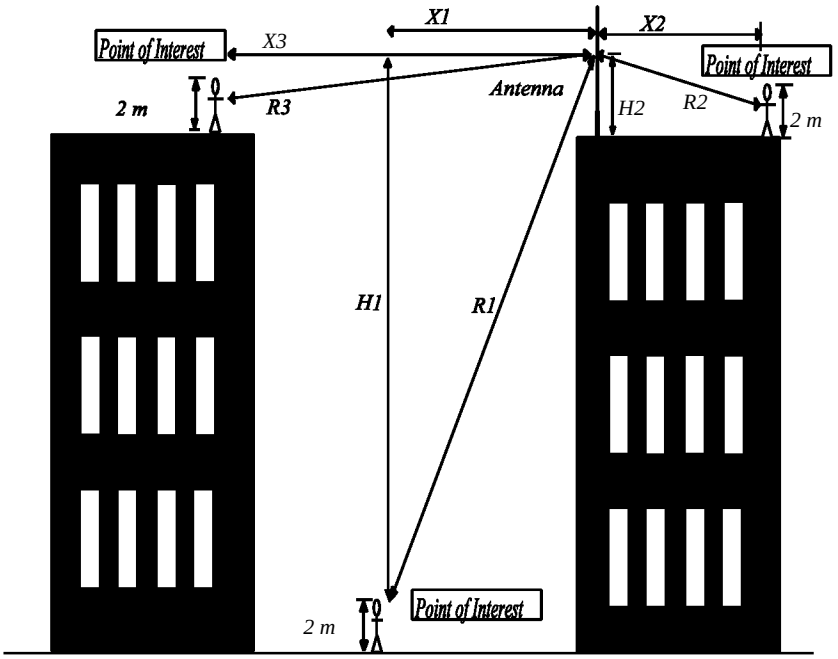


**FIGURE 6. Single roof-top antenna, various exposure locations.**

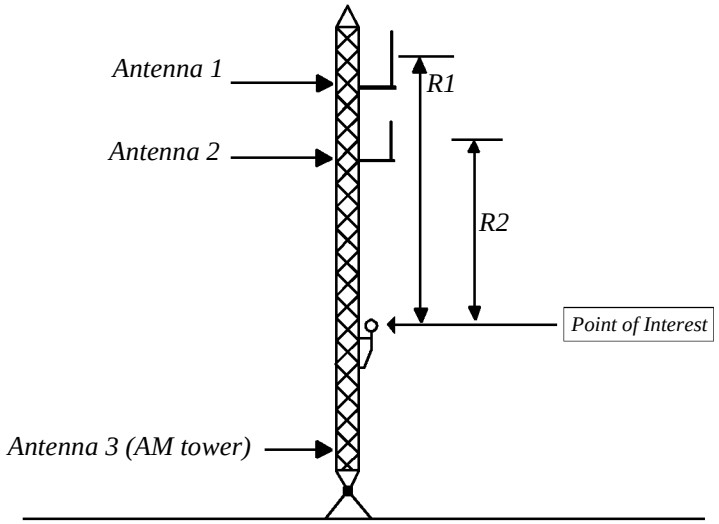


**FIGURE 7. Single tower, co-located antennas, on-tower exposure.**

**Evaluating Mobile and Portable Devices**

Portable and mobile devices present something of a special case with respect to evaluating RF exposure. The user of such a device would most likely be in the near vicinity of the RF radiator, and the predictive methods described above may not apply in all cases. Therefore, evaluation of exposure due to these devices requires special consideration. The FCC's rules for evaluating portable and mobile devices for RF compliance are contained in 47 CFR §§2.1091 and 2.1093 (see Appendix A).

The new FCC guidelines differentiate between devices according to their proximity to exposed persons. In that regard, "portable" devices are defined as those devices that are designed to be used with any part of the radiating structure of the device in direct contact with the body of the user or within 20 cm of the body of the user under normal conditions of use. This category would include such devices as hand-held cellular telephones that incorporate the radiating antenna into the handpiece. "Mobile" devices are defined by the FCC as transmitting devices designed to be used in other than fixed locations that would normally be used with radiating structures maintained 20 cm or more from the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location.
Examples of mobile devices, as defined above, would include transportable cellular telephones ("bag" phones), cellular telephones and other radio devices that use vehicle-mounted antennas and certain other transportable transmitting devices. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

Evaluation of exposure from a portable or mobile device depends on how the device is to be used. With respect to portable devices, both the 1992 ANSI/IEEE standard and the NCRP exposure criteria, upon which the FCC guidelines are based, permit devices designed to be used in the immediate vicinity of the body, such as hand-held telephones, to be excluded from compliance with the limits for field strength and power density provided that such devices comply with the limits for specific absorption rate (SAR). Therefore, portable devices, as defined by the FCC, are to be evaluated with respect to SAR not MPE limits. For most consumer-type devices, such as hand-held cellular telephones, the appropriate SAR limit is 1.6 watt/kg as averaged over any one gram of tissue, defined as a tissue volume in the shape of a cube (see Appendix A for details).

The selection of the 20-cm value for differentiating between "portable" and "mobile" devices is based on the specification in the 1992 ANSI/IEEE standard that 20 cm should be the minimum separation distance where reliable field measurements to determine adherence to MPEs can be made.[24] Therefore, although at closer distances a determination of SAR is

[24] Although ANSI/IEEE does not explicitly state a rule for determining when SAR measurements are preferable to MPE measurements, we believe that the 20 cm distance is appropriate based on Sec. 4.3(3) of ANSI/IEEE C95.1-1992.

normally a more appropriate measure of exposure, for "mobile" devices, as defined above, compliance can be evaluated with respect to MPE limits, and the generic equations of this section, such as Equations (3) and (4), can be used for calculating exposure potential.

For portable devices SAR evaluation is routinely required by the FCC prior to equipment authorization or use for the following categories: (1) portable telephones or portable telephone devices to be used in the Cellular Radiotelephone Service authorized under Part 22, Subpart H of the FCC's rules or to be used in the Private Land Mobile Radio Services for SMR systems under Part 90 of our rules; (2) portable devices to be used in the Personal Communications Services (PCS) authorized under Part 24; (3) portable devices that operate in the General Wireless Communications Services or the Wireless Communications Service authorized under Parts 26 and 27; (4) portable devices to be used for earth-satellite communication authorized under Part 25 and Part 80; and (5) portable unlicensed PCS, portable unlicensed NII and portable millimeter-wave devices authorized under Part 15 of our rules (see Appendix A for specific rule parts).

Mobile devices, as defined above, are to be evaluated with respect to the MPE limits specified in Table 1 of Appendix A (and in 47 CFR § 1.1310). Evaluation prior to equipment authorization or use is routinely required for the following mobile transmitters if the operating frequency is 1.5 GHz or below and the effective radiated power (ERP) of the station, in its normal configuration, will be 1.5 watts or greater, ***or*** if the operating frequency is above 1.5 GHz and the ERP is 3 watts or more: (1) mobile telephones or portable telephone devices to be used in the Cellular Radiotelephone Service authorized under Part 22 Subpart H of the FCC's rules or to be used in the Private Land Mobile Radio Services for SMR systems under Part 90 of our rules; (2) mobile devices to be used in the Personal Communications Services (PCS) authorized under Part 24; (3) mobile devices that operate in the General Wireless Communications Services or the Wireless Communications Service authorized under Parts 26 and 27; (4) mobile devices to be used for earth-satellite communication authorized under Part 25 and Part 80; and (5) unlicensed PCS, unlicensed NII and millimeter-wave mobile devices authorized under Part 15 of our rules.

Although the FCC's exposure criteria apply to portable and mobile devices in general, at this time routine evaluation for compliance is not required for devices such as "push-to-talk" portable radios and "push to talk" mobile radios used in taxicabs, business, police and fire vehicles and used by amateur radio operators. These transmitting devices are excluded from routine evaluation because their duty factors (percentage of time during use when the device is transmitting) are generally low and, for mobile radios, because their antennas are normally mounted on the body of a vehicle which provide some shielding and separation from the user. This significantly reduces the likelihood of human exposure in excess of the RF safety guidelines due to emissions from these transmitters. Duty factors associated with transmitting devices that are not "push-to-talk," such as transportable cellular telephones ("bag" phones) or cellular telephones that use vehicle-mounted antennas, would be generally higher, and these devices are subject to routine evaluation. Although we are not requiring routine evaluation of all portable and mobile devices, under Sections 1.1307(c) and 1.1307(d) of the FCC's Rules, 47 CFR 1.1307(c) and (d), the Commission reserves the right to require

evaluation for environmental significance of any device (in this case with respect to SAR or compliance with MPE limits).

The following guidelines should be used to determine the application of the exposure criteria to portable and mobile devices in general. First of all, devices may generally be evaluated based on whether they are designed to be used under occupational/controlled or general population/uncontrolled conditions. Devices that are designed specifically to be used in the workplace, such as many hand-held, two-way portable radios, would be considered as operating in an occupational/controlled environment and the applicable limits for controlled environments would apply. On the other hand, devices designed to be purchased and used primarily by consumers, such as cellular telephones and most personal communications devices, would be considered to operate under the general population/uncontrolled category, and limits for uncontrolled environments would apply. Devices that can be used in either environment would normally be required to meet uncontrolled exposure criteria.

In situations where higher exposure levels may result from unusual or inappropriate use of a device, instructional material should be provided to the user to caution against such usage. With regard to mobile devices that are not hand-held, labels and instructional material may be useful as when a minimum separation distance is desired to be maintained. For example, in the case of a cellular "bag" phone a prominent warning label as well as instructional information on minimum required distances for compliance would be an acceptable means of ensuring that the device is used safely.

With respect to evaluating portable devices, various publications are available that describe appropriate measurement techniques and methods for determining SAR for compliance purposes.[25] The use of appropriate numerical and computational techniques, such as FDTD analysis, may be acceptable for demonstrating compliance with SAR values. Studies have indicated that such techniques can be used to determine energy absorption characteristics in exposed subjects (e.g., see Reference [24]). However, in order for numerical techniques to be valid the basic computational algorithm and modeling of the portable device should be validated, and appropriate models of the human body should be used which will provide reasonable accurate estimates of SAR. Accurate models of the adult human body exist at the present time, but developing models of devices may be more problematic. In general, numerical device and antenna models should represent the actual device under test and should be confirmed accordingly, e.g., with appropriate techniques, analytical data, published data or far-field radiation patterns.

For purposes of evaluating compliance with localized SAR guidelines, portable devices should be tested or evaluated based on normal operating positions or conditions. Because of the location of the antenna, the antenna may be closer to the body, e.g., the head, when the

[25] For example, see sections of ANSI/IEEE C95.3-1992 and NCRP Report No. 119, discussed below, that describe SAR evaluation techniques. Also, see References [5], [7], [12], [13], [14], [16], [17], [23] and [24]. Other organizations are developing information on SAR evaluation procedures, and SAR evaluation services and systems are commercially available.

device is held against the left side of the head or body versus when it is held against the right side. In such cases, there will be differences in coupling to the body resulting in higher SARs when the device is held on one side rather than the other. Since various users may hold these devices in either position, both positions should be tested to determine compliance.

Industry groups and other organizations are expected to develop product performance standards and other information to ensure compliance with SAR criteria in the future. This effort will be very helpful in facilitating the provision of compliance guidelines and services to manufacturers and others. In that regard, a sub-committee sponsored by the IEEE has been recently formed to develop specific and detailed recommendations for experimental and numerical evaluation of SAR from portable devices.[26] FCC staff participate as members of this sub-committee, and it is expected that the FCC will be able to use the recommendations made by this group to provide future guidance on SAR evaluation.[27] In the meantime, the FCC expects to periodically issue statements or guidance on compliance with SAR requirements pending the issuance of any recommended protocols or guidelines from the IEEE or other organizations. Inquiries with respect to FCC requirements for SAR evaluation should be directed to the FCC's laboratory in Columbia, Maryland, telephone: (301) 725-1585.

For portable devices operating at frequencies above 6 GHz special considerations are necessary. The localized SAR criteria used by the FCC, and specified in the ANSI/IEEE 1992 standard, only apply at operating frequencies between 100 kHz and 6 GHz.[28] For portable devices that operate above 6 GHz (e.g., millimeter-wave devices) localized SAR is not an appropriate means for evaluating exposure. At these higher frequencies, exposure from portable devices should be evaluated in terms of power density MPE limits instead of SAR. Power density values can be either calculated or measured, as appropriate.

If power density is to be measured at these higher frequencies to show compliance of portable devices, a question arises as to an appropriate minimum distance at which to make such a measurement. The ANSI/IEEE 1992 standard specifies 20 cm as a minimum separation distance for such measurements. The guidelines delineated in NCRP No. 86 indicated that measurements should be made at least 5 cm "from any object in the field."[29] The more recent NCRP Report 119 seems to endorse the 20 cm value, at least for the case of

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[26] IEEE Standards Coordinating Committee 34 (IEEE SCC34), sub-committee II. For further information contact the IEEE at 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.

[27] It should also be noted that in February 1997 the European Committee for Electrotechnical Standardization released a CENELEC document entitled, "Considerations for Human Exposure to EMFs from Mobile Telecommunications Equipment (MTE) in the Frequency Range 30 MHz - 6 GHz." This document contains information and guidance on techniques for evaluating SAR compliance for RF devices.

[28] ANSI/IEEE C95.1-1992, Section 4.2.

[29] See Reference [20], NCRP Report No. 86 at Section 17.5.

"secondary" sources.[30] In some cases, for example, near an open-ended waveguide or consumer device operating at a millimeter-wave frequency, a 20 cm separation requirement from the ***primary*** radiating source for measurements would not be practical for determining exposure potential. Therefore, in such cases a 5 cm separation requirement can be justified to allow for evaluation of potential exposure at distances closer than 20 cm. Some research relevant to this issue has been done in the VHF band that indicates there is no practical reason why a 5 cm minimum distance cannot be used for measuring power density.[31] Since a 5 cm separation distance is already built-in to many isotropic broadband RF probes, performing measurements at this distance is straightforward.

In view of these facts, it is appropriate to evaluate ***both*** mobile and portable devices that operate at frequencies above 6 GHz for compliance with FCC RF guidelines in terms of the FCC MPE limits for power density. In that regard, it is appropriate to make measurements of power density at a minimum distance of 5 cm from the radiator of a portable device to show compliance.

## Section 3: MEASURING RF FIELDS

### Reference Material

In some cases the prediction methods described in Section 2 of this bulletin cannot be used, and actual measurements of the RF field may be necessary to determine whether there is a potential for human exposure in excess of the MPE limits specified by the FCC. For example, in a situation such as an antenna farm, with multiple users the models discussed previously would not always be applicable. Measurements may also be desired for cases in which predictions are slightly greater or slightly less than the threshold for excessive exposure or when fields are likely to be seriously distorted by objects in the field, e.g., conductive structures.

Techniques and instrumentation are available for measuring the RF environment near broadcast and other transmitting sources. In addition, references are available which provide detailed information on measurement procedures, instrumentation, and potential problems. Two excellent references in this area have been published by the IEEE and by the NCRP. The ANSI/IEEE document (ANSI/IEEE C95.3-1992) is entitled, "Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave,"

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[30] Reference [21], NCRP Report 119 at Section 3.3.6.

[31] R.A. Tell, *"An Investigation of RF Induced Hot Spots and their Significance Relative to Determining Compliance with the ANSI Radiofrequency Protection Guide."* Report prepared for the National Association of Broadcasters, July 3, 1989.

(Reference [2]) and the NCRP publication (NCRP Report No. 119) is entitled, "A Practical Guide to the Determination of Human Exposure to Radiofrequency Fields" (Reference [21] ). Both of these documents contain practical guidelines and information for performing field measurements in broadcast and other environments, and the FCC strongly encourages their use. Other selected references are given in the reference section of this bulletin.

**Instrumentation**

Instruments used for measuring radiofrequency fields may be either broadband or narrowband devices. A typical broadband instrument responds essentially uniformly and instantaneously over a wide frequency range and requires no tuning. A narrowband instrument may also operate over a wide frequency range, but the instantaneous bandwidth may be limited to only a few kilohertz, and the device must be tuned to the frequency of interest. Each type of instrument has certain advantages and certain disadvantages, and the choice of which instrument to use depends on the situation where measurements are being made.

All instruments used for measuring RF fields have the following basic components: (1) an antenna to sample the field, (2) a detector to convert the time-varying output of the antenna to a steady-state or slowly varying signal, (3) electronic circuitry to process the signal, and (4) a readout device to display the measured field parameter in appropriate units.

The antennas most commonly used with broadband instruments are either dipoles that respond to the electric field (E) or loops that respond to the magnetic field (H). Surface area or displacement-current sensors that respond to the E-field are also used. In order to achieve a uniform response over the indicated frequency range, the size of the dipole or loop must be small compared to the wavelength of the highest frequency to be measured. Isotropic broadband probes contain three mutually orthogonal dipoles or loops whose outputs are ***summed*** so that the response is independent of orientation of the probe. The output of the dipoles or loops is converted to a proportional steady-state voltage or current by diodes or thermocouples, so that the measured parameter can be displayed on the readout device.

As described in the first edition of this bulletin, there are certain characteristics which are desirable in a broadband survey instrument. The major ones are as follows:

(1) The response of the instrument should be essentially isotropic, i.e., independent of orientation, or rotation angle, of the probe.

(2) The frequency range of the instrument and the instruments response over that range should be known. Generally this is given in terms of the error of response between certain frequency limits, e.g. , $\pm$ 0.5 dB from 3 to 500 MHz.

(3) Out-of-band response characteristics of the instrument should be specified by the manufacturer to assist the user in selecting an instrument for a particular application.

For example, regions of enhanced response, or resonance, at frequencies outside of the band of interest could result in error in a measurement, if signals at the resonant frequency(ies) are present during the measurement.

(4) The dynamic range of the instrument should be at least $\pm$ 10 dB of the applicable exposure guideline.

(5) The instrument's readout device should be calibrated in units that correspond to the quantity actually being measured. An electric field probe responds to E or $E^2$, and a magnetic field probe responds to H or $H^2$, equally well in both the near-field and far-field. However, a readout device calibrated in units of power density does not read true power density if measurements are made in the near-field. This is because under plane-wave conditions, in which E, H, and power density are related by a constant quantity (the wave impedance which, for free space, is equal to 377 ohms), do not exist in the near-field where the wave impedance is complex and generally not known. Readout devices calibrated in "power density" actually read "far-field equivalent" power density or "plane-wave equivalent" power density (see discussion of MPE limits in Section 1 of this bulletin).

(6) The probe and the attached cables should only respond to the parameter being measured, e.g. , a loop antenna element should respond to the magnetic field and should not interact significantly with the electric field.

(7) Shielding should be incorporated into the design of the instrument to reduce or eliminate electromagnetic interference.

(8) There should be some means, e.g., an alarm or test switch to establish that the probe is operating correctly and that none of the elements are burned out. Also, a means should be provided to alert the user if the measured signal is overloading the device.

(9) When the amplitude of the field is changing while measurements are being made, a "peak-hold" circuit may be useful. Such a change in amplitude could result either from variation in output from the source or from moving the probe through regions of the field that are non-uniform.

(10) For analog-type meters, the face of the meter should be coated with a transparent, conductive film to prevent false readings due to the accumulation of static charge in the meter itself. Also, the outer surface of the probe assembly of electric-field survey instruments should be covered with a high-resistance material to minimize errors due to static charge buildup.

(11) The instrument should be battery operated with easily replaceable or rechargeable batteries. A test switch or some other means should be provided to determine whether the batteries are properly charged. The instrument should be capable of operating

within the stated accuracy range for a time sufficient to accomplish the desired measurements without recharging or replacing the batteries.

(12) The user should be aware of the response time of the instrument, i.e., the time required for the instrument to reach a stable reading.

(13) The device should be stable enough so that frequent readjustment to zero ("rezeroing") is not necessary. If not equipped with automatic zeroing capability, devices must be zeroed with the probe out of the field, either by shielding them or turning off the RF source(s). Either method is time consuming, making stability an especially desirable feature.

(14) If the instrument is affected by temperature, humidity, pressure, etc., the extent of the effect should be known and taken into account.

(15) The sensor elements should be sufficiently small and the device should be free from spurious responses so that the instrument responds correctly to the parameter being measured, both in the near-field and in the far-field. It should be emphasized that an instrument with a readout expressed in terms of power density will only be correct in the far-field. However, the term "far-field equivalent" or "plane-wave equivalent" power density is sometimes used in this context and would be acceptable as long as its meaning is understood and it is appropriately applied to the situation of interest (see discussion in Section 1).

(16) The instrument should respond to the average (rms) values of modulated fields independent of modulation characteristics. With respect to measurements of pulsed sources such as radar transmitters, many commercially-available survey instruments cannot measure high peak-power pulsed fields accurately. In such cases, the instrument should be chosen carefully to enable fields close to the antenna to be accurately measured.

(17) The instrument should be durable and able to withstand shock and vibration associated with handling in the field or during shipping. A storage case should be provided.

(18) The accuracy of the instrument should not be affected by exposure to light or other forms of ambient RF and low-frequency electromagnetic fields.

(19) The markings on the meter face should be sufficiently large to be easily read at arm's length.

(20) Controls should be clearly labeled and kept to a minimum, and operating procedures should be relatively simple.

(21) Typical meters use high-resistance leads that can be particularly susceptible to flexure noise when measuring fields at relatively low intensities. Therefore, when a broadband isotropic meter is used for measuring power density levels that fall into the lower range of detectability of the instrument (e.g., a few $\mu W/cm^2$), the meter should exhibit low noise levels if such measurements are to have any meaning.

(22) When measuring fields in multiple-emitter environments, the ability of many commonly available RF broadband survey meters to accurately measure multiple signals of varying frequencies may be limited by how the meter sums the outputs of its diode detectors. This can lead to over-estimates of the total RF field that may be significant. Although such estimates can represent a "worst case," and are allowable for compliance purposes, users of these meters should be aware of this possible source of error.

A useful characteristic of broadband probes used in multiple-frequency RF environments is a frequency-dependent response that corresponds to the variation in MPE limits with frequency. Broadband probes having such a "shaped" response permit direct assessment of compliance at sites where RF fields result from antennas transmitting over a wide range of frequencies. Such probes can express the composite RF field as a percentage of the applicable MPEs.

Another practical characteristic of some RF field instruments is their ability to automatically determine spatial averages of RF fields. Because the MPEs for exposure are given in terms of spatial averages, it is helpful to simplify the measurement of spatially variable fields via data averaging as the survey is being performed. Spatial averaging can be achieved via the use of "data loggers" attached to survey meters or circuitry built into the meter.

Narrowband devices may also be used to characterize RF fields for exposure assessment. In contrast to broadband devices, narrowband instruments may have bandwidths of only a few hundred kilohertz or less. Narrowband instruments, such as field-strength meters and spectrum analyzers, must be tuned from frequency to frequency, and the field level at each frequency measured. Spectrum analyzers can be scanned over a band of frequencies, and the frequency and peak-amplitude information can be stored and printed for later analysis. The results of all narrowband measurements may then be combined to determine the total field.

As with broadband instruments, narrowband devices consist of basically four components: an antenna, cables to carry the signal from the antenna, electronic circuitry to process the output from the antenna and convert it to a steady-state signal proportional to the parameter being measured, and a readout device. Narrowband instruments may use various antennas, such as rods (monopoles), loops, dipoles, biconical, conical log spiral antennas or aperture antennas such as pyramidal horns or parabolic reflectors. A knowledge of the gain, the antenna factor, or the effective area for a particular antenna provides a means for determining the appropriate field parameter from a measurement of voltage or power. Cable

loss also should be taken into account. Tunable field strength meters and spectrum analyzers are appropriate narrowband instruments to use for measuring antenna terminal voltage or power at selected frequencies. Each has certain advantages and disadvantages.

**Field Measurements**

Before beginning a measurement survey it is important to characterize the exposure situation as much as possible. An attempt should be made to determine:

(1) The frequency and maximum power of the RF source(s) in question, as well as any nearby sources.

(2) Duty factor, if applicable, of the source(s).

(3) Areas that are accessible to either workers or the general public.

(4) The location of any nearby reflecting surfaces or conductive objects that could produce regions of field intensification ("hot spots").

(5) For pulsed sources, such as radar, the pulse width and repetition rate and the antenna scanning rate.

(6) If appropriate, antenna gain and vertical and horizontal radiation patterns.

(7) Type of modulation of the source(s).

(8) Polarization of the antenna(s).

(9) Whether measurements are to be made in the near-field, in close proximity to a leakage source, or under plane-wave conditions. The type of measurement needed can influence the type of survey probe, calibration conditions and techniques used.

If possible, one should estimate the maximum expected field levels, in order to facilitate the selection of an appropriate survey instrument. For safety purposes, the electric field (or the far-field equivalent power density derived from the E-field) should be measured first because the body absorbs more energy from the electric field, and it is potentially more hazardous. In many cases it may be best to begin by using a broadband instrument capable of accurately measuring the total field from all sources in all directions. If the total field does not exceed the relevant exposure guideline in accessible areas, and if the measurement technique employed is sufficiently accurate, such a determination would constitute a showing of compliance with that particular guideline, and further measurements would be unnecessary.

When using a broadband survey instrument, spatially-averaged exposure levels may be determined by slowly moving the probe while scanning over an area approximately equivalent to the vertical cross-section (projected area) of the human body. An average can be estimated by observing the meter reading during this scanning process or be read directly on those meters that provide spatial averaging. Spatially averaging exposure is discussed in more detail in the ANSI/IEEE and NCRP documents referenced above. A maximum field reading may also be desirable, and, if the instrument has a "peak hold" feature, can be obtained by observing the peak reading according to the instrument instructions. Otherwise, the maximum reading can be determined by simply recording the peak during the scanning process.

The term "hot spots" has been used to describe locations where peak readings occur. Often such readings are found near conductive objects, and the question arises as to whether it is valid to consider such measurements for compliance purposes. According to the ANSI C95.3 guidelines (Reference [2]) measurements of field strength to determine compliance are to be made, "at distances 20 cm or greater from any object." Therefore, as long as the 20 cm criterion is satisfied, such peak readings should be considered as indicative of the field ***at that point.*** However, as far as ***average*** exposure is concerned such localized readings may not be relevant if accessibility to the location is restricted or time spent at the location is limited (see Section 4 of this bulletin on controlling exposure). It should be noted that most broadband survey instruments already have a 5 cm separation built into the probe.

In many situations there may be several RF sources. For example, a broadcast antenna farm or multiple-use tower could have several types of RF sources including AM, FM, and TV, as well as CMRS and microwave antennas. Also, at rooftop sites many different types of CMRS antennas are commonly present. In such situations it is generally useful to use both broadband and narrowband instrumentation to fully characterize the electromagnetic environment. Broadband instrumentation could be used to determine what the overall field levels appeared to be, while narrowband instrumentation would be required to determine the relative contributions of each signal to the total field if the broadband measurements exceed the most restrictive portion of the applicable MPEs. The "shaped" probes mentioned earlier will also provide quantification of the total field in terms of percentage of the MPE limits.

In cases where personnel may have close access to intermittently active antennas, for example at rooftop locations, measurement surveys should attempt to minimize the uncertainty associated with the duty cycle of the various communications transmitters at the site to arrive at a conservative estimate of maximum possible exposure levels.

At broadcast sites it is important to determine whether stations have auxiliary, or stand-by, antennas at a site in addition to their main antennas. In such cases, either the main antenna or the auxiliary antenna, which may be mounted lower to the ground, may result in the highest RF field levels in accessible areas, and contributions from both must be properly evaluated.

At frequencies above about 300 MHz it is usually sufficient to measure only the electric field (E) or the mean-squared electric field. For frequencies equal to or less than 30

MHz, for example frequencies in the AM broadcast band, measurements for determining compliance with MPE limits require independent measurement of ***both*** E field and the magnetic field (H). For frequencies between 30 and 300 MHz it may be possible through analysis to show that measurement of only one of the two fields, not both, is sufficient for determining compliance. Further discussion of this topic can be found in Sections 4.3(2) and 6.6 of Reference [1]. At sites with higher frequency sources, such as UHF-TV stations, only E-field measurements should be attempted since the loop antennas used in H-field probes are subject to out-of-band resonances at these frequencies.

In many situations a relatively large sampling of data will be necessary to spatially resolve areas of field intensification that may be caused by reflection and multipath interference. Areas that are normally occupied by personnel or are accessible to the public should be examined in detail to determine exposure potential.

If narrowband instrumentation and a linear antenna are used, field intensities at three mutually orthogonal orientations of the antenna must be obtained at each measurement point. The values of $E^2$ or $H^2$ will then be equal to the sum of the squares of the corresponding, orthogonal field components.

If an aperture antenna is used, unless the test antenna responds uniformly to all polarizations in a plane, e.g., a conical log-spiral antenna, it should be rotated in both azimuth and elevation until a maximum is obtained. The antenna should then be rotated about its longitudinal axis and the measurement repeated so that both horizontally and vertically polarized field components are measured. It should be noted that when using aperture antennas in reflective or near-field environments, significant negative errors may be obtained.

When making measurements, procedures should be followed which minimize possible sources of error. For example, when the polarization of a field is known, all cables associated with the survey instrument should be held perpendicular to the electric field in order to minimize pickup. Ideally, non-conductive cable, e.g., optical fiber, should be used, since substantial error can be introduced by cable pick-up.

Interaction of the entire instrument (probe plus readout device) with the field can be a significant problem below approximately 10 MHz, and it may be desirable to use a self-contained meter or a fiber-optically coupled probe for measuring electric field at these frequencies. Also, at frequencies below about 1 MHz, the body of the person making the measurement may become part of the antenna, and error from probe/cable pickup and instrument/body interaction may be reduced by supporting the probe and electronics on a dielectric structure made of wood, styrofoam, etc. In all cases, it is desirable to remove all unnecessary personnel from an area where a survey is being conducted in order to minimize errors due to reflection and field perturbation.

In areas with relatively high fields, it is a good idea to occasionally hold the probe fixed and rotate the readout device and move the connecting cable while observing the meter reading. Alternatively, cover the entire sensor of the probe with metal foil and observe the

meter reading. Any significant change usually indicates pickup in the leads and interference problems. When a field strength meter or spectrum analyzer is used in the above environments, the antenna cable should occasionally be removed and replaced with an impedance matched termination. Any reading on the device indicates pickup or interference.

As noted previously, substantial errors may be introduced due to zero drift. If a device is being used which requires zeroing, it should frequently be checked for drift. This should be done with the probe shielded with metal foil, with the probe removed from the field or, ideally, with the source(s) shut off.

With regard to compliance with the FCC's guidelines in mixed or broadband fields where several sources and frequencies are involved, the fraction or percentage of the recommended limit for power density (or square of the field strength) incurred within each frequency interval should be determined, and the sum of all contributions should not exceed 1.0 or 100% (see discussion of this topic in Section 1 of this bulletin). As mentioned before, probes with "shaped" responses may be useful in these environments.

## Section 4: CONTROLLING EXPOSURE TO RF FIELDS

### Public Exposure: Compliance with General Population/Uncontrolled MPE Limits

Studies have indicated that the majority of the United States population is normally exposed to insignificant levels of RF radiation in the ambient environment (e.g. see References [22] and [30]). However, there are some situations in which RF levels may be considerably higher than the median background, and in those cases preventive measures may have to be taken to control exposure levels.

As discussed in Section 1 of this bulletin (also see Appendix A), the FCC's guidelines for exposure incorporate two tiers of limits, one for conditions under which the public may be exposed ("general population/uncontrolled" exposure) and the other for exposure situations usually involving workers ("occupational/controlled" exposure). Exposure problems involving members of the general public are generally less common than those involving persons who may be exposed at their place of employment, due to the fact that workers may be more likely to be in close proximity to an RF source as part of their job. However, if potential exposure of the general public is a problem there are several options available for ensuring compliance with the FCC RF guidelines.

In general, in order for a transmitting facility or operation to be out of compliance with the FCC's RF guidelines an area or areas where levels exceed the MPE limits must, first of all, be in some way ***accessible*** to the public or to workers. This should be obvious, but there is often confusion over an ***emission*** limit, e.g., a limit on field strength or power density

at a specified distance from a radiator that always applies, and an ***exposure*** limit, that applies anywhere people may be located. The FCC guidelines specify exposure limits not emission limits, and that distinction must be emphasized. This is why the accessibility issue is key to determining compliance. The MPE limits indicate levels above which people may not be safely exposed regardless of the location where those levels occur. When accessibility to an area where excessive levels is appropriately restricted, the facility or operation can certify that it complies with the FCC requirements.

Restricting access is usually the simplest means of controlling exposure to areas where high RF levels may be present. Methods of doing this include fencing and posting such areas or locking out unauthorized persons in areas, such as rooftop locations, where this is practical.[32] There may be situations where RF levels may exceed the MPE limits for the general public in remote areas, such as mountain tops, that could conceivably be accessible but are not likely to be visited by the public. In such cases, common sense should dictate how compliance is to be achieved. If the area of concern is properly marked by appropriate warning signs, fencing or the erection of other permanent barriers may not be necessary.[33]

In some cases, the time-averaging aspects of the exposure limits may be used by placing appropriate restrictions on occupancy in high-field areas. However, such restrictions are often not possible where continuous exposure of the public may occur. In general, time averaging of exposures is usually more practical in controlled situations where occupational exposure is the only issue.

Although restricting access may be the simplest and most cost-effective solution for reducing public exposure, other methods are also available. Such methods may be relevant for reducing exposure for both the general public and for workers. For example, modifications to antennas, elevating antennas on roof-top installations or incorporation of appropriate shielding can reduce RF fields in locations accessible to the public or to workers.

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[32] Standard radiofrequency hazard warning signs are commercially available from several vendors. They incorporate the format recommended by the American National Standards Institute (ANSI) as specified in ANSI C95.2-1982 (Reference [3]). Although the ANSI format is recommended, it is not mandatory. Complaints have been received concerning the lack of color durability in outdoor environments of the yellow triangle specified by ANSI. In that regard, long-lasting and clearly visible symbols are more important than the exact color used, and the use of the ANSI format with more durable colors may be more practical in certain environments. When signs are used, meaningful information should be placed on the sign advising of the potential for high RF fields. In some cases, it may be appropriate to also provide instructions to direct individuals as to how to work safely in the RF environment of concern. U.S. vendors of RF warning and hazard signs include: National Association of Broadcasters (800-368-5644), EMED Co., Inc. (800-442-3633) and Richard Tell Associates (702-645-3338).

[33] Regarding this issue, the Commission's Mass Media Bureau released a Public Notice, on January 28, 1986, entitled, "Further Guidance for Broadcasters Regarding Radiofrequency Radiation and the Environment," (No. 2278). This Notice lists several typical exposure situations around broadcast sites and explains what is expected of broadcast licensees and applicants with respect to ensuring compliance with the FCC's RF guidelines. This Notice may be useful as guidance for other antenna sites. A summary of the major points of the 1986 Public Notice are included as Appendix B of this bulletin. Also, another Public Notice, dealing primarily with occupational exposure, was issued by the Mass Media Bureau on August 19. 1992 (No. 24479).

With regard to antennas used for FM broadcast stations, the EPA found that there are several corrective measures that may be taken to reduce ground-level field strength and power density (Reference [11]). Some of these findings may also be relevant to other similar types of antenna systems. EPA's examination of measured elevation patterns for several different types of FM antennas has shown that some antennas direct much less radiation downward than others. Therefore, in some cases a change of antenna may be an appropriate way to reduce ground-level fields below a given level.

A more expensive, but also effective, approach for FM antennas involves modifying the array pattern by reducing the spacing between the radiating elements. The pattern of an FM antenna is the product of the element pattern and the array pattern. FM antennas typically use one-wavelength spacing between elements. Because the wave from each element adds in phase with all the other elements, at points directly beneath the elements the array pattern results in downward radiation that can be significant and, in the case of dipole elements, could equal that in the main beam. If the spacing is reduced to one-half wavelength spacing (for an antenna with an even number of bays), each wave will have a counterpart which is out-of-phase. This will result in a significant reduction in the energy radiated toward the ground.

The disadvantage of this method is that the shorter aperture that will occur with one-half wavelength spacing reduces the overall gain of the antenna. To maintain the original gain of the antenna, the number of elements (bays) has to be increased and, usually, doubled. Alternatively, the spacing between elements could be reduced so that waves from element (n) and from element (N/2 + n) are exactly out of phase, where n is a particular element in an array with a total of N bays.

Use of the latter method would result in a smaller increase in the total number of bays that would be necessary. However, EPA has noted that feeding such an array would be more difficult since the length of the transmission line between bays determines phasing. For one-half wave spacing, EPA suggests that criss-crossing the transmission line or turning alternate elements upside down will yield proper phasing.

The EPA's report (Reference [11]) contains a table showing suggested interbay spacings required to reduce downward radiation in the array pattern of FM antennas. Unfortunately, the optimum spacing may differ for different types of antennas. Coupling effects may occur at spacings of less than one wavelength that are not easy to predict theoretically. EPA has studied this problem, and Reference [11] also contains figures showing the effects of altering spacing for three types of FM antenna elements.

Another possible method for reducing downward radiation that has been suggested involves using 1.5-wavelength spacing between elements. This method reportedly results in little significant change in antenna gain.

Other actions that could be taken to reduce the potential for excessive exposure would be raising the height of an FM or TV antenna or relocating a broadcast tower. However, such

actions would have to take into account other factors including signal coverage, land use limitations, and air traffic safety.

In the case of television broadcast antennas, the EPA identified two methods for reducing potential exposure, besides the obvious method of restricting access discussed above. The first measure that might be taken, as with FM antennas, would be a change of antenna. EPA verified, for example, that arrays for VHF-TV antennas can be designed to minimize downward radiation to as little as 7% of the main beam field. However, such antennas apparently are at least twice as expensive as standard antennas. Antennas used for UHF-TV have very high gain in the main beam and radiate relatively little directly down toward the ground. Therefore, these antennas already are designed for minimum downward radiation. The remaining option for both VHF-TV and UHF-TV antennas would be an increase in antenna height above ground. However, this could involve the same difficulties as discussed above with regard to FM broadcast facilities.

With respect to AM radio broadcast stations, monopole antennas are used for transmissions. The MPE limits in the AM broadcast band (see Appendix A) are given in terms of electric and magnetic field strength, since significant exposures always occur in the near-field of these antenna systems. Electric and magnetic field strengths near monopole antennas decrease rapidly with increasing distance, and normally the MPE limits can only be exceeded very close-in to these antennas. Therefore, exposure problems due to AM radio antennas are usually those involving workers or others who have access to the immediate vicinity of these antennas (see discussion below).

**Occupational Exposure: Compliance with Occupational/Controlled MPE Limits**

Exposure to RF fields in the workplace or in other controlled environments usually presents different problems than does exposure of the general public. For example, with respect to a given RF transmitting facility, a worker at that facility would be more likely to be close to the radiating source than would a person who happens to live nearby. Although restricting access to high RF field areas is also a way to control exposures in such situations, this may not always be possible. In some cases a person's job may require him or her to be near an RF source for some part of the workday. Depending on the level and time of exposure this may present a problem with respect to compliance with the MPE limits.

In general, a locked rooftop or other appropriately restricted area that is only accessible to workers who are "aware of" and "exercise control over" their exposure would meet the criteria for occupational/controlled exposure, and protection would be required at the applicable occupational/controlled MPE limits for those individuals who have access to the rooftop. Persons who are only "transient" visitors to the rooftop, such as air conditioning technicians, etc., could also be considered to fall within the occupational/controlled criteria as long as they also are "made aware" of their exposure and exercise control over their exposure (see Appendix A for definitions of exposure tiers and MPE limits).

As explained in Section 1 of this bulletin, the MPE limits adopted by the FCC are ***time-averaged*** exposure limits. This means that the exposure duration should be taken into account when evaluating a given exposure situation, and this is especially relevant for cases of occupational/controlled exposure. For example, a person walking into an area where RF fields exceed the ***absolute*** MPE limit (in terms of field strength or power density) might not exceed the ***time-averaged*** MPE limit as long as the exposure was for an appropriately short period of time (relative to the time-averaging interval). However, if that person were to remain in the area for an extended period it is more probable that the time-averaged limit would be exceeded. Therefore, in order to comply with the FCC's guidelines, in some situations it may be necessary to limit exposure in certain areas to specific periods of time. For example, in workplace situations where extended maintenance tasks must be performed in areas where RF fields exceed MPE limits, the work may have to be divided up and carried out during several intervals of time so that the time-averaged exposure during each interval is acceptable. The actual exposure time allowed during any given interval would have to be determined by use of the appropriate averaging time specified in the guidelines (six-minutes for occupational exposure) as explained in Section 1.

In addition to time-averaging, other means are available for controlling exposures in occupational or controlled environments. These include reducing or shutting off power when work is required in a high RF area, switching to an auxiliary transmitter (if available) while work on a main system is in progress or incorporating appropriate shielding techniques to reduce exposure.

In multiple-transmitter environments, reducing power or RF shielding may be especially important for allowing necessary work procedures to be carried out. For example, on-tower exposures due to nearby co-located transmitting sources may be more significant when work on another station's tower is required. In such complex environments power reduction agreements may often be necessary to ensure that all licensees are aware of the potential for their station to expose other individuals at the site and site occupants are generally jointly responsible for compliance with FCC guidelines (see discussion of multiple-transmitter sites in Section 2 of this bulletin).

Although reduction of power at broadcasting and other telecommunications sites is one approach to reducing personnel exposure, this may not always be possible. For example, measurements have shown that relatively high RF fields may exist in the immediate vicinity of high-powered antennas such as those used at FM broadcast stations (Reference [25]). If power reduction or other measures are not practical, alternative means for protecting personnel from excessive exposure may be necessary when access to these areas is required. In such instances, the use of radiofrequency protective clothing may facilitate compliance with RF exposure guidelines even in the presence of intense RF fields.

Radiofrequency protective clothing has become commercially available in recent years that appears to effectively attenuate fields over a broad frequency band. This clothing has been manufactured into RF protective suits that cover the entire body of the user and allow him or her to perform maintenance and other procedures in the presence of RF fields that may

exceed MPE limits. A recent study performed for the FCC by Richard Tell Associates, Inc., concluded that if properly used by appropriately trained personnel, and with adequate coupling to ground potential, RF protective suits can provide significant reduction in whole-body RF absorption (Reference [29]).

Recently, direct measurements of reduction in SAR afforded by one RF protective suit were completed using a full-size human phantom filled with a dielectric fluid having the RF absorption characteristics of biological tissue.[34] The SAR was determined by scanning the interior of the body of the phantom with a robotically controlled miniature, isotropic electric-field probe with and without the suit covering the phantom. Near-field exposure conditions were duplicated at frequencies of 150 MHz, 450 MHz and 835 MHz. The measurement results supported the contention that the protective suit provides a nominal minimum reduction in SAR of 10 times or more. These measurements also were consistent with measurement data obtained by the Deutsche Telekom Technologiezentrum (German Telekom).[35]

Another observation from the tests performed by Tell is that the peak SAR in the unprotected head of the phantom clothed with the protective suit did not reach the SAR limit of 8 W/kg (localized partial-body exposure limit for occupational/controlled environments) until the 150-MHz near-field exposure was 23 times the most restrictive whole-body averaged MPE limit of 1.0 $mW/cm^2$. At 450 MHz, the maximum field incident on the unprotected head was found to be more than 11 times the applicable MPE limit of 1.5 $mW/cm^2$, and, at 835 MHz, more than 3 times the MPE limit of 2.8 $mW/cm^2$. Such data suggest that, at least in some environments, complete coverage of the body may not be necessary for compliance with MPE limits.

In general, the use of RF protective clothing may be considered an acceptable mitigation technique for occupational exposures as long as sufficient precautions are taken to comply with all of the clothing manufacturer's recommendations and caveats and to ensure that use of the clothing is confined to RF environments for which it is designed in terms of RF field intensity and frequency range. As with any personal protective equipment, RF protective clothing should be considered as a method of choice only when other engineering or administrative controls cannot be used to reduce exposure or are otherwise impractical. Those employing or supervising the wearer should ensure that the wearer has full knowledge of the proper use and limitations of the protective clothing being used. Also, users should be knowledgeable of the approximate RF environment before spending a prolonged period of time in areas where RF fields are believed to significantly exceed MPE limits. Users of RF protective clothing are cautioned that, in addition to evaluating RF field intensity and frequency considerations, they should routinely visually inspect the clothing material for

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[34] Tell, Richard A. (1996). *SAR Evaluation of the Naptex™ Suit for Use in the VHF and UHF Telecommunications Bands.* Presented at the International RF Safety Workshop, Schwangau, Germany, September 25-26.

[35] Heinrich, W. (1996). *Test Method for Determining the Attentuation of RF-protective Clothing.* Presented at the International RF Safety Workshop, Schwangau, Germany, September 24-26.

indications of substantial wear, such as tears and rips, that may reduce the clothing's effectiveness in reducing exposure. When users are climbing towers, special caution is advised regarding possible safety hazards from RF shocks and burns, trip hazards, decreased mobility/agility and reduced visibility (if a protective hood is worn) that may occur while climbing.

In addition to the issue of protective clothing, Tell's 1995 study for the FCC investigated the use of RF personal monitors that have become commercially available in recent years. These monitors are warning devices that are worn by the user and alert him or her by an audible or visible signal to the presence of RF fields that approach the MPE limits for occupational/controlled exposure. The Tell study concluded that such devices can act as reliable RF detectors and the device tested generally responded in accordance with the manufacturer's specifications. Such devices could be especially useful in areas where multiple transmitters are located and it may not be easy or possible to predict the presence of high RF fields. Work procedures could be instituted requiring the wearer of such a device to leave an area or take other precautions when the device alerts that an RF field approaching the MPE limit is present. These monitors can be a valuable component of an RF safety program. However, they should be viewed only as warning devices and should not be viewed as protective devices.

For workers who must occupy areas near AM broadcast antennas, MPE limits are normally only exceeded very close to an antenna. Even for a 50 kW transmitter, distances from an antenna of less than fifteen meters are required before field strengths are likely to approach the FCC limits (References [26] and [33]). For multiple-tower arrays the spacing between adjacent antennas would not be less than 35 meters, so that, as one antenna is approached, the contribution of field strength from other antennas in the array would decrease to relatively insignificant levels. However, if work on or immediately adjacent to a tower is required it may be necessary to designate zones within which a worker may remain for specified periods of time appropriate for compliance with the FCC limits.

Tuning circuits for AM broadcast antennas have been identified as a source of locally intense magnetic fields (Reference [31]). These magnetic fields decrease rapidly with distance from the tuning circuits but should be carefully considered when evaluating exposure very near the base of AM towers or at other locations where such coils may be located. It should be possible to locate the tuning circuits in such a way as to greatly reduce the potential for exposures exceeding the FCC magnetic field limits. For example, separating the circuits from normally accessible areas by a few meters should provide sufficient protection. Time-averaging exposure near such coils is another method for complying with the MPE limits.

Probably the most common means by which workers at AM radio stations may be exposed in excess of the FCC exposure guidelines occurs when persons must climb actively transmitting AM antennas to perform maintenance tasks. Measurement surveys and studies conducted by the FCC and the EPA have clearly indicated that significant RF currents exist in the body of a person climbing such a tower (References [6], [27], [28] and [32]). As addressed by the 1992 ANSI/IEEE standard, such currents can cause significant levels of RF

absorption in the body that can be well in excess of allowable SAR thresholds (see discussion in Section 1 of this bulletin).

Although the FCC RF exposure guidelines did not specifically adopt limits on RF body currents, evaluation of such currents is the only practical means to control exposure of persons climbing transmitting AM radio towers. The FCC and EPA studies referenced above include data and models that allow a correlation to be made between the power fed into an AM antenna and the potential current that will be induced in the body of a person climbing the antenna. This current can be correlated with the appropriate limit on whole-body absorption specified by the FCC's guidelines and thereby can be used as a guideline for the appropriate power reduction that an AM station must undertake when a person is on a tower. Further information and guidance on controlling such exposures can be found in Supplement A to this bulletin that is designed for radio and television broadcast applications.

With regard to maintenance of FM and TV broadcast transmitters and antennas, two situations are of particular interest and should be noted. Because currents and voltages in power amplifier cabinets can be lethal, it is common practice that cabinet doors be closed when the transmitter is on. However, it may not be recognized that at multiple station locations high RF field strengths can be encountered even when the transmitter being worked on is completely shut down. This is because the antenna for a particular station is likely to pick up high levels of energy from other stations. That energy can be conducted to the final amplifier cubicle and produce high field strengths and high voltages in the vicinity of the cubicle. Therefore, if measurements are made in a multistation environment this factor should be evaluated. If such induced field strength levels are found to be a problem, it should be possible to reduce them to acceptable levels by either opening the RF transmission line leading to the antenna or by bypassing the center conductor to ground of the coaxial line wherever access can be conveniently achieved.

With regard to protecting personnel at paging and cellular antenna sites, Motorola, in association with Richard Tell Associates, Inc., has developed a video for electromagnetic energy awareness that is focused on wireless telecommunications service providers. Although this video was originally produced for Motorola's use and is copyrighted, Motorola has decided to make this video commercially available to other interested industrial users.[36] Also, as mentioned earlier, software has been developed by various organizations for use in estimating RF levels and ensuring compliance at transmitter sites, particularly rooftop sites used for personal wireless, cellular and paging services.[37]

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[36] The title of the video is: "EME Awareness for Antenna Site Safety," ©Motorola, 1996. Copies are available in the U.S.A. from Stephen Tell Productions (702-396-5912), or from Narda Microwave Corporation, (516) 231-1700 (Narda Part No. 42929000).

[37] *See* footnote 23.

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# *APPENDIX A*
## SUMMARY OF RF EXPOSURE GUIDELINES

This appendix summarizes the policies, guidelines and requirements that were adopted by the FCC on August 1, 1996, amending Part 1 of Title 47 of the Code of Federal Regulations, and further amended by action of the Commission on August 25, 1997 (see 47 CFR Sections 1.1307(b), 1.1310, 2.1091 and 2.1093, as amended). Commission actions granting construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities, require the preparation of an Environmental Assessment (EA), as described in 47 CFR Section 1.1311, if the particular facility, operation or transmitter would cause human exposure to levels of radiofrequency (RF) electromagnetic fields in excess of these limits. For exact language, see the relevant FCC rule sections.

FCC implementation of the new guidelines for mobile and portable devices became effective August 7, 1996. For other applicants and licensees a transition period was established before the new guidelines would apply. With the exception of the Amateur Radio Service, the date established for the end of the transition period is October 15, 1997. Therefore, the new guidelines will apply to applications filed on or after this date. For the Amateur Service only, the new guidelines will apply to applications filed on or after January 1, 1998.

**Summary of Station and Transmitter Requirements**

Applications to the Commission for construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities must contain a statement or certification confirming compliance with the limits unless the facility, operation, or transmitter is categorically excluded from routine evaluation, as discussed below. Technical information showing the basis for this statement must be submitted to the Commission upon request.

The FCC-adopted limits for Maximum Permissible Exposure (MPE) are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Sections 17.4.1, 17.4.1.1, 17.4.2 and 17.4.3. Copyright NCRP, 1986, Bethesda, Maryland 20814. In the frequency range from 100 MHz to 1500 MHz, exposure limits for field strength and power density are also generally based on the MPE limits found in Section 4.1 of , "IEEE Standard for Safety

Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1-1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017, and approved for use as an American National Standard by the American National Standards Institute (ANSI).

The FCC's MPE limits for field strength and power density are given in Table 1 (and in 47 CFR § 1.1310) Figure 1 is a graphical representation of the limits for plane-wave (far-field) equivalent power density versus frequency. The FCC's limits are generally applicable to ***all*** facilities, operations and transmitters regulated by the Commission, and compliance is expected with the appropriate guidelines. However, ***routine*** determination of compliance with these exposure limits (routine environmental evaluation), and preparation of an EA if the limits are exceeded, is required only for facilities, operations and transmitters that fall into the categories listed in Table 2, or those specified below under the headings "mobile," "unlicensed" or "portable" devices. All other facilities, operations and transmitters are categorically excluded from routine evaluation or preparing an EA for RF emissions, except that the Commission may, on its own merits or as the result of a petition, complaint or inquiry, require RF environmental evaluation of transmitters or facilities even though they are otherwise excluded [see 47 CFR Sections 1.1307(c) and (d)].

For purposes of Table 2, the term "building-mounted antennas" means antennas mounted in or on a building structure that is occupied as a workplace or residence. The term "power" in column 2 of Table 2 refers to total operating power of the transmitting operation in question in terms of effective radiated power (ERP), equivalent isotropically radiated power (EIRP), or peak envelope power (PEP), as defined in 47 CFR. § 2.1. For the case of the Cellular Radiotelephone Service, 47 CFR § 22, Subpart H, the Personal Communications Service, 47 CFR § 24, and Specialized Mobile Radio Service, 47 CFR § 90, the phrase "total power of all channels" in column 2 of Table 2 means the sum of the ERP or EIRP of all co-located simultaneously operating transmitters owned and operated by a single licensee.

When applying the criteria of Table 2, radiation in all directions should be considered. For the case of transmitting facilities using sectorized transmitting antennas, applicants and licensees should apply the criteria to all transmitting channels in a given sector, noting that for a highly directional antenna there is relatively little contribution to ERP or EIRP summation for other directions.

For purposes of calculating EIRP of an MDS station, the power level refers to the cumulative EIRP of all channels. Further, this power limit assumes conventional NTSC transmissions with 10% aural power, and refers to peak visual power. MDS stations employing other than NTSC transmissions, e.g., digital transmissions, must apply the appropriate NTSC peak visual to average power conversion factor for their modulation scheme in order to determine whether the EIRP power criteria is exceeded.

In general, as specified in 47 C.F.R. 1.1307(b), as amended, when the FCC's guidelines are exceeded ***in an accessible area*** due to the emissions from multiple fixed transmitters the following policy applies. Actions necessary to bring the area into compliance

with the guidelines are the shared responsibility of ***all*** licensees whose transmitter's contribution to the RF environment ***at the non-complying area*** exceeds 5% of the exposure limit (that applies to their particular transmitter) in terms of power density or the square of the electric or magnetic field strength. This applies regardless of whether such transmitters would, by themselves, normally be excluded from performing a routine environmental evaluation. Owners of transmitter sites are expected to allow applicants and licensees to take reasonable steps to comply with the FCC's requirements and, where feasible, should encourage co-location of transmitters and common solutions for controlling access to areas where the RF exposure limits might be exceeded.

The following policy applies in the case of an application for a proposed transmitter, facility or modification (not otherwise excluded from performing a routine RF evaluation) that would ***cause non-compliance*** at an accessible area previously in compliance. In such a case, it is the responsibility of the applicant to submit an EA if emissions from the applicant's transmitter or facility would cause non-compliance at the area in question. However, this applies only if the applicant's transmitter causes exposure levels at the area in question that exceed 5% of the exposure limits applicable to that particular transmitter in terms of power density or the square of the electric or magnetic field strength.

For a renewal applicant whose transmitter or facility (not otherwise excluded from routine evaluation) contributes to the RF environment at an accessible area ***not in compliance*** with the guidelines the following policy applies. The renewal applicant must submit an EA if emissions from the applicant's transmitter or facility, at the area in question, result in exposure levels that exceed 5% of the exposure limits applicable to that particular transmitter in terms of power density or the square of the electric or magnetic field strength. In other words, although the renewal applicant may only be responsible for a fraction of the total exposure (greater than 5%), the applicant (along with any other licensee undergoing renewal at the same time) will trigger the EA process, unless suitable corrective measures are taken to prevent non-compliance before an EA is necessary. In addition, in a renewal situation if a determination of non-compliance is made, other co-located transmitters contributing more than the 5% threshold level must share responsibility for compliance, regardless of whether they are categorically excluded from routine evaluation or submission of an EA.

**Table 1. LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

**(A) Limits for Occupational/Controlled Exposure**

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) ($mW/cm^2$) | Averaging Time $|E|^2$, $|H|^2$ or S (minutes) |
|---|---|---|---|---|
| 0.3-3.0 | 614 | 1.63 | (100)* | 6 |
| 3.0-30 | 1842/f | 4.89/f | ($900/f^2$)* | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1500 | -- | -- | f/300 | 6 |
| 1500-100,000 | -- | -- | 5 | 6 |

**(B) Limits for General Population/Uncontrolled Exposure**

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) ($mW/cm^2$) | Averaging Time $|E|^2$, $|H|^2$ or S (minutes) |
|---|---|---|---|---|
| 0.3-1.34 | 614 | 1.63 | (100)* | 30 |
| 1.34-30 | 824/f | 2.19/f | ($180/f^2$)* | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | -- | -- | f/1500 | 30 |
| 1500-100,000 | -- | -- | 1.0 | 30 |

f = frequency in MHz *Plane-wave equivalent power density

NOTE 1: ***Occupational/controlled*** limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2: ***General population/uncontrolled*** exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

*Figure 1.* *FCC Limits for Maximum Permissible Exposure (MPE)*

*Plane-wave Equivalent Power Density*

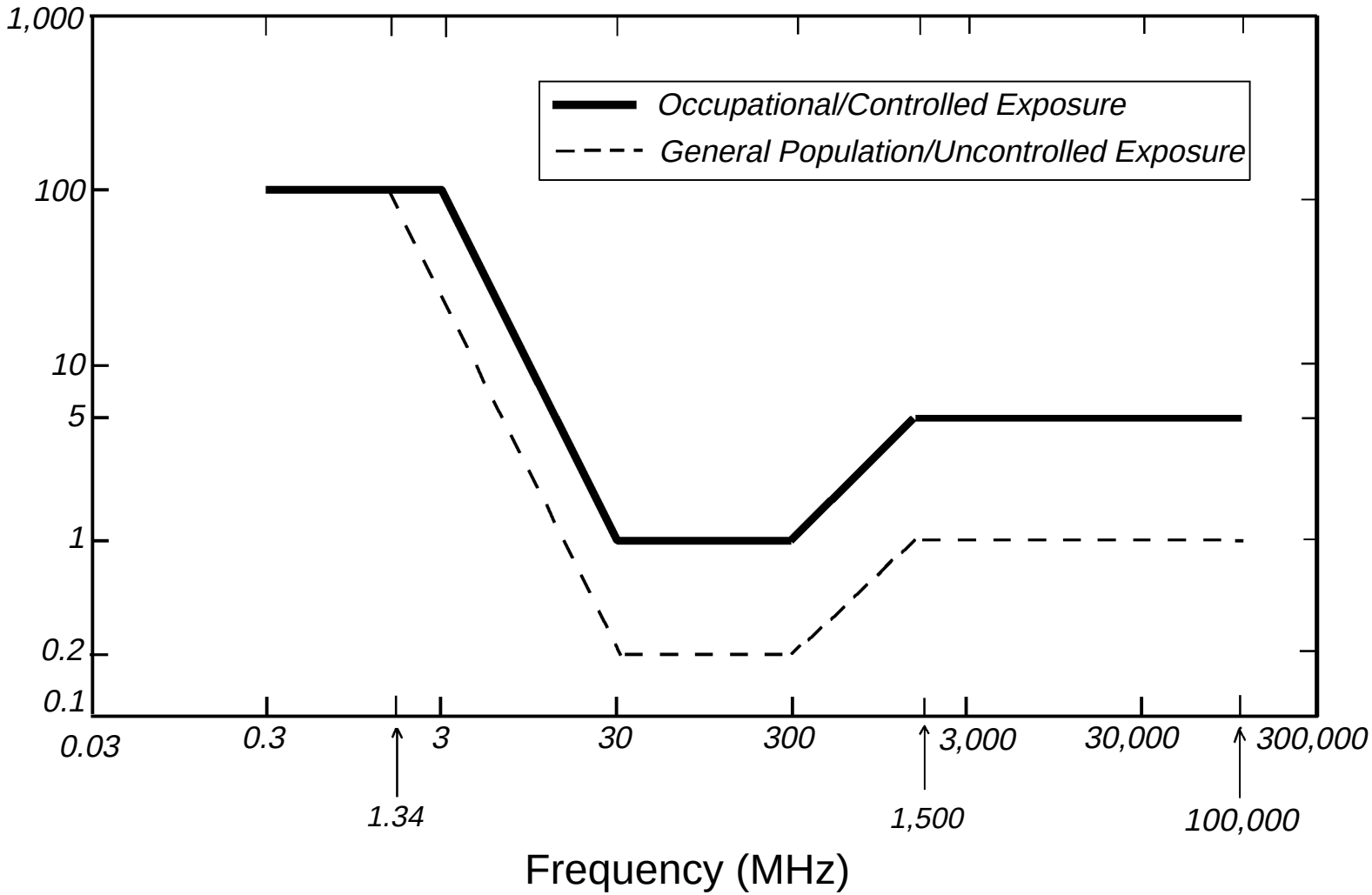

**TABLE 2: TRANSMITTERS, FACILITIES AND OPERATIONS SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION**

| SERVICE (TITLE 47 CFR RULE PART) | EVALUATION REQUIRED IF: |
|---|---|
| Experimental Radio Services (part 5) | power > 100 W ERP (164 W EIRP) |
| Multipoint Distribution Service (subpart K of part 21) | non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and power > 1640 W EIRP<br>building-mounted antennas:<br>power > 1640 W EIRP |
| Paging and Radiotelephone Service (subpart E of part 22) | non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and power > 1000 W ERP (1640 W EIRP)<br>building-mounted antennas:<br>power > 1000 W ERP (1640 W EIRP) |
| Cellular Radiotelephone Service (subpart H of part 22) | non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP)<br>building-mounted antennas:<br>total power of all channels > 1000 W ERP (1640 W EIRP) |

**TABLE 2 (cont.)**

| SERVICE (TITLE 47 CFR RULE PART) | EVALUATION REQUIRED IF: |
|---|---|
| Personal Communications Services (part 24) | (1) Narrowband PCS (subpart D): non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP) building-mounted antennas: total power of all channels > 1000 W ERP (1640 W EIRP)<br><br>(2) Broadband PCS (subpart E): non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP) building-mounted antennas: total power of all channels > 2000 W ERP (3280 W EIRP) |
| Satellite Communications (part 25) | all included |
| General Wireless Communications Service (part 26) | total power of all channels > 1640 W EIRP |
| Wireless Communications Service (part 27) | total power of all channels > 1640 W EIRP |
| Radio Broadcast Services (part 73) | all included |

**TABLE 2 (cont.)**

| SERVICE (TITLE 47 CFR RULE PART) | EVALUATION REQUIRED IF: |
|---|---|
| Experimental, auxiliary, and special broadcast and other program distributional services (part 74) | subparts A, G, L: power > 100 W ERP<br><br>subpart I:<br>non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and power > 1640 W EIRP<br>building-mounted antennas:<br>power > 1640 W EIRP |
| Stations in the Maritime Services (part 80) | ship earth stations only |
| Private Land Mobile Radio Services Paging Operations (part 90) | non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and power > 1000 W ERP (1640 W EIRP)<br>building-mounted antennas: power > 1000 W ERP (1640 W EIRP) |
| Private Land Mobile Radio Services Specialized Mobile Radio (part 90) | non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP)<br>building-mounted antennas:<br>total power of all channels > 1000 W ERP (1640 W EIRP) |

**TABLE 2 (cont.)**

| SERVICE (TITLE 47 CFR RULE PART) | EVALUATION REQUIRED IF: |
|---|---|
| Amateur Radio Service<br>(part 97) | transmitter output power > levels specified in § 97.13(c)(1) of this chapter<br>**(see Table 1 in text)** |
| Local Multipoint Distribution Service<br>(subpart L of part 101) | non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and power > 1640 W EIRP<br>building-mounted antennas: power > 1640 W EIRP<br><br>LMDS licensees are required to attach a label to subscriber transceiver antennas that: (1) provides adequate notice regarding potential radiofrequency safety hazards, *e.g.*, information regarding the safe minimum separation distance required between users and transceiver antennas; and (2) references the applicable FCC-adopted limits for radiofrequency exposure specified in § 1.1310 of this chapter. |

**Mobile and Portable Devices**

Mobile and portable transmitting devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services (PCS), the Satellite Communications Services, the Maritime Services (ship earth stations only) and the Specialized Mobile Radio (SMR) Service are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in 47 CFR § 2.1091 and § 2.1093. Unlicensed PCS and millimeter wave devices are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in 47 C.F.R. § 15.253(f), § 15.255(g), and § 15.319(i). All other mobile, portable, and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure under 47 CFR § 2.1091 and § 2.1093, except (as described previously) as specified in 47 CFR § 1.1307(c) and (d) .

**(a) Mobile Devices**

This section describes the requirements of Section 2.1091 of the FCC's Rules (47 CFR § 2.1091) that apply to "mobile" devices. For purposes of these requirements mobile devices are defined as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimeter separation requirement.

Mobile devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services, the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services and the Specialized Mobile Radio Service authorized under the following parts and subparts of the FCC's Rules: subpart H of part 22, part 24, part 25, part 26, part 27, part 80 (ship earth station devices only) and part 90 (SMR devices only), are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more. Unlicensed personal communications service devices, unlicensed millimeter wave devices and unlicensed NII devices authorized under FCC Rule parts 15.253, 15.255 and subparts D and E of part 15 are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified below, requiring evaluation under the provisions of 47 CFR §2.1093. All other mobile and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in 47 CFR §§ 1.1307(c) and 1.1307(d), as discussed previously.

The limits to be used for evaluation of mobile and unlicensed devices (except portable unlicensed devices) are the MPE field strength and power density limits specified in Table 1 above (and in 47 CFR §1.1310). Applications for equipment authorization must contain a statement confirming compliance with these exposure limits as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request.

All unlicensed personal communications service (PCS) devices shall be subject to the limits for general population/uncontrolled exposure. For purposes of analyzing mobile transmitting devices under the occupational/controlled criteria specified in Table 1, time-averaging provisions of the guidelines may be used in conjunction with typical maximum duty factors to determine maximum likely exposure levels. Time-averaging provisions may not be used in determining typical exposure levels for devices intended for use by consumers in general population/uncontrolled environments. However, "source-based" time-averaging based on an inherent property or duty-cycle of a device is allowed. An example of this is the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal. In general, maximum average rms power levels should be used to determine compliance.

If appropriate, compliance with exposure guidelines for mobile and unlicensed devices can be accomplished by the use of warning labels and by providing users with information concerning minimum separation distances from transmitting structures and proper installation of antennas.

In some cases, for example, modular or desktop transmitters, the potential conditions of use of a device may not allow easy classification of that device as either mobile or portable. In such cases, applicants are responsible for determining minimum distances for compliance for the intended use and installation of the device based on evaluation of either specific absorption rate (SAR), field strength or power density, whichever is most appropriate.

**(b) Portable Devices**

This section describes the requirements of Section 2.1093 of the FCC's Rules (47 CFR §2.1093) that apply to "portable" devices. For purposes of these requirements a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user.

Portable devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services, the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services and the Specialized Mobile Radio Service, and authorized under the following sections of the FCC's rules: subpart H of part 22, part 24, part 25, part 26, part 27, part 80 (ship earth

station devices only), part 90 (SMR devices only), and portable unlicensed personal communication service, unlicensed NII devices and millimeter wave devices authorized under rule parts 47 CFR §§15.253, 15.255 or subparts D and E of part 15, are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use. All other portable transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in 47 CFR §§ 1.1307(c) and (d), as discussed previously. Applications for equipment authorization of portable transmitting devices subject to routine environmental evaluation must contain a statement or certification confirming compliance with the limits specified below as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request.

The limits to be used for evaluation are based generally on criteria published by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) for localized specific absorption rate ("SAR") in Section 4.2 of "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz," ANSI/IEEE C95.1-1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in "Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814. SAR is a measure of the rate of energy absorption per unit mass due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potentially adverse biological effects. The criteria to be used are specified below and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices, as defined above, that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in Table 1 above (and in 47 CFR §1.1310). Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

(**1) Limits for Occupational/Controlled exposure:** 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.

**(2) Limits for General Population/Uncontrolled exposure:** 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over

any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure.

Compliance with SAR limits can be demonstrated by laboratory measurement techniques or by computational modeling, as appropriate. Methodologies and references for SAR evaluation are described in technical publications including "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave," IEEE C95.3-1991, and further guidance on measurement and computational protocols is being developed by the IEEE and others (see text of this bulletin for further discussion).

For purposes of analyzing a portable transmitting device under the occupational/controlled criteria only, the time-averaging provisions of the MPE guidelines identified in Table 1 above can be used in conjunction with typical maximum duty factors to determine maximum likely exposure levels. However, assurance must be given that use of the device will be limited to occupational or controlled situations, as defined previously.

Time-averaging provisions of the MPE guidelines identified in Table 1 may not be used in determining typical exposure levels for portable devices intended for use by consumers, such as hand-held cellular telephones, that are considered to operate in general population/uncontrolled environments as defined above. However, "source-based" time-averaging based on an inherent property or duty-cycle of a device is allowed. An example of this would be the determination of exposure from a device that uses digital technology such as a time-division multiple-access (TDMA) scheme for transmission of a signal. In general, maximum average rms power levels should be used to determine compliance.

# *APPENDIX B*
## Summary of 1986 Mass Media Bureau Public Notice on RF Compliance

On January 28, 1986, the FCC's Mass Media Bureau released a Public Notice providing guidance to broadcast licensees and applicants regarding compliance with the FCC's RF exposure guidelines.[38] The primary sections of that Public Notice are reproduced below (text in brackets has been added or edited). Non-broadcast applicants and licensees may also find this information helpful in evaluating compliance (see discussion in text of Section 4 on controlling exposure).

> "Most broadcasting facilities produce high RF radiation levels at one or more locations near their antennas. That, in itself, does not mean that the facilities significantly affect the quality of the human environment. Each situation must be examined separately to decide whether humans are or could be exposed to high RF radiation. . . . . [A]ccessibility is a key factor in making such a determination. As a general principle, if areas of high RF radiation levels are publicly marked and if access to such areas is impeded or highly improbable (remoteness and natural barriers may be pertinent) then it may be presumed that the facilities producing the RF radiation do <u>not</u> significantly affect the quality of the human environment and do not require the filing of an [E]nvironmental [A]ssessment. Because we wish to avoid burdening applicants with unnecessary work, expenses and administrative filings, we offer the following guidance as to how we will view typical situations. The term "high RF level" means an intensity of RF radiation, whether from single or multiple sources, which exceeds the [FCC] guidelines.
>
> <u>Situations</u>
>
> (A) High RF levels are produced at one or more locations above ground level on an applicant's tower.
>
> - If the tower is marked by appropriate warning signs, the applicant may assume that there is no significant effect on the human environment with regard to exposure of the general public.
>
> (B) High RF levels are produced at ground level in a remote area not likely to be visited by the public.

---

[38] *Further Guidance for Broadcasters Regarding Radiofrequency Radiation and the Environment,* January 28, 1986, FCC Public Notice No. 2278.

- If the area of concern is marked by appropriate warning signs, an applicant may assume that there is no significant effect on the human environment with regard to exposure of the general public. It is recommended that fences also be used where feasible.

(C) High RF levels are produced at ground level in an area which could reasonably be expected to be used by the public (including trespassers).

- If the area of concern is fenced and marked by appropriate warning signs, an applicant can assume that there is no significant effect on the human environment with regard to exposure of the general public.

(D) High RF levels are produced at ground level in an area which is used or is likely to be used by people and to which the applicant cannot or does not restrict access.

- The applicant must submit an [E]nvironmental [A]ssessment [*unless corrective action is taken prior to submission of an application*]. This situation may require a modification of the facilities to reduce exposure or could lead to a denial of the application.

(E) High RF levels are produced in occupied structures, on balconies, or on rooftops used for recreational or commercial purposes.

- The applicant must submit an [E]nvironmental [A]ssessment [*unless corrective action is taken prior to submission of an application*]. The circumstances may require a modification of the broadcasting facility to reduce exposure or could lead to a denial of the application.

(F) High RF levels are produced in offices, studios, workshops, parking lots or other areas used regularly by station employees.

- The applicant must submit an [E]nvironmental [A]ssessment [*unless corrective action is taken prior to submission of an application*]. The circumstances may require a modification of the facilities to reduce exposure or the application may be denied. This situation is essentially the same as (E). We have included it to emphasize the point that station employees as well as the general public must be protected from high RF levels [*also, see FCC definitions used to determine application of exposure tiers: general population/uncontrolled vs. occupational/controlled]*. Legal releases signed by employees willing to accept high exposure levels are not acceptable and may not be used in lieu of corrective measures.

(G) High RF levels are produced in areas where intermittent maintenance and repair work must be performed by station employees or others.

> - [FCC] guidelines also apply to workers engaged in maintenance and repair. As long as these workers will be protected from exposure to levels exceeding [FCC] guidelines, no [E]nvironmental [A]ssessment is needed. Unless requested by the Commission, information about the manner in which such activities are protected need not be filed. If protection is not to be provided, the applicant must submit an [E]nvironmental [A]ssessment. The circumstances may require corrective action to reduce exposure or the application may be denied. Legal releases signed by workers willing to accept high exposure levels are not acceptable and may not be used in lieu of corrective measures.

The foregoing also applies to high RF levels created in whole or in part by reradiation.

A convenient rule to apply to all situations involving RF radiation is the following:

(1) Do not create high RF levels where people are or could reasonably be expected to be present, and (2) [p]revent people from entering areas in which high RF levels are necessarily present.

Fencing and warning signs may be sufficient in many cases to protect the general public. Unusual circumstances, the presence of multiple sources of radiation, and operational needs will require more elaborate measures.

Intermittent reductions in power, increased antenna heights, modified antenna radiation patterns, site changes, or some combination of these may be necessary, depending on the particular situation.

# No Health Threat From Smart Meters

*by*
***Klaus Bender. PE***
*Director of Standards & Engineering*
*Utilities Telecom Council*

As utilities seek to modernize their aging infrastructure and upgrade to a “smart” electric grid, wireless communications will play an ever increasingly important role in the facilitating these enhancements. Several consumer groups have raised concerns about the potential health effects of a two way communications device, the next generation electric meter or smart meter, on their homes.

This article provides a brief review of the safety standards dealing with radio frequency energy and safety and shows that smart utility devices pose no health threat. We compare other household wireless devices to smart meters to show the energy from a meter is actually less than commonly used devices.

Smart grid deployments use devices that fall into the same category as many wireless devices found in the home, such as wireless routers used for internet connectivity and wireless baby monitors. And unlike the laptop or WiFi router in the home that are always transmitting, smart meters transmit for only a fraction of the day for short durations.

## Introduction

Smart Grid is a transformed electricity transmission and distribution network or "grid" that uses robust two-way communications, advanced sensors, and distributed computers to improve the efficiency, reliability and safety of power delivery and use. Deploying the Smart Grid became the policy of the United States with passage of the Energy Independence and Security Act of 2007 (Title 13). The Smart Grid is also being promoted by the European Union and other nations.

The smart grid will rely on the use of radio frequencies to provide wireless connectivity to the various components of the new electric distribution system. Wireless communications technology has become ubiquitous in our lives, enabling mobile connectivity with cell phones, wireless internet services and home area networking with WiFi technology and even cooking our food with microwave ovens. Yet

there are unsubstantiated concerns that the smart meters being installed around the country and the world will cause ill health effects to members of the household where the meters are installed.

Therefore, we examine the facts about the impact of radio frequency energy on the body, showing that the devices utilities seek to install pose no threat of harm to humans. We show that the type of radio energy used and emitted by smart meters, cell phone, wireless routers and microwave ovens can only damage the body at extremely high levels. While research continues into long term effects, there has been no conclusive evidence that low level RF energy has a long term negative impact. We concentrate on RF energy and acknowledge that electric meters are connected to the power system and unauthorized tampering or dismantling an electric meter could pose electric shock danger to anyone coming in direct contact with energized electric conductors.

## Federal Jurisdiction for Safety of Radio Frequency Devices

The Federal Communications Commission (FCC) has jurisdiction over the approval and use of radio frequency devices, whether a license is required for the devices or if unlicensed operation is allowed. FCC regulations are based on standards set by the Institute of Electrical and Electronic Engineers (IEEE) based on years of research by health professionals. The FCC has a twofold role in ensuring safety. First, the FCC has allocated the radio spectrum into a variety of pieces, most of which need coordination and a license before operation is permitted. Examples of this include television, satellite and radio broadcast channels, a variety of cellular and personal communications service frequencies, and microwave frequencies that transmit huge amounts of information from one point to another using dish style antennas. At the same time, the FCC has allocated some frequencies for unlicensed operation, allowing consumers to purchase products at Best Buy or Wal-Mart and install them in their homes. These devices operate at low power levels, enabling communications but posing no threat of health effects to humans. Examples include the WiFi routers already discussed, wireless baby monitors and garage door openers.

The FCC's second role is to approve radio devices for manufacture, import and sale. Regardless of whether the equipment operates on low power unlicensed channels or at higher power operations that require an authorization, each device must be tested to meet FCC standards. The sale of untested and unapproved equipment is a serious offense and the FCC aggressively prosecutes violators.

## FCC Mandates on RF Exposure and Impact on Humans

The FCC is required by the National Environmental Policy Act of 1969, among other things, to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment. Several organizations, such as the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE), and the National Council on Radiation Protection and Measurements (NCRP) have issued recommendations for human exposure to RF electromagnetic fields.

On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. In addition, the Commission adopted the specific absorption rate (SAR) limits for devices operating within close proximity to the body as specified within the ANSI/IEEE C95.1-1992 guidelines.

(See Report and Order, FCC 96-326) The Commission's requirements are detailed in Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]. The potential hazards associated with RF electromagnetic fields are discussed in FCC's Office of Engineering and Technology (OET) Bulletin No. 56, "Questions and Answers About the Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields."[1]

The FCC also offers OET Bulletin 65 on this topic. The revised OET Bulletin 65 has been prepared to provide assistance in determining whether proposed or existing transmitting facilities, operations or devices comply with limits for human exposure to radiofrequency (RF) fields adopted by the Federal Communications Commission (FCC). The bulletin offers guidelines and suggestions for evaluating compliance.

## Understanding the Impact of RF Energy on Humans

RF signals are known to propagate as waves, and one of the key characteristics of the wave is its frequency. Frequency is the most significant control factor in radio transmission and impacts how the waves travel through space, whether they pass through walls or bounce off them, the wave's interaction with foliage, etc. Use of the transit frequency is common knowledge in our society, as commercial radio and television stations often use this parameter as part of the public persona.

Frequency also determines the impact of RF energy on the human body. Only very high frequencies, ultraviolet rays and above, have the capability of mutating living cells to cause cancer and similar illness. This frequency range is known as ionizing radiation because the RF energy creates ions out of living cells by removing or adding electrons at the cellular level.

Non-ionizing radio energy fall below this frequency range and the primary interaction with human cells is to heat them. This is the basis for the microwave oven. Non-ionizing energy, at a high enough level, will heat human cells until they die, but non-ionizing energy is simply incapable of mutating cells and causing diseases like cancer.

Industry research and standards agencies, such as ANSI and IEEE, have compiled the research associated with human exposure of RF energy and created guidelines that the FCC and the Federal Occupational Safety and Health Administration (OSHA) have adopted. The standards incorporate frequency of the energy to define maximum permissible exposure levels (MPE) correlated to frequency. The standards are most conservative at frequencies where the wavelength of the energy is near the size of the average human and have the most potential for whole body impact. The resulting MPE levels incorporated into the requirements include a 10:1 safety ratio to account for variations in size, weight and physical condition of the subject. Therefore, exposure even at 100% of the MPE level will not cause physical harm.

In order to further protect the public from exposure to RF energy, the FCC set the MPE levels discussed above as the "occupational" or "controlled" environment, intended for workers and other professional

[1] http://www.fcc.gov/oet/rfsafety/

previously trained in safety related to RF energy. The FCC then created a "general public" or "uncontrolled" environment criteria that added an additional 5:1 safety factor over the occupational level. Thus the FCC's MPE limit for the general public is 50 times less than the level research shows can actually cause harm. The tables below show the limits for occupational and general public MPE.

**Table 1. LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)**

**(A) Limits for Occupational/Controlled Exposure**

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) ($mW/cm^2$) | Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes) |
|---|---|---|---|---|
| 0.3-3.0 | 614 | 1.63 | (100)* | 6 |
| 3.0-30 | 1842/f | 4.89/f | ($900/f^2$)* | 6 |
| 30-300 | 61.4 | 0.163 | 1.0 | 6 |
| 300-1500 | -- | -- | f/300 | 6 |
| 1500-100,000 | -- | -- | 5 | 6 |

**(B) Limits for General Population/Uncontrolled Exposure**

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) ($mW/cm^2$) | Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes) |
|---|---|---|---|---|
| 0.3-1.34 | 614 | 1.63 | (100)* | 30 |
| 1.34-30 | 824/f | 2.19/f | ($180/f^2$)* | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | -- | -- | f/1500 | 30 |
| 1500-100,000 | -- | -- | 1.0 | 30 |

f = frequency in MHz *Plane-wave equivalent power density

NOTE 1: ***Occupational/controlled*** limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2: ***General population/uncontrolled*** exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

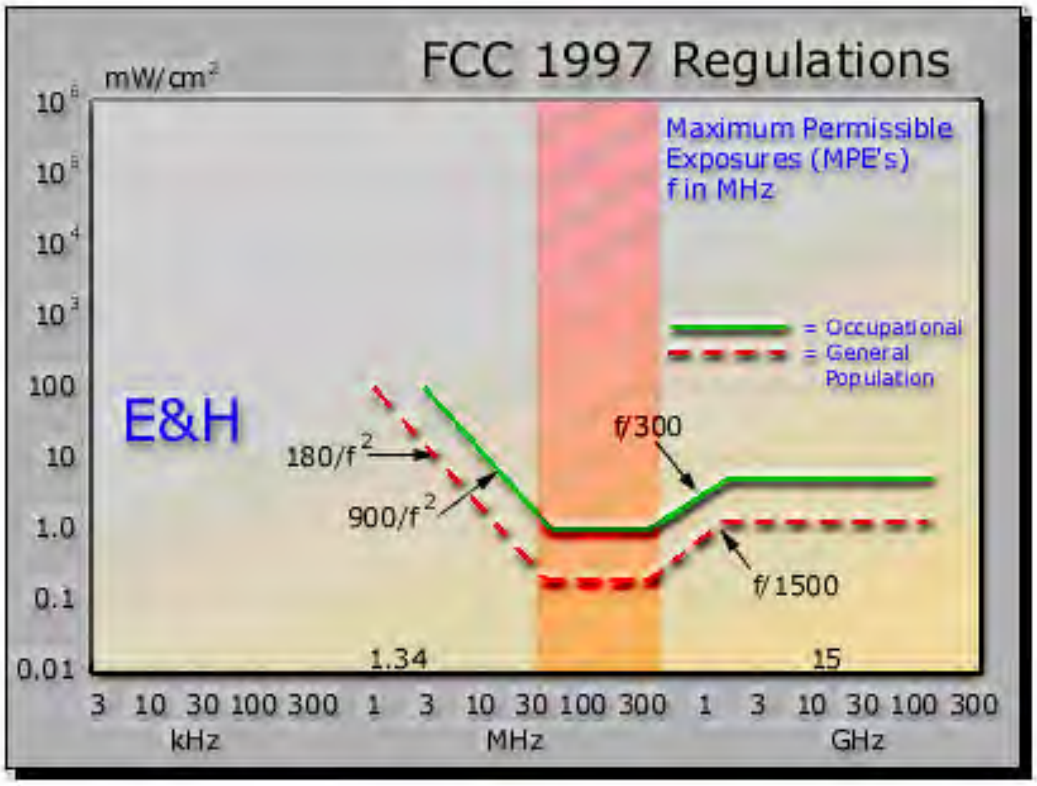


**Figure 1. MPE Level by Frequency and Class (Source: Sitesafe, Inc., Arlington VA)**

The FCC's OET 65 document also defines concepts like time averaging. As shown in the tables above, the averaging time for occupational/controlled exposures is 6 minutes, while the averaging time for general population/uncontrolled exposures is 30 minutes. It is important to note that for general population/uncontrolled exposures it is often not possible to control exposures to the extent that averaging times can be applied. In those situations, it is often necessary to assume continuous exposure. [2] Since the known danger in RF energy is tissue heating, if the subject moves out of the area of high RF levels, the cells will return to normal temperature. At 100% or less of MPE, there is no danger in continuous exposure. Time average says that if one is an area identified as 200% of the occupational MPE, up to three minutes of exposure is safe as long as three minutes elapse in an area at less than 100% MPE.

In summary, there is no known long term health effect from exposure to RF energy at levels below those designated by the FCC. This energy is all around and the energy associated with smart meters is far less than those of other common services and equipment.

[2] FCC OET Bulletin 65

## Comparison of RF Power Density in the Everyday Environment

**Device Relative Power Density in microwatts per square centimeter (µW/cm2)**

| | |
|---|---|
| FM radio or TV broadcast station signal | 0.005 |
| **SmartMeter™ device at 10 feet** | **0.1** |
| Cyber cafe (Wi-Fi) | 10-20 |
| Laptop computer | 10-20 |
| Cell phone held up to head | 30-10,000 |
| Walkie-Talkie at head | 500-42,000 |
| Microwave oven, two inches from door | 5,000 |

*Source: Richard Tell Associates, Inc.*[3]

## Meter Reading System Configurations

Residential and industrial electric meters allow utilities to accurately bill for the energy consumed. These devices have been used as long as the electric industry has been in place. Early meters required manual reading, with a utility employee writing down the use data and returning to the office to enter that information into the utility billing system. The use of radio frequencies to interrogate meters began in the early 1980's. These systems used an interrogation signal sent from a utility employee either walking or driving through the area of interest. A radio signal "pings" the meters within range and the devices respond with consumption information, also using radio signals.

As previously noted, the electric infrastructure in the US is going through a major transition, replacing equipment that can be 40 to 50 years old. At the same time, variable renewable energy sources like solar and wind must be integrated into this new grid. Increased communication with consumers that allows customers to adjust their energy usage in response to pricing or reliability based signals. Remote meter reading and cutoff, as well as other smart grid applications are all key components of the smart grid and these capabilities rely on smart meters.

Smart meter systems varying in implementation depending on the utility's needs and the vender selected. Most utilities are electing to install radio based smart meter systems. Radio based systems also vary in configuration, but each system is made up of the following components:

1. Meter: The meter device measures consumption and stores the information for retrieval by the utility.

[3] Pacific Gas and Electric: http://www.pge.com/myhome/edusafety/systemworks/rf/

2. Meter Transceiver: The transceiver is a radio that receives instructions from the utility network and transmits necessary information to the utility. The transceiver is often an integral part of the meter, especially in the case of electric meters. Often, water and gas meters' transceivers are mounted near the device. The meter's radio system can also communicate with home energy management systems used by customers to control and monitor appliance power consumption. The meter transceivers operate on low power unlicensed channels, or in some cases, using cellular radio channels.

3. Data Aggregation Points: The meter transceiver transmits information to nearby collection devices, often called data aggregation points (DAPs). These devices are often mounted on nearby power poles at heights of 20 to 30 feet above ground. The DAPs collect information and transmit that information to the utility. If the utility has high capacity fiber infrastructure, that resource carries information from the DAPs. Typically, the DAP will communicate with center receive stations on radio frequencies in the unlicensed bands, or using cellular technology.

A common misconception about smart meters is that they are always "on" or transmitting. This is far from the case. Until recently, water and gas utilities usually read meters once or twice a month and the time needed to transmit information is less than 1 second. Only recently have gas and water utilities initiated more frequency meter queries. Electric utilities are implementing time-of-use billing structures but rarely need to read the meter more than once every 15 minutes. Again, the time to transmit consumption data is less than 1 second. This means, in this scenario, these low power devices are transmitting approximately 0.11% of the day[4], at short bursts of less than one second. Even if the meter transmits once every 15 seconds, as is the case when no interrogation signal is used, transmission would still only by 6.7% of the day

We know from our discussion of RF exposure, even if the RF levels from these devices would exceed 100% of the FCC MPE, the impact on the body takes time. For the RF signal from a smart meter to be powerful enough to harm the human, that signal would have to be so powerful the transmission would be on the order of TV or radio broadcast stations. This is clearly not the case for smart meters.

[4] Daily exposure percentage = [(4 seconds/hour)/(24 hours/day*60 minutes/hour*60 seconds/minute)]* 100

## Summary

In this article, we defined the concept of the smart grid and the benefits to society. We also highlighted the importance of radio networks to the successful deployment of the smart grid. We discuss the important concepts of RF energy and the impact on humans. Specifically, there is no demonstrated long term impact of low level non-ionizing energy on humans. Ionizing energy, beginning with the ultraviolet component of sunlight, has been demonstrated to have long term impact, but the frequencies citing in this report are hundreds of orders of magnitude below that of sunlight. Therefore, this shows that the often quoted sources in the media expressing concern about the RF safety from smart meters are shown to be based on faulty logic, or faulty "facts" and misrepresentations.

We show that a specific analysis of the component used in this smart grid deployment are significantly below general population MPE and note, again, that FCC limits for MPE of general population are already at least 50 times lower than levels that can cause tissue heating.

An examination of a majority of smart meters being deployed today will show these devices use low power levels associated with unlicensed devices, on the equivalent magnitude as the devices that provide WiFi connectivity in the home. Millions of laptop computers are used in homes every day that transmit at levels similar to the smart meter and the transmitters from these devices are always "on". Some utilities are deploying meter reading systems that use commercial wireless providers to gather data. These meters have the same radio components as cell phones, the same phone consumers raise to their head every day.

So when confronted with complaints that say smart meters cause a variety of health effects, ask the complainant to produce the science to support the claim. The conversation should end shortly thereafter.

#

***Appendix – Useful Links***

*http://www.fcc.gov/oet/rfsafety*

*http://www.fcc.gov/oet/rfsafety/rf-faqs.html*

*http://www.fcc.gov/oet/info/documents/bulletins/Welcome.html#56*

*http://www.fcc.gov/oet/info/documents/bulletins/Welcome.html#65*

**For more information, please contact:**
**Klaus Bender, PE**
**Director of Standards & Engineering**
**Utilities Telecom Council**
**klaus.bender@utc.org**
**+1.202.833.6803**

# Product Information Notice

SENSUS
The Measure of the Future

| | |
|---|---|
| Subject: RF Health Issues and Concerns | PIN: AMIWGE-23-May-2011-1 |
| | Date: May, 23, 2011 |

Distribution: Sensus Internal & Sales: ☒ Distributors & Agents: ☒ Customers: ☐

Lately in the news there has been a lot of talk about radio frequency (RF) exposure in regards to smart meters. I am sure a lot of you have read about the problems out in California and other regions where people are calling for the meters to be taken out and the issues many utilities are having to deal with as a result of this pushback. The reality is that a lot of this public backlash is based on misconceptions and mismanaged public relations.

To help clarify and better inform the public, our employees and our customers, Marketing and the Product Management team has compiled references from leading organizations such as UTC, FCC and the World Health Organization that show there is no evidence that smart meter RF has any health effects to human beings.

These references are online and the link to the Sensus site, “Understanding RF and Smart Meters”, is located at: http://www.sensus.com/rf/index.xml .

I invite you to share this with any of your customers and colleagues.

If you have any additional questions, please don’t hesitate to contact me.
.

Tom Galuska

Tom Galuska

Product/Marketing Manager – Water – AMR/AMI

# VILLAGE OF ALGONQUIN

*PUBLIC WORKS DEPARTMENT*

**– M E M O R A N D U M –**

DATE: November 13, 2018

TO: Bob Mitchard, Public Works Director

FROM: Steven R. Ludwig, General Services Superintendent

SUBJECT: Landscape Contractor Approval – 2019 Season

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As you are aware, we had a very difficult time securing quality performance from our landscape contractor this year. In an effort to provide the quality services the residents deserve for next season, we sent out a new request for proposals for landscape contracting to five reputable organizations within our region. We received two proposals, one from Sebert Landscaping of Bartlett, IL, and in addition, one from the Acres Landscape Group of Wauconda, IL.

Sebert Landscaping was the low proposer at a submitted cost of $342,681. The work includes all Village-owned property that requires this type of work. I am familiar with the work of this organization and they have previously proven their ability to perform at a reputable level. Therefore, I am recommending the award of this work to Sebert Landscaping of Bartlett, IL.

I am also requesting a pre-budget consideration in signing the attached purchase agreement, or a resolution committing to such budgetary funding in the next fiscal year. With such a large scale of work, the new vendor will need the winter months to secure the staffing and acquire/commit the equipment for this large account. A purchase agreement or resolution will provide our commitment to our new vendor and allow them to prepare appropriately to perform these services. Please let me know if this is something that is doable. I look forward to your response.

# VILLAGE OF ALGONQUIN PURCHASE AGREEMENT - VENDOR (Services)

**Effective Date: May 1, 2019** **Purchase Order No.**

| **Project: Landscaping Services** | **Location: Village-wide** |
|---|---|
| **Originating Department:** | |

| **Owner** | **Consultant/Vendor** | **Developer** |
|---|---|---|
| **Village of Algonquin**<br>Address: 2200 Harnish Dr. Algonquin, IL.<br><br>**Phone: (847) 658-2700**<br>**Fax:**<br>**Contact:** Steve Ludwig | Name: Sebert Landscaping<br>Address: 1550 W. Bartlett Rd. Barlett, IL.<br><br>**Phone: (630) 497-2110**<br>**Fax:**<br>**Contact:** Shannon Hoban | **(where applicable)**<br><br>**Phone:**<br>**Fax:**<br>**Contact:** |

**COST OF WORK**

**The Contract Price of the Work under this Purchase Agreement is: $ 342,681**

**SCOPE OF WORK:**

**Furnish the Work/items described below in accordance with the following plans and specifications:**

- ⌧ **General Contract, dated _____, 20__**
- ⌧ **Plans dated : _____**
- ⌧ **Other: _____**
- ⌧ **Specification No(s): Attached , dated _____, 20__**
- ⌧ **Addendum No(s): _____**

**The Scope of the Work and prices under this Purchase Agreement are for the duration of project:**

| QUANTITY | UNIT OF MEASURE | DESCRIPTION/ITEMS | CONTRACT SUM | EXTENSION |
|---|---|---|---|---|
| | | See attached completed RFPs | $ 342,681<br>NOT TO EXCEED | $ 342,681 |
| | | | TOTAL | $ 342,681 |

**NOTES:**

1) The SCOPE OF WORK shall not be changed without written agreement between the Consultant/Vendor and the Owner. Payment is based upon the attached Schedule of values and reimbursables.
2) No work beyond the SCOPE OF WORK shall be undertaken until written authorization is received from the Owner. Consultant/Vendor shall notify the Owner when the value of the Services performed equals eighty percent (80%) of the Contract Sum, at which point the Owner, Developer and Consultant/Vendor shall determine the time remaining on the Project for which Consultant/Vendor Services are or may be required, and the sufficiency of the Developer escrow account regarding payment for such Services.

**WARRANTIES and INDEMNIFICATION**

Consultant/Vendor agrees to employ the skill and efforts of a professional engineer in this area. CONSULTANT/VENDOR SHALL FULLY INDEMNIFY AND SAVE THE OWNER HARMLESS FROM ALL CLAIMS, LIENS, FEES, AND CHARGES, AND THE PAYMENT OF ANY OBLIGATIONS ARISING THEREUNDER, pursuant to the provisions in the Supplemental Conditions attached hereto.

**THE TERMS OF THIS PURCHASE AGREEMENT AND THE ATTACHED SUPPLEMENTAL CONDITIONS ARE THE ENTIRE AGREEMENT BETWEEN THE OWNER AND CONSULTANT/VENDOR. No payment will be issued unless a copy of this Purchase Agreement is signed, and dated and returned to the Owner. Material certifications/test reports required.**

**ACCEPTANCE OF PURCHASE AGREEMENT**

**The parties, for themselves, their heirs, executors, administrators, successors and assigns, do hereby agree to the full performance of all terms and provisions herein contained. IN WITNESS WHEREOF, the parties hereto have executed this Purchase Agreement the day and year written below.**

**CONSULTANT/VENDOR:**

SEBERT LANDSCAPE

**By:** _____ 11/9/2018

**Representative of Vendor authorized to execute Purchase Agreement**

**OWNER:**
**Village of Algonquin**

**By:** _____

**Title:** _____

**Dated:** _____

## SUPPLEMENTAL CONDITIONS

**1. Acceptance of Purchase Agreement:** The Purchase Agreement is an offer to contract, buy or rent and not an acceptance of an offer to contract, sell or rent. Acceptance of this Purchase Agreement is expressly limited to the terms hereof, and in the event that Consultant/Vendor's acknowledgment or other response hereto states terms additional to or different from those set forth herein, this Purchase Agreement shall be deemed a notice of objection to such additional or different terms and rejection thereof. This Purchase Agreement may be accepted by the commencement of any Work hereunder, and in any event, shall be deemed accepted in its entirety by Consultant/Vendor unless the Owner is notified to the contrary within ten (10) days from its date of issue.

**2. Amendment, Modification or Substitution:** This Purchase Agreement contains the entire agreement between the parties. Any modification or rescission thereof must be in writing and signed by the Owner. No proposals or prior dealings of the parties or trade custom not embodied herein shall alter the interpretation or enforcement of this Purchase Agreement.

**3. Familiarity With Plans; Qualifications:** Consultant/Vendor acknowledges that it (a) has examined the site of the proposed Work and is familiar with the conditions surrounding same; and (b) has examined the plans and drawings, and has studied and is aware of, and satisfied with, the requirements of the Contract Documents as they relate to Consultant/Vendor's Services under this Purchase Agreement. Consultant/Vendor represents to the Owner that it is fully experienced and properly qualified as an expert to perform the class of work provided for herein, and that it is properly equipped, organized and financed to handle such work. Consultant/Vendor shall finance its own operations hereunder, shall operate as an independent contractor and not as the agent of the Owner, and shall hold the Owner free and harmless from all liability, costs and charges by reason of any act or representations of Consultant/Vendor, its agents or employees.

**4. Safety:** Insofar as jobsite safety is concerned, the Consultant/Vendor is responsible solely for its own and its employees' activities on the jobsite, but this shall not be construed to relieve the Owner or any construction contractors from their responsibilities for maintaining a safe jobsite. Neither the professional activities of the Consultant/Vendor, nor the presence of the Consultant/Vendor or its employees and subcontractors, shall be construed to imply the Consultant/Vendor has any responsibility for the methods of work performance, superintendence, sequencing of construction, or safety in, on or about the jobsite by others.

**5. Extra's and Change Orders:** No claim by Consultant/Vendor that any instructions, by drawing or otherwise, constitute a change in Consultant/Vendor's performance hereunder, for which Consultant/Vendor should be paid additional compensation shall be valid, unless prior to commencing such allegedly extra or changed performance, Consultant/Vendor shall have received a written supplement to this Purchase Agreement authorizing such performance signed on behalf of the Owner by a person have actual authority to do so.

**6. Inspection and Acceptance:** The Owner shall have the right at all reasonable times to inspect all Work performed or furnished by Consultant/Vendor. Notwithstanding any prior inspection or payment, all Work is subject to final acceptance by the Owner.

**7. Taxes:** This project is tax exempt. The Owner's tax-exempt number is **E 9995 0855 05.**

**8. Payment:** The Owner will make partial payments to the Consultant/Vendor from time to time for Services performed by the Consultant/Vendor. Provided, however, in no event shall the Owner be obligated to pay Consultant/Vendor any sum that exceeds the Contract Price absent a written change order executed by the Owner. Consultant/Vendor shall invoice Owner monthly on a time and materials basis in the amount(s) and at the rate(s) set forth in the attached Schedule. Each invoice shall detail the dates worked, Services performed, and, where applicable, reimbursable expenses reasonably and directly incurred for such Services. Consultant/Vendor shall only be reimbursed for expenses shown on the attached Schedule. Reimbursement shall be at the amount shown on the attached Schedule, or if no amount is shown, at cost. Consultant/Vendor shall invoice Owner for all Reimbursable Expenses, where applicable, due and owing together with an itemization of such (including receipts). Invoices in compliance with this Purchase Agreement shall be paid by the Owner to Consultant/Vendor within 60 days after Owner's receipt of the invoice. The amount(s) and rate(s) set forth on the attached Schedule include all anticipated costs of providing the Services. No additional costs of any kind may be incurred without the prior written consent of Owner.

**9. Consultant/Vendor Warranty:** Consultant/Vendor warrants to perform the Services to the best of its ability and in a diligent and conscientious manner and to devote appropriate time, energies and skill to those duties called for hereunder during the term of this Purchase Agreement and in connection with the performance of such duties. All Services performed by Consultant/Vendor pursuant to this Purchase Agreement shall be performed in accordance with all applicable federal, state and local laws, rules and regulations, and shall conform to the *Village's 2006 Contractual Inspection Services Guide* and any specifications and drawings applicable to this Purchase Agreement.

**10. Insurance:**

10.1 Consultant/Vendor shall at all times maintain business automobile, commercial liability and workers compensation insurance covering its work and all obligations under this Purchase Order, and shall name the Owner as an additional insured on its commercial liability insurance policies for Consultant/Vendor operations under this Purchase Agreement. Liability insurance limits shall be in an such amounts and include such coverages as set forth in the VILLAGE OF ALGONQUIN PURCHASE ORDER INSURANCE REQUIREMENTS attached to this Agreement. Consultant/Vendor shall furnish the Owner with a certificate of insurance and such other documentation (including a copy of all or part of the policy) at the time of execution of this Agreement and thereafter on an annual basis on the anniversary date of this Agreement or at any other time as the Owner deems necessary to establish compliance with this provision.

10.2 Consultant/Vendor shall furnish and pay for surety bonds and with surety or sureties satisfactory to Owner, guaranteeing the full performance of all of the conditions and terms hereof and guaranteeing that Consultant/Vendor shall promptly pay for all labor, materials, supplies, tools, equipment and other charges or costs of Consultant/Vendor in connection with the Work. Such performance and payment bond shall be in an amount determined by Owner.

10.3 Breach of this paragraph is a material breach subject to immediate termination.

**11. Indemnity:** Consultant/Vendor hereby agrees to indemnify, and hold the Owner directors, officers, employees, agents, successors and assigns (the "Indemnitees") harmless from any and all claims, demands, liability, loss, damage, fines, penalties, attorney's fees and litigation expenses (collectively "Loss") arising out of injury to, including the death of, persons and/or damage to property, to the extent caused by the negligent acts or omissions of Consultant/Vendor, its agents, employees, subcontractors, successors and assigns. In any and all claims against the Owner or any of its agents or employees, by any employee of Consultant/Vendor, the indemnification obligation under this paragraph shall not be limited by any limitation on the amount or type of damages, compensation or benefits payable by or for Consultant/Vendor under workers compensation acts, disability benefits acts or employee benefit acts, or other applicable law. Consultant/Vendor assumes the entire liability for its own negligence, and as part of this Purchase Agreement waives all defenses available to Consultant/Vendor as an employer which limit the amount of Consultant/Vendor's liability to the Owner to the amount of Consultant/Vendor's liability under any workers compensation, disability benefits or employee benefit acts.

**12. Term and Termination:** The term of this Purchase Agreement shall commence as of the Effective Date and shall continue until the Project is completed or the Purchase Agreement is terminated by either party, or the value of the service provided by Consultant/Vendor has reached 100% of the Contract Sum. Notwithstanding the foregoing, either party may terminate this Purchase Agreement with or without cause at any time by providing written notice within a reasonable period of time prior to termination. In the event of a termination, Consultant/Vendor shall be paid for all services performed through the date of termination, based on the percentage of services completed. In no event shall the Consultant/Vendor be entitled to any additional compensation or damages in connection with a termination hereunder.

**13. Remedies:** Consultant/Vendor shall, for the duration of this Purchase Agreement, at the discretion of the Owner and at the expense of Consultant/Vendor, undertake or re-do any and all faulty or imperfect Services furnished or performed by Consultant/Vendor thereunder. In the event Consultant/Vendor fails to perform under this Purchase Agreement, it will be in default and the Owner may furnish or perform the same and recover from Consultant/Vendor the cost and expense directly or indirectly resulting there from, including all consequential damages but not limited to the cost or expense of providing such services, inspections, testings and reasonable attorneys fees as a result of a default. The foregoing remedies shall be available in addition to all other remedies available to the Owner.

**14. Compliance With Laws:**. During the performance hereunder, Consultant/Vendor agrees to give all notices and comply with all Laws and Regulations of the United States and/or the State of Illinois applicable to the performance of the Work, including but not limited to those Laws and Regulations regarding the payment of prevailing wages, non-discrimination laws, employment of Illinois workers, labor, wage and collective bargaining. Except where otherwise expressly required by applicable Laws and Regulations, the Owner shall not be responsible for monitoring Consultant/Vendor's compliance with any Laws or Regulations.

**15. Notices:** All notices, demands, requests or other communications which may be or are required to be given, served, or sent by any party to any other party pursuant to this Purchase Agreement shall be in writing and shall be hand delivered, or sent by courier, or via facsimile with confirmation to the addresses shown on the Purchase Agreement.

**16. Records, Reports and Information:** Consultant/Vendor agrees to furnish Owner with reports and information regarding the Services performed under this Purchase Agreement, at such times as Owner may reasonably request, making full disclosure of efforts made by Consultant/Vendor and the results thereof. Consultant/Vendor agrees to maintain records, documents, and other evidence which will accurately show the time spent and Services performed under this Purchase Agreement for a minimum period of five (5) years after completion of the Services, and such records shall be subject to audit by Owner upon reasonable advance notice to Consultant/Vendor on a mutually agreed date and time.

**17. Assignment:** Neither party shall assign this Purchase Agreement without written consent of the other, which consent shall not be unreasonably withheld, except that Owner may unilaterally assign its rights under this Purchase Agreement upon reasonable notice to Consultant/Vendor to the Developer/Owner (if any) identified in this Purchase Agreement.

**18. Limitation Of Liability:** In no event shall the Owner by liable for special, incidental or consequential damages (including without limitation loss of use, time or data, inconvenience, commercial loss, lost profits or savings) to the full extent such may be disclaimed by law.

**19. Waiver:** Either party's failure to insist in any one or more instances, upon the strict performance of any provision hereof or to exercise any right hereunder shall not be deemed to be a waiver or relinquishment of the future performance of any such provision or the future exercise of such right, but the obligation of Consultant/Vendor and Owner with respect to such future performance shall continue in full force and effect.

**20. Controlling Law, Severability:** The validly of this Purchase Agreement or any of its provisions and the sufficiency of any performance thereunder shall be determined under the laws of Illinois. Venue shall be in McHenry County, Illinois. The Owner is entitled recover its reasonable attorneys fees incurred in enforcing the terms of this Purchase Agreement. If any provision or requirement of this Purchase Agreement is declared or found to be unenforceable that balance of this Purchase Agreement shall be interpreted and enforced as if the unenforceable provision or requirement was never a part hereof.

**CONSULTANT/VENDOR:**

SEBERT LANDSCAPE

11/9/18
Date

# VILLAGE OF ALGONQUIN
# PURCHASE ORDER INSURANCE REQUIREMENTS

A. At all times while providing, performing, or completing the Work, Contractor (Contractor/Vendor and Vendor/Consultant) shall maintain the following minimum insurance coverage in the form, and from companies, acceptable to Owner.

1. **Commercial General Liability Insurance**

   Limits: Each Occurrence and in the Aggregate $1,000,000

   Such insurance shall include completed operations, contractual liability and personal/advertising injury coverage. The policy will name the Village of Algonquin as an additional insured on a primary non-contributory basis.

2. **Commercial Automobile Liability Insurance**

   Limits: Each Occurrence $1,000,000

3. **Workers Compensation/Employers Liability Insurance**

   Limits: Coverage A Statutory
   Limits: Coverage B $1,000,000

   The policy will contain a waiver of subrogation clause in favor of the Village of Algonquin.

4. **Umbrella Excess Liability Coverage** ☐ ***Required if an "x"***

   Limits: Each Occurrence and in the aggregate $2,000,000

   The policy will name the Village of Algonquin as an additional insured on a primary non-contributory basis.

5. **Professional Liability Coverage** *(required if professional services are being provided)*

   Limits: Each Occurrence $1,000,000

   The Contractor shall provide the Village with a copy of the professional liability insurance policy and any endorsements.

B. All insurance required of the Contractor shall state that it is primary insurance as to additional insureds with respect to all claims arising out of the operations by or on their behalf. If additional insureds have other applicable insurance coverages, those coverages shall be regarded as on an excess or contingent basis.

C. All required coverage shall be placed with an insurance company licensed to conduct business in the State of Illinois and be rated at least A VI by A.M. Best Company.

D. Prior to commencing work under this Agreement, the Contractor shall furnish the Village with a copy of all certificates showing the minimum coverage in insurance companies acceptable to the Village. All Certificates of Insurance required to be obtained by the Contractor shall be provide coverages under the policies named shall not be canceled, modified, reduced or allowed to expire without at least thirty (30) days prior written notice given to the Village. All certificates evidencing coverage extended beyond the date of final payment shall be provided at the time of the final pay request. All Certificates of Insurance shall name the Village as additional insured as provided in these Requirements.

E. The Contractor agrees that the obligation to provide insurance as required is solely the Contractor's responsibility and cannot be waived by any act or omission of the Village, including, but not limited to:

1. allowing work by Contractor or any subcontractor of any tier to start before receipt of Certificates of Insurance; or

2. failure to examine, or to demand correction of any deficiency, of any Certificate of Insurance received.

F. The purchase of insurance by the Contractor under this Agreement shall not be deemed to limit the liability of the Contractor in any way, for damages suffered by the Village in excess of policy limits or not covered by the policies purchased.

G. Such insurance coverages and limits are minimums, and shall not be construed in any way as a limitation on the duty of the Contractor to carry adequate insurance or on Contractor's liability for losses or damages under this Contract.

H. The Contractor shall notify the Village, in writing of any possible or potential claim for personal injury or property damage arising out of the work of this Agreement promptly whenever the occurrence giving rise to such a potential claim becomes known to the contractor.

I. The Contractor shall require every subcontractor of any tier, if any, not protected under the Contractor's policies, to maintain insurance of the same nature in amounts, and under the same terms, as required of the Contractor.