path. The angle of incidence at any point along the path profile (the evaluation point) is found from simple geometry as follows:

$$\gamma_t = \tan^{-1}[(h_t / d_t] \tag{16}$$

for the transmitter, and

$$\gamma_r = \tan^{-1}[(h_r / d_r] \tag{17}$$

for the receiver. The terms h_t, h_r, d_t, and d_r are the transmit antenna height above the evaluation point, the receive antenna height above the evaluation point, and the distances from the evaluation point to the transmitter and receiver, respectively. The evaluation point where $\gamma_t = \gamma_r$ is considered the reflection point. However, it is unlikely that these angles will ever be exactly equal. In such cases, at the two adjacent evaluation points where the angles inflect (i.e. γ_r becomes larger than γ_t), the reflection point is considered to exist along the profile segment defined by the adjacent points. The exact reflection point is then found along this profile segment using linear interpolation since the profile segment is by definition a linear slope. With the distance and elevation of the reflection point established, the reflection angle of incidence γ_0 is found using an equation of the form of Equation (16). This value of γ_0 is then used in Equation (9) or (10) to find the magnitude and phase of the reflection coefficients.

The effect of the nearby ground reflection will be to reduce the amplitude of the directly received ray because, in general, the two rays will add out of phase. The amplitude of the reflected ray will be nearly equal to the direct ray because, at low reflection angles of incidence, $|R| \cong 1.0$ for most practical combinations of frequency, conductivity, and permittivity. For an antenna placed very near the ground, the cancellation calculated through use of these formulas will be almost perfect, so that the directly received (free space) ray will be reduced by 40 dB or more. It is unlikely, however, that such a perfect cancellation will occur in the real world. It is therefore appropriate to put some reasonable limits on the change in amplitude of the directly-received ray that can be caused by a reflection. Based on measurement and theoretical data, the limits placed on change in the free space amplitude due to reflections are -25 dB and + 6 dB.

Thus based on the preceding discussion, the path loss or attenuation term $A_{reflection}$ can be written as:

$$A_{reflection} = 20.0 \log \left[\left(1 + |R| \angle \left(\varphi_r + \Delta\varphi \right) \right) \right] \text{ dB} \tag{18}$$

with the limits that $-6.0 \text{ dB} \leq A_{reflection} \leq 25.0 \text{ dB}$.

Attenuation Due to Partial Obstruction of the Fresnel Zone

When a path is LOS but terrain obstacles are close to obstructing the path, additional attenuation will occur which cannot be accounted for using the ray approach just discussed. The failure of the ray approach to account for attenuation due to a "near miss" of obstacles on the path can be overcome to some extent by including a loss term in the LOS formulation which is based on the extent to which an obstacle penetrates the first Fresnel zone. From diffraction theory, when the ray just grazes an obstacle, the field on the other side is reduced by 6 dB (half the wavefront is obstructed). When the clearance between the obstacle and the ray path is 0.6 of the first Fresnel zone, the change in the field strength at the receiver is 0 dB, and with additional clearance a field strength increase of 6 dB can occur owing to the in-phase contribution from the ray diffracted from the obstacle. For additional clearance, an oscillatory pattern in the field strength occurs.

In the model described, if the ray path clears intervening obstacles by at least 0.6 of the first Fresnel zone, then no adjustment to the receiver field will occur. For the case when an obstacle extends into the 0.6 first Fresnel zone, a loss factor ranging from 0 to 6 dB is applied based on a linear proportion of how much of the 0.6 First Fresnel zone is penetrated. This Fresnel zone path loss or attenuation term can be written as:

$$A_{Fresnel} = 6.0\left(1.0 - \frac{C_{obs}(d_p)}{R_{FR}(d_p)}\right) \text{ dB} \tag{19}$$

where:

$C_{obs}(d_p)$ is the height difference in meters between the ray path and the terrain elevation at distance d_p along the path

$R_{FR}(d_p)$ is the 0.6 first Fresnel zone radius at distance d_p along the path

The values $C_{obs}(d_p)$ and $R_{FR}(d_p)$ are calculated taking into account the effective earth radius using the K factor. The 0.6 first Fresnel zone radius is given by

$$R_{FR}(d_p) = 0.6\left[549.367\sqrt{\frac{d_p(d_r - d_p)}{f\, d_r}}\right] \text{ meters} \tag{20}$$

where f is the frequency in MHz and all distances are in kilometers.

The use of the partial Fresnel zone obstruction loss from 0 dB at 0.6 clearance to 6 dB at grazing also provides a smooth transition into the NLOS mode in which knife-edge diffraction loss just below grazing will start at 6 dB and increase for steeper ray bending angles to receiving locations in the shadowed region. Note that this attenuation factor is

found only for the terrain profile point that extends farthest into the 0.6 first Fresnel zone, not for every profile point which extends into the 0.6 first Fresnel zone.

Summary of Calculation of Field Strength at the Receiver Under LOS Conditions

All of the formulations for computing the field strength at the receiver under LOS conditions are now in place. They can be summarized with the following simple equation:

$$E_r = 76.92 - 20\log(d_r) + P_T - A_{reflection} - A_{Fresnel} \text{ dBuV / m} \tag{21}$$

where $A_{reflection}$ is the change due the reflection in dB from Equation (18), and $A_{Fresnel}$ is the partial Fresnel zone obstruction loss from Equation (19). The term P_T is the effective radiated power (ERP_d) in dBW in the direction of the receiver.

In terms of path loss between two antennas with gains of 0 dBi in the path direction, Equation (21) can be written as:

$$L_{LOS} = 32.45 + 20.0\log f + 20\log d_r + A_{reflection} + A_{Fresnel} \quad \text{dB} \tag{22}$$

Non-Line-of-Sight (NLOS) Mode

The mechanism for deciding when to use the LOS mode and when to use the NLOS mode is described at the beginning of the subsection on Line-of-Sight Mode above. When the model elects to use the NLOS formulations to follow, it means that one or more terrain or other features obstructs the ray path directly from the transmitter to the receiver. In this case, the free space field strength is further reduced for the attenuation caused by the obstacles. For the model defined here, the calculation of obstruction loss over an obstacle is done by assuming the obstacle is a perfect electrical conductor rounded obstacle with a height equal to the elevation of the obstruction and a radius equal to 1 meter. Diffraction loss in this model is calculated assuming individual obstacles on the path can be modeled as isolated rounded obstacles. The losses from multiple isolated obstacles are then combined.

Diffraction Loss

The loss over an individual rounded obstacle is primarily a function of the parameter v that is related to the path clearance over the obstacle. The total diffraction loss, $A(v,\rho)$, in dB, is the sum of three parts — $A(v,0)$, $A(0,\rho)$, and $U(v,\rho)$. The equations to calculate the total and the three parts are given below:

$$A(v,\rho) = A(v,0) + A(0,\rho) + U(v,\rho) \tag{23}$$

$$A(v,0) = 6.02 + 9.0v + 1.65v^2 \quad \text{for } -0.8 \le v \le 0 \tag{24}$$

$$A(v,0) = 6.02 + 9.11v + 1.27v^2 \quad \text{for } 0 < v \le 2.4 \tag{25}$$

$$A(v,0) = 12.593 + 20\log_{10}(v) \quad \text{for } v > 2.4 \tag{26}$$

$$A(0,\rho) = 6.02 + 5.556\rho + 3.418\rho^2 + 0.256\rho^3 \tag{27}$$

$$U(v,\rho) = 11.45v\rho + 2.19(v\rho)^2 - 0.206(v\rho)^3 - 6.02 \text{ for } v\rho \le 3 \tag{28}$$

$$U(v,\rho) = 13.47v\rho + 1.058(v\rho)^2 - 0.048(v\rho)^3 - 6.02 \quad \text{for } 3 < v\rho \le 5 \tag{29}$$

$$U(v,\rho) = 20v\rho - 18.2 \quad \text{for } v > 5 \tag{30}$$

where the curvature factor is

$$\rho = 0.676R^{0.333} f^{-0.1667} \sqrt{\frac{d}{d_1 d_2}} \tag{31}$$

The obstacle radius R is in *kilometers*, and the frequency f is in MHz. The distance term d is the path length from the transmitter (or preceding obstacle) to the receiver (or next obstacle), d_1 is the distance from the transmitter (or preceding obstacle) to the obstacle, and d_2 is the distance from the obstacle to the receiver (or next obstacle). When the radius is zero, the obstacle is a knife edge, and $A(v,\rho) = A(v,0)$.

The parameter v in the equations above takes into account the geometry of the path and can be thought of as the bending angle of the radio path over the obstacle. It is computed as:

$$v = \sqrt{\frac{2d\tan(\alpha)\tan(\beta)}{\lambda}} \tag{32}$$

where d is the path length from the transmitter (or preceding obstacle) to the receiver (or next obstacle), α is the angle relative to a line from the transmitter (or preceding

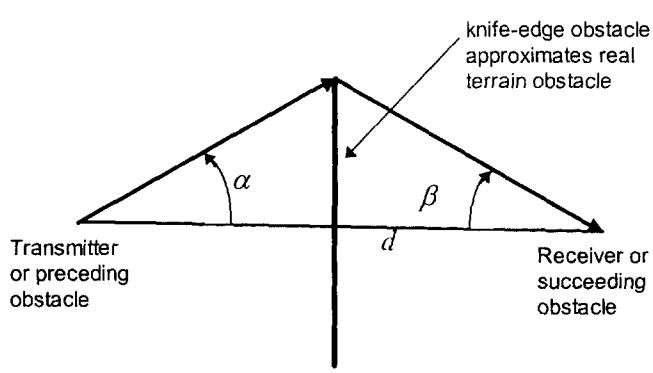

Figure 1. Geometry for computing v

obstacle) to the receiver (or next obstacle), and β is the angle relative to a line from the receiver (or next obstacle) to the transmitter (or preceding obstacle). The definitions of α and β are shown in Figure 1. For the multiple obstacle case, obstacles are treated successively as transmitter-obstacle-receiver triads to construct the path geometry and bending angle v over each obstacle. The value of v is then used to calculate the diffraction loss over each obstacle. The resulting obstacle losses are summed to arrive at the total obstacle diffraction loss for the path.

Summary of Calculation of Field Strength at the Receiver Under NLOS Conditions

The field strength at the receiver in the NLOS mode can then be written as:

$$E_r = 104.77 - 20\log(d_r) + P_T - A_{diff} \text{ dBuV / m} \tag{33}$$

where all the terms have the same definitions as given in the preceding subsection and the term A_{diff} is defined as:

$$A_{diff} = \sum_{n=1}^{\text{NOBS}} A_n(v,\rho) \text{ dB} \tag{34}$$

where $A(v,\rho)$ is defined in Equation (23).

The corresponding path loss between antennas with 0 dBi gain in the path direction can be written as:

$$L_{NLOS} = 32.45 + 20.0\log f + 20\log d_r + A_{diff} \text{ dB} \tag{35}$$

File Format

To facilitate the exchange of data on the relatively complex systems that can be designed under these Rules, a file format is defined for Submission with MDS/ITFS Two-Way Applications for the description of systems and for supplying the results of many of the calculations required in this document. The file format shall be used in addition to any requirements in the Rules or elsewhere for supplying information on paper forms. The file format shall be supplied to the Commission for inclusion of the data in the Commission's on-line database, and the file format shall be supplied on appropriate media to all parties required to be served with notice of applications and/or engineering

studies. The media and basic formatting of that media[4] are defined by ISO/IEC Standards 9293,[5] 9529-1,[6] and 9529-2.[7]

The remainder of this document outlines the format of technical information regarding each Response Service Area (RSA) to be submitted with each MDS/ITFS two-way application. The data shall appear in a number of sections for the purpose of grouping similar items within the file. Data shall be coded in an ASCII-formatted,[8] comma-delimited file. Carriage return (0Dh) and line feed (0Ah) characters shall be placed at the end of each line in the file, as is normal when using standard text editors. To help in identifying data, where file sections are formatted as tables, the first entry in each row within a table shall be a sequence number indicating the position of the row within the table. To the extent possible, the sequence number shall be representative of the type of data contained on the row, such as the number of degrees of azimuth or elevation.

A generic example of the required file construction appears at the end of this section and may be used as a template for the submission of data. As shown there, section titles shall appear on a separate line in square brackets "[ ]" and shall be separated from the preceding sections and from the data within their own sections by a blank line. Headers shall appear on the top line of the data contained within a section. Headers may contain data and may also help with both human and machine readability.

Units of measure that are to be utilized for all information supplied in the file are:

Latitude – Degrees, Minutes, Seconds (DD,MM,SS)
Longitude – Degrees, Minutes, Seconds (DDD,MM,SS)
Azimuth or Bearing – Degrees (to 1 decimal place)
Radius – Miles (to 2 decimal places)
Ground Elevation – Feet AMSL (to 0 decimal places)

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[4] The cited ISO/IEC standards describe disks having a formatted capacity of 1.44 Mbytes. It is intended to allow the use of disks of other capacities (such as 720 kBytes) based upon the same techniques as and compatible with the disks described in the specified standards.

[5] ISO/IEC 9293: 1994, Information Technology — Volume and File Structure of Flexible Disk Cartridges for Information Interchange

[6] ISO/IEC 9529-1:1987, Information Processing Systems— Data Interchange on 90 mm (3.5 in) Flexible Disk Cartridges Using Modified Frequency Modulation Recording at 15916 ftprad on 80 Tracks on Each Side — Part 1: Dimensional, Physical and Magnetic Characteristics.

[7] ISO/IEC 9529-2:1987, Information Processing Systems — Data Interchange on 90 mm (3.5 in) Flexible Disk Cartridges Using Modified Frequency Modulation Recording at 15916 ftprad on 80 Tracks on Each Side — Part 2: Track Format

[8] ANSI X3.4-1986 (R1992), Coded Character Set — 7-Bit American National Standard Code for Information Interchange

Antenna Height – Feet AGL (to 0 decimal places)
Antenna Tilt – Degrees (to 1 decimal place)
Power (EIRP) – dBW (to 2 decimal places)
Antenna Gain – dBi (to 2 decimal places)

1. General Information

Section Title: "General Info"

Entries:
File Number (Assigned by Commission)
Licensee name
City/State of hub location
Coordinates of hub location
Ground Elevation of hub location (feet)
Call sign/file number of station being modified (if applicable)
City/State of station being modified

2. Geographic Boundary Definitions – Circular Areas Only

Section Title: "Circular Geographic Areas"

Section Header: RSA Circular (0 or 1), Regions Circular (00 or RR, where RR = total # of circular regions)

Entries:
00, RSA Center Latitude, RSA Center Longitude, RSA Radius (omit entries other than leading 00 if RSA is non-circular)
01, Region 01 Center Latitude, Region 01 Center Longitude, Region 01 Radius
02, Region 02 Center Latitude, Region 02 Center Longitude, Region 02 Radius
:
:
RR, Region RR Center Latitude, Region RR Center Longitude, Region RR Radius

The geographic area of an RSA or region may be described by a circle having a defined center point location and a radius. If the RSA is circular, then RSA Circular = 1, otherwise 0.

If there are circular regions, then Regions Circular = the number of such regions, RR. Otherwise, Regions Circular = 00.

3. Geographic Boundary Definitions – Non-Circular Areas

Section Title: "Non-Circular Areas"

Section Header: RSA Non-Circular (0 or 1), Regions Non-Circular (00 or NN, where NN = total # of non-circular regions), # of points defining RSA (XXX), # of points defining region RR+1 (AAA), ..., # of points defining region RR+NN (ZZZ)

Entries: RSA Latitude (001), RSA Longitude (001), Region 01 Latitude (001), Region 01 Longitude (001), ..., Region NN Latitude (001), Region NN Longitude (001)

RSA Latitude (002), RSA Longitude (002), Region 01 Latitude (002), Region 01 Longitude (002), ..., Region NN Latitude (002), Region NN Longitude (002)

:

:

RSA Latitude (XXX), RSA Longitude (XXX), Region 01 Latitude (AAA), Region 01 Longitude (AAA), ..., Region NN Latitude (ZZZ), Region NN Longitude (ZZZ)

The geographic descriptions of an RSA in the sections for Circular Areas Only (Section 2) and for Non-Circular Areas are mutually exclusive. One of them shall have the RSA indicator set to 1; the other shall be set to 0. Any RSA data contained in the section with the RSA indicator set to 0 shall be ignored.

Regions of both types, i.e., circular and non-circular, are permitted within a single RSA. Regions in this non-circular section shall be numbered sequentially continuing from the last region number in the circular section, i.e., from RR+1 to RR+NN, so that all regions have unique region numbers.

4. Hub Sectorization Data

Section Title: "Sectorization"

Section Header: # of sectors within RSA (SS)

Entries: "Sector 01," Hub Receive Antenna Pattern #, Gain, Azimuth of Main Lobe, Height AGL, Mechanical Beam Tilt, Polarization, Max Simultaneous Transmitters

"Sector 02," Hub Receive Antenna Pattern #, Gain, Azimuth of Main Lobe, Height AGL, Mechanical Beam Tilt, Polarization, Max Simultaneous Transmitters

:

:

"Sector (SS)," Hub Receive Antenna Pattern #, Gain, Azimuth of Main Lobe, Height AGL, Mechanical Beam Tilt, Polarization, Max Simultaneous Transmitters

Each sector is to be assigned a number beginning with the sector whose main lobe azimuth is pointing due north or the closest to due north when proceeding in a clockwise direction from true north.

The receiving antenna pattern used in each sector is defined in the Antenna Pattern Data section, and the association of each sector with a specific antenna pattern is made here. This pattern shall be used in the calculation of potential interference to a hub from surrounding stations.

The geographic definition of each sector is found in the Sector Geographic Definitions section.

Mechanical beam tilt for each hub receiving antenna is specified in this section. Tilting the antenna downward is defined using a positive number.

The polarization of each sector is defined as either horizontal or vertical.

The maximum number of transmitters that can operate simultaneously on the channel or any subchannel within each sector is specified in this section.

5. Grid Point Definitions

Section Title: "Grid Points"

Table Header: # of grid points (MMMM)

Entries: Point 0001: Latitude, Longitude, Elevation, Region # in which Located, Bearing to Hub, Polarization (H, V, or B), Number of associated Class(es) of Station(s), Class Designators

Point 0002: Latitude, Longitude, Elevation, Region # in which Located, Bearing to Hub, Polarization (H,V, or B), Number of associated Class(es) of Station(s), Class Designators

:

:

Point MMMM: Latitude, Longitude, Elevation, Region # in which Located, Bearing to Hub, Polarization (H,V, or B), Number of associated Class(es) of Station(s), Class Designators

The header specifies the total number of grid points (MMMM) defined in the Grid Point Definition Table.

The location of each grid point is defined by latitude and longitude. The bearing from the grid point to the hub is specified. The region in which the grid point is located is indicated using the region number assigned in the sections above giving geographic boundary definitions. Grid points not located in specifically defined regions shall be indicated as being in Region 00, which describes the remainder of the RSA.

Polarization for each grid point must be specified as horizontal (H), vertical (V), or both (B). In areas where sectors having opposite polarizations overlap, it may be desirable to have the flexibility to utilize both polarizations. If so, grid points in these overlapping areas must be specified as B, both polarizations.

Each grid point must be assigned at least one class of station. Assignment of multiple classes to a single grid point is also permitted.

6. Sector Geographic Definitions

Section Title: "Sector Definitions"

Table Header: # of sectors (SS), Bearings or Coordinates (B or C)

Entries:
(Bearings)

"Sector 01," Start Bearing, Stop Bearing
"Sector 02," Start Bearing, Stop Bearing
:
"Sector SS," Start Bearing, Stop Bearing

OR

Table Header: # of sectors (SS), Bearings or Coordinates (B or C), # of Coordinates in sector 01 (CC1), # of Coordinates in Sector 02 (CC2), ..., # of Coordinates in sector SS (CCC)

Entries:

Sector 01 Latitude (001), Sector 01 Longitude (001), Sector 02 Latitude (001), Sector 02 Longitude (001), ..., Sector SS Latitude (001), Longitude Sector SS (001)

Sector 01 Latitude (002), Sector 01 Longitude (002), Sector 02 Latitude (002), Sector 02 Longitude (002), ..., Sector SS Latitude (002), Sector SS Longitude (002)
:
:
Sector 01 Latitude (CC1), Sector 01 Longitude (CC1), Sector 02 Latitude (CC2), Sector 02 Longitude (CC2), ..., Sector SS Latitude (CCC), Sector SS Longitude (CCC)

Sector geographic boundaries can be described in either of two ways: (1) as straight lines radiating out from the hub location at the specified bearings until they cross the

outer boundary of the RSA, or (2) as sets of coordinates between which straight boundary lines exist that describe closed geographic areas. In either case, sectors may overlap, and, when they do, grid points in the overlap areas must be analyzed as though they were included exclusively within each sector. When sets of coordinates are used, the last coordinate pair shall be assumed to connect to the first such pair.

7. Response Station Class Data

Section Title: "Class Info"

Table Header: # of classes (CL)

Entries: "Class 1," Worst Case Ant Pattern #, Max Height, Max Power, Number of Regions in Which Used, Region(s) in Which Used, Maximum Simultaneous Number within Each Region

"Class 2," Worst Case Ant Pattern #, Max Height, Max Power, Region(s) in Which Used, Maximum Simultaneous Number within Each Region

:

:

"Class CL," Worst Case Ant Pattern #, Max Height, Max Power, Region(s) in Which Used, Maximum Simultaneous Number within Each Region

Classes are defined by the combination of the worst case antenna pattern, the maximum height above ground level (AGL) at which the antennas may be mounted, and the maximum power (EIRP) they may emit.

Associated with each class description is one or more pairs of values indicating the region numbers in which the class is used and the maximum number of transmitters that may transmit simultaneously on the channel or on each subchannel within each region. The two types of values alternate, and one pair is present for each region in which the particular class is used. The regions shall be listed in ascending numerical order.

8. Antenna Pattern Data (Hub Receive and Worst Case Response Transmit)

Section Title: "Antenna Patterns"

Table Header: # hub antenna patterns (HP), # of worst case response station transmit antenna patterns (RP)

Entries: 000, Hub (1) Plane Azimuth, Hub (1) Cross Azimuth, Hub (1) Plane Elevation, Hub 1 Cross Elevation, Hub (2) Plane Azimuth, Hub (2) Cross Azimuth, Hub (2) Plane Elevation, Hub (2) Cross

Elevation, ..., Hub (HP) Plane Azimuth, Hub (HP) Cross Azimuth, Hub (HP) Plane Elevation, Hub (HP) Cross Elevation, Response (1) Plane Azimuth, Response (1) Cross Azimuth, Response (2) Plane Azimuth, Response (2) Cross Azimuth, ..., Response (RP) Plane Azimuth, Response (RP) Cross Azimuth

001, Hub (1) Plane Azimuth, Hub (1) Cross Azimuth, Hub (1) Plane Elevation, Hub (1) Cross Elevation, Hub (2) Plane Azimuth, Hub (2) Cross Azimuth, Hub (2) Plane Elevation, Hub (2) Cross Elevation, ..., Hub (HP) Plane Azimuth, Hub (HP) Cross Azimuth, Hub (HP) Plane Elevation, Hub (HP) Cross Elevation, Response (1) Plane Azimuth, Response (1) Cross Azimuth, Response (2) Plane Azimuth, Response (2) Cross Azimuth, ..., Response (RP) Plane Azimuth, Response (RP) Cross Azimuth

:

:

359, Hub (1) Plane Azimuth, Hub (1) Cross Azimuth, Hub (1) Plane Elevation, Hub (1) Cross Elevation, Hub (2) Plane Azimuth, Hub (2) Cross Azimuth, Hub (2) Plane Elevation, Hub (2) Cross Elevation, ..., Hub (HP) Plane Azimuth, Hub (HP) Cross Azimuth, Hub (HP) Plane Elevation, Hub (HP) Cross Elevation, Response (1) Plane Azimuth, Response (1) Cross Azimuth, Response (2) Plane Azimuth, Response (2) Cross Azimuth, ..., Response (RP) Plane Azimuth, Response (RP) Cross Azimuth

The hub receiving antenna patterns and response station transmitting antenna patterns shall be defined in 1 degree increments beginning with 0 degrees and ending at 359. All entries shall be in dB relative to the peak response. Both azimuth and elevation patterns shall be entered from 0 to 359 degrees. In cases where elevation data is known only over a limited range, just the known points should be entered. For example, if elevation data is known from –10 degrees to +20 degrees of elevation, this data should be entered beginning at 350 and ending at 20. For angles at which data is not available, a space (20h) shall be inserted as a place holder.

Example File & Template

In the example file and template below, formatting elements and descriptive terms to be included in the submitted file exactly as shown are in `plain text`. Those items to be replaced by real data and shown here as place holders for purposes of example are shown in *`italicized text and CAPITAL LETTERS`*.

```
[General Info]

File FILE NUMBER
Licensee LICENSEE NAME
Hub Lat DDMMSS, Hub Lon DDDMMSS
```

```
Hub City CITY, ST
Elevation AMSL FEET
Call CALL SIGN
Stn City CITY, ST

[Circular Geographic Areas]

RSA 0/1, Regions 00/RR
00,DDMMSS,DDDMMSS,MI.MM
01,DDMMSS,DDDMMSS,MI.MM
02,DDMMSS,DDDMMSS,MI.MM
:: :::::: ::::::: ::::::
:: :::::: ::::::: ::::::
RR,DDMMSS,DDDMMSS,MI.MM

[Non-Circular Areas]

RSA 0/1, Regions 00/NN
00,XXX,RR+1,AAA,RR+2,BBB,...,RR+NN,ZZZ
001,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,...,DDMMSS,DDDMMSS
002,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,...,DDMMSS,DDDMMSS
:::,
:::,
ZZZ,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,...,DDMMSS,DDDMMSS

[Sectorization]

Sectors SS
Sector, Hub Pat, Gain, Az, AGL, Tilt, Pol, Max # Trans
01,HP,dB.dB,DDD.DD,FFFF,DD.D,H/V,TTTT
02,HP,dB.dB,DDD.DD,FFFF,DD.D,H/V,TTTT
03,HP,dB.dB,DDD.DD,FFFF,DD.D,H/V,TTTT
:: :: :: :: ::: :::: :: : : : ::::
:: :: :: :: ::: :::: :: : : : ::::
SS,HP,dB.dB,DDD.DD,FFFF,DD.D,H/V,TTTT

[Grid Points]

Points MMMM
Pnt, Lat, Lon, Elev, Regn, Bearing, Pol, # Classes, Class Designators...
0001,DDMMSS,DDDMMSS,FFFF,R#,DDD.DD,H/V/B,###,CC1,CC2,CC3,...CC###
0002,DDMMSS,DDDMMSS,FFFF,R#,DDD.DD,H/V/B,###,CC1,CC2,CC3,...CC###
0003,DDMMSS,DDDMMSS,FFFF,R#,DDD.DD,H/V/B,###,CC1,CC2,CC3,...CC###
:::: :::::: ::::::: :: :: :::: : : : ::: ::: ::: :::     :::
:::: :::::: ::::::: :: :: :::: : : : ::: ::: ::: :::     :::
MMMM,DDMMSS,DDDMMSS,FFFF,R#,DDD.DD,H/V/B,###,CC1,CC2,CC3,...CC###

[Sector Definitions]

Sectors SS, Type B
01,DD.DD,DD.DD
02,DD.DD,DD.DD
03,DD.DD,DD.DD
:: :: :: :: ::
```

```
:: :: :: :: ::
SS,DD.DD,DD.DD
```

OR

```
Sectors SS, Type C,01,CC1,02,CC2,03,CC3,...SS,CCC
001,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,...DDMMSS,DDDMMSS
002,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,...DDMMSS,DDDMMSS
003,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,...DDMMSS,DDDMMSS
::: :::::: ::::::: :::::: ::::::: :::::: :::::::    :::::: :::::::
::: :::::: ::::::: :::::: ::::::: :::::: :::::::    :::::: :::::::
CCC,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,DDMMSS,DDDMMSS,...DDMMSS,DDDMMSS

[Class Info]

Classes CL
Class, Pattern, AGL, Max EIRP, # Reg, Reg, Max # Tx
01,PAT,HHH,dB.dB,##,R1,##R1,R2,##R2,...RG,##RG
02,PAT,HHH,dB.dB,##,R1,##R1,R2,##R2,...RG,##RG
03,PAT,HHH,dB.dB,##,R1,##R1,R2,##R2,...RG,##RG
:: ::: ::: :: :: :: :: :::: :: ::::    :: ::::
:: ::: ::: :: :: :: :: :::: :: ::::    :: ::::
CL,PAT,HHH,dB.dB,##,R1,##R1,R2,##R2,...RG,##RG

[Antenna Patterns]

Hub HP, Response RP
Deg,H01PA,H01CA,H01PE,H01CE,H02PA,H02CA,H02PE,H02CE,...HHPPA,HHPCA,HHPPE
,HHPCE,R01PA,R01CA,R01PE,R01CE,R02PA,R02CA,R02PE,R02CE,...RRPPA,RRPCA,RR
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