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REPORT TO the
REGULATORY COMMISSION of ALASKA
On
UNITED UTILITIES
RURAL ALASKA BROADBAND INTERNET
ACCESS GRANT

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Report to the Regulatory Commission of Alaska On United Utilities Rural Alaska Broadband Internet Access Grant

INTRODUCTION

In November of 2003, United Utilities Inc. submitted a grant request to the Regulatory Commission of Alaska for the purpose of providing broadband internet service in the Yukon-Kuskowim Delta region. They proposed to add facilities to an existing terrestrial microwave backbone which provides telephone service to several communities in the area.

In a separate grant from the Yukon-Kuskokwim Healh Corporation, United Utilities, Inc. proposed to provide telemedicine services to enhance diagnosis and treatment by village health aids.

The proposal to the RCA was to enhance the existing microwave backbone for broadband internet and intranet service, and to add buildings and towers to communities that had limited existing service..

However, as stated in a letter from Steve Hamlin, President and CEO of UUI, the bid amount for the grant was based upon historical experience from several previous construction projects in the area. They subsequently determined that the conditions under which this project had to be built had changed dramatically, i.e. that later geotechnical evaluation of permafrost issues indicates that the permafrost temperatures are rising in some regions. Warm permafrost has not been an issue for anyone involved in arctic and subarctic construction, being a new phenomenon possibly brought on by global warming.

The Electronics Industry Alliance (EIA) promulgates technical standards in association with the American National Standards Institute (ANSI) and has upgraded the national tower standard from F to G recently, which requires more stringent oversight respective to tower and wind loading, and this affects the foundation engineering. UUI's previous towers were designed and built under EIA tower standard F and I'm reasonably sure that they didn't take the pending EIA standard G into account as it required more complex considerations.

Tower construction standards undergo minor revisions every three to five years and a major revision happens about every ten to twenty years as the engineering profession advances its knowledge about structural loading, evaluating catastrophic tower failures and the advances in structural engineering design. Standard F did not address many outstanding issues that were added to Standard G, such as geotechnical soil evaluation, more stringent windloading calculations with more wind categories and a specific map for each state, adding seismic activity in certain areas prone to earthquakes. Safety standards were also upgraded to more closely match the standards of OSHA. The standard also complies more closely with the

International Building Code, and local codes are based on the IBC. When the changes were made, this was the largest modification to tower standards ever done. Refer to Exhibit G for more background on this revision.

As a result of this, UUI brought back an engineer who had previously worked for them, David Heimke. Dave proceeded to look into variables that might affect the tower, foundation and building designs. They brought Bratslavsky Consulting Engineers, a structural engineering firm and Duane Miller & Associates, a group that specializes in arctic geotechnical studies on board when concern was voiced about permafrost issues and the more stringent requirements as a result of EIA 222-G.

The resulting engineering study determined that the warm permafrost was a real issue that has not been commonly addressed. It was determined that several changes in structural design were necessary to mitigate the problems of warm permafrost, which resulted in the need for additional steel and equipment to keep the permafrost temperatures low. Also, the added mobilization/demobilization requirements would impact the projects.

Because of these design and logistic revisions, UUI requested additional money in the grant to offset the cost increases. This request increased their bid amount by nearly 200%.

METHODOLOGY

At the request of the RCA, this report is tasked to evaluate the reasonableness of engineering revisions to the construction of buildings and towers as well as the foreseeability or lack thereof respective to new structural requirements. Specifically, would all of the changes made in the design be necessary to support the rural broadband internet grant. Because of the additional services (telephone and telemedicine), the requirements are more stringent than a design for strictly internet operations. A telco is required to design their systems to "five nines" standards (a 99.999% reliability) if possible. In the real world, practical considerations such as terrain and other aspects affecting signal transmission may not allow this level of reliability, but it is a factor in the actual FCC licensing process (Exhibit H). Several elements need to go into planning a microwave system that would necessarily go above and beyond the requirements for transporting internet and intranet traffic. The reliability factor includes adding redundancy, such as hot standby radios, diversity antenna systems and the largest practical antennas to ensure good signal strength under various conditions.

Our company has been building facilities and towers in arctic and sub-arctic regions since 1980, and we have considerable experience in the unique problems associated with construction on tundra and in environments where it is necessary to depend upon permafrost for foundation stability. This experience will factor in to the evaluation of the changes that were made in the structural engineering for this project.

After initial interviews with RCA staff and researching documents, letters and getting familiar with the historical timeline of the grant process, it was necessary to meet with the UUI staff to develop a better understanding of their perspective. We had a presentation by David Heimke, Senior Engineer for UUI. Mr. Heimke outlined the various permutations necessary to arrive at the revised project engineering.

The next step was to meet with Tanya Bratslavsky, principal of Bratslavsky Conulting Engineers, in order to get an in-depth appraisal of the steps taken to determine revisions. Mr. Heimke was in attendance as well.

We had a final meeting at Bratslavsky Consuling Engineers to get specific data and plans for Bethel, Kongigank and Tuntutuliak.

Finally, there was a compilation of collective data and other information in order to get a better assessment of the rationale for the design determinations.

PROCEDURAL DISCUSSION

On March 2, 2005 we held a meeting at United Utilities wherein their Senior Engineer, David Heimke, gave a presentation to reflect the historical timeline of events leading up to the request for cost revisions. These revisions to the original design parameters came about after it was determined that the basis for original tower and building designs was flawed, and/or inadequate for the purpose of an interconnected terrestrial microwave link.

This microwave backbone will extend, in addition to broadband internet interconnectivity, telco services and a telemedicine project in association with the Yukon-Kuskokwim Health Corporation.

The original design of buildings and towers on which the grant application was bid had been based upon historical data from prior construction projects for United Utilities. However, Mr. Heimke was not employed by UUI at the time this information was gathered, and upon his return, his evaluation of the system led to a rethinking of the viability of many of the sites as currently configured.

Subsequent geotechnical studies and soil samples gave rise to a phenomenon not previously observed in arctic and sub-arctic regions. It was determined that the permafrost temperatures had risen slightly, and this has, at least for now, been attributed to global warming. The integrity of the permafrost is essential for construction in these regions, as it becomes the footing and foundation because the tundra cannot support loads.

In previous construction, it has been noted that piles driven into permafrost can transfer heat down to the permafrost and make it unstable. I've seen evidence of this in the mid-80's during a project in Bethel. While doing work for KYUK, I noticed that workers were jacking up and shimming parts of the building, as some of the wooden piles had begun to sink.

In 1991 in Barrow we began a construction project for a 400 foot guyed tower for KBRW. We hired LCMF to engineer the foundations for building and tower plus guy anchors. The utilized a combination of insulation and a thermosyphon for the tower and guys. The concern at the time was to mitigate the transfer of heat into the permafrost. However, we did not address the possibility of the permafrost temperature rising as the result of external events, such as global warming.

As a result of the geotechnical evaluations performed by Duane Miller of Duane Miller and Associates, UUI hired Bratslavsky Consulting Engineers to address these concerns and recommend structural changes.

On the 9th of March, we had a meeting with Tanya Bratslavsky and David Heimke to get her assessment of the problem and how she arrived at her conclusions and solutions. With Mr. Miller's computer modeling of the permafrost temperatures, she derived plans that included increasing pile mass and temperature abatement by cooling the piles. In addition, it was determined to add temperature monitoring equipment to the piles to monitor any potential changes in permafrost temperatures. By Ms. Bratslavsky's own explanation, she indicated that the outcome was not an overly conservative or extreme over-design, but one that would specifically address the concerns of heat transfer, both directly via the piles or indirectly as a result of external warming. Additionally, the design was influenced by the wind load on the structure.

The resulting re-design has in a much larger footprint for each tower leg support. Considering the height of some of these towers and the windloading, this extra mass was deemed necessary. The towers will have in some instances, four ten foot parabolic antennas and in other cases 8 foot antennas, with two antennas aimed at the same path azimuth for diversity reception (to reduce signal fades). According to the Andrew catalog, at a wind force of 125MPH, the axial (head-on) windoad is 2,712 lbs. for a ten foot antenna with radome, and 1,736 lbs. for an eight foot. The two antennas would double this force, but the backside of the other antennas will also have added forces. The waveguides are additional winload generators, as is the tower structure itself, and it would not be unlikely to have in excess of 8,000 lbs. of load. At different wind directions there is also a twisting force that will act on the tower. For the purpose of further discussion, if a six foot antenna were employed, its windload would be 976 lbs.

Tower manufacturers give foundation specifications based upon the calculated windload (different under G, with more complex requirements for icing and seismic events).The structural engineer must adhere to the requirements of standard G, which now includes the actual geotechnical soil evaluation with regard to load support, uplift, and the problems of using permafrost as the foundation. The active layer above the permafrost has little or no capacity for support; therefore the effective height of the tower is larger, as the piles become part of the tower until they are imbedded in permafrost.

The Bratslavsky structural design has taken into account the aforementioned problems of warm permafrost and the additional requirements of EIA RS-222-G by adding two or three piles per leg. This has the effect of increasing the area of the pile face and therefore the load on the permafrost becomes exponentially less with the increase in pile surface area. The design took into account the soil studies for each location, which in turn determined the pile design for each site. It would also be apparent that larger towers will have more loading and require additional piles, therefore some sites utilized three per leg and some require four.

The logistical hurdles for construction in this region are many and complex, and it only stands to reason that when the scope of the projects expands due to the aforementioned engineering concerns, costs will increase. We've engaged in discussions about the increasing cost of steel, but the addition of multiple piles adds to that burden, both in terms of requiring more steel, additional freight expense and more complex installation requirements.

Mr. Heimke's discussion of how they planned and staged each phase, such as coordinating personnel and equipment with other non-related projects, seems prudent. The use of as much local labor and equipment as possible should result in some cost savings. As mentioned in one of our meetings, the inability to work on unfrozen tundra is a further complication, as some equipment must be staged in the summer or fall but cannot be employed until winter.

While the overall engineering design of this system is not overbuilt for the class of service(s) that are to be provided, and was designed prudently to be more robust to meet the reliability goal, there are significant differences from a single use design. A system that is designed to provide inter/intranet connectivity does not need to meet the stringent factors assigned to telephone operations, with their life-safety consequences. An internet outage would not be a catastrophic occurrence. It happens to my cable modem all the time. Therefore, according to my calculations to mimic Micronet Communications engineering evaluations (Exhibit H), a system dedicated to internet traffic could get by with smaller antennas (8 foot or even 6 foot, with less fade margin). There would also be no need for diversity antennas unless there was a significant ongoing problem on a certain path. This would result in smaller towers (diversity antennas need 20 to 40 feet of spacing, requiring a taller tower to achieve this). Less windloading and lighter towers would reduce the cost of towers, and in most instances the lighter loads would result in less need for the robust pile designs. However, consideration still must be given to permafrost issues, so thermosyphons and monitoring would still be needed.

TECHNICAL DISCUSSION

The Bethel hub feeds a satellite uplink to allow connection to the worldwide web, and the terrestrial microwave system with a capacity of 155.52 megabits per second (Mbps). The standard for this bandwidth is known as OC3 (Optical Carrier 3). This is the equivalent of about one hundred T1's (a T1 has the capacity for twenty-four telephone circuits and a digital bandwidth of 1.544Mbps).

This somewhat technical discussion is to underscore the engineering requirements for predicting capacity in a given transmission system. A typical broadband internet connection might provide 256Kbps inbound to a computer and 64Kpbs outbound. The engineer must add the predicted internet, telco and other (video, telemedicine, etc. plus housekeeping data) load and allow for future growth in determining the operating bandwidth. A single 3000Hz telephone circuit, depending upon outside variables, should require 26.63Kbps. However, it is not possible to apply an iron-clad rule respective to analog frequency bandwidth required for a given digital bit rate. This is because of variances in digital modulating schemes, and the variable compression ratios that can be employed.

Under SONET (Synchronous Optical Network) of which OC3 is a subset, the bandwidth can extend from 51.8Mbps (T3) to 2.48Gbps, so the proposed system is at the lower end of the digital bandwidth specification.

Another engineering element is the proper design of the transmission and receive systems to ensure that they perform with adequate signal strength (fade margin-it's prudent to be as conservative as possible, generally shooting for margins in excess of 45dB). These engineering parameters are also necessary for submittal to the FCC for licensing.

The engineering for each path must take into account the operating frequency (6GHz in this case), transmitter power, receiver gain, antenna gain, loss in the transmission lines and, most critically, path loss. The size of each antenna is dictated by the results of such calculations. Antennas in this particular band come in 6, 8, 10, 12 and 15 foot diameters. Antenna gain is a function of the operating frequency and the size of the antenna. The higher the operating frequency, the greater the antenna gain for a given diameter. In this case, 6GHz is at the lower end of the spectrum, reserved for telco and C band satellite transmission. Therefore the antennas must be larger to achieve a given gain. In this system with typical paths in excess of 20 miles and in some instances approaching 40 miles, the path loss dictates higher gain antennas. As previously noted, space diversity is employed to take into account any path fades that may result from atmospheric or terrain problems such as fresnel zone clearance (terrain or objects that are near the microwave signal path, more problematic at lower frequencies), over-water paths (signal can reflect off of water and cancel out all or part of the signal) or knife-edge diffraction (skimming a ridge or mountain top which can bend the signal). The antennas are spaced at different elevations on the tower to mitigate signal loss due to changes in the path characteristics.

Equipment requirements to provide these various classes of service will determine the physical plant size (building footprint, power requirements and HVAC as well as amount of rack space required for electronics).

SITE EVALUATION OF BETHEL, KONGIGANAK AND TUNTUTULIAK

Bethel, while not part of this grant was studied because it is the hub of the UUI microwave backbone and satellite uplink system.

The tower is located at Lat. 60-46-53.8/Long. 161-53-1.6 where ground AMSL (Above Mean Sea Level) is 151 feet. The tower is 221 feet high. As this is the hub tower, it will have the most antenna load, thus the highest wind load. (Ref. Exhibit A-A4). The tower is a Microflect with 4 legs, and there are four piles per leg (Ref. Exhibit A4). Spacing requirements result in a very large pile cap for each set of piles, spaced over 91/2 feet apart (A1, A2). The piles are driven to a depth of nearly fifty feet.

The aforementioned permafrost issues at many sites, where the permafrost temperatures are approaching thirty degrees (Ref. Exhibit E-E3, data compiled by Duane Miller & Associates). This results in the requirement for thermosyphons to extract heat from the permafrost layer, insulation blankets to minimize heat buildup in the summer when the thermosyphons don't operate, and thermistors for temperature monitoring.

These precautions are necessary because of several factors in addition to the permafrost issues. The tower load is severe (Exhibit A) and the EIA tower specification has been raised another level to G (Exhibit G), resulting in an increased need to be more conservative with respect to tower reactions.

Buildings in this region are constructed on piles to minimize heat transfer and to allow snow to blow under rather that pile up against the windward side of the structure. In addition, these telecom buildings are prefabricated out of state specifically for the environment in which they will be used.

It may be noted that the latitude and longitude as well as the tower heights may differ slightly from those in the grant proposal and the engineering exhibits. This probably resulted from one of several factors: Land availability, Micronet's calculations may have given substandard reliability, or some logistical or construction problem relative to the original. In any event, there is no impact on the operation of the system, but in the case of availability or logistics, there may have been some cost savings. These figures have been retrieved from the FAA website for tower registration, with the exception of Tuntutuliak which did not appear on the FAA database, and may not yet be registered. The FCC and FAA require all towers to be registered, and accurate height and location are necessary, both for FCC technical reasons and for FAA safety reasons. Towers have been a significant flight hazard everywhere, but Alaska is more critical due to poor flying conditions. The charts that pilots use must identify all such hazards to navigation, and are updated regularly. Between map updates, the FAA issues NOTAMS (Notice to Airmen) informing the pilots of all kinds of changes that may affect flight.

Kongigiak has a 235 foot tower, located at Lat. 59-58-12.3 and Long. 162-51-20.1. Ground elevation AMSL is 42 feet.

Refer to Exhibits B through B4 for engineering drawings relative to this site. This is a Microflect three leg tower and it should be noted on Exhibit B that the loading is not much different than the Bethel tower, as the load per leg is higher.

This design requires driven piles fifty-eight feet below grade, and the design is nearly the same as Bethel, with four piles per leg and a large pile cap for each set. Leg spacing is slightly more than Bethel, at 45 feet. Again, thermosyphons and themistors are employed. The H pile design for these two locations results in more surface area in contact with the surrounding ground and permafrost which, in turn, increases the strength necessary to counteract uplift during wind loads, and download for tower weight.

Duane Miller's exhibits (E-E3) also apply to this foundation design.

The similarity in design between Bethel and Kongigiak is the result of needing to overcome similar loading effects and permafrost issues. The three-legged tower is less costly, and requires fewer piles for support, so that would mitigate cost factors. While the tower has somewhat less windloading, requiring only four ten foot antennas, the load is spread over three legs instead of four, so uplift and download per leg is actually higher in the case of Kongigiak.

Tuntutuliak, with a seventy foot three-legged tower, located at Lat 60-20-27 and Long. 162-40-00 where the ground elevation is 30 feet AMSL, results in a different pile design.

Refer to Exhibits C through C2 and Exhibits F and F1 for site photographs.

Instead of several driven piles, a three foot diameter hole is augered sixteen feet deep and a single round pile per leg is seated in a slurry mix (Exhibit C1). A helical ring surrounds the pile for added friction. The pile itself is designed as a thermosyphon and a thermistor is placed at each pile for temperature monitoring. Uplift and download forces are considerably less in this tower, allowing for a more cost efficient pile design. Material and installation costs would also be reduced, while retaining the necessary cooling and monitoring systems to stabilize the tower.

SUMMARY

It was apparent that on their first cut of the grant application that UUI and/or their structural engineers were not up to date on changes in tower standards, and as I stated earlier, most of us did not address the warm permafrost issues in our site planing, and they were no exception. The structural engineer, however, should have at least been concerned about the effects of heat transfer into the permafrost, as we all have been for a long time.

After Mr. Heimke's return, these factors were addressed, and UUI prudently hired consultants that were able to address these issues. As a result, the tower foundations underwent a total redesign to address those issues. This resulted in the need for additional steel piles for each site, either three or four piles per leg, depending upon tower mass and other load variables.

While the extensive redesign was both prudent and necessary for the intended use of this microwave system, would the parameters be the same if the system were designed strictly as an inter/intranet backbone?

Some elements would change little, such as the need to address the warm permafrost issues, mobilization and demobilization expense, as well as other logistical elements, but because this system would not be designed to the same high standards as a telco, smaller antennas and towers could be utilized and therefore the cost would be less. Exactly how much less would only be calculated after re-engineering the paths and the loads as well as the tower company (Microflect) redesigning each tower, but it could be as much as 25% less.

Another question arises, i.e. what is the greatest and best use of such a microwave backbone?

Obviously, considering the cost of such an infrastructure, it would be to invest more and therefore allow the system to handle multiple types of traffic. This would necessitate the design that resulted from the engineering revisions.

CONCLUSION

All of the sites were designed to address the complex concerns of permafrost temperatures, tower loading and maintaining the stability necessary for microwave transmission, which is highly directional with a narrow focused beam that requires a stable platform and careful aiming during installation. While the diversity system employed results in a better path margin in case one path fades, in addition to temperature monitoring, keeping track of received signal strength is another method to ascertain any shifting of the tower foundation(s). Another installation requirement is to ensure the tower is plumb upon installation, using a surveyor's transit, and checking it again during each annual tower inspection.

The evaluation of the three sites was representative of all the sites for this project, as each location is individually engineered to account for local conditions and the tower type required for a specific site. While my conclusions are that the engineering upgrades were reasonable and necessary, given the soils studies and subsequent computer modeling of permafrost temperatures and the intended use of the system, I'm not entirely convinced that some of these precautionary steps could not have been taken prior to submitting the grant application. It doesn't seem prudent to engage in large tower construction without geotechnical analysis, and given that there has been longstanding concern about, at minimum, preserving the integrity of the permafrost, that these matters should have not raised concern, even without considering the global warming factor. A careful study of the requirements of EIA 222-G would have alerted them to the more stringent standards that would affect this project.

With respect to the system's designed reliability, the calculations I did on the four paths that have been done so far (Bethel to Akiak, Bethel to Eek, Eek to Tuntutuliak and Quinhagk to Eek), in order to service only the broadband internet needs, the system could utilize smaller antennas and therefore smaller towers, if there was no space diversity utilized. In the case of Bethel to Akiak, a distance of 23 miles, an eight foot antenna would give a 51.49dB fade margin and a six foot antenna results in a 48.77dB fade margin. The six foot antenna is absolutely acceptable for the intended application. Bethel to Eek, with a 39.41 mile path Micronet calculated it using a ten foot antenna, fade margin of 46.32dB. an eight foot antenna would give us 44.39dB and a six foot antenna's fade margin is 41.89dB. In this case the prudent choice for the internet application would be an eight foot dish. In the case of Eek to Tuntutuliak (20 mile path), Micronet calculated the path utilizing an eight foot antenna with a fade margin of52.5dB. If a six foot antenna were employed the fade margin drops to 50dB, still acceptable for our purposes. The Quinhagk to Eek path (20 miles) Micronet utilized a ten foot antenna and the fade margin is 47.02dB, an eight foot antenna is 45.09dB and the six foot antenna results in a 42.59dB fade margin. This must be a difficult path and for telco use, the ten foot was a reasonable choice, but for our purposes the eight foot antenna would suffice. I would not recommend anything smaller.

So, the short answer is if this were only utilized for the internet, it could be done for significantly less cost. If UUI had a heads up on both the permafrost issue and the tower standard revision, their original bid would have been more in line with reality today.

The decision respective to adjusting the grant amount would necessarily need to take into account the extremes of a strictly broadband internet application and the fact that UUI did not plan adequately for the cost of the original bid. And, we can't forget the issue of greatest and best use of such an infrastructure.

The following documents were redacted based on the finding of confidentiality. Additional information regarding the confidentiality determination can be found at the Commission's website at (insert link).

Exhibit A

Provides the site plan of UUI's tower in Bethel. The information includes the location of tower relative to the CO building, tower height, tower reactions, and structural standards considered in the erection of the tower.

Exhibit A1

Provides the piling detail, including foundation plan, and piling layout of UUI's Bethel tower. Exhibit A1 also includes details of the thermosyphon, such as the distance of the thermosyphon to the pile.

Exhibit A2

Provides the tower base and beam detail.

Exhibit A3

Provides the beam to H-Pile detail, and thermistor lead installation detail.

Exhibit A4

Provides the isometric view of the piles per leg of the tower, and the bill of materials per one tower leg support. The isometric view shows the number of piles (4) per leg of the tower.

Exhibit B

Provides the site plan of UUI's tower in Konginganak. The information includes the approximate location of tower, tower height, tower reactions, and structural standards considered in the erection of the tower.

Exhibit B1

Provides the piling detail, including foundation plan, and piling layout of UUI's Konginganak tower. Exhibit B1 also includes details of the thermosyphon, such as the distance of the thermosyphon to the pile.

Exhibit B2

Provides the tower base and beam detail.

Exhibit B3

Provides the beam to H-Pile detail, and thermistor lead installation detail.

Exhibit B4

Provides the isometric view of the piles per leg of the tower, and the bill of materials per one tower leg support. The isometric view shows the number of piles (4) per leg of the tower.

Exhibit C

Provides the site plan of UUI's tower in Tuntutuliak. The information includes the location of tower relative to the CO building, tower height, tower reactions, pile size, and structural standards considered in the erection of the tower.

Exhibit C1

Provides the piling detail, including foundation plan, and piling cap detail of UUI's Tuntutuliak tower.

Exhibit C2

Provides the isometric view of the pile per leg of the tower, and the bill of materials per one tower leg support. The isometric view shows single pile per leg structure of the tower.

Exhibit D

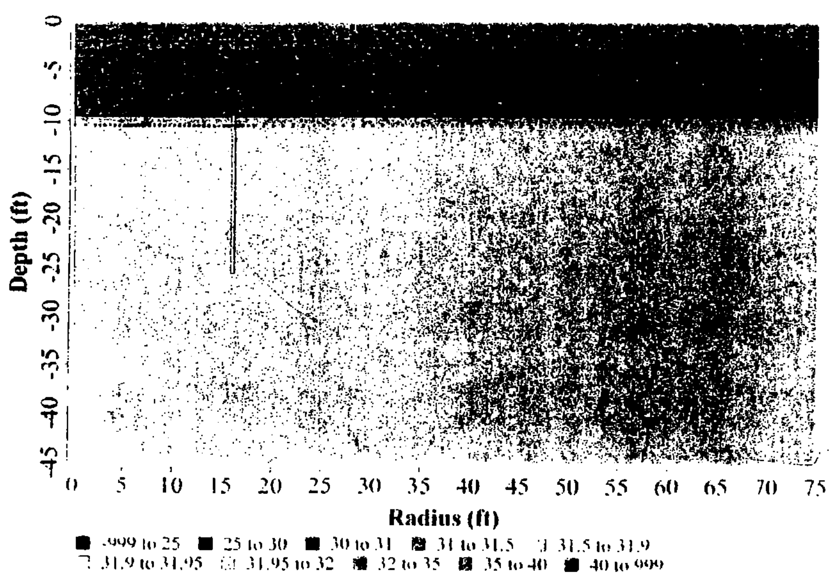
A detailed foundation plan for UUI's tower in Tununak. Exhibit D also includes installation instructions.

EXHIBIT E

VERY ROUGH DRAFT. NEEDS SITE CLIMATE. Uses Bethel Ambient and 50% of Kong Windspeeds

DM&A Tuluksak Antenna Project. Predicted Temperature Contours Along Vert. Plane. NES 8/19/04
Startup Early September 2004. Soil Initially Thawed to -9 ft. Sandy Soil 31.9F to -50 feet.
Simulation Assumes Three HPs Per Pile Group. Pile Groups 19' Apart. Uses AFI 3.5-in. OD.
26-ft long HPs with 70 ft2 Condensers. 6-in. thick by 30-ft Dia. Boardstock Insulation.
Bethel Ambient w/ 0.08 F/year Warming. Simulation Uses 50% of Kong Windspeeds.

Temp. 31.95, Time 0, early September, 2004



Temp. 31.95, Time 4380, early March, 2005

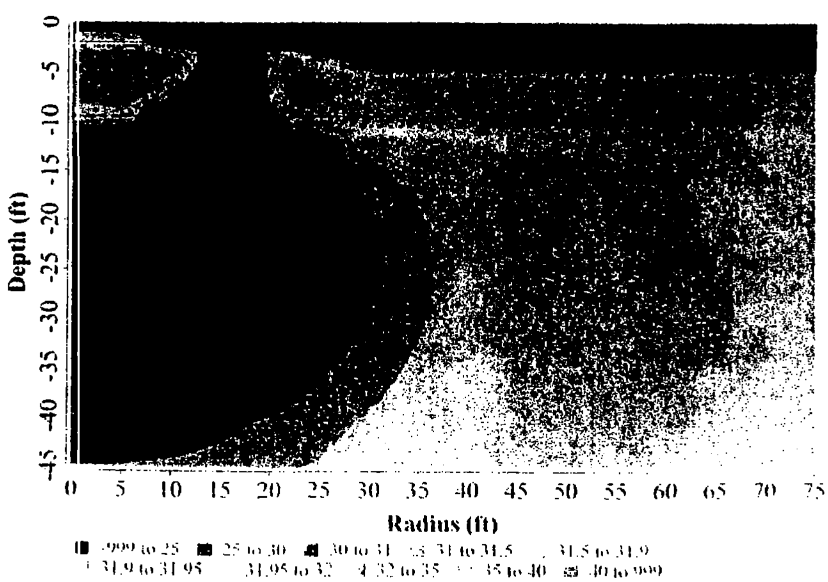
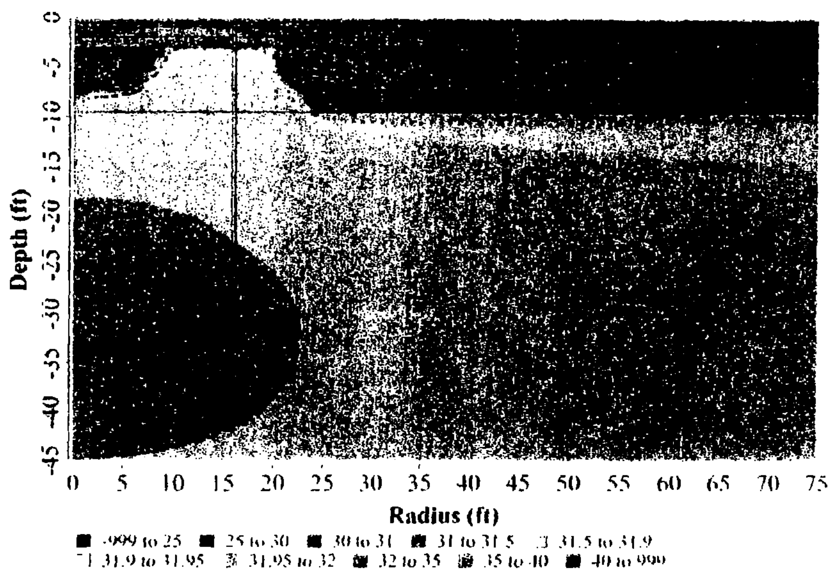


EXHIBIT E1

VERY ROUGH DRAFT. NEEDS SITE CLIMATE. Uses Bethel Ambient and 50% of Kong Windspeeds

DM&A Tuluksak Antenna Project. Predicted Temperature Contours Along Vert. Plane. NES 8/19/04
Startup Early September 2004. Soil Initially Thawed to -9 ft. Sandy Soil 31.9F to -50 feet.
Simulation Assumes Three HPs Per Pile Group. Pile Groups 19' Apart. Uses AFI 3.5-in. OD,
26-ft long HPs with 70 ft2 Condensers. 6-in. thick by 30-ft Dia. Boardstock Insulation.
Bethel Ambient w/ 0.08 F/year Warming. Simulation Uses 50% of Kong Windspeeds.

Temp. 31.95, Time 8760, early September, 2005



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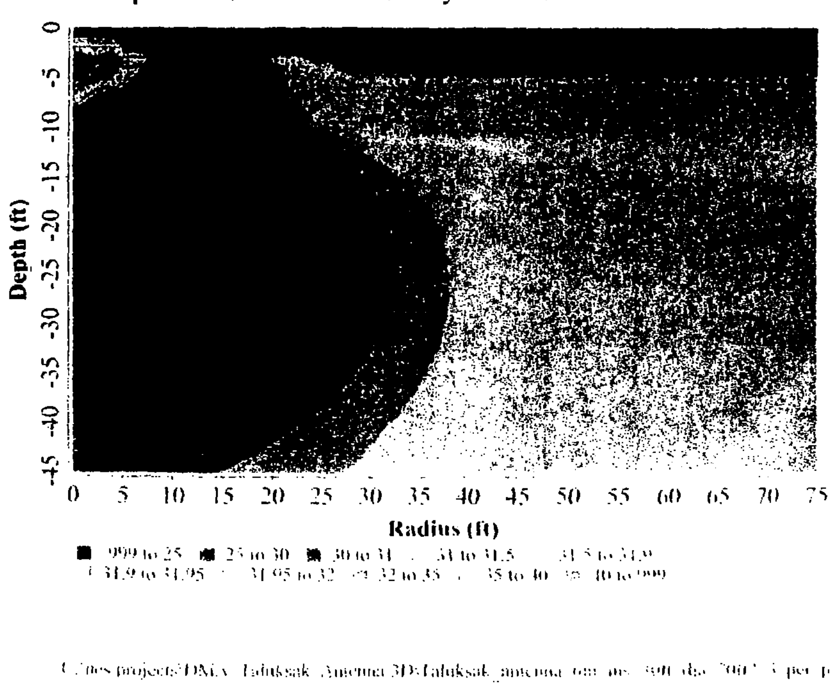
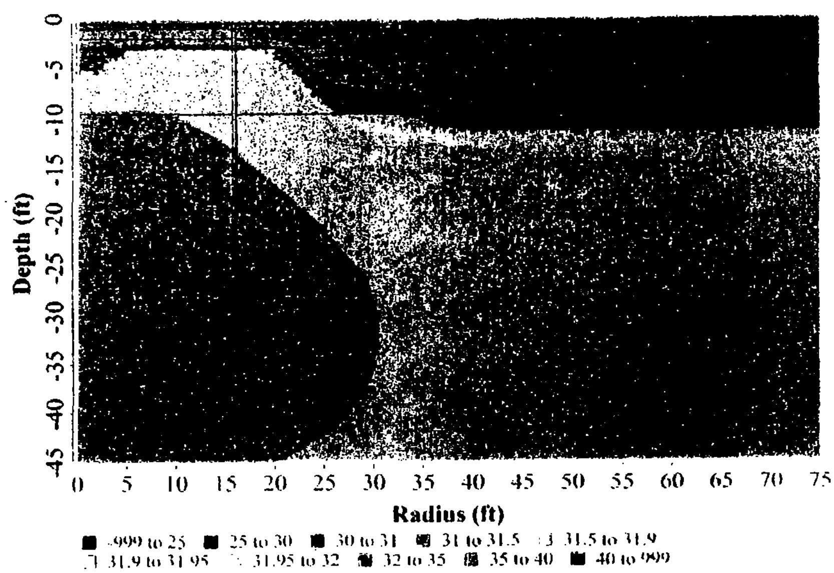


EXHIBIT E2

VERY ROUGH DRAFT. NEEDS SITE CLIMATE. Uses Bethel Ambient and 50% of Kong Windspeeds

DM&A Tuluksak Antenna Project. Predicted Temperature Contours Along Vert. Plane. NES 8/19/04
Startup Early September 2004. Soil Initially Thawed to -9 ft. Sandy Soil 31.9F to -50 feet.
Simulation Assumes Three HPs Per Pile Group. Pile Groups 19' Apart. Uses AFI 3.5-in. OD.
26-ft long HPs with 70 ft2 Condensers. 6-in. thick by 30-ft Dia. Boardstock Insulation.
Bethel Ambient w/ 0.08 F/year Warming. Simulation Uses 50% of Kong Windspeeds.

Temp. 31.95. Time 17520, early September, 2006



Temp. 31.95, Time 21900, early March, 2007

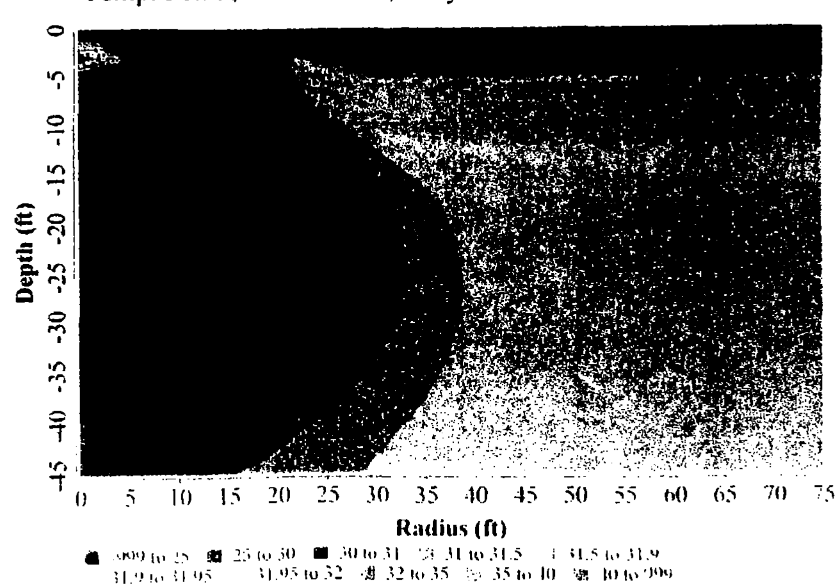
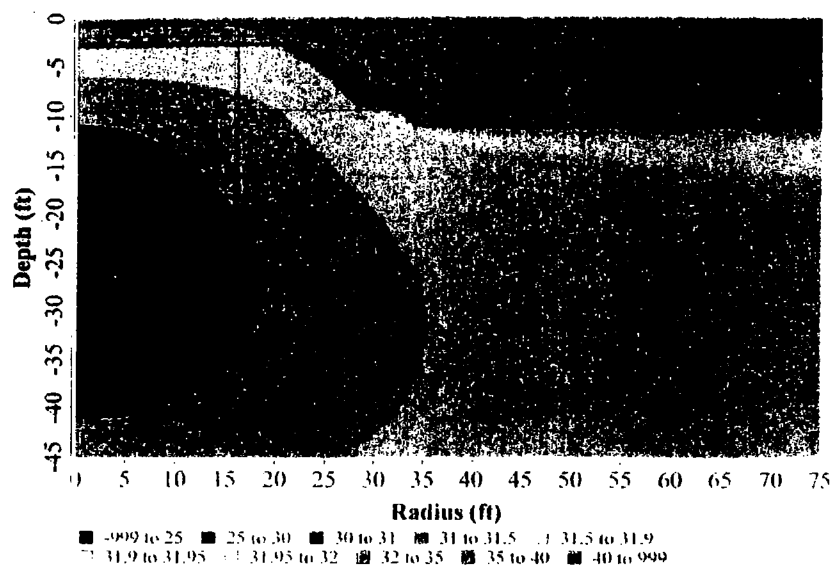


EXHIBIT E4

VERY ROUGH DRAFT. NEEDS SITE CLIMATE. Uses Bethel Ambient and 50% of Kong Windspeeds

DM&A Tuluksak Antenna Project. Predicted Temperature Contours Along Vert. Plane. NES 8/19/04
Startup Early September 2004. Soil Initially Thawed to -9 ft. Sandy Soil 31.9F to -50 feet.
Simulation Assumes Three HPs Per Pile Group. Pile Groups 19' Apart. Uses AFI 3.5-in. OD,
26-ft long HPs with 70 ft2 Condensers. 6-in. thick by 30-ft Dia. Boardstock Insulation.
Bethel Ambient w/ 0.08 F/year Warming. Simulation Uses 50% of Kong Windspeeds.

Temp. 31.95, Time 35040, early September, 2008



Temp. 31.95, Time 39420, early March, 2009

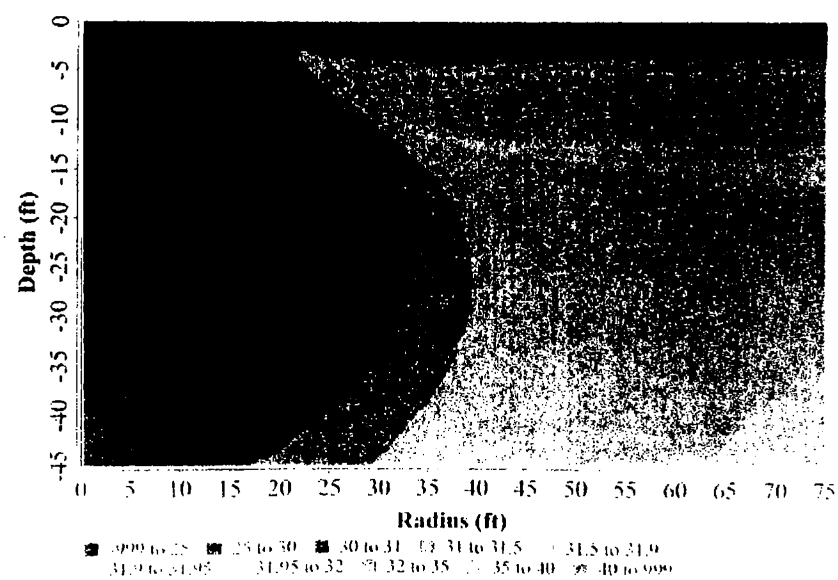
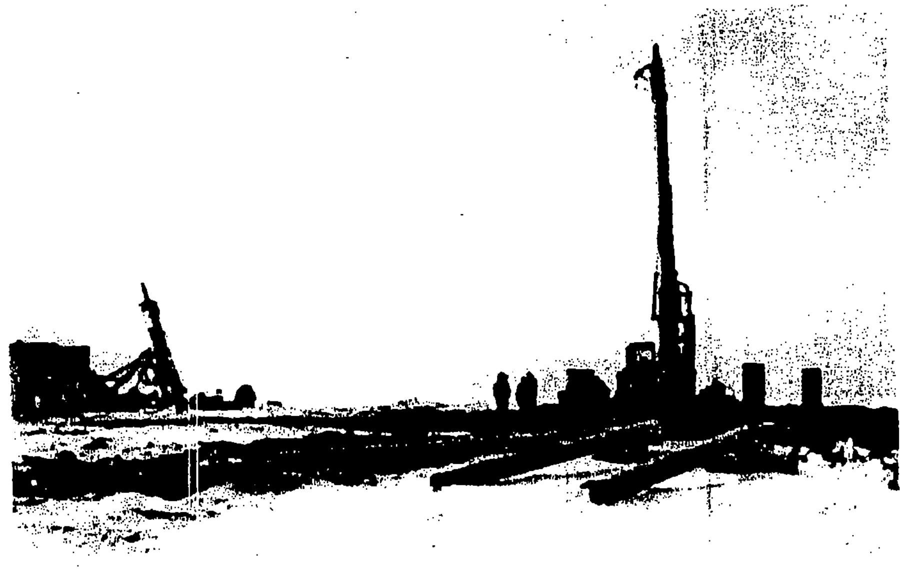


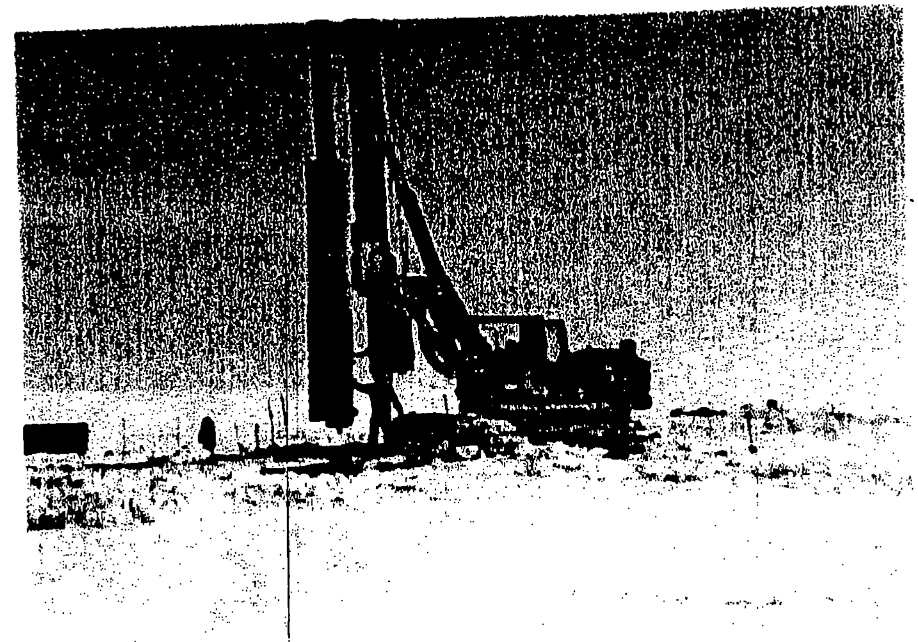
EXHIBIT F

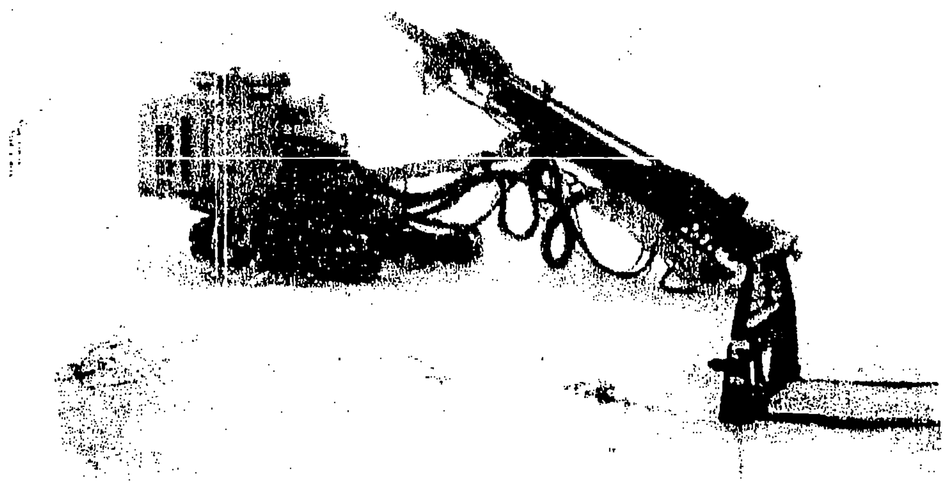
Dave Heimke, Senior Engineer for UUI, inspecting drilled pile hole at tuntutuliak. The hole is sixteen feet deep and three feet in diameter. The white patches are permafrost lenses.

EXHIBIT F1

pile placement at Tuntutuliak







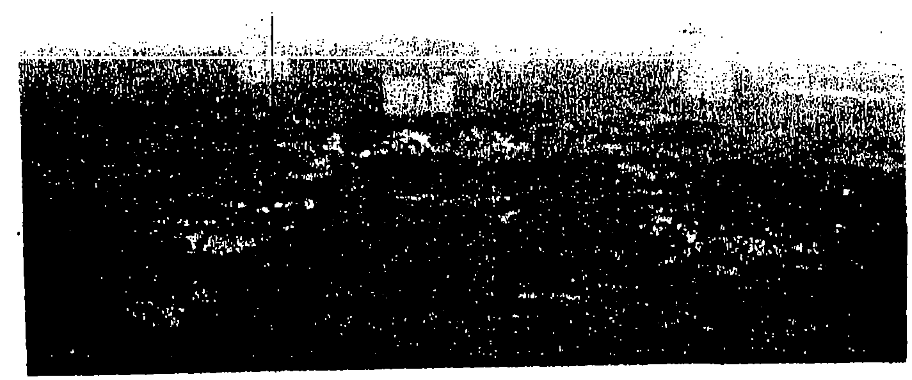


EXHIBIT G

Radio
THE RADIO TECHNOLOGY LEADER
Radio Magazine

A Primedia Publication

23 June 2005
Currents Online

Changes in tower standards

By Kevin McNamara, CNE

Mar 1, 2004 12:00 PM

E-mail this article

Sometime this year the Telecommunications Industries Association (TIA) will release the most comprehensive revision to the tower standards since 1996. The standard currently known as EIA/TIA-222-F defines the industry accepted practices and minimum standards for the design of steel antenna supporting structures.

History

The EIA RS-222 standard was first published in 1949 and encountered only two updates until 1980, when the 222C version was published. This was an important document because it took into account more of the real-world knowledge acquired as the deployment of so-called tall towers (up to 2,000 feet) were becoming widespread and the effects of wind and icing were becoming apparent. Not only were these towers taller, but they supported significantly more weight, particularly with antennas used for TV.

Version C provided a perspective for rating wind load based on the height of the tower and where it was located. A map of the United States was delineated into three wind zone categories labeled A, B and C. The wind loading was considered over the full length of the structure and was measured in pounds per square foot (PSF). The specific PSF rating started at about 30 PSF and increased based on the tower height.

The 222-D specification made a dramatic change to the way wind loading was to be calculated. First, the wind speed was measured in miles per hour (MPH) and a new map was created that depicted basic wind speeds measured at 33 feet above the ground. The value for basic wind speed increased as a function of tower height.

Revision E was the first iteration of the code to be defined by the TIA and Electronics Industries Association (EIA) and thusly called EIA/TIA 222-E. It further created a wind-loading map based on specific counties within each state, as well as directing the engineer to consider and design for specific conditions that might exceed the standard values.

The current version of the code, called EIA/TIA 222-F, was

Recording & Playback
Routing
Streaming Technologies
Transmitters
Wire & Cable
Advertiser Links

For Advertisers
Comprehensive Advertising Information

Related Sites
Broadcast Engineering
Electronic Musician
Mix
Remix
Entertainment Design
Mobile Radio Technology
http://radio.about.com/
Primedia Business

adopted in 1996 and expanded the scope of the previous version to include the effects of ice loading. Basically, it provided two methods for analysis of ice. Both assume an accumulation of ice based on that specified by the engineer; however, the wind load applied to the tower could be analyzed at full-speed or at about 75 percent of the full assumed speed.

Enter EIA/TIA-222-G

The differences are significant in revision G and will most likely affect tower owners who want to make additions to existing structures or those building new towers.

The philosophy behind the new revision is based on two design limit states — strength and serviceability. The strength limit considers the loading of a tower under extreme conditions; the serviceability limit ensures the tower will provide the proper service under normal conditions.

Towers are also analyzed under four specific types of loading: wind, environmental, ice and seismic.

The effects of wind on a tower are no longer based on a single wind zone chart, but rather a number of external conditions that might change the dynamic of wind, such as terrain, gusts, the method that wind-speed is determined and the value of safety factors used for a specific tower type.

An interesting feature of the new standard is the inclusion of so-called environmental loads. While the underlying thinking for this feature directs the designer to apply wind-loading characteristics based on mean wind speeds averaged over 25, 50 or 100-year periods, it requires that the tower be classified into one of three categories. The categories, labeled I, II or III, define the impact a failure of the tower would have to operational integrity, human life and property then apply a proportionate amount of over design.

Ice loads assume the ice has formed completely around a steel member and is assumed to be twice the maximum projected thickness of the radial ice. To assess the potential for icing a fixed factor for temperature drop is assumed, typically 50∞F ice loads are increased as a function of tower height.

The final load criteria, seismic, is also a new consideration within the 222G standard. Generally, this will only be considered within certain seismically active areas.

222G and local building codes

For the first time, the EIA/TIA-222-G code will line-up with national building codes, most notably the 2002 version of the International Building Code (IBC). If you haven't seen a copy of this code, it outlines all of the possible code-related items and refers the reader to several references of other codes, such as NEC and NFPA. The underlying reference to which the IBC deals with telecommunications towers is called ASCE-7. ASCE is an acronym for the American

Industry Events
E-mail your event info to radio@primediabusiness.com

BGS 2005 Midwest Equipment Expo
May 19
Dayton, OH

Dayton Hamvention and ARRL National Convention
May 20 - 22
Dayton, OH

118th AES Convention
May 28 - 31
Barcelona

Western Association of Broadcasters (WAB)
June 3 - 4
Kananaskis, AB

Radio Asia 2005 Conference
June 15 - 17
Singapore

Northern New England Broadcasters
June 23
Manchester, NH

Arbitron Summer 2005 Ratings Period
Jun 30 - Sep 21

EXHIBIT G1

New Standards for Broadcast Structures ANSI/EIA/TIA-222-G

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Peoria, IL

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Plymouth, IN

ABSTRACT

The next revision of the ANSI/TIA/EIA standard "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures" will represent the most drastic change to the standard since its first publication in 1949. This revision will change the loads and design criteria for communication towers including broadcast structures. It will also have an impact on the load carrying capacity of existing structures.

The revised standard (Rev G) is scheduled for release in 2003. The proposed changes will require an aggressive training schedule for all users of the standard. The authors of this paper who are members of he technical review committee for the TIA/EIA-222 standard will present in this paper the major changes proposed and also explain how theses changes may affect broadcast structures.

INTRODUCTION

This paper outlines the latest development regarding the next revision of the ANSI/TIA/EIA-222. It is based on the most recent proposals at the time of this writing. Subsequent revisions and additions may occur during the consensus verification process.

DESIGN PHILOSOPHY

This proposed revision of the standard is based on limit states design. The structures are checked for two major limit states (i) strength limit states and (ii) serviceability limit states. The strength limit states ensures that structures are safe under extreme loading conditions while the serviceability limit states checks that the structures is capable of providing the service under normal conditions.

ENVIROMENTAL LOADS

Structures Classification

Structures are classified according to reliability requirements. Three categories are provided. Category I structures have the lowest reliability requirements and are intended to represent structures for which there is a low hazard to human life and damage to property in the event of failure. This classification is intended for structures that are used for services that are optional and /or where a delay in returning the services would be acceptable. Ice loading does not apply to this category of structures. The nominal 50-year return wind load is reduced using an importance factor to a nominal 25-year return loading. Category II structures represent a substantial hazard to human life and damage to property in the event of failure and are intended for services that may be provided by other means. Category II structures use nominal 50-year return wind and ice loads. Category III structures are essential facilities and use nominal 100-year return loads determined using appropriate importance factors applied to the nominal 50-year return loads.

Wind Loads

A load factor of 1.6 is applied to nominal wind loads for strength limit states design. A directionality factor is applied to the factored wind loads to account for the probability of the wind occurring from the worst-case direction. Structures that are highly wind direction dependant have a lower directionality factor. Triangular or square latticed towers are assigned a directionality factor of 0.85, whereas pole structures are assigned a directionality factor of 0.95. The directionality factor for a structure is to be used for determining wind loads on the structure as well as all attached appurtenances. When determining strength requirements for an appurtenance itself, however, a directionality factor of 0.95 applies.

Wind speeds are escalated with height according to the terrain characteristics surrounding a given site. The exposure categories are identical to those contained in ASCE 7 for Exposure B (urban or hilly areas), Exposure C (flat open areas) and Exposure D (non-hurricane shorelines). Simplified equations are also provided for determining wind speed-up effects due to significant topographic features such as hills, ridges and escarpments.

Gust effect factors vary based on the type of structure. For self-supporting latticed towers, the gust effect factor varies from 0.85 to 1.00 as the structure height increases. A constant gust effect factor of 1.10 is proposed for pole structures. A 0.85 gust effect factor is specified for guyed masts, however, wind load responses are modified after analysis to account for the dynamic characteristics of wind load on guyed structures. A 1.25 amplification factor to account for dynamic interaction effects is proposed to be applied to the gust effect factor for structures supported on buildings or other structures. A gust effect factor of 1.00 is used for determining the strength requirements of appurtenances.

A patch loading is introduced for tapered sel supporting latticed towers that have extended straigl portions or portions with significantly reduced l slopes. The patch loading is intended to simulate th dynamic wind loading effects on such structures.

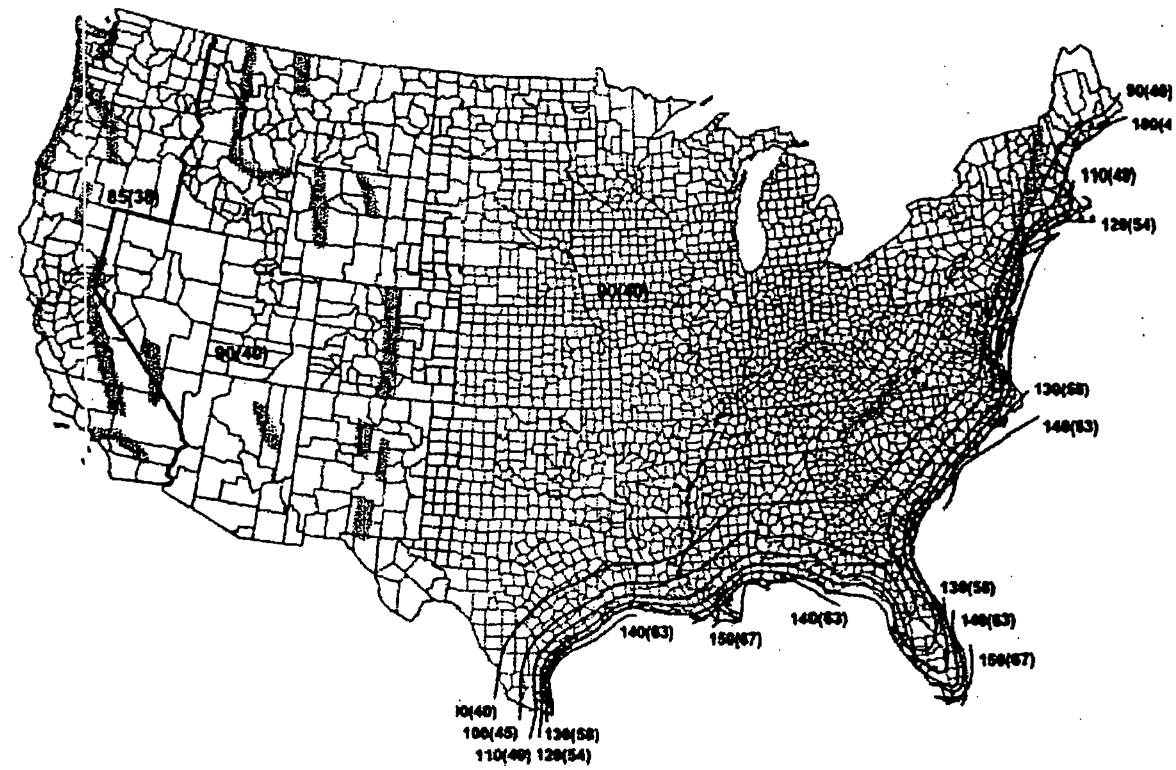

Figure 1: Wind Map

Ice Loads

A load factor of 2.0 is applied to the nominal radial thickness of ice as opposed to the weight of ice or to the projected area of ice. For guyed masts, a 50 degree F temperature drop is to be considered for the ice condition. The weight of ice on a member is calculated by considering the factored radial thickness of ice around a cylinder that circumscribes the member. The projected area of ice is calculated by considering twice the factored radial thickness of ice. The additional projected area due to ice is considered round for t purposes of calculating drag factors.

Nominal 3-second gust wind speeds that are to considered to occur simultaneously with ice . provided. A load factor of 1.0 is applied to wi loading for the ice condition since wind pressure applied to a factored ice thickness. Ice loads . escalated with height since ice accumulation is kno to increase with wind speed. Ice Map is shown Figure 2.

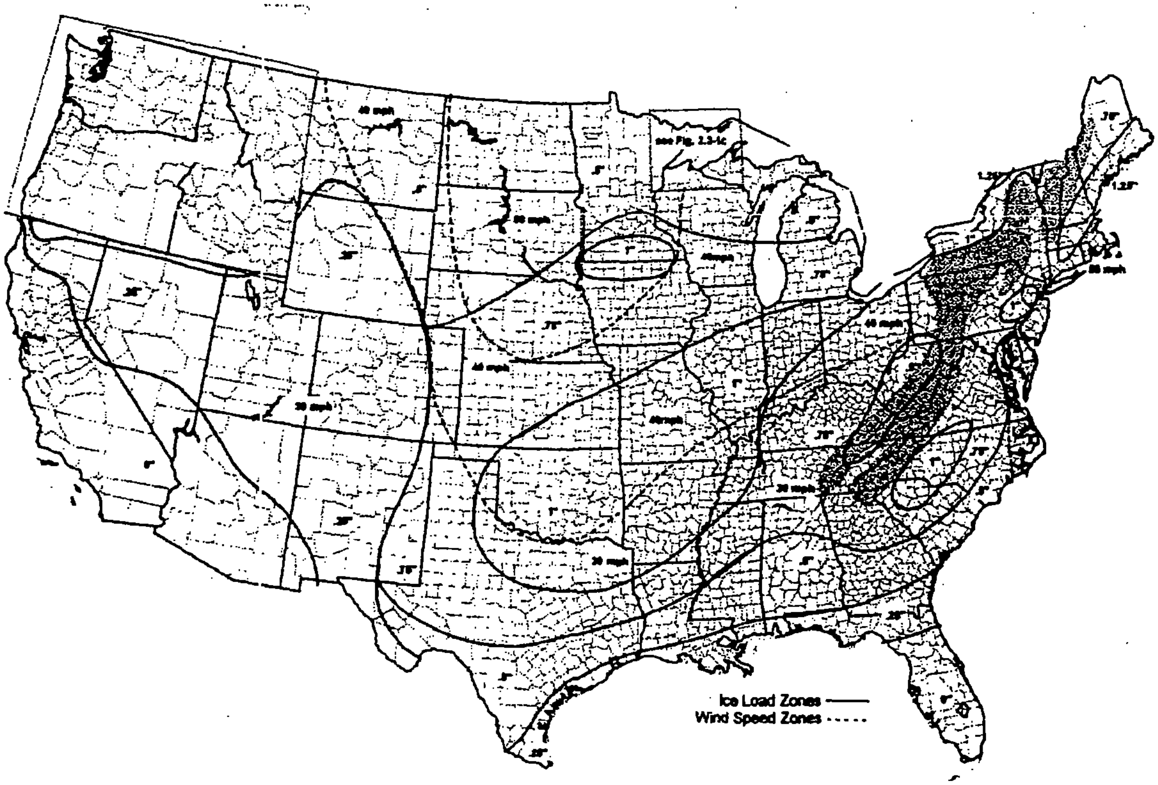

Figure 2: Ice Map

Earthquake Loads

Earthquake loads rarely govern the design of broadcast antennas and their supporting structures; however, these structures require special considerations of their response characteristics in regions of high seismicity. The standard provides design criteria to insure sufficient strength and stability to resist the effects of seismic ground motions for self-supporting and guyed antenna supporting structures. Unless otherwise required, earthquake effects are only specified to be considered in very limited areas of high seismicity.

Serviceability Limit States

Limit state deformations under service load conditions are provided in the standard. The service load condition is defined as a 60 mph wind speed without ice using an importance factor of 1.00, a gust effect factor equal to 1.0 and a directionality factor of 0.85 for all structures. Structures are limited to 4 degrees twist or sway rotation and a horizontal displacement equal to 5% of the height of the structure. In addition, more stringent rotation requirements are provided for structures supporting microwave antennas.

ANALYSIS METHODS

This new section of the standard includes the minimum acceptable models of analysis with requirements to consider the effects of displacements on member forces (P-Δ effects).

For self-supporting lattice towers, the analysis model should be either: (a) an elastic three-dimensional truss model made up of straight members pin connected at joints producing only axial forces in the members, or (b) an elastic three-dimensional frame-truss model where continuous members (legs) are modeled as 3-D beam elements while other members are modeled as 3-D truss elements.

For self-supporting pole structures, the analysis model should be an elastic three-dimensional beam-column model producing moments, shears and axial forces in the structure with a minimum of five beam elements per pole section.

For guyed masts, the analysis model should be either: (a) an elastic three-dimensional beam-column on non-linear elastic supports where the mast is modeled as equivalent three-dimensional beam-column members supported by cable members with a minimum of five beam elements in each span; (b) or an elastic three-dimensional truss model made up of straight members or cables pin connected at joints producing only axial forces in the members; or (c) an elastic three-dimensional frame-truss model were the continuous members (legs) are modeled as 3-D beam elements while other members are modeled as 3-D truss elements.

Modified Guyed Mast Response

In addition, section 3.0 of the standard provides a prescribed method of modifying guyed mast responses to account for the dynamic effects of wind loading on taller guyed masts. The procedure redistributes the loads to account for the effects of the dynamic load response. Unlike other approximate methods such as patch-loading techniques, the new procedure generates an estimate of the peak dynamic response envelopes based on the analysis results from the static analysis. The non-wind load responses are separated from the wind load responses and the resulting wind load components are then modified. By employing scaling factors, which are determined based on structure properties and geometry, the wind-induced dynamic component of the mast axial, shear, torsion, bending moment and guy forces are obtained. Calibration studies indicate that the prescribed method provides a reliable prediction of the dynamic effects of wind loads.

FOUNDATIONS

The design of communication structure foundations is dominated by unusual and unique design and installation techniques. When combined with the marked change in the design criteria that will be legislated by revision G to create loads, reaction sets and subsequent foundation designs, it is important to understand the changes that will affect foundation designs. The foundation chapter has been updated to improve and replace many older design practices and to provide more concise design information. The changes implemented are intended to provide the designer the information required to design a foundation that is economical and consistent with limit states design methodology. Changes contained within the new foundation chapter include the elimination of "normal soil", the inclusion of assumed soil design parameters for sites lacking geotechnical information and a more concise presentation of the design parameters required to maintain foundation stability.

IMPACT ON THE DESIGN OF NEW BROADCAST STRUCTURES

Revision G will introduce new variables to consider for the design of broadcast structures. The proposed design methodology will allow the design criteria for a structure to be fine tuned based on site-specific data as opposed to generic criteria used in previous additions of the standard.

Procurement and user guidelines are provided in an annex to identify site-specific and/or suggested supplementary requirements for the design of a structure. Default parameters are provided when site-specific conditions are not available. The default values are intended to result in design criteria similar to the generic criteria used in the existing version of the standard. Following is a description of some of the major site-specific and supplementary requirements issues to consider for a structure. Some of these issues are also appropriate to consider when using the existing standard.

The standard provides county listings of wind, ice and earthquake loading criteria, however, when more stringent loadings are know to exist or are required to satisfy a local requirement, the more stringent requirements should be specified. For example, some counties are listed as being in a special wind or ice loading area. Local authorities in these areas may have more stringent loading requirements. Some areas may be subject to in-cloud icing which may be a more stringent ice loading condition. These conditions must be considered as supplementary conditions and be included in the specification for a structure.

Criteria for determining loading criteria are provided within the standard. This is required for locations outside the United States and may be also be used to determine loading criteria for counties located in special loading regions. Minimum design values applicable to any location are provided. A means for handling specifications that involve "survival" or "withstand" conditions is also clarified in the standard.

It is not uncommon to have wind speeds reported over different averaging periods (for example, a 1 minute average wind speed or an average hourly wind speed). A conversion table (Table 1) is provided to convert wind speeds to 3-second gust wind speeds which are to be used with the standard.

3-sec gust (mph)	Fastest-mile (mph)	10-min avg. (mph)	Hourly mean (mph)
60	50	42	40
70	58	49	46
80	66	56	53
85	70	59	56
90	75	62	60
95	78	66	63
100	80	69	66
105	85	73	70
110	90	76	73
115	95	80	76
120	100	83	79
125	105	87	83
130	110	90	86
135	115	94	89
140	120	97	93
145	125	101	96
150	130	104	99
155	135	108	103
160	140	111	106
165	145	115	109
170	150	118	113

Table 1: Wind Speed Conversions

The category of a structure must be established based on the reliability requirements for the structure. The design loadings for a structure are modified according to the structure's category. The standard provides for progressively more stringent loading as the reliability requirements or importance of a structure increases (category 1 to category 3). Importance relates to the consequences of failure to human life or property as well as to the type of communication services that are supported by a structure. The use of different classifications results in cost savings for structures that have lower reliability requirements. The default category is specified as being category 2.

The terrain surrounding a site significantly affects wind loading for a structure. The proposed standard allows the flexibility to consider various types of terrain (exposure B for rough surfaces, exposure C for flat surfaces, and exposure D for smooth surfaces). Exposure D results in the most stringent loading. Previous versions of the standard were based on exposure C conditions. Allowing the use of other exposures results in site-specific design criteria for a structure based on its surrounding terrain. Exposure C is specified as the default exposure.

It is known that topographic features can produce significantly higher wind speeds as the wind passes over them. The standard provides definitions of various types of topographic features which must be considered in design. Simplified methods are provided to determine the magnitudes of the increased wind speeds. The standard also allows the use of more sophisticated methods when accurate topographic data is available. The appropriate type of topographic feature for a structure must be included in the specifications. The default condition assumes that a structure is not located on a significant topographic feature with that no wind speed-up considerations are required for design.

It is important to note that for a guyed mast, the relative differences between the base of the mast and the guy anchor locations must be considered in design. These relative elevation differences must be included in the specification of the structure if detailed topographic data is not available. This information is required in order to perform a proper analysis of a guyed mast even though the structure may not be located on a significant topographic feature. This information is also required in order to provide the correct length of guys. The default condition is assumed to be level grade between the guy anchor locations and the base of the structure.

For any type of structure, it is important to specify the elevation of the base of the structure. Since wind loads are escalated with height, the wind load for a 100 ft. structure supported at ground level would be less than the wind load for the same structure supported on top of a building or other structure.

Specific criteria are provided in the standard regarding loading from transmission lines. As a default, transmission lines may be considered to be bundled together in blocks or clusters and distributed on multiple faces. The arrangement of lines has a significant effect on the wind and ice loading of a structure. If specific arrangements of lines are desired, the requirements should be clearly defined in the specification for the structure.

The ground elevation for a specific site may influence the loading for a structure due to the change in air density with elevation. Wind loading is a direct function of the density of air. The air temperature, weather and the season also affects air density. The standard provides a value to use for design, however, other values may be provided in the specification for a structure based on the air density representative of the site.

Revision G of the standard is the first version of the standard that addresses earthquake loading. The soil structure at a site has a significant effect on the loads resulting from an earthquake. Design parameters are provided for various soil conditions. When soil conditions at a site are known, they should be included in the specification for the structure. A stiff soil condition is assumed as a default condition for the purposes of determining earthquake design parameters.

Serviceability requirements are to be investigated under a 60 mph basic wind speed loading condition without ice. This is equivalent to the 50 mph fastest-mile wind speed specified in the current standard for investigating serviceability requirements. Twist, sway and deflection limitations are provided. When more stringent requirements are required for an application, the requirements should be included in the specification for the structure.

The minimum corrosion protection required by the proposed standard is hot dip galvanizing as in previous versions. The proposed standard, however9, requires additional corrosion protection for steel guy anchors in direct contact with corrosive soil (resistivity less than 5000 Ohm-cm and/or Ph values below 3 or greater than 9). It is also recommended that additional corrosion control methods be used for AM antenna structures and other structures in close proximity to buried pipelines or electrical substations.

Cathodic control and concrete encasement are specified as acceptable additional corrosion protection. When taping or coatings are utilized, cathodic protection is also required due to the increased risk of corrosion at cracks or discontinuities. The default soil condition is considered non-corrosive. It is recommended that soil resistivity and Ph values be included in the scope of a geotechnical investigation and be included in the specification for a structure.

The proposed standard eliminates the use of the term "normal soil". Instead, presumptive soil parameters are included in an appendix for use when a geotechnical report is not available. Presumptive soil parameters for both sand and clay type soils are provided. The default soil type is clay with a frost depth equal to 3.5 ft. It is the intent of the standard that the presumptive parameters will be verified at the time of installation. The use of presumptive soil parameters for design is not allowed for essential facilities (category 3 structures).

Revision G contains significantly more climbing and working facilities requirements. For example, rest platforms are required at 150 ft. minimum spacing for structures greater than 500 ft. in height. It is a requirement that warning signs be placed on structures that do not meet the requirements of the standard regarding climbing and working facilities. A stamped or engraved metal identification tag is also to be affixed at the base of cable safety climb systems indicting the size and type of cable (to insure compatibility with a climber's safety sleeve). The standard specifies a 3/8 inch diameter cable as a standard in order to minimize the safety sleeve sizes required to be maintained by a climber.

IMPACT ON EXISTING BROADCAST STRUCTURES

Several new provisions of the standard will have a major impact on the existing broadcast towers and their support capacities.

The new standard accounts for the site-specific conditions more accurately. Classification of the importance category of the structure based on its location and its usage, wind exposure categories to reflect surface irregularities, topographic effects, and ice thickness specified by county location; these factors are combined to reflect the particularity of the structure based on its use and location. This categorization will allow the owner of a broadcast tower to have the environmental loading (by adjusting the return period) more closely match the importance of the structure and the associated risk taken by the owner.

This new revision of the standard is based on the limit state loading which will amplify the applied loads and expose any overall stability issues within a tower structure. Some of the slender broadcast towers with long guy spans will have difficulties having their analysis model converge to a solution under the ultimate loading conditions as determined from the new G revision. Some of these overall stability issues may not have always been detected using the older loading provisions.

The new standard provides a county listing of mandatory ice thickness that escalates with height and its corresponding simultaneous wind speed. This is intended to reflect the limit state condition of heavy icing and the related lower simultaneous wind speed when these parameters are combined. Older broadcast towers that were designed with no ice loading consideration will be negatively impacted while some other towers that were designed for higher wind speed combined with an ice thickness may result in an increase in their support capacity.

The appurtenances loading provisions of the new standard allow for reduction of the drag factors when it falls into a supercritical flow condition and allow for a reduction in the effective projected areas based on the location of the appurtenances. For a broadcast tower with large diameter waveguide lines, this will result in a significant reduction of the loading impact from these appurtenances.

Guyed masts are to be analyzed to resist a modified load response under the G revision to account for the dynamic loading that these structures are susceptible to. By redistributing the loading response from a static analysis, this simplified method provides a loading pattern that more closely matches a dynamic analysis results. This provision will impact existing broadcast towers in that some additional capacity may be available in the lower portion of the tower and in the guy wires and anchors, and some reduction in capacity will result in the upper portions of the tower. Also, the minimum shear response requirements will negatively affect towers that were originally designed to closely meet the loading requirement curve.

The new standard also introduces seismic requirements for towers that are in high seismic zones. In general, this provision should not affect broadcast towers unless they have structural irregularities and are located in high seismic zones. Then, either a modal analysis (self-support) or a time history analysis (guyed) would be required to properly account for the seismic loading.

There are other miscellaneous provisions that will affect broadcast towers, such as high-frequency dampers requirements and end articulation of guy assemblies. These requirements need to be met when modifying an existing tower.

CONCLUSIONS

In conclusion, the new provisions of the TIA/EIA 222-G standard will allow the designer to use the state of the art knowledge in the design of structures and will allow owners of broadcast towers to fine-tune the design requirements and utilize site-specific data that more closely represent the current understanding of the environmental loading these structures are subjected to.

ACKNOWLEDGEMENT

The authors wish to acknowledge the hard work of all their colleagues on the TR14.7 technical committee for the development of this standard.

REFERENCES

ASCE-98 "Minimum Design Loads for Building and other Structures" American Society of Civil Engineers, Jan 2000.

EXHIBIT H
PATH CALCULATIONS

Micronet Communications, Inc.
720 F Avenue, Suite 100
Plano, Texas 75074
972-422-7200

File: M0423905 1
Original PCN Date: May 10, 2005
Company: UNITED UTILITIES INC

Company Code	P8965	P8965
Site Name, State	Bethel Tower, AK	Akiak, AK
Call Sign/County	/Bethel	/Bethel
Latitude N (NAD83)	60 46 53.80	60 54 41.00
Longitude W (NAD83)	161 53 01.60	161 13 38.50
Azimuth (degrees)	67.66	248.23
Distance (miles/km)	23.93/38.51	23.93/38.51
Space Loss (db)	139.991	
Elevation AMSL (ft/m)	159.1/48.50	20.0/6.10
Transmit-Receive Ant Type	HP8-59E	PL8-59D
FCC Designation	A64100	
Antenna Manufacturer	ANDREW CORPORATION	ANDREW CORPORATION
Gain/Beamwidth (dbi/deg)	41.5/1.4	41.6/1.4
Antenna Height AGL (ft/m)	215.00/65.53	75.00/22.86
Tilt (degrees)	-0.256	-0.003
Diversity Ant Type	PL8-59D	PL8-59D
FCC Designation		
Antenna Manufacturer	ANDREW CORPORATION	ANDREW CORPORATION
Gain/Beamwidth (dbi/deg)	41.6/1.4	41.6/1.4
Antenna Height AGL (ft/m)	185.00/56.39	59.00/17.98
Equipment Manufacturer	HARRIS CORPORATION	HARRIS CORPORATION
Manufacturer's Type	HRS-CX-06G155M-H	HRS-CX-06G155M-H
FCC Identifier		
Emission/Stability %	30M0D7W/0.0003	30M0D7W/0.0003
ATPC/Trigger Level (dbm)	NO/	NO/
Transmitter Power (dbm/Watts)	31.10/1.2882	31.10/1.2882
Fixed Losses Cm,Tx,Rx (db)	5.0,0.0,0.0	3.6,0.0,0.0
Receive Level (dbm)	-34.46	-34.46
EIRP (dbm/Watts)	67.57/5714.79	69.06/8053.78
Traffic (kbps/vc)	172560.0/2016	172560.0/2016
Modulation/Lvl	TCM/128	TCM/128
Frequencies Transmitted (MHz)	6004.5H	6256.54H

PATH PERFORMANCE CALCULATION SHEET FOR:			UUI - 8 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Akiak
OPERATING FREQUENCY......GHZ.			6.00	
PATH LENGTH............MILES			23.93	
PATH LENGTH.............KM			39.23	
FREE SPACE LOSS.......DB			139.99	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	215.00		90.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.16		1.32
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			5.48	
TOTAL FIXED LOSSES.....DB			145.47	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		8.00		8.00
ANTENNA GAIN................DB		41.13		41.13
RADOME LOSS.................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			80.86	
NET PATH LOSS....(E32-E26)...DB			-64.61	
TRANSMITTER POWER...............DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-33.51	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			51.49	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			1.31	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.15	0.98
PROPAGATION OUTAGE........MIN/YR	0.8	0.8
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

Bethel to Adiak

	PATH LENGTH...KM			39.23
18	PATH RAINFALL RATE............MM/HR			134.4
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			1.46E-06
				0.77
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.364			
CALC LO	7.32	10.07		
LO>LX	3.000	2.440		
CALC UX	0.0000	0.0002		

PATH PERFORMANCE CALCULATION SHEET FOR:			UUI - 6 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Akiak
OPERATING FREQUENCY......GHZ.			6.00	
PATH LENGTH.............MILES			23.93	
PATH LENGTH.............KM			39.23	
FREE SPACE LOSS.......DB			139.99	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	230.00		90.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.38		1.32
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			5.70	
TOTAL FIXED LOSSES.....DB			145.70	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		6.00		8.00
ANTENNA GAIN.................DB		38.63		41.13
RADOME LOSS..................DB		0.70		0.70
TOTAL ANTENNA GAIN............DB			78.36	
NET PATH LOSS....(E32-E26)...DB			-67.33	
TRANSMITTER POWER...............DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-36.23	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			48.77	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			1.24	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.18	1.12
PROPAGATION OUTAGE........MIN/YR	1.4	1.4
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	PATH LENGTH...KM			39.23
18	PATH RAINFALL RATE............MM/HR			128.6
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			2.73E-06
				1.44
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.364			
CALC LO	7.32	10.07		
LO>LX	3.000	2.440		
CALC UX	0.0000	0.0002		

Micronet Communications, Inc.
720 F Avenue, Suite 100
Plano, Texas 75074
972-422-7200

File: M0423905 2
Original PCN Date: May 10, 2005
Company: UNITED UTILITIES INC

Company Code		P8965	P8965
Site Name, State		Bethel Tower, AK	Eek, AK
Call Sign/County		/Bethel	/Bethel
Latitude N	(NAD83)	60 46 53.80	60 12 57.40
Longitude W	(NAD83)	161 53 01.60	162 00 43.40
Azimuth	(degrees)	186.44	6.33
Distance	(miles/km)	39.41/63.42	39.41/63.42
Space Loss	(db)	144.324	
Elevation	AMSL (ft/m)	159.1/48.50	40.0/12.20
Transmit-Receive Ant Type		HP10-59E	PL10-59D
FCC Designation		A68700	A71700
Antenna Manufacturer		ANDREW CORPORATION	ANDREW CORPORATION
Gain/Beamwidth	(dbi/deg)	43.3/1.1	43.3/1.1
Antenna Height	AGL (ft/m)	215.00/65.53	260.00/79.25
Tilt	(degrees)	-0.234	-0.193
Diversity Ant Type		PL10-59D	PL10-59D
FCC Designation		A71700	A71700
Antenna Manufacturer		ANDREW CORPORATION	ANDREW CORPORATION
Gain/Beamwidth	(dbi/deg)	43.3/1.1	43.3/1.1
Antenna Height	AGL (ft/m)	95.00/28.96	135.00/41.15
Equipment Manufacturer		HARRIS CORPORATION	HARRIS CORPORATION
Manufacturer's Type		HRS-CX-06G155M-H	HRS-CX-06G155M-H
FCC Identifier			
Emission/Stability %		30M0D7W/0.0003	30M0D7W/0.0003
ATPC/Trigger Level	(dbm)	NO/	NO/
Transmitter Power	(dbm/Watts)	31.10/1.2882	31.10/1.2882
Fixed Losses Cm,Tx,Rx	(db)	6.1,0.0,0.0	7.6,0.0,0.0
Receive Level	(dbm)	-40.28	-40.28
EIRP	(dbm/Watts)	68.30/6760.83	66.84/4830.58
Traffic	(kbps/vc)	172560.0/2016	172560.0/2016
Modulation/Lvl		TCM/128	TCM/128
Frequencies Transmitted	(MHz)	6063.8H	6315.84H

PATH PERFORMANCE CALCULATION SHEET FOR:			UUI - 10 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Eek
OPERATING FREQUENCY......GHZ.			6.06	
PATH LENGTH.............MILES			39.41	
PATH LENGTH..............KM			64.61	
FREE SPACE LOSS.......DB			144.32	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	230.00		275.00
FEED LINE...................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.38		4.04
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.42	
TOTAL FIXED LOSSES.....DB			152.75	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		10.00		8.00
ANTENNA GAIN.................DB		43.15		41.22
RADOME LOSS..................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			82.97	
NET PATH LOSS....(E32-E26)...DB			-69.78	
TRANSMITTER POWER................DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-38.68	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN.....................DB			46.32	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			0.72	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.33	1.85
PROPAGATION OUTAGE........MIN/YR	11.4	11.4
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	PATH LENGTH...KM			64.61
18	PATH RAINFALL RATE............MM/HR			80.8
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			2.16E-05
				11.37
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.258			
CALC LO	8.54	11.75		
LO>LX	3.000	2.440		
CALC UX	0.0001	0.0004		

PATH PERFORMANCE CALCULATION SHEET FOR			UUI - 8 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Eek
OPERATING FREQUENCY......GHZ			6.06	
PATH LENGTH.............MILES			39.41	
PATH LENGTH..............KM			64.61	
FREE SPACE LOSS.......DB			144.32	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	230.00		275.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.38		4.04
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.42	
TOTAL FIXED LOSSES.....DB			152.75	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		8.00		8.00
ANTENNA GAIN.................DB		41.22		41.22
RADOME LOSS..................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			81.03	
NET PATH LOSS....(E32-E26)...DB			-71.71	
TRANSMITTER POWER...............DBM			31.10	
RECEIVED CARRIER LEVEL (RCL).....DBM			-40.61	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN.....................DB			44.39	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			0.69	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.37	2.05
PROPAGATION OUTAGE........MIN/YR	17.8	17.8
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	PATH LENGTH...KM			64.61
18	PATH RAINFALL RATE............MM/HR			78.0
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			3.38E-05
				17.77
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.258			
CALC LO	8.54	11.75		
LO>LX	3.000	2.440		
CALC UX	0.0001	0.0004		

PATH PERFORMANCE CALCULATION SHEET FOR			UUI - 6 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Eek
OPERATING FREQUENCY......GHZ.			6.06	
PATH LENGTH.............MILES			39.41	
PATH LENGTH.............KM			64.61	
FREE SPACE LOSS.......DB			144.32	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	230.00		275.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.38		4.04
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.42	
TOTAL FIXED LOSSES.....DB			152.75	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		6.00		8.00
ANTENNA GAIN.................DB		38.72		41.22
RADOME LOSS.................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			78.53	
NET PATH LOSS....(E32-E26)...DB			-74.21	
TRANSMITTER POWER...............DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-43.11	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			41.89	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			0.65	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.45	2.36
PROPAGATION OUTAGE........MIN/YR	31.6	31.6
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

PATH PERFORMANCE CALCULATION SHEET FOR:			UUI - 10 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Eek
OPERATING FREQUENCY......GHZ			6.06	
PATH LENGTH............MILES			39.41	
PATH LENGTH..............KM			64.61	
FREE SPACE LOSS.......DB			144.32	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	230.00		275.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.38		4.04
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.42	
TOTAL FIXED LOSSES.....DB			152.75	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		10.00		8.00
ANTENNA GAIN.................DB		43.15		41.22
RADOME LOSS..................DB		0.70		0.70
TOTAL ANTENNA GAIN..........DB			82.97	
NET PATH LOSS....(E32-E26)...DB			-69.78	
TRANSMITTER POWER..............DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-38.68	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			46.32	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			0.72	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.33	1.85
PROPAGATION OUTAGE........MIN/YR	11.4	11.4
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	PATH LENGTH...KM			64.61
18	PATH RAINFALL RATE............MM/HR			80.8
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			2.16E-05
				11.37
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.258			
CALC LO	8.54	11.75		
LO>LX	3.000	2.440		
CALC UX	0.0001	0.0004		

PATH PERFORMANCE CALCULATION SHEET FOR			UUI - 8 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Eek
OPERATING FREQUENCY......GHZ.			6.06	
PATH LENGTH.............MILES			39.41	
PATH LENGTH..............KM			64.61	
FREE SPACE LOSS.......DB			144.32	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	230.00		275.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.38		4.04
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.42	
TOTAL FIXED LOSSES.....DB			152.75	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		8.00		8.00
ANTENNA GAIN.................DB		41.22		41.22
RADOME LOSS.................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			81.03	
NET PATH LOSS....(E32-E26)...DB			-71.71	
TRANSMITTER POWER................DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-40.61	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			44.39	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			0.69	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.37	2.05
PROPAGATION OUTAGE........MIN/YR	17.8	17.8
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	PATH LENGTH...KM			64.61
18	PATH RAINFALL RATE............MM/HR			78.0
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			3.38E-05
				17.77
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.258			
CALC LO	8.54	11.75		
LO>LX	3.000	2.440		
CALC UX	0.0001	0.0004		

PATH PERFORMANCE CALCULATION SHEET FOR			UUI - 6 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Bethel		Eek
OPERATING FREQUENCY......GHZ.			6.06	
PATH LENGTH............MILES			39.41	
PATH LENGTH.............KM			64.61	
FREE SPACE LOSS.......DB			144.32	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	230.00		275.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.38		4.04
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.42	
TOTAL FIXED LOSSES.....DB			152.75	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		6.00		8.00
ANTENNA GAIN.................DB		38.72		41.22
RADOME LOSS..................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			78.53	
NET PATH LOSS....(E32-E26)...DB			-74.21	
TRANSMITTER POWER...............DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-43.11	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN.....................DB			41.89	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			0.65	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.45	2.36
PROPAGATION OUTAGE........MIN/YR	31.6	31.6
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	PATH LENGTH...KM			64.61
18	PATH RAINFALL RATE............MM/HR			74.4
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			6.01E-05
				31.58
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.258			
CALC LO	8.54	11.75		
LO>LX	3.000	2.440		
CALC UX	0.0001	0.0004		

Micronet Communications, Inc.
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Plano, Texas 75074
972-422-7200

File: L0423905 1
Original PCN Date: May 10, 2005
Company: UNITED UTILITIES INC

Company Code		P8965	P8965
Site Name, State		Tuntutuliak, AK	Eek, AK
Call Sign/County		/Bethel	/Bethel
Latitude N	(NAD83)	60 20 29.30	60 12 57.40
Longitude W	(NAD83)	162 40 00.10	162 00 43.40
Azimuth	(degrees)	110.83	291.40
Distance	(miles/km)	24.13/38.83	24.13/38.83
Space Loss	(db)	140.771	
Elevation	AMSL (ft/m)	20.0/6.10	40.0/12.20
Transmit-Receive Ant Type		PL8-65D	PL8-65D
FCC Designation			
Antenna Manufacturer		ANDREW CORPORATION	ANDREW CORPORATION
Gain/Beamwidth	(dbi/deg)	42.3/1.3	42.3/1.3
Antenna Height	AGL (ft/m)	70.00/21.34	157.00/47.85
Tilt	(degrees)	-0.083	-0.179
Diversity Ant Type			
FCC Designation			
Antenna Manufacturer			
Gain/Beamwidth	(dbi/deg)		
Antenna Height	AGL (ft/m)		
Equipment Manufacturer		HARRIS CORPORATION	HARRIS CORPORATION
Manufacturer's Type		HRS-CX-06G28D1-H	HRS-CX-06G28D1-H
FCC Identifier			
Emission/Stability %		10M0D7W/0.0003	10M0D7W/0.0003
ATPC/Trigger Level	(dbm)	NO/	NO/
Transmitter Power	(dbm/Watts)	29.90/0.9772	29.90/0.9772
Fixed Losses Cm,Tx,Rx	(db)	4.4,0.0,0.0	5.3,0.0,0.0
Receive Level	(dbm)	-35.96	-35.96
EIRP	(dbm/Watts)	67.76/5970.36	66.95/4954.50
Traffic	(kbps/vc)	50281.8/672	50281.8/672
Modulation/Lvl		TCM/64	TCM/64
Frequencies Transmitted	(MHz)	6745.0V	6585.0V

RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Tuntutuliak		Eek
OPERATING FREQUENCY......GHZ.			6.75	
PATH LENGTH............MILES			20.00	
PATH LENGTH.............KM			32.79	
FREE SPACE LOSS.......DB			140.77	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	85.00		175.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.35	1.15		2.36
LOSSES...........DB/100 FT.	1.35	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			4.51	
TOTAL FIXED LOSSES.....DB			145.28	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		8.00		8.00
ANTENNA GAIN................DB		42.14		42.14
RADOME LOSS.................DB		0.70		0.70
TOTAL ANTENNA GAIN..........DB			82.88	
NET PATH LOSS....(E32-E26)...DB			-62.40	
TRANSMITTER POWER..............DBM			29.90	
RECEIVED CARRIER LEVEL(RCL).....DBM			-32.50	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			52.50	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			1.60	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.12	0.79
PROPAGATION OUTAGE........MIN/YR	0.4	0.4
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	PATH LENGTH...KM			32.79
18	PATH RAINFALL RATE............MM/HR			131.3
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			7.58E-07
				0.40
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.407			
CALC LO	6.83	9.39		
LO>LX	3.000	2.440		
CALC UX	0.0000	0.0002		

PATH PERFORMANCE CALCULATION SHEET FOR			UUI - 6 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Tuntutuliak		Eek
OPERATING FREQUENCY......GHZ.			6.75	
PATH LENGTH.............MILES			20.00	
PATH LENGTH.............KM			32.79	
FREE SPACE LOSS.......DB			140.77	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	85.00		175.00
FEED LINE.................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.35	1.15		2.36
LOSSES...........DB/100 FT.	1.35	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			4.51	
TOTAL FIXED LOSSES.....DB			145.28	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		6.00		8.00
ANTENNA GAIN................DB		39.64		42.14
RADOME LOSS.................DB		0.70		0.70
TOTAL ANTENNA GAIN..........DB			80.38	
NET PATH LOSS....(E32-E26)...DB			-64.90	
TRANSMITTER POWER...............DBM			29.90	
RECEIVED CARRIER LEVEL(RCL).....DBM			-35.00	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			50.00	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			1.53	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.13	0.89
PROPAGATION OUTAGE........MIN/YR	0.7	0.7
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

Tuntutuliak to Eek

	PATH LENGTH...KM			32.79
18	PATH RAINFALL RATE............MM/HR			126.1
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			1.35E-06
				0.71
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.407			
CALC LO	6.83	9.39		
LO>LX	3.000	2.440		
CALC UX	0.0000	0.0002		

Micronet Communications, Inc.
720 F Avenue, Suite 100
Plano, Texas 75074
972-422-7200

File: M0423905 3
Original PCN Date: May 10, 2005
Company: UNITED UTILITIES INC

Company Code	P8965	P8965
Site Name, State	Quinhagak, AK	Eek, AK
Call Sign/County	/Bethel	/Bethel
Latitude N (NAD83)	59 43 43.30	60 12 57.40
Longitude W (NAD83)	161 54 26.70	162 00 43.40
Azimuth (degrees)	353.90	173.81
Distance (miles/km)	33.93/54.60	33.93/54.60
Space Loss (db)	143.024	
Elevation AMSL (ft/m)	20.0/6.10	40.0/12.20
Transmit-Receive Ant Type	PL10-59D	PL10-59D
FCC Designation	A71700	A71700
Antenna Manufacturer	ANDREW CORPORATION	ANDREW CORPORATION
Gain/Beamwidth (dbi/deg)	43.3/1.1	43.3/1.1
Antenna Height AGL (ft/m)	225.00/68.58	285.00/86.87
Tilt (degrees)	-0.158	-0.210
Diversity Ant Type	PL8-59D	PL8-59D
FCC Designation		
Antenna Manufacturer	ANDREW CORPORATION	ANDREW CORPORATION
Gain/Beamwidth (dbi/deg)	41.6/1.4	41.6/1.4
Antenna Height AGL (ft/m)	120.00/36.58	197.00/60.05
Equipment Manufacturer	HARRIS CORPORATION	HARRIS CORPORATION
Manufacturer's Type	HRS-CX-06G155M-H	HRS-CX-06G155M-H
FCC Identifier		
Emission/Stability %	30M0D7W/0.0003	30M0D7W/0.0003
ATPC/Trigger Level (dbm)	NO/	NO/
Transmitter Power (dbm/Watts)	31.10/1.2882	31.10/1.2882
Fixed Losses Cm,Tx,Rx (db)	5.8,0.0,0.0	6.7,0.0,0.0
Receive Level (dbm)	-37.84	-37.84
EIRP (dbm/Watts)	68.58/7211.08	67.70/5888.43
Traffic (kbps/vc)	172560.0/2016	172560.0/2016
Modulation/Lvl	TCM/128	TCM/128
Frequencies Transmitted (MHz)	6034.15H	6286.19H

RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Quinhagak		Eek
OPERATING FREQUENCY......GHZ.			6.03	
PATH LENGTH............MILES			20.00	
PATH LENGTH..............KM			32.79	
FREE SPACE LOSS.......DB			143.02	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	240.00		300.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.53		4.41
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.94	
TOTAL FIXED LOSSES.....DB			151.96	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		8.00		8.00
ANTENNA GAIN................DB		41.17		41.17
RADOME LOSS..................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			80.95	
NET PATH LOSS....(E32-E26)...DB			-71.01	
TRANSMITTER POWER...............DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-39.91	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN.....................DB			45.09	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			1.38	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.18	1.14
PROPAGATION OUTAGE........MIN/YR	2.0	2.0
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

QuinhFK to Eek

	PATH LENGTH...KM			32.79
18	PATH RAINFALL RATE............MM/HR			143.4
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			2.39E-06
				1.26
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.407			
CALC LO	6.83	9.39		
LO>LX	3.000	2.440		
CALC UX	0.0000	0.0002		

PATH PERFORMANCE CALCULATION SHEET FOR:			UUI - 6 FT. ANT	
RADIO MODEL TYPE		HRS-CX-06G155M-N		HRS-CX-06G155M-H
STATION NAME		Quinhagak		Eek
OPERATING FREQUENCY......GHZ.			6.03	
PATH LENGTH.............MILES			20.00	
PATH LENGTH.............KM			32.79	
FREE SPACE LOSS.......DB			143.02	
FEED LINE TYPE (ENTER W/G SUFFIX ONLY)				
FEED LINE ....TYPE	63	240.00		300.00
FEED LINE..................TYPE	63	0.00		0.00
FEED LINE LOSSES				
LOSSES...........DB/100 FT.	1.47	3.53		4.41
LOSSES...........DB/100 FT.	1.47	0.00		0.00
BRANCHING LOSS.........DB		0.00		1.00
FIELD ALLOWANCE.......(TYPICALLY 2 DB)			0.00	
TOTAL LINE LOSSES.....6+7			8.94	
TOTAL FIXED LOSSES.....DB			151.96	
ANTENNA GAIN				
ANTENNA SIZE (DIAMETER)......FT		6.00		8.00
ANTENNA GAIN................DB		38.68		41.17
RADOME LOSS.................DB		0.70		0.70
TOTAL ANTENNA GAIN...........DB			78.45	
NET PATH LOSS....(E32-E26)...DB			-73.51	
TRANSMITTER POWER...............DBM			31.10	
RECEIVED CARRIER LEVEL(RCL).....DBM			-42.41	
RECEIVER THRESHOLD (37 DB S/N)..DBM			-85.00	
FADE MARGIN....................DB			42.59	
RATIO FADE MARGIN/PATH LENGTH...DB/KM			1.30	
RAIN ZONE...ENTER STATE		AK	E	

N-NORTH,W-WEST,E-EAST,S-SOUTH,C-CENTRAL

	VERTICAL	HORIZONTAL
RAIN OUTAGE ....MIN/YR	0.22	1.31
PROPAGATION OUTAGE........MIN/YR	3.5	3.5
RELIABILITY (RAIN + PROPAGATION)	> 99.99 %	> 99.99 %

	Quinhagk to Eek			
	PATH LENGTH...KM			32.79
18	PATH RAINFALL RATE............MM/HR			138.5
19	POINT RAINFALL RATE(FROM GRAPH)...			17.00
19	PROPAGATION OUTAGE.....MIN/YR			3.74E-06
				1.97
RAIN CALCULATION AREA				
CALC S	VERTICAL	HORIZONTAL		
	0.512	0.704		
a	0.0016	0.0018		
b	1.2650	1.3080		
R	98.00	98.00		
CALC R	0.407			
CALC LO	6.83	9.39		
LO>LX	3.000	2.440		
CALC UX	0.0000	0.0002		