EXHIBIT 14

Microwave Beam Path/FCC Assessment Reports

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ENGINEERING REPORT
CONCERNING THE EFFECTS UPON
FCC LICENSED RF FACILITIES
DUE TO THE CONSTRUCTION OF THE
DOGDEN BUTTE WIND PROJECT
In
McLEAN COUNTY, NORTH DAKOTA

New Frontier Renewable Energy

February 29, 2008

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ENGINEERING REPORT CONCERNING THE EFFECTS UPON FCC LICENSED RF FACILITIES DUE TO THE CONSTRUCTION OF THE DOGDEN BUTTE WIND TURBINE FARM In McLEAN COUNTY, NORTH DAKOTA

New Frontier Renewable Energy

I. INTRODUCTION

This engineering report describes the results of a study and analysis to determine the locations of federally-licensed (FCC) microwave and fixed station radio frequency (RF) facilities that could be adversely impacted as a result of the construction of the proposed Dogden Butte Wind Project located in McLean County, North Dakota. This document describes impact zones and any necessary mitigation procedures, along with recommendations concerning individual wind turbine siting. All illustrations, calculations and conclusions contained in this document are subject to on-site verification[1].

Frequently, wind turbines located on land parcels near RF facilities can cause more than one mode of RF impact, and may require an iterative procedure to minimize adverse effects. This procedure is necessary in order to ensure that disruption of RF facilities either does not occur or, in the alternative, that mitigation procedures will be effective. The purpose of this study is to facilitate the siting of turbines to avoid unacceptable impact to FCC licensed RF facilities.

The wind turbines to be used have a hub height of up to 80 meters above ground and a blade diameter of 77 meters. Thus, the total height will be up to 118.5 meters above ground level to the tip of one blade at the 12:00 position. The turbine project comprises several parcels on either side of State Highway 53, just west of the city of Butte, in McLean County, North Dakota.

Using industry standard procedures and FCC databases, a search was conducted to determine the presence of any existing microwave paths crossing the subject property, as well as other RF facilities within or adjacent to the identified area. The turbine layout is not yet in the final planning stages. Thus, this report will described impact zones within which turbines should not be sited rather than evaluate the impact of specific turbine sites.

[1] The databases used in creating the attached tables and maps are generally accurate, but anomalies have been known to occur. An on-site verification survey is suggested as part of the due diligence process.

The instant analysis consists of three sections:

1. Microwave path analysis
2. Non-broadcast station analysis
3. Broadcast television and radio analysis

The following analyses examine in detail the pertinent FCC licensed services in the area for potential adverse impact. The determination of the RF impact zones described in this report is based upon the notified operating parameters of the FCC-licensed stations as contained in the FCC databases.

These analyses assume that all licensed services have been designed and constructed according to FCC requirements and good engineering practice. If this is not the case, the impacted facility must share responsibility with the wind turbine company for the costs of any mitigation measures[2].

The locations of several communications towers in the project area which are the transmit or receive sites for many of the non-broadcast facilities identified in this report had previously been verified by survey during an on-site visit. To the extent possible, this data has been used to generate the results described in this report.

Each of the RF analyses is described separately in the sections that follow.

II. ANALYSIS OF MICROWAVE LINKS

An extensive analysis was undertaken to determine the likely effect of the new wind turbine farm upon the existing microwave paths, consisting of a Fresnel x/y/z axis study.

Important Note: Microwave path studies are based upon third party and FCC databases that normally exhibit a high degree of accuracy and reliability. Although Evans performs due diligence to ensure that all existing microwave facilities are represented, we cannot be responsible for database errors that may lead to incomplete or inaccurate results. In addition, some frequencies are occasionally "warehoused" by imbedded licensees for future use, and do not therefore currently appear as operational links. Although this practice is technically illegal in a "first come first served" service, disruptive delays can result. However, should such situations occur, Evans would perform an engineering analysis to determine how the additional facilities can be accommodated or, if wind turbine structures are already built, determine a method to re-direct the affected beam path.

[2] For instance, some microwave paths may have insufficient ground clearances as they are presently configured.

For this microwave study, *Worse Case Fresnel Zones* (WCFZ) were calculated for microwave paths crossing any part of the turbine property. The radius *R* of the Worst Case Fresnel Zone, in meters, is calculated for each path using the following formula:

$$Rn \cong 17.3\sqrt{\frac{n}{FGHz}\left(\frac{d1d2}{d1+d2}\right)}$$

where:

R_n = First Fresnel Zone Radius, meters

n = 1

F_{GHz} = Frequency of microwave link, GHz

d_1 = Distance to wind turbine site from one end of the microwave link, km

d_2 = Distance to wind turbine site from other end of the microwave link, km

In general, the WCFZ is defined by the cylindrical area whose axis is the direct line between the microwave link endpoints and whose radius is *R* as calculated above. This is the zone where the siting of obstructions should be avoided. Possible geographic coordinate errors must be taken into account when siting turbines near microwave paths[3].

For the Dogden Butte study, the WCFZ radius of each microwave path was determined to be the first Fresnel zone radius at the point at which the Fresnel zone is widest *inside the turbine property*, rather than at the path mid-point. For purposes of this analysis, 100% of the first Fresnel zone radius was used to calculate minimum turbine clearances from the microwave paths.

Evans Associates has identified five microwave links, traversing four unique paths, that cross the project area. These links are tabulated in attached Figure 3-A. One of these links, ID#5, which was not found in the database, was discovered during an on-site visit.

It has been determined that these four microwave paths create x/y "blackout" zones within which turbines would penetrate the Fresnel zone.

[3] Many microwave facilities were built before accurate methods were available to establish exact geographic coordinates (such as GPS). It is not unusual for database errors of up to 4 or 5 seconds to occur, which can effect the positioning of critical turbines located near microwave paths.

Mitigation of microwave path encroachment can involve one of these possibilities:

1. Configuring the turbines to avoid the blackout zone.
2. Shifting the microwave path to by moving one endpoint to another location.
3. Increasing the height of the microwave tower above the turbines.

In this particular case, configuring the turbines to avoid the microwave path WCFZ is the most practical alternative. The right-angle distance from the microwave path centerline must be at least the WCFZ for the path in question plus the radius of the blade (38.5 meters). Final siting of the turbines should be done in coordination with a land surveyor to verify the coordinates of the endpoints of the microwave paths. The accuracy of license coordinates as obtained from the FCC's database generally does not exhibit the precision required for turbine siting. In addition, as part of this due diligence process, notification letters should be sent to the microwave licenses when a turbine layout has been determined.

The maps in attached Figure 1 show the microwave path "blackout" zones, determined as described previously. Figure 2 shows the microwave link specifications pertinent to turbine siting, and the axial radius of each microwave path impact zone, which includes the radius of the rotor, within which a turbine should not be sited.

During an on-site visit by New Frontier's wind technician, one tower on the butte, identified as "Tower #5", was found to have a microwave dish mounted on it. This antenna is not among the microwave facilities identified in this report and is not documented in any accessible microwave database. It's possible that this dish is no longer in use. Another on-site visit might reveal the status of this antenna, and if it is active, the exclusion area map should be revised accordingly.

III. ANALYSIS OF NON-BROADCAST FIXED RADIO FACILITIES

3.1 Land Mobile & Public Safety Stations

There are 27 *Land Mobile* transmitters identified from the FCC's database whose sites are within the project area boundaries (see Figure 3-B for complete list). These stations are located at eight unique antenna sites, six of which had been surveyed during the on-site visit by New Frontier.

Evans Associates has determined exclusion zones for the land mobile stations as circles centered at the land mobile sites. For each land mobile site, an impact radius was calculated based on a conservative estimate of the distance to the beginning of the far-field region of the land mobile antenna plus the radius of the turbine rotor. These circular exclusion zones are shown in Figure 1 and described in Figure 2.

Turbines should be sited outside the circular areas shown in Figure 1 and described in Figure 2 if at all possible. If siting a turbine outside these areas is unavoidable due to other restrictions, this situation should be evaluated on a case-by-case basis to determine if there would be an adverse

effect on the land mobile station and, if such an effect is likely, what mitigation methods are appropriate. In meeting the minimum clearance distances, higher priority should be given to trunked radio and public safety facilities, since these facilities use equipment more complex than conventional two-way radio and thus are more expensive to mitigate.

It should be noted that two land mobile sites with exclusion zones associated with them are not among the sites that were surveyed previously. The exclusion zones for these two sites were based on the geographical coordinates in the FCC licenses. It is recommended that these two antenna sites be surveyed during the process of final turbine siting.

With respect to the land mobile and public safety stations, we conclude and recommend the following:

1. When the turbine layout is in the final planning stages, avoiding the circular impact areas in Figure 1 maintaining as much as possible. All licensees of the land mobile stations listed in Figure 3-B should be contacted to solicit their opinions concerning any adverse effects they contend will result from the turbine project. A deadline should be established for a reply. If comments of potential adverse effects are received, they should be addressed via an engineering analysis that either:

    a. Shows how the licensee's analysis is not accurate, or
    b. Suggests a compromise mitigation procedure.

2. Mitigation measures can include relocating the station to another nearby location, increasing the transmitting antenna height, or installing more sensitive radios.

3. The two land mobile station sites that had not previous been surveyed should be surveyed as part of the turbine siting process.

3.2 FAA and DoD Concerns

The Department of Defense and the Department of Homeland Security *Long Range Radar Joint Program Office* "JPO" has adopted interim procedures for evaluating wind turbine impact to long range radar.

It is prudent to submit 7460-1 forms to the FAA as the first consideration in the site development process. At the same time, notification should be made to the JPO and the National Telecommunication Information Agency (see Section 3.3).

According to the FAA's Long Range Radar Tool, no impact to Air Defense and Homeland Security radars by the proposed Dogden Butte project is anticipated. However, an aeronautical study is required.

The public airport nearest to the Dogden Butte wind project area is Turtle Lake Municipal. This airport is 19.75 nautical miles south of the center of the turbine area, and should not ordinarily pose a problem to airport operations, unless flagged by the FAA during the 7460-1 evaluation process.

3.3 Other Government RF Facilities

Operation of RF frequencies for federal government use is managed by the National Telecommunication Information Agency (NTIA), which is part of the U.S. Department of Commerce. The technical specifications for most government facilities are unavailable to the public. In order to avoid the derailment of the Dogden Butte wind energy project due to late objections from a government agency, the NTIA should be notified of the proposed project during pre-construction planning. The NTIA has set in place a review process, wherein the Interdepartmental Radio Advisory Committee (IRAC), consisting of representatives from various government agencies, reviews new proposals for wind turbine projects for impact on government frequencies. In almost all cases, no adverse impact is found, and IRAC usually issues a determination within 30 days. However, notification to NTIA should not be regarded as an alternative to notifying JPO concerning military radar impact or the FAA. All three agencies should be notified.

3.4 Cellular Facilities

The FCC database does not necessarily reflect the existence of all cellular and PCS (personal communications service) towers in a particular area. If there are cellular or PCS antennas located near turbine sites, impact to these services is expected to be insignificant to non-existent[4]. It is recommended that possible cellular and PCS antennas be researched via an on-site site visit.

IV. ANALYSIS OF BROADCAST FACILITIES

4.1 TV Broadcast Facilities

The rotating blades of a wind turbine have the potential to disrupt over-the-air broadcast TV reception within a few miles of the turbine. This is manifested in an analog TV picture by a flickering or tearing of the image in time with the blade rotation, which is caused by signals reflected by the blades arriving at the TV antenna along with the direct signal. This is known as "multipath interference." However, as turbine manufacturers have replaced all-metal blades with blades constructed of mostly nonmetallic materials[5], this effect has been reduced. Also, the new generation of HDTV receivers is better equipped to deal with multipath interference (which is

[4] Cellular antennas employ diversity and multiple receivers to compensate for any disruptions at any one location.

[5] Modern turbine blades are usually constructed from glass-reinforced plastic (GRP), although they usually contain some metal for strengthening, balance and grounding.

manifested by "pixilating" or "freezing" of the digital picture) than analog TV sets, as special circuitry is employed to suppress the reflected signal. Occasionally, however, multipath interference from one or more turbines can cause video failure in HDTV receivers, especially if the receiver location is in a valley or other place of low elevation. Analog TV transmission is scheduled to end in February of 2009, after which TV stations will only transmit in DTV (Digital or "High Definition").

The area where the Dogden Butte wind project would be located is within the Minot-Bismarck-Dickinson, ND TV Designated Market Area, as defined by Nielsen Media Research, but the area is determined to be served only by the Minot TV stations. The following full service analog TV facilities have been identified as placing a receivable signal in the wind project area (distance and azimuth are relative to the geographic center of the turbine area):

Call Sign	Affiliate	Channel	City of Lic.	Power (KW)	Ant. Ht. (m HAAT)	Dist. (km)	Azimuth (°T)
KSRE	PBS	6	Minot ND	100	323	51.3	299.3
KMOT	NBC	10	Minot ND	214	207	58.5	317.9
KXMC-TV	CBS	13	Minot ND	316	344	48.1	301.3
KMCY	ABC	14	Minot ND	513	229	51.1	299.8
KXND	FOX	24	Minot ND	740	239	54.4	297.3

Table 1 – Analog TV Signals in Project Area

Ordinarily, there is some possibility of multipath disruption to over-the-air reception of TV stations whose signals are degraded by distance or terrain obstructions. However, since the analog facilities have only until the end of February of 2009 to operate[6], and since the area around the wind project is sparsely populated, it should be assumed that the disruption caused by the wind turbines would not be significant. The usual effect is intermittent "pixelating" or "freezing" of the digital picture, and "tearing" of an analog picture.

In addition to the above analog TV stations, the digital television facilities listed below have been identified:

Call Sign	Affiliate	Channel	City of Lic.	Power (KW)	Ant. Ht. (m HAAT)	Dist. (km)	Azimuth (°T)
KMCY	ABC	15	Minot ND	500	216	51.1	299.7
KSRE	PBS	40	Minot ND	146	249.4	51.3	299.3
KXMC-TV	CBS	45	Minot ND	50	249.4	51.3	299.3
KMOT	NBC	58	Minot ND	110	144	58.5	317.9

Table 2 – Digital TV Signals in Project Area

There appear to be no TV translators or Low Power TV stations, analog or digital, whose signals reach the project area.

[6] Unless extended by the FCC or Congress.

The majority of modern TV sets should successfully handle the described anomalies. According to this engineer's calculations, there are 100 households within an area likely to be affected[7]. If the turbines disrupt any direct off-air TV signals, the number of instances should be small and the cost of mitigation quite manageable. The most likely mitigation measure would be to install a directional high(er)-gain outside antenna to increase the strength of the direct wave and reduce reflections. The worst-case mitigation measure, if required, could consist of installing a satellite dish or cable TV, if not already installed. The implementation of these solutions has been relatively infrequent. A small number of the 10% of over-the-air TV receive locations that are disrupted (perhaps about one-fifth) may have to be resolved by upgrading the antenna system, adding a satellite dish, or connecting to the local cable TV system. TV receiver disruptions at the other affected locations could be dealt with by relocating the antenna to another place in the residence.

At the present time, it is conservatively estimated that approximately 10 locations (10% of the 100 households in the potential impact area) could require mitigation, assuming that all broadcast TV viewing comes from off-air rather than cable or satellite. To obtain a better handle on this number, it is suggested that a TV antenna inventory be compiled during the site survey.

4.2 FM Broadcast Facilities

The following full-service FM stations each place a predicted primary over at least a portion of the turbine property (According to the FCC, ONLY stations providing predicted service are entitled to protection):

Call Sign	Format	Freq (MHz)	City	Power (KW)	Ant. Height (m HAAT)	Dist. (km)	Azimuth (°T)
KMPR	Classical/News/Jazz	88.9	Minot, ND	50	283	51.3	299.3
KIZZ	Adult Contemp.	93.7	Minot, ND	100	169	54.3	297.8
KTZU	Classic Rock	94.9	Velva, ND	98	156	48.1	301.5
KWGO	Adult Contemp.	102.9	Burlington, ND	98	156	48.1	301.5
KZPR	Classic Rock	105.3	Minot, ND	100	169	54.3	297.8
KYYX	Country	97.1	Minot, ND	95	300	48.1	301.3

Table 3 – FM Broadcast Signals in Project Area

Because of the "capture effect" supported by the "discriminator" in FM receivers, significant disruptions to the above facilities are not expected. Although the received signal may vary with the blade rotation at some receive locations in the immediate area, good quality FM radios will most likely factor out such time-varying signals. In those relatively few cases where significant impact is caused (e.g. when a listener is located within one kilometer of a turbine), home FM

[7] This area was determined as follows: One kilometer beyond the project area boundaries in all directions except in directions away from the Minot TV station transmitters, representing the "back-scatter" of TV signals reflected from the turbines, and 5 kilometers beyond the project boundaries in directions opposite the TV stations, generally to the east-southeast, representing the "forward-scatter" of TV signals.

radios could be connected to the rooftop TV receive antennas to pull in a stronger direct signal. Mobile or portable receivers would only need to be moved slightly (for instance, radios using line cords for antennas).

4.3 AM Broadcast Facilities

A search of the FCC's broadcast database revealed no operating or authorized AM stations within the notification distance of three kilometers beyond the turbine property boundaries.

There should therefore be no reasonable expectations of disruptions in transmitted radiations on the AM band due to the presence of the turbines. Occasionally, depending upon ground conditions, local AM receivers may experience slight signal changes due to local effects, but such anomalies are not recognized by the FCC or the standards of good engineering practice.

V. CONCLUSIONS

The following conclusions have been reached as a result of the analysis undertaken with respect to the Dogden Butte wind turbine project:

1. Four unique microwave paths have been determined to create "blackout" zones. A possible fifth microwave link that is undocumented could impact the turbine area, and a follow-up is recommended. Turbines should not be sited within the areas shown in Figure 1 and described in Figure 2. The licensees of the microwave links that impact the project area should be sent notification letters.

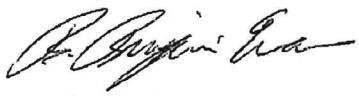
2. Turbines should not be placed in the circular areas around land mobile sites as shown in Figure 1. In each case where this is not possible, a detailed analysis should be made to determine the potential for adverse effects to the radio station. Notification should be made to all licensees whose antenna sites are within the turbine area. On-site verification of all communications sites in and near the butte should be done to confirm the status and exact location of each impacted radio station.

3. Based upon FCC database information, no significant impact is expected to FM broadcast facilities. A few receive locations may experience signal fluctuations in time with the blade rotors, but the receiver automatic gain control should be able to manage these variations. In a few cases, it might be necessary to utilize outside antennas at nearby homes.

4. Some slight to moderate impact to a very small number of local over-the-air TV receivers tuned to broadcast TV or digital TV stations may occur in and near the project area, especially if viewers are not using high-gain antennas. The most likely scenario is that perhaps up to 10% of over-the-air TV receiver sites may have to be mitigated (rough estimate). According to the U.S. Census, approximately 100 households are in areas

likely to be affected. Assuming that all of these households rely on over-the-air TV broadcast, some level of mitigation could be required for about 10 of these residences. Mitigation measures are expected to be available for all expected anomalies, with satellite or cable TV service providing the worst-case resolution for very few of those 10 residences.

Respectfully Submitted,



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February 29, 2008

ATTACHED FIGURES:

Figure 1 -- RF Impact Exclusion Zone Map
Figure 2 -- Specifications of RF Exclusion Zones
Figure 3 -- Tabulation of RF Facilities in Turbine Property

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Figure 1 – RF Exclusion Zones Within Dodgen Butte Windfarm Area

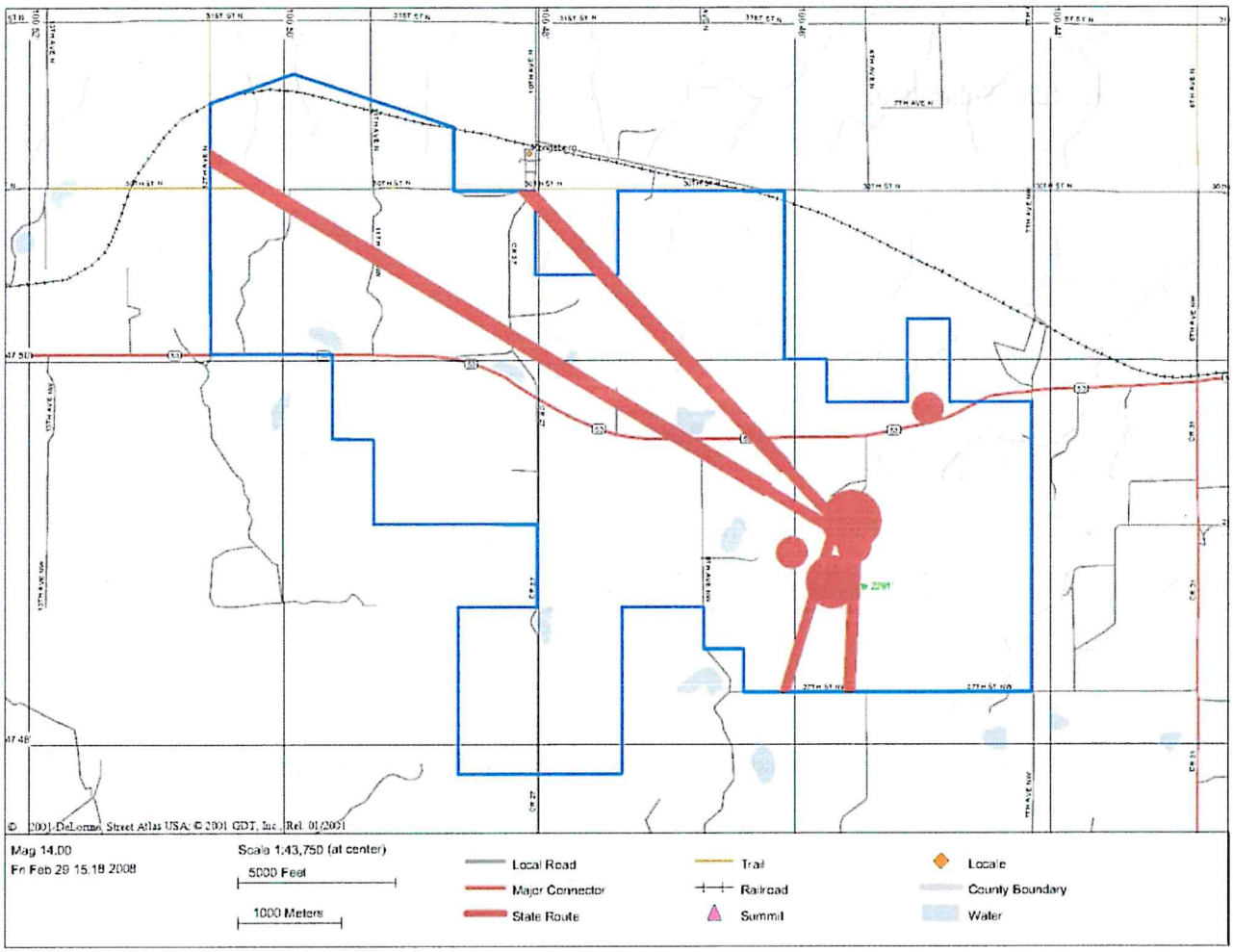

Figure 2 – Specifications of RF Exclusion Zones

Situation	Coords. of RF Site in Project Area	Azimuth of Path from RF Site	Radius (m) of Exclusion Zone[8]
Reiten Television MW Path between Butte & Wilton	47-49-03.0; 100-45-31.3 Based on Survey of Tower #4	182.5°	53.1
Reiten Television MW Path from Butte to KXMC Transmitter	47-49-03.0; 100-45-31.3	300.9°	≤ 1 km: 50.6 > 1 km: 69.7
Reiten Television MW Path from Minot to Butte	47-49-03.0; 100-45-31.3	317.0°	≤ 1 km: 50.4 > 1 km: 69.5
SRT MW Path from Butte to Lake Brekken	47-49-11.7; 100-45-39.7 Based on Survey of Tower #1	197.0°	47.8
Land Mobiles on Towers # 2 & 3	47-49-10.0; 100-45-33.3 Halfway between surveyed sites of both towers	-	290
Land Mobiles on Tower #5	47-49-02.0; 100-45-32.1 Based on Survey	-	166
Land Mobiles on Tower #6	47-48-50.8; 100-45-42.6 Based on Survey	-	253
Other Land Mobiles	47-49-00.0; 100-46-01.5 Based on FCC Licenses	-	153
Other Land Mobile	47-49-45.0; 100-44-57.5 Based on FCC License	-	154

[8] For microwave paths, this is the right-angle distance (or axial radius) from the microwave path centerline. This distance is applied on both sides of the microwave path centerline. In other words, the width of the impact zone for microwave links is two times the zone radius. For land mobile stations, this is the distance from the land mobile transmitter site. The radius of the rotor (38.5 meters) is included in the distances in this column.

Figure 3-A – Microwave Links Crossing Turbine Area

ID	Name Site 1	Name Site 2	Call Sign Site 1	Call Sign Site 2	Band Name	Licensee	WCFZ (m)
1	WILTON	BUTTE	KAM51	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	14.4
2	BUTTE	KXMC XMTR	KAM52	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	12.1/31.2
3	S MINOT	BUTTE	WMU366	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	11.9/31.0
4	BUTTE	WILTON	WMU367	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	14.6
5	BUTTE	LAKE BREKKEN	BUTTE	LAKE BREKKEN	5.8 GHz	SRT COMMUNICATIONS	9.3

Figure 3-B – Land Mobile Facilities Within Turbine Property Boundaries

ID	Call Sign	Antenna Height (m)	Frequency (MHz)	Licensee	Contact	Phone
1	KAP990	60.0	151.1	State of North Dakota		701-224-2529
2	KNDN919	24.0	451.5	Souris River Telephone Mutual Aid Corp.	Eugene Maliszewsky	202-828-5536
3	KNFF835	53.0	453.325	State of North Dakota		701-328-6935
4	KNIQ947	67.0	463.525	Myles Frounfelter		701-728-6863
5	KNNJ554	26.0	461.5	Donald R. Aaseth		701-626-7586
6	KNNJ558	26.0	461.5	Arnold Tarasenko		701-839-6530
7	KNNJ578	26.0	461.5	James L. Hystad	L. Ayers	717-334-9262
8	KWI834	70.0	154.905 – 155.475	State of North Dakota		701-224-2127
9	WNIT566	67.0	463.525	John E. Rust		701-447-2667
10	WNLA647	22.0	464.925	Team Electronics		701-852-3281
11	WNLR536	67.0	463.525	Clarence J. Hanson		701-626-7597
12	WNNQ567	67.0	463.525	Gerald R. Olson		701-852-2525
13	WNPH720	29.0	856.6625 – 864.6375	Al Deck		701-693-2355
14	WNPR903	26.0	461.5	Carvel W. Lick		406-447-2640
15	WNUG418	55.0	153.605	Midwest Drywall Company Inc.		913-345-1913
16	WNYN750	67.0	463.525	John Thomas		701-624-5473
17	WNZE414	18.0	851.8875	Kotana Communications Inc.		701-774-8001
18	WPDG886	26.0	461.5	Windy Ridge Ranch	Leo W. Thomas	701-338-2004
19	WPDG887	26.0	461.5	Earl L. Goven	Marshall Pudwill	701-258-7698
20	WPMY511	67.0	463.525	Robert Voth		701-448-2689
21	WPPE905	70.0	460.275 – 460.55	State of North Dakota		701-328-8154
22	WPRF499	61.0	451.225	Great River Energy	Salyers Watson & Associates	219-567-9168
23	WPSN423	26.0	461.5	David Aaseth		701-258-7698
24	WQBR517	58.0	155.895	McLean County Emergency Management	Charles Hale	701-258-7698
25	WQDA881	63.9	154.695 – 155.475	State of North Dakota	Christine Phelps	386-322-2500
26	WQY804	26.0	464.325	Daniel Movchan		701-626-7152
27	WYL744	55.0	153.605	Otter Tail Power Company	Marty Berlinger	218-739-8584

ATDI

Wind Farm / Microwave Link Analysis

New Frontier Wind Farm

Solutions in radiocommunications

Table of Contents

1. Introduction

1.1 Background

Wind turbine generators, with their metallic construction, large proportions, and moving parts are potential interferers for fixed communications links and air traffic control and navigational aids. Due to their unique physical characteristics, the turbines may have negative impacts upon these wireless communications channels, including licensed microwave links.

The two main types of terrestrial microwave stations are those that communicate with satellites and those that communicate with each other, in a point-to-point fashion. Satellite communications links are not likely to be affected by wind turbines because of the high angle of inclination of the parabolic antenna. Terrestrial point-to-point links may be affected by wind turbines because of the low altitudes that their transmission paths occupy.

Point-to-point microwave links are communications systems that transmit their signals via beams of radio waves. They are used to transmit anything from data to audio and video information in the microwave frequency range from 1 to 30 gigahertz. Such links are often used as backhaul systems due to their vast bandwidth (ability to carry large amounts of information); long distance telephone calls, sports broadcasts, and cellular network backbone transmission are common microwave transmissions.

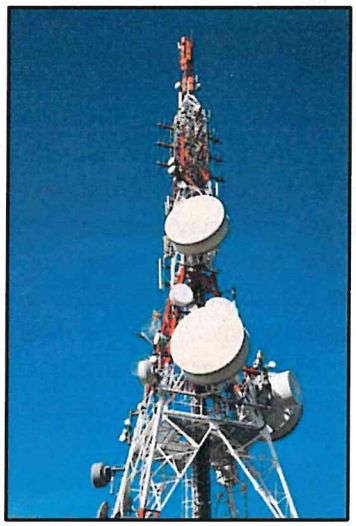

Figure 1: Mast with terrestrial microwave antennae

Most terrestrial microwave links feature two highly-directional parabolic antennas situated several miles from each other, forming a fixed radio link. These two parabolic antennas must be in line-of-sight, otherwise transmission quality may be degraded or not at all possible. Since the transmission path is usually within several hundred feet of ground level, any structures or

vegetation that fully or partially impinge upon the electromagnetic energy that is transmitted between two microwave antennas will lower the quality and reliability of transmission.

For unlicensed transmission, a certain amount of degradation of service must be tolerated, as long as the object responsible for the degradation does not emit electromagnetic waves of too much power, within the unlicensed frequency range. Point-to-point microwave paths mainly consist of licensed links. This means that a user purchases a certain frequency range in a given area and thus becomes the sole user of that frequency [in that area], greatly decreasing the probability of electromagnetic interference.

When a user pays for a radio frequency in a certain area, they are in essence paying for a guarantee of little to no interference to their transmission system. Licensed transmission paths are also often operated by government and safety agencies, like weather reporting entities and police and fire departments. In most jurisdictions, interfering with such transmission links is prohibited by law.

1.2 Wind Turbine Effects on Point-to-Point Microwave Links

Obstacles located between the transmitter and the receiver in a microwave link, including wind turbines, affect the received signal strength in wireless communication. Wind turbines can also generate electromagnetic noise which may interfere with communication signals. The resulting effect can be a decrease of reliability and in some cases the inability to communicate. Point-to-point microwave links rely on line of sight to establish communication. The signal is subject to refraction in the atmosphere and diffraction from obstructions in the Fresnel zone volume.

A Fresnel zone is an elliptical volume around a direct radio path that contains a certain amount of electromagnetic energy. While the energy nearest the direct radio path (within the first Fresnel zone) contributes to the total amount of energy received at the receiving station, energy within the second Fresnel zone may sum destructively at the receiver, lowering the total amount of power received and potentially negatively effecting the quality of transmission. Microwave operators usually try to maintain 60% of the first Fresnel zone cleared from obstructions when designing their links. As a conservative measure, second Fresnel zone clearance is considered to avoid any harmful effects caused by the energy contained in that volume.

2. Objective

The objective of this report is to utilize the optimal cartographic data in ATDI's ICS Telecom RF planning software to most efficiently analyze any potential interference effects of the projected site area where the wind turbines will be located SE of Minot, North Dakota, supported by a comprehensive technical database containing licensed microwave systems while using theoretical calculations based on formulas from commonly available literature.

2.1 The New Frontier Wind Farm Project Information

The proposed wind farm turbines have the following specifications:

Table 1: Wind Turbine Specifications

Wind Turbines	Vestas v90	Siemens 2.3
Number of Turbines	56	44
Hub Height (m)	80	80
Rotor Diameter (m)	90	101
Turbine Height (m)	124	129

The Proposed location of the New Frontier Wind Farm Project is South East of Minot, ND:

Figure 2: Area of Interest for the New Frontier Wind Farm Project

3. Methodology

The accepted second Fresnel zone clearance method is applied to determine the protected width of the microwave beam paths:

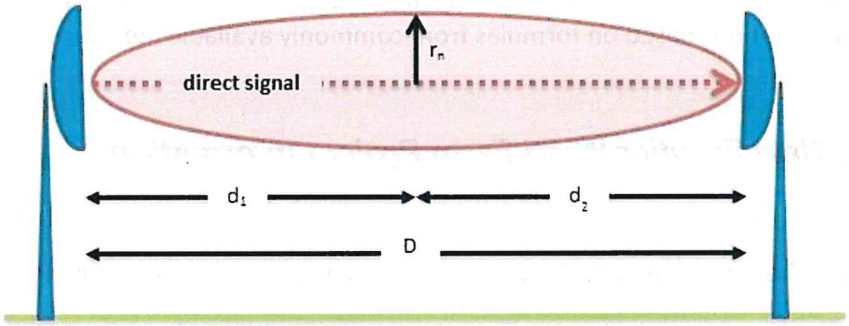

Figure 3: Fresnel zone calculation

The Fresnel zone size depends on the frequency and distance from the microwave stations, given by the generic formula:

$$r_n = \sqrt{\frac{n\lambda d_1 d_2}{d_1 + d_2}}$$

where:

rn is the radius of the nth Fresnel zone in meters
n is the Fresnel zone number
λ is the wavelength of the microwave signal in meters
d1 and d2 are the distances to the microwave stations from the point in question

The second Fresnel zone is the largest at the midpoint between the two antennas where d1 = d2. Its radius is defined by:

$$r_{WCFZ2} = 12.243\sqrt{\frac{D}{f}}$$

where:

rWCFZ2 is the radius of the second Fresnel zone in meters
f is the frequency in gigahertz
D is the total link distance in kilometers

This radius is commonly called the Worst Case Fresnel Zone and can be abbreviated as WCFZ2. When applied to a microwave link, it should provide enough clearance for the link to continue functioning without a drop in quality or reliability of transmission.

The wind farm and existing microwave links are now imported into the ATDI ICS Telecom tool for beam path analysis.

3.1 Beam Path Analysis

To accomplish the beam path analysis required to determine whether or not microwave radio link infringement is possible, a database search is first conducted for microwave links in existence in the area of the proposed wind farm. The FCC Universal Listing System repository is searched for any microwave links intersecting the bounds of the proposed wind farm. If there are none, the analysis is complete and there is no need for further investigation. The analysis uses the information available from the weekly download dated 11/23/2010.

Two microwave links in active status have been found to be near the area of interest. Figure 4 shows the proximity of the microwave links to the Wind Farm for the Siemens wind turbine model:

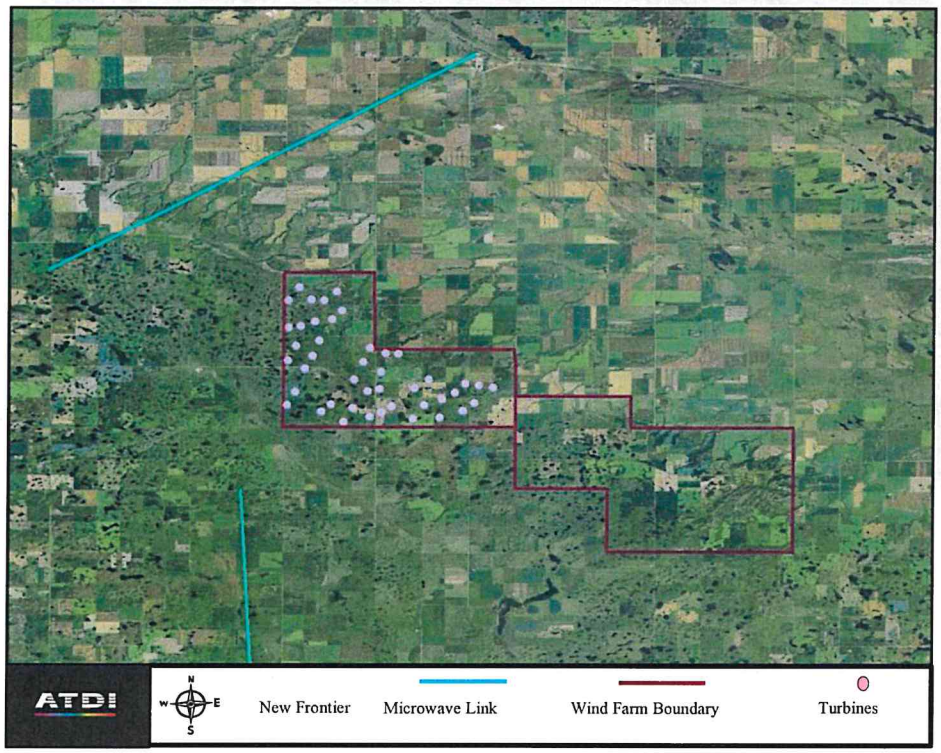

Figure 4: New Frontier Wind Project Area (Siemens Turbines)

Two microwave links in active status have been found to be near the area of interest. Figure 5 shows the proximity of the microwave links to the Wind Farm for the Vestas wind turbine model:

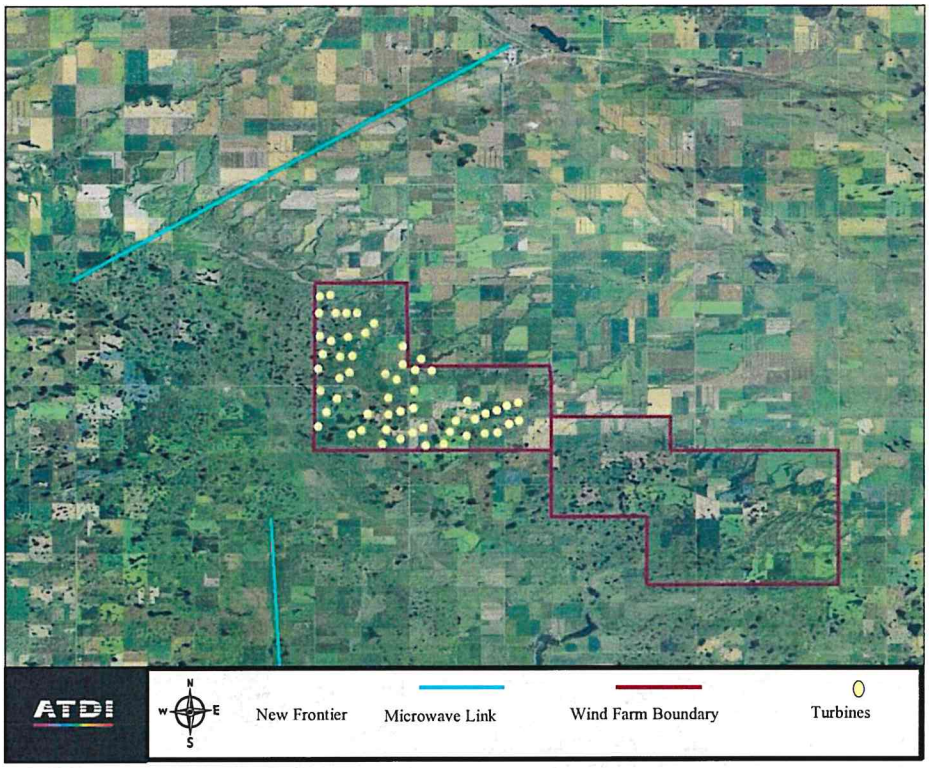

Figure 5: New Frontier Wind Project Area (Vestas Turbines)

The following table includes the Licensed Microwave links retrieved from the FCC Universal Licensing System repository for Microwave links near the New Frontier Wind Farm area (database retrieval date 11/23/2010):

Table 2: Licensed Microwave Links Near Projected Wind Farm Project Area

Licensee ID	Callsign	Site A	Site B	Licensee	MHz	WCFZ2
1	WHC467	STATION	525	BASIN ELECTRIC POWER COOPERATIVE	6780.00	20.2
2	WPYP790	TURTLE LAKE	RUSO	PRAIRIE PUBLIC BROADCASTING INC	6034.15	30.4

The following tables show the clearance distance between each SIEMENS wind turbine (including rotor volume) and the closest microwave link second Fresnel zone:

Tables 3 and 4: All Siemens wind turbine locations are clear from MW beam paths

Wind Turbine Id	MW Callsign	3D distance(m)
33	WPYP790	4664.9
38	WPYP790	4907.6
44	WPYP790	4970.4
29	WPYP790	5397.8
32	WPYP790	5403.6
37	WPYP790	5705.9
41	WPYP790	5822.8
1	WHC467	5946.3
4	WHC467	6236.7
40	WPYP790	6281.4
19	WPYP790	6657.5
3	WHC467	6705.3
28	WPYP790	6719.0
36	WPYP790	6731.9
2	WHC467	6895.5
17	WPYP790	6904.9
21	WPYP790	6926.9
43	WPYP790	6959.2
5	WHC467	7002.5
26	WPYP790	7078.7
16	WPYP790	7356.5
10	WHC467	7397.9

Wind Turbine Id	MW Callsign	3D distance(m)
9	WHC467	7567.8
35	WPYP790	7681.4
12	WPYP790	7698.3
8	WHC467	7705.5
20	WPYP790	7784.6
42	WPYP790	7787.6
6	WHC467	7790.2
18	WPYP790	7846.8
7	WHC467	7957.5
25	WPYP790	7960.7
11	WPYP790	8181.0
31	WPYP790	8358.7
13	WPYP790	8594.8
22	WPYP790	8627.8
39	WPYP790	8658.7
14	WPYP790	8669.8
15	WPYP790	8904.6
30	WPYP790	8922.8
34	WPYP790	9202.4
23	WPYP790	9476.8
24	WPYP790	9807.1
27	WPYP790	10153.5

The following tables show the clearance distance between each VESTAS wind turbine (including rotor volume) and the closest microwave link second Fresnel zone:

Tables 5 and 6: All Vestas wind turbine locations are clear from MW beam paths.

Wind Turbine Id	MW Callsign	3D distance(m)
42	WPYP790	4689.4
48	WPYP790	4859.7
54	WPYP790	5146.6
46	WPYP790	5182.2
34	WPYP790	5407.5
2	WHC467	5645.2
45	WPYP790	5730.6
53	WPYP790	5771.1
1	WHC467	5800.7
36	WPYP790	5954.3
28	WPYP790	6148.1
3	WHC467	6243.2
56	WPYP790	6250.3
49	WPYP790	6267.1
25	WPYP790	6322.9
37	WPYP790	6346.8
5	WHC467	6607.5
44	WPYP790	6718.9
33	WPYP790	6741.0
4	WHC467	6806.1
55	WPYP790	6822.4
27	WPYP790	7006.0
6	WHC467	7051.7
23	WPYP790	7119.3
32	WPYP790	7130.5
9	WHC467	7153.7
47	WPYP790	7300.7
18	WPYP790	7369.1

Wind Turbine Id	MW Callsign	3D distance(m)
21	WPYP790	7464.1
11	WHC467	7563.9
52	WPYP790	7660.6
10	WHC467	7753.6
26	WPYP790	7771.5
40	WPYP790	7776.4
7	WHC467	7790.2
24	WPYP790	7878.9
22	WPYP790	7918.6
13	WHC467	7922.1
8	WHC467	7951.7
15	WPYP790	8076.0
14	WPYP790	8254.3
51	WPYP790	8268.2
39	WPYP790	8346.1
19	WPYP790	8584.5
17	WPYP790	8599.3
50	WPYP790	8661.6
29	WPYP790	8669.4
38	WPYP790	8781.8
20	WPYP790	8906.4
16	WPYP790	9169.5
43	WPYP790	9200.4
35	WPYP790	9201.0
12	WHC467	9255.3
41	WPYP790	9578.8
31	WPYP790	9588.3
30	WPYP790	9993.8

4. Conclusion

Point-to-point microwave links are communications systems that transmit their signals via beams of radio waves. Obstacles located between the transmitter and the receiver in a microwave link, including wind turbines, affect the received signal strength in wireless communication.

Microwave deployment users, such as government and safety agencies, pay for a radio frequency in a certain area. Essentially their frequency purchase additionally guarantees a level of little to no interference to their transmission system. In most jurisdictions, interfering with such transmission links is prohibited by law.

The accepted second Fresnel zone clearance method was applied to determine the protected width of the microwave beam paths. The wind farm and existing microwave links were imported into ATDI's ICS Telecom tool to determine whether or not microwave radio link infringement is possible. A database search in the FCC Universal Listing System repository revealed the existence of two microwave links in the area of the proposed wind farm.

The Microwave Beam Path Analysis conducted for the New Frontier Wind Farm, which took into consideration both the Siemens and Vestas wind turbine models, using ATDI's ICS Telecom tool and the above mentioned methodology, determined that all the planned wind turbines in the wind farm area are clear from any licensed microwave path.

Report prepared on behalf of **Element Power**

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ATDI

Wind Farm / Microwave Link Short Analysis

New Frontier Wind Farm

Solutions in radiocommunications

1. Short Analysis on Evans Associates Results

1.1 Evans Associates Microwave Links

Figure 3-A – Microwave Links Crossing Turbine Area

ID	Name Site 1	Name Site 2	Call Sign Site 1	Call Sign Site 2	Band Name	Licensee	WCFZ (m)
1	WILTON	BUTTE	KAM51	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	14.4
2	BUTTE	KXMC XMTR	KAM52	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	12.1/31.2
3	S MINOT	BUTTE	WMU366	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	11.9/31.0
4	BUTTE	WILTON	WMU367	RXONLY	2 GHz	REITEN TELEVISION, INC (KXMC)	14.6
5	BUTTE	LAKE BREKKEN	BUTTE	LAKE BREKKEN	5.8 GHz	SRT COMMUNICATIONS	9.3

1.2 ATDI's Assessment on Evans Microwave Links

Callsign	Status	Location	Grant Date	Expired Date
KAM51	Cancelled	47-08-31.9 N 100-48-08.4 W	06/19/79	08/24/09
KAM52	Cancelled	47-48-51.0 N 100-45-48.5 W	01/25/84	08/24/09
WMU366	Cancelled	48-11-57.0 N 101-17-38.5 W	03/24/95	08/24/09
WMU367	Cancelled	47-48-51 N 100-45-48.5 W	11/24/93	08/24/09
BUTTE	IRRELEVANT	N7/A	N/A	N/A

1.3 Analysis

The Intersecting Microwave Links provided by Evans Associates in the February 29, 2008 Engineering Report, are no longer in Active Status and are no longer of concern to the New Frontier Wind Farm. Table 1.2 above is a representation of the data from a search in the ULS database (completed on 12/01/2010), which reveals that the MW links previously mentioned by Evans Associates have been cancelled as of 08/24/2009. The MW link with ID #5 in Table 1.1 above, also mentioned in the Evans Report, is of no relevance to the Microwave Beam Path Analysis since this MW link is operating under the 5.8 GHz range of unlicensed MW deployment. Thus the owner of this link has no legal claim to the link path and anyone, including the New Frontier Wind Farm. Element Power is able to build in the path of this link without any legal consequences.

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