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2.10 Public Safety

This section addresses the potential public safety impacts of the Project. Section 2.10.1 contains background information on public health and safety issues associated with the Project Area and more generally with the construction and operation of wind energy projects. Section 2.10.2 discusses the proposed Project's anticipated public health and safety impacts. Section 2.10.3 details measures to mitigate or avoid anticipated impacts discussed in Section 2.10.2.

2.10.1 Existing Conditions

The scope of existing public health and safety conditions considered in this section is limited to those associated with identifiable mechanical and electromechanical hazards associated with everyday living, working, and traveling in a rural area. Certain weather related phenomena common to the Project Area, such as heavy snowfalls or blowing or drifting snow, tend to exacerbate these risks and potentially complicate provision of emergency services. With limited exceptions (icing and lightning), such weather related phenomena interacting with wind energy facilities do not introduce new risks. These exceptions are discussed in Section 2.10.2.2. Climate and other extreme weather related risks such as flooding and tornados represent low probability risks to public health and safety in the Project Area and are not discussed further in this section.

2.10.1.1 Gas Infrastructure

The Project Area is populated by a network of gas infrastructure including approximately 115 gas wells as identified through the National Fuel Gas Company, and service lines running from gas wells to residences. The Applicant will be conducting a field investigation to confirm the location and status of these wells within the Project Site as shown in Figure 2.1-4.

2.10.1.2 Transportation

As discussed in Section 2.8, Traffic and Transportation, the main transportation route in the vicinity of the Project Site is Interstate 90 (approximately 3 miles away), which is a high volume west-east thoroughfare. The primary transportation route to access the Project Area will be New York State Route 83 (Route 83), which has an AADT of fewer than 2,000 vehicles per day (NYSDOT 2006). The Project Site is served by an existing network of local, county, and state roads. Local traffic is limited to primarily residential traffic to and from the approximately 230 dwellings located within the Project Site.

2.10.1.3 Electrical

One existing high voltage power line, the Niagara Mohawk 115 kV line, is located in the vicinity of the Project Area, running north-south along the western boundary of the Project Area. Existing electrical transmission lines create the potential for electrical safety hazards in the immediate vicinity of the lines and the potential for personal injury, property damage, or fire in the event of transmission line failure or tower/pole collapse. The high-voltage electrical current running through these existing power lines results in the propagation of electromagnetic fields (EMFs). As discussed in Section 2.10.3, data do not support a cause and effect relationship between exposure to environmental levels of EMF and elevated risk of disease.

2.10.1.4 General Wind Energy Facility Concerns

Public safety concerns associated with construction of wind energy projects are generally standard construction-related concerns. These include the potential for injuries from 1) the movement of construction vehicles, equipment, and materials; 2) falling overhead objects; 3) falls from atop equipment or into open excavations; 4) electrocution; 5) contamination or fires resulting from improper handling of hazardous or combustible materials. These types of incidents are well understood, and do not require extensive background information. These risks are largely limited to construction personnel but cannot be entirely shielded from the general public. Specifically, landowners and their workers or guests may likely need to access the construction area, motorists or pedestrians share public roadways, and contaminants or fires could spread from the construction area. The decentralized nature of a wind energy facility also raises concerns about how to prevent curiosity seekers from attempting to observe construction activity at close range.

The operation of wind energy facilities is in most ways safer to the public than other forms of energy or electricity production. There is no environmental pollution or greenhouse gasses resulting from the extraction or transportation, or combustion of a primary fuel source. Since combustible fuel usage and storage is limited to facility maintenance, associated emissions, leaks, and spills that could potentially contaminate the surrounding environment are avoided. Wind facility decentralization coupled with limited use of combustibles significantly reduces threats of fires, explosions, or complete plant meltdowns. In addition, the use and/or generation of toxic or hazardous materials is minor when compared to other types of power generating facilities.

Nevertheless, operation of wind energy facilities is not totally without risk of fire, explosion, or contamination, as will be discussed in the following section. Additionally, decentralized wind energy facilities afford the general public many locations with which to access operating wind turbines, although such access would be prohibited. This greater accessibility for a wind facility than for other types of generating facilities carries with it certain risks to public health and safety. Examples of such safety concerns include ice shedding, tower collapse, blade throw, stray voltage, fire in the nacelle, and lighting strikes. A wind energy facility’s high visibility and public exposure may also raise public safety concerns regarding attacks of terrorism, sabotage, or vandalism.

There are no records of trespassers, bystanders or people passing by being killed as a direct result of either wind energy facility construction or operation. One civilian incident did occur when a parachutist in Germany was killed by drifting into the blades of a turbine; although unfortunate, this is an atypical scenario and would be better categorized as negligence or unsafe practice by the parachutist (Gipe 2004). An additional civilian fatality occurred as a result of wind energy development, when a crop dusting plane crashed after clipping a guy wire extending from a newly installed wind monitoring tower (Gipe 2006). Gipe reported in 2006 that since the mid-1990s, when turbine size and wind energy generation expanded, there have been 18 accidental fatalities in the United States at commercial wind energy facilities. Annual worldwide mortality rates as a function of generation output have declined from 0.40 deaths/TWh in 1995 to 0.05 deaths/TWh in 2006. The current rate is roughly one-third of that associated with mining, processing, and burning coal for electrical generation (excluding impacts of air pollution) (Gipe 2006). Since that report, a recent death at a wind farm in Oregon was reported in August 2007 due to the collapse of a tower. The victim was a technician employed by the turbine manufacturer and was inside the turbine when it collapsed (Woodall 2007).

Additional public health concerns focus on audible noise, low frequency noise/vibrations, and rotating shadows (shadow flicker) produced by operating wind turbines as the cause of various neurological conditions including vertigo, non-specific dizziness, migraine headaches, or epileptic seizures. As discussed in Section 2.10.2.2.8, a thorough review of existing medical and scientific peer-review literature failed to find any basis for the claim that visual or acoustic emissions from wind turbines trigger such symptoms. However, this literature review could not rule out the possibility that the simple detection of wind turbine emissions could induce sufficient mental stress to trigger migraine headaches and associated symptoms in individuals predisposed to such ailments.

2.10.2 Anticipated Impacts

The following section describes the anticipated impacts on public safety that may arise from Project construction and operation. Mitigation measures for each are addressed in Section 2.10.3

2.10.2.1 Construction

The anticipated impacts during Project construction include the potential for injuries to workers and the general public from 1) the movement of construction vehicles, equipment and materials; 2) falling overhead objects; 3) falls from atop equipment or into open excavations; 4) electrocution; and 5) contamination or fires resulting from improper handling of hazardous or combustible materials. Injuries have included minor injuries to more serious injuries and even fatalities. Of the 18 accidental fatalities in the United States previously mentioned, 12 people have been killed during the construction of wind energy facilities (Gipe 2006). These data indicate a relatively constant annual mortality level. Considering annual increases in the number and size of wind energy facility installations, the data suggests that improved safety measures and safety devices are addressing risks in wind energy facility construction.

2.10.2.1.1 Fire or Explosion

The presence of gas infrastructure within the Project Area could create an additional construction-related risk to public health and safety. There are approximately 47 gas wells within the Project Site, none of which are within 500 feet (twice the workspace radius of 250 feet) of any proposed wind turbine sites. There are also locations within the Project footprint where access roads and/or interconnects could cross sections of the gas pipelines. Certain construction activities such as excavation and heavy vehicular travel in the vicinity of natural gas facilities could result in the dislocation, cracking, or crushing of gas pipelines or wells. The fiberglass composition of the pipelines provide less compression strength than steel pipes, but in either case the heavy weights of construction equipment and associated loads could be sufficient to threaten the integrity of unprotected buried gas pipelines. Resulting leaks from such damage may be difficult to detect as natural gas has no odor or color and dissipates quickly into the atmosphere. If unchecked such leaks could result in fires or explosions posing risks to construction personnel and the general public. Work occurring around these gas facilities will require tailored construction methodologies and safety precautions. The Applicant will ensure locations of active wells and/or pipelines are incorporated into construction planning.

As mentioned in Section 2.4.1.1, the region receives on average 42.08 inches of precipitation per year, making drought conditions highly unlikely. The associated chance of a wild fire induced by construction activity is equally unlikely. Chautauqua County and Western New York, in general do not have a particularly high lightning flash density. Over the period from 1996 to 2000, the area fell in the fourth highest of eight categories of lightning intensity in the United States (2 to 4 flashes per square kilometer per year) (NOAA 2007). Nevertheless, the incidence of lightning strikes may increase over natural conditions due to the presence of Project facilities. Lightning strikes on improperly grounded cranes or partially completed turbines can result in fires or electrocution. Additional information on lightning strikes is presented in Section 2.10.2.2.5.

2.10.2.1.2 Release or Potential Release of Hazardous Materials

Construction of the proposed Project will require the use of diesel and gasoline fuels for operating construction equipment and vehicles. The contractor will utilize fuel trucks for refueling cranes and large earth-moving equipment and fuel storage tanks. The fuel trucks will drive to the equipment and tank (1,000-gallon capacity) locations and will incorporate automatic shutoff devices to limit accidental spills. Some construction vehicles could refuel at nearby gas stations.

Lubricating oils and cooling fluids would be present in construction vehicles and equipment. Small quantities of lubricating oils may also be stored at construction staging areas. Large power transformers located at the proposed Project substation and small pad-mounted transformers located the base of each turbine or inside the nacelle contain mineral oil to dissipate heat during operation. The large substation transformers would be filled with mineral oil via a truck after delivery and installation on the site. The pad-mounted transformers at the base of the towers or the nacelle-mounted transformers in the towers would be filled at the factory.

Spills of fuels, lubricating oils, and mineral oil could occur as a result of vehicle accidents, equipment malfunction, human error, terrorism, sabotage, vandalism, or aircraft impact.

2.10.2.1.3 Transportation

The general public could also be exposed to construction-related hazards due to the passage of large construction equipment on area roads. In addition, should members of the public gain unauthorized access to the work site (on foot, by motor vehicle, ATV, or snowmobile), the potential for construction related accidents increases. The latter could result in collision with construction equipment or stockpiled materials (e.g., soil, rebar, turbine/tower components), falls into open excavations, or even electrocution.

2.10.2.2 Operation

Routine operation and maintenance of the proposed Project poses health and safety risks primarily to workers performing their duties. The previous section on general risk of wind energy facilities covers these risks. The following sections detail the risks to public health and safety posed by the operation of the proposed Project.

2.10.2.2.1 Ice Shedding

Icing in the Project Area will generally result from freezing rain events forming a “glaze” ice (as opposed to “rime” icing that occurs at higher elevations). Ice shedding, also known as ice throw, refers to the phenomenon that can occur when ice accumulates on rotor blades and subsequently breaks free falling to the ground. Field observations and studies of ice shedding indicate that most ice shedding occurs as air temperatures rise, causing ice on the rotor blades to thaw. Therefore, the tendency is for ice fragments to drop off the rotors and land near the base of the turbine (Morgan 1998). Ice can potentially be “thrown” when ice begins to melt and stationary turbine blades begin to rotate again (although usually turbines cannot restart until most of the ice has melted). Several observational studies and mathematical models examining this phenomenon have calculated how far ice can theoretically be thrown from a moving rotor blade before hitting the ground (Morgan and Bossanyi 1996). The distance traveled by a piece of ice depends on a number of factors, including: the position of the blade when the ice breaks off, the location of the ice on the blade when it breaks off, the rotational speed of the blade, the shape of the ice that is shed (e.g., spherical, flat, smooth), and the prevailing wind speed. Data gathered at existing wind farms have documented ice fragments on the ground at a distance of 50 to 328 feet from the base of the tower. These fragments were in the range of 0.2 to 2.2 pounds in mass (Morgan 1998). The risk of ice landing at a specific location is found to drop dramatically as the distance from the turbine increases. European studies have identified a safety threshold of 200 to 250 meters (660 to 820 feet) from any turbine, beyond which there is no significant risk from falling ice fragments (Morgan and Bossanyi 1996). Because of the turbine setback distances to structures and public roads risks of ice throw are considered minimal at the Project Area, as described further in 2.10.4.2.1. Ice throw at the proposed Project Area presents more of a concern with respect to snowmobile traffic on trails that may pass in close proximity to turbines. Appendix S, Ice Shedding/Blade Throw Analysis provides additional information regarding this issue.

Although a potential safety concern, it is important to note that while more than 55,000 wind turbines have been installed worldwide, there has been no reported injury caused by ice being thrown from a turbine (NYSERDA 2006). However, occasional ice shedding does occur, and remains a potential safety concern.

2.10.2.2.2 Tower Collapse/Blade Failure

Another potential public safety concern is the possibility of a rotor blade dropping or being thrown from the nacelle or a wind turbine tower collapsing. Blade or blade fragment throw would most likely be the result of lightning strike, equipment failure, improper assembly, or an act of sabotage. The hazard zone for such blade failure should be approximately that for ice throw. Blade failure after a lightning strike occurred at the Searsburg, Vermont wind farm most recently in February 2006 and at the Fenner Wind Farm, Madison County, New York in early 2007. In both blade failure cases, the blade fell directly to the ground, very close to the base of the tower. Because of the significant distances from the proposed tower locations to existing residences and public roads, the lower probability of people being outside during a lightning storm, and restricted site access, the proposed Project should not result in any risk to the public due to blade failure.

Wind turbine tower collapses are even more rare occurrences, but such incidents have occurred. A tower collapse at the Weatherford Wind Power Project in Oklahoma occurred in May 2005 and more recently a collapse occurred at the Klondike III wind farm in Oregon in August 2007 as described above. Although these incidents are rare, they are potentially dangerous for Project personnel and the general public. The reasons for the turbine collapses on record vary depending on conditions and tower type. Past occurrences of these incidents have generally been the result of design defects during manufacturing, poor installation or maintenance, wind gusts that exceed the maximum design load of the engineered turbine structure, or lightning strikes (AWEA 2006).

The majority of instances of blade failure and turbine collapse were reported during the early years of the wind industry. Technological improvements and mandatory safety standards during turbine design, manufacturing, and installation as well as more frequent maintenance have largely eliminated such occurrences. Modern utility-scale turbines are certified according to international engineering standards. These include ratings for withstanding different levels of hurricane-strength winds and other criteria (AWEA 2006). The engineering standards of the wind turbines proposed for this Project are of the highest level and meet all federal, state, and local codes. In the design phase, state and local laws require that licensed professional engineers review and approve the structural elements of the turbines. Improved braking systems, pitch controls, sensors, and speed controls on wind turbines have greatly reduced the risk of tower collapse and blade throw. The wind turbines proposed for the Project automatically shut down at wind speeds over approximately 56 mph. They also cease operation if significant vibrations or rotor blade stress is sensed by the turbines' blade monitoring system. For all of these reasons, the risk of catastrophic tower collapse or blade failure is minimal. However, if an unforeseen event causes a tower collapse or blade failure (such as a fire or lightening strike), setbacks from structures and roads would mitigate the risk of damage to adjacent property or public roads, as described further in Section 2.10.3.2.2.

2.10.2.2.3 Stray Voltage and Electrical Shock

Stray voltage can be defined as a "low level of neutral-to-earth electrical current that occurs between two points on a grounded electrical system" (Wisconsin Rural Energy Management Council 2000). Most cases of stray voltage arise from amateur installations or repairs to electrical lines in or around barns and areas where livestock frequent. Livestock possess greater sensitivity to stray voltage than humans and will often provide the first indications of a stray voltage situation.

The proposed Project's collector system, like other electrical facilities, has the potential to create stray voltage to varying degrees based on factors such as operating voltage, geometry, shielding, rock/soil electrical resistively, and proximity. Stray voltage from such facilities, though unlikely, may occur if two circumstances are simultaneously present: the system is poorly grounded; and it is located in close proximity to ungrounded or poorly grounded metal objects (fences, pipelines, buildings, etc.). Such defects in the installation of the Project's collection system could result in low voltage/nuisance shocks detectable by humans within close range of the alternate/stray voltage pathway. Voltage drops in the collector system sufficient to harm human health would be sufficient to trip circuit breakers.

2.10.2.2.4 Fire

Wind turbines, due to their height, physical dimensions, and complexity, have the potential to present response difficulties to local emergency service providers and fire departments should a fire occur in the tower or nacelle. Although the turbines contain relatively few flammable components, the presence of electrical generating equipment and electrical cables, along with various oils (lubricating, cooling, and hydraulic) creates the potential for fire or medical emergency within the tower or the nacelle. This, in combination with the elevated location of the nacelle and the enclosed space of the tower interior, makes response to a fire or other emergency difficult, and beyond the capabilities of most local fire departments and emergency service providers.

Other Project components create the potential for a fire or medical emergency due to the storage and use of diesel fuels, lubricating oils, and hydraulic fluids. Storage and use of these substances may occur at the substation, in electrical transmission structures, staging area(s), and the O&M building and maintenance vehicles. The presence of potentially hazardous materials as well as high voltage electrical equipment presents unique safety risks to local responders. However, due to the accessibility of these areas (as opposed to the tall wind turbines), local and emergency personnel would respond to such an emergency in accordance with their hazardous materials and electrical fire training.

The limited flammable materials located within the Project as well as the proximity from residences, make the potential for fire to be a limited threat to public safety.

2.10.2.2.5 Lightning Strikes

Due to their height and metal/carbon components, wind turbine blades are susceptible to lightning strikes. Likewise, lightning can also strike a wind turbine nacelle or tower. It is reasonable to assume that the addition of a tall structure such as a wind turbine will increase the possibility of a lightning strike occurring at the turbine location. However, there is no evidence suggesting that wind turbines increase the frequency of lightning in a broader area, nor is there evidence suggesting the increased probability of lightning striking structures, utilities, or unoccupied areas immediately adjacent to a wind turbine. More likely, due to its height and conductivity, a grounded wind turbine would channel lightning strikes that otherwise would be drawn to trees, silos, and other potentially ungrounded structures, thereby reducing the probability of local lightning strikes and associated property damage and fires.

Statistics on lightning strikes to wind turbines are not readily available for most areas, but several European databases have calculated that lightning is responsible for four to eight damage events (faults) per 100 turbine-years in northern Europe, and up to 14 faults per 100 turbine-years in southern Germany (Korsgaard and Mortensen 2006). Other wind operating systems owned and operated by the Applicant routinely experience lightning events during storms. Most of the lightning strikes hit the rotor, and the effects are highly variable, ranging from no damage and minor surface damage to complete blade failure. All modern wind turbines include extensive lightning protection systems which are designed to prevent damage or catastrophic blade failure thereby limiting the risk to public safety.

2.10.2.2.6 Electromagnetic Fields

Electromagnetic Fields (EMF) emanate from any wire carrying electricity. For an electric transmission line, the highest EMF level is next to the transmission lines (typically near the center of the transmission line right-of-way) and decrease as the distance from the transmission corridor increases.

Humans are exposed to a wide variety of natural and man-made EMF both in the outdoor environment and in homes, schools, and businesses. Most people in the United States are exposed to EMF that average less than 2 milligauss, although individual exposures vary. The

EMF produced by electric transmission lines are well within the range of EMF exposures from such other sources.

Numerous public health review groups, including the National Institute of Environmental Health Sciences, the National Institutes of Health, and the U.S. Department of Energy, have examined the public's exposure to EMFs produced by power lines. The consistent overall conclusion of these groups is that available data do not support a cause and effect relationship between exposure to environmental levels of EMF and elevated risk of disease.

The Project electrical collection system will operate at 34.5 kV, which is a relatively low voltage and will be stepped up to 115 kV at the substation near the point of interconnection with an existing 115 kV transmission line. No significant impacts from EMF are expected as a result of the Project.

2.10.2.2.7 Vibration

According to turbine manufacturers, turbine vibration is minimal and if vibration occurs, the SCADA system detects the abnormality and the turbine is shut down. No vibration related health effects have been documented at operating wind power facilities and no related health effects are anticipated as a result of this automated detection and shut down process.

Additionally, all WTGs are designed in accordance with the International Engineering Standards. The relevant standard is the International Electrotechnical Commission (IEC) Standard 61400-1. Adherence to these standards and structural design of the wind turbine indicate that any vibrations which might be caused by turbine mechanical problems would not result in turbine foundation failure.

2.10.2.2.8 Health Effects

Recently, Dr. Nina Pierpont coined the term "wind turbine syndrome" to describe health effects speculated to be associated with prolonged exposure to wind turbines. Pierpont argues that wind turbine syndrome consists of: (1) symptoms associated with audible noise and related/indirect consequences such as sleep loss, communications interference, inhibited cognitive functioning, and exacerbation of headache; (2) symptoms associated with low frequency noise including "vibroacoustic disease" and its associated symptoms (cardiopulmonary fibrosis, seizures and cognitive changes); and (3) symptoms associated with shadow flicker including loss of balance, nausea, and triggering of epileptic seizures. Pierpont had earlier speculated that wind turbines could cause Mad Cow Disease, although she later backed down from that theory.

At the request of the Applicant, ENVIRON International Corporation of Amherst, MA (ENVIRON), recently conducted a literature review to determine if the medical and scientific community shared Pierpont's opinion of the hazards posed by wind turbines as well as to find evidence from non-turbine related studies that might help substantiate or disprove a public health threat.

Health Threat from Audible and Low-Frequency Noise

Audible and low-frequency noises can be generated by both mechanical and aerodynamic actions of wind turbine operation. Aerodynamic noise results from the flow of wind over the turbine blades, while mechanical noise results from the physical interaction of turbine components. ENVIRON found no peer-reviewed papers that investigated public health impacts of low-frequency turbine noise/vibrations. ENVIRON also found four peer-reviewed articles, including two surveys of existing literature (Jakobson 2005; Bellhouse 2004) that indicate low-frequency components of turbine noise tend to be inaudible and as such pose no threat to public health. Canadian and British government reports (HGC Engineering 2006; Leventhall 2003, respectively) reach similar conclusions. ENVIRON concludes that Pierpont's papers do not sufficiently demonstrate a correlation between low-frequency turbine noise and a public health threat. Additionally, according to the *Environmental Sound Survey and Noise Impact Assessment* conducted by Hessler Associates (Appendix I), the turbines proposed for the Project do not emit harmful low frequency sound.

Likewise, ENVIRON found no studies quantifying a public health threat posed by audible turbine-related noise. Nevertheless, empirical evidence shows that audible turbine-related noise could present an annoyance for sensitive receptors. It is logical to assume that sensitive receptors may experience elevated levels of anxiety that could potentially complicate existing health conditions. According to a study by Pedersen and Persson-Waye (Pedersen 2005) where residents living in and around an operational wind farm in Europe were interviewed about their reactions to various aspects of the project including noise. The results of this poll showed that it is not necessarily the magnitude of the sound level that leads to annoyance but rather individual attitudes towards the project in general.

Exposure to any number of environmental risk factors, such as existing traffic noise, could present similar or greater levels of risk to sensitive receptors in the Project Area. Without studies comparing such risk factors with audible turbine noise in a variety of real world conditions, there is no evidence supporting a conclusion that audible wind turbine noise poses a public health threat. For more information on noise impacts, see Section 2.7.

Health Threat from Shadow Flicker and Visual Impact of Rotating Turbines

Shadow flicker results from the cast shadows of the rotating blades of a turbine intermittently blocking the sun. Shadow flicker only occurs when the sun is unobstructed and the turbine is between a viewer and the sun. Computer models can calculate shadow flicker exposure at residences within or adjacent to the Project Site. These models are based on known coordinates for turbines and area residences and use statistical data on cloud cover to develop an estimate of likely exposure. These models can also assess the relative intensity of an unobstructed shadow cast on a given house. Based on assumption of wind speed and direction, as well as orientation of "receptor" residences, and the presence of screening vegetation or topography likely exposure levels can be further refined. See Section 2.5.2.4 for further details of shadow flicker analysis.

Pierpont suggests that shadow flicker may cause adverse effects through both a "strobe" effect and through creating a disorienting sense of motion. Wind turbines rotate at approximately 20 RPM, which means that the blade passes the sun about every second. The frequency of strobe lights is an order of magnitude higher, so to imply that wind turbines cause a "strobe" effect is misleading, Nevertheless, Pierpont does not refer to any peer reviewed publications supporting adverse health effects from shadow flicker (loss of balance, nausea, and triggering of epileptic seizures) generated by wind turbines; nor could ENVIRON identify any relevant peer reviewed publications. Pierpont does not offer any studies that either examine shadow flicker generated by wind turbines or examine the health effects of shadow/light flicker from other sources.

Scientific studies have demonstrated a correlation between strobe light and negative health effects such as triggering seizures in people with epilepsy. According to the British Epilepsy Foundation, approximately five percent of individuals with epilepsy have sensitivity to light (2006). Most people with photosensitive epilepsy are sensitive to strobe lights around 16 to 25 Hz (1 Hertz or Hz = 1 cycle per second), although some people may be sensitive to rates as low as 3 Hz and as high as 60 Hz. The frequency, or number of times something happens per second, is measured in Hertz. Depending on the blade rotational speed or revolutions per minute (RPM), shadow flicker from wind turbines have a frequency of 0.5 Hz to 1.25 Hz, which is equivalent to approximately 1 cycle per second, or 1 complete blade rotation. The Applicant proposes turbine with a 3-blade 90-meter diameter rotor, 80-meter hub height, and a nominal rotor speed of 14.9 RPM. This translates to a maximum blade pass frequency of less than 1 Hz. Given this, health effects to individuals with photosensitive epilepsy are not anticipated.

As with audible noise, however, the annoyance of turbine-related shadow flicker could induce second-order health problems due to anxiety. There is no evidence supporting turbine-related shadow flicker as a public health threat.

ENVIRON conducted an independent literature search and found no reliable references indicating negative health effects from operating wind farms. The Global Wind Energy Council shows more than 59,000 MW of wind energy operating world-wide at the end of 2005. No reliable studies indicating adverse health effects from these operating facilities have been recorded, therefore no health related impacts are anticipated from the operation of the Project.

2.10.3 Mitigation Measures

The following section describes the mitigation measures proposed to help counteract the impacts on public safety from Project construction and operation.

2.10.3.1 Construction

The exposure of the general public to any construction-related risks/hazard is expected to be very limited because construction activities will occur primarily on private land and be well removed from adjacent roads and residences. The anticipated impacts will be further minimized by extensive signage across the Project Site warning the general public of the ongoing construction activities. The general public will not be allowed on the construction site, and after hours, vehicular access to such sites will be blocked by parked equipment or temporary construction fencing. Temporary construction fencing or other visible barriers will be placed around excavations that remain open during off hours. In addition, material safety data sheets (MSDS) for potentially hazardous construction materials will be provided to local fire and emergency service personnel. The contractor will also coordinate with these entities to ensure that they are aware of various construction activity locations, and avoid potential conflicts between construction activity and the provision of emergency services (e.g., road blockages, etc.).

The risk of construction-related injury will be minimized through careful safety planning, regular safety training and use of appropriate safety equipment. No crews will be allowed to begin work on the Project until they have gone though safety and environmental training. The construction contractor will appoint at least one safety officer who will be responsible for ensuring that the work site complies with the safety plan, that crews are trained, and that any safety incidents are addressed and/or reported as required by law and the provisions of the Project safety plan.

2.10.3.1.1 Fire or Explosion

Special care has been taken to plan the placement of Project facilities so that there will be very little intersection of construction activities with existing natural gas infrastructure as identified through available location data. The locations of turbines, roads, and underground collection lines were adjusted to minimize construction risk. Turbines were sited at least 500 feet (twice the workspace radius) from existing gas wells

The following activities will be undertaken prior to and during Project construction:

- Prior to final engineering, the Applicant will incorporate the results of the underground field study to ensure Project components are sited safely relative to gas lines and gas wells.
- Prior to starting excavation work at the site, the construction contractor will review the location of underground facilities with site personnel. Sharing information and safety issues during an on site meeting between the construction contractor and its excavating crews will help avoid confusion and needless damage to underground facilities.
- The construction contractor will adhere to all applicable federal and state safety regulations, which include training as it relates to the protection of underground facilities.

Construction crews will be informed regarding best practices and regulations applicable to the protection of underground facilities.

- The construction contractor will protect and preserve the staking, marking or other designations for underground facilities until they are no longer required for proper and safe excavation. The construction contractor will stop work and notify the one-call center for re-marks if any facility mark is removed or is no longer visible.
- The construction contractor will have an observer assist the equipment operator when operating excavation equipment around known underground facilities.
- The construction contractor will support and protect any exposed underground facilities from damage as required in the crossing agreement and by law.

Protection of exposed underground facilities is as important as preventing damage to the facility while digging. Exposed facilities can shift, separate, or be damaged when they are no longer supported or protected by the soil around them. OSHA has addressed this issue in Subpart P-Excavation Standard 29 CFR 1926.651(b)(4), which requires that underground installations be protected, supported, or removed as necessary to safeguard employees while the excavation is open. Contractors will comply with all OSHA regulations, in addition to state worker safety regulations, regarding electricity, structural climbing, and other hazards, during construction of the wind farm. To minimize safety risks to construction personnel, all workers will be required to adhere to a safety compliance program protocol, which will be prepared by the construction contractor or their representative, prior to construction. The safety compliance program will address appropriate site health and safety related issues including:

- Personal protective equipment such as hardhats, safety glasses, orange vests, and construction boots
- Job safety meetings and attendance requirements
- Fall prevention
- Construction equipment operation
- Maintenance and protection of traffic
- Hand and power tool use
- Open hole and excavation area safety parking
- General first aid
- Petroleum and hazardous material storage, use, containment, and spill prevention
- Posting of health and safety requirements
- Visitors to the job site
- Local emergency resources and contact information
- Incident reporting requirements

2.10.3.1.2 Release or Potential Release of Hazardous Materials

The Applicant will prepare a SPCC Plan that addresses such risks. The SPCC Plan would be submitted to local emergency response organizations and other governmental agencies prior to the start of construction. Spills, should they occur, would likely be confined to the Project Site.

2.10.3.1.3 Transportation

As mentioned in Section 2.8, a construction routing plan will be developed to assure that construction vehicles avoid areas where public safety could be a concern (schools, clusters of homes, etc.). Speed limits will be set and strictly enforced. Oversize vehicles will be accompanied by an escort vehicle and/or flagman to assure safe passage of vehicles on public roads. The routing plan will be provided in the FEIS, but may be modified thereafter if necessary to address permit conditions contained in authorizations that cannot be issued until a FEIS has been accepted.

2.10.3.2 Operation

The following section presents the proposed mitigation methods for potential operational impacts to public safety due to the Project.

2.10.3.2.1 Ice Shedding

The wind turbine layout was developed accordance with setbacks designed to protect the public from, among other things, ice shedding. Compliance with setbacks and measures to control public access (gates, warning signs, etc.) will minimize public safety risks associated with ice shedding. All turbines have been sited to maintain a distance of a minimum of 1,200 feet from any residence, participating or non-participating. Skiing and snowmobiling are popular recreational activities in the vicinity of the Project Area and multiple trails may cross through the Project Area. Although the Applicant cannot control where people may chose to recreate, the Applicant will meet with local landowners to explain the risks of ice shedding and proper safety precautions.

Additionally, ice detectors will be installed at the maintenance facility, on the meteorological tower, and on wind turbines to alert maintenance personnel of icing conditions, and allow for turbine shut-down and/or notification of area residents.

Wind turbine manufacturers have developed engineering controls that help to minimize safety risks associated with ice build up on wind turbine components. When ice builds up on rotor blades and/or sensors, the rotational speed is slowed and icing potentially creates an imbalance in the weights of the individual blades. Such effects of ice accumulation can be sensed by the turbine's computer (SCADA system) and result in the turbine being shut down until the most of the ice melts. The turbine has to be manually restarted by the operator for the turbine to commence operation.

Based upon the results of studies and field observations at other wind power projects, with the Project's siting criteria, the proposed control of public access to the turbine sites, and engineering controls in the turbines themselves, it is not anticipated that the Project will result in significant risks to the health or safety of the general public due to ice shedding.

2.10.3.2.2 Tower Collapse/Blade Failure

As stated above, the setbacks established for the Project are designed to protect nearby residences, buildings, roads, transmission lines and other infrastructure from the unlikely incidence of tower collapse and blade failure. If a tower collapsed or a blade failed, a fall zone setback from roads and transmission lines equivalent to the maximum turbine height (i.e., base of tower to tip blade), plus an additional distance safety factor, has already been built into the Project layout. Setbacks from homes and buildings provide even more protection. In those rare instances where towers have failed, the failure typically results in components crumpling. It would be very unusual for the tower to break off at the base and fall straight over. Similarly, wind turbines are designed so that if blade failure occurs, blades fall directly to the ground, close to the tower base. Further measures to reduce risk due to an unlikely turbine collapse or blade failure will be implemented through the use of gates, signage, and public education/outreach efforts to discourage unauthorized access onto the private lands on which the turbines are located.

Technological improvements and mandatory safety standards during turbine design, manufacturing, and installation as well as frequent maintenance scheduling have reduced occurrences of tower collapse or blade throw. Modern utility-scale turbines are certified according to international engineering standards. These include ratings for withstanding different levels of hurricane-strength winds and other criteria (AWEA 2006). The engineering standards of the wind turbines proposed for the Project are of the highest level and meet all applicable codes. In the design phase, state and local laws require that licensed professional engineers review and approve the structural elements of the turbines. State-of-the-art braking systems, pitch controls, sensors, and speed controls on wind turbines have greatly reduced the risk of tower collapse and blade failure. The wind turbines proposed on the Project automatically shut down at wind speeds over approximately 56 mph. They also cease operation if significant vibrations or rotor blade stress is sensed by the turbines' blade monitoring system, see Section 2.10.3.2.7 for more on vibration. For all of these reasons, the risk of catastrophic tower collapse or blade failure is minimal.

2.10.3.2.3 Stray Voltage and Electrical Shock

Stray voltage is a legitimate concern in the design of wind generating facilities as with any large scale electrical generating facility. Stray voltage is preventable with proper electrical installation and grounding practices. The Project’s power collection system will be properly grounded, and will not be connected to the local electrical distribution lines that provide electrical service to farm buildings and homes. It will be physically and electrically isolated from all of the buildings in and adjacent to the Project Area. Additionally, the wind farm's electrical collection lines will be located a minimum of 48 inches below ground, which will prevent any incidental contact with farming operations and will protect the collection system's insulation materials from damage.

Proper grounding, installation, and maintenance practices will assure that the Project does not cause or contribute to stray voltage in the area. In the event that a Project participant suspects that there is a pre-existing stray voltage problem at their agricultural operation, the Applicant will conduct tests to quantify the existing voltage potential prior to construction and during operation to determine later if the problem has increased as a result of Project improvements. The Applicant will implement a complaint resolution procedure to assure that any complaints regarding stray voltage are adequately investigated and resolved.

2.10.3.2.4 Fire

All turbines and electrical equipment will be inspected by the installation contractor prior to being brought on-line. This, along with built-in safety systems, minimizes the chance of fire occurring in the turbines or electrical stations. However, though rare, fire at these facilities could result from a lightning strike, short-circuit or mechanical failure/malfunction. Any occurrences of fire at a turbine will be sensed by the SCADA system and reported to the Project control center. Under these conditions, the turbines would automatically shut down and/or Project maintenance personnel will respond as appropriate.

If a wind turbine were to catch fire, it would be allowed to burn itself out while maintenance and fire personnel maintain a safety area around the turbine and protect against the potential for spot ground fires that might start due to sparks or falling material. Power to the section of the Project with the turbine fire would be disconnected. An effective method for extinguishing a turbine fire from the ground does not exist, and because of the limited amount of combustible material in the nacelle, fire events would generally not last long enough to warrant attempts to extinguish the fire from the air (NYSERDA 2006). However, since the public typically does not have access to the private land on which the turbines are located, risk to public safety during a fire event would be minimal. Separation of Project components due to the engineering design also prevents the spread of fires should one occur.

Transformers at the substation are equipped with a fire suppression system. This system would quickly extinguish any fires that occur at the Project substation and automatically shut down power to the facility.

Generally, any emergency/fire situations at a wind turbine site or substation that are beyond the capabilities of the local service providers will be the responsibility of the Project owner/operator. Construction and maintenance personnel will be trained and will have the equipment to deal with emergency situations that may occur at the Project Site (e.g., tower rescue, working in confined spaces, high voltage, etc.). Outside assistance from the local municipalities and for emergency service providers may be required; however, they will be assisted by Project personnel. Many of these situations will be pre-planned for and all participants will be trained how to react. Consequently, such an incident would generally not expose local emergency service providers or the general public to any public health or safety risk.

An employee safety manual will include a Fire Protection and Emergency Response Plan and will be incorporated into the overall operating and maintenance policies and procedures for the Project. Included in that manual will be specific requirements for a fire prevention program. This program will include the following components:

- Initial and refresher training of all operating personnel (including procedures review) in conjunction with local fire and safety officials.
- Regular inspection of all wind turbines including regular bolt tightening.
- Regular inspection of transformer oil condition at each wind turbine step-up transformer.
- Regular inspection of transformer oil condition at each step-up transformer installed at the main substation.
- Regular inspection of all substation components, including thermal imaging and other continuous monitoring techniques.
- Regular inspection of fire extinguishers at all facility locations where they are installed.
- All Project vehicles will be equipped with fire fighting equipment (fire extinguishers and shovels) as well as communication equipment for contacting the appropriate emergency response teams.
- The MSDS for all hazardous materials on the Project will be on file in the construction trailers (during construction) and the O&M building (during operation). The MSDS for these materials will be provided to local fire departments and emergency service providers.
- The facility Safety Coordinator shall notify the local fire department of any situation or incident where there is any question about fire safety, and will invite an officer of the fire department to visit the workplace and answer any questions to help implement a safe operating plan.

Development and implementation of this plan will assure that Project construction and operation will not have a significant adverse impact on public safety, or the personnel and equipment of local emergency service providers. A preliminary plan is provided in Appendix P. However, the final plan cannot be created until after the SEQR process is complete because various aspects of the plan will depend upon permit conditions contained in authorizations that cannot be issued until a FEIS has been accepted.

2.10.3.2.5 Lightning Strikes

Lightning that strikes a blade must still be safely channeled and dispersed to the ground without interfering with the turbines electronics and power generation equipment. Manufacturers have designed lightning protection systems that integrate across each component of the wind turbine. Many first generation wind turbines deployed in the 1970s and 1980s did not have lightning protection built into the blades and instead relied on grounding of towers to prevent damage from a lightning strike. As blade size increased, this strategy became ineffective and by the early 1990s blade manufacturers began to incorporate tip-end lightning protection into their engineering design. This protection is now a standard component of modern turbines (Korsgaard and Mortensen 2006). Subsequent design improvements continue to improve turbine safety and performance during and after lightning strikes. A typical blade design, as shown in Appendix B (Technical Description of a Lightning Protection System, NEG Micon A/S 2003), shows the location of lightning receptors on both sides of a blade tip that are connected to a metallic mesh conduction system laminated into the blade and running the length of the blade. Using the example system in Exhibit 1.5-11, lightning that strikes a blade is conveyed from the rotor to the machine base frame through a copper brush. By design, the generator and other components inside the nacelle are not directly mounted to the machine base frame and would not impede the flow of current if lightning were to strike the nacelle. As a precaution, the generator and components are independently protected via grounding cables to divert any residual current safely to the ground. The machine base frame conveys the lightning current to the tower via grounding cables and the tower conveys the lightning current to a loop of copper cable encircling the tower buried at least 3 feet below ground surface. The loop of copper cable is connected to vertical two grounding rods buried beyond the edge of the turbine foundation (approximately 30 feet) on opposite sides of the tower and extending below the foundation depth. This network of underground cable and grounding rods conveys the current away from the turbine's shielded distribution wires and away from rebar in the foundation. A lightning strike to the nacelle will likely hit the lightning rod that extends above the nacelle. The lightning rod is connected to the machine base frame and the rest of the lightning protection system as described above. If a lightning strike is detected, the turbine may shut down automatically, and at a minimum, it will be inspected to assure that damage has not occurred.

The typical lightning diversion scheme of a wind turbine is illustrated in Exhibit 1.5-11.

Beyond the turbine lightning protection system, and the fire/emergency response plan described previously, no additional measures to mitigate the effects of lightning strikes are proposed. Mitigation measures regarding blade failure are addressed in Section 2.10.3.2.2 above.

2.10.3.2.6 Electromagnetic Fields

EMFs will be generated by the operation of various Project components, including the turbine generator, electrical collection lines, and transformers. However, the strength of the EMF produced by these components will not be significant at any receptor location. Electromagnetic fields are attenuated by objects such as trees and walls of structures, and are shielded by materials such as metal and the earth. Thus, the buried electrical lines are not anticipated to produce any EMF at the ground surface. Additionally, as distance from a source doubles, the amount of EMF exposure is quartered. The height of the turbine generator above the ground, the location of electrical collection cables, and the location of substation transformers and other electrical equipment inside a fenced yard should adequately separate these components from any receptors.

Because no significant impacts from EMF are expected, no mitigation is required. However, to reduce the potential effects of EMF from the Project to the maximum extent practicable, the Applicant will adhere to the electric field strength interim standards established in the New York State PSC Opinion No. 78-13, and the magnetic field strength interim standards established in the PSC's Interim Policy on Magnetic Fields, issued September 11, 1990.

2.10.3.2.7 Vibration

No adverse impacts to public safety are anticipated due to vibration. Therefore no mitigation is required.

2.10.3.2.8 Health Effects

No adverse health effects are anticipated as a result of the construction and/or operation of the Project. Therefore no mitigation is required.