

Outside Management Control

GADS Wind Training Module 06

March 2019 – Final

RELIABILITY | ACCOUNTABILITY



- This module will review:
 - What are OMC Events?
 - Weather
 - Catastrophes
 - Grid Availability / Stability
 - Legal / Contractual
 - Labor Strikes (external)
 - Security
 - External Control
 - Execution Delays (Special Requirements)
 - General Guidance

- As the title suggest, OMC events are beyond management's control and should not be considered when evaluating management or turbine performance. These events can occur as Forced Outage (FO), Maintenance Outage (MO) or Planned Outage (PO) events and have a variety of flavors:
 - Weather
 - Catastrophes
 - Grid availability and stability
 - Legal / Contractual
 - Labor Strikes (external)
 - Security
 - External control
 - Execution delays (special requirements)

FO = Forced Outage

MO = Maintenance Outage

PO = Planned Outage

Most of these event occur beyond the plant boundary but not all. As an example lightning can occur anywhere. A forest fire may cause blades to catch on fire. Large hail can damage turbine components. Generally, OMC events occur or start outside of the plants boundaries.

Weather is the most frequent type of OMC. It can manifest itself in a number of ways:

- Ice – Examples are ice on blades that stop the turbine or ice on overhead lines that cause a failure or line slaps
 - Note: Ice that degrades performance is not an outage but could be considered a derate
- Lightning – Can cause transmission and turbine outages. Sometimes brown outs are caused by lightning on the off-taker lines miles away from the site
- Very High and Low Temperatures – Sometime temperatures can exceed the operating envelope of the turbine. Understanding limits also helps when reliably delivering power in situations like the Polar Vortex
- Extreme Turbulence – May cause the blade to slap the tower, overspeed faults due to pitch reaction time or yaw run away faults

Weather comes in many different forms. Basically, these events are beyond the operating limits of the system and cause a turbine outage.

Ice – Ice collects on blades and turbine surfaces. It can degrade power production, cause abnormal vibration and shut the turbine down. More importantly it poses a significant safety risk when ice falls from or is slung from blades. When power output is reduced it is not an outage. It could be considered a derate if derate calculations are performed (Optional).

Lightning – Lightning usually causes transmission outages and breaker trips in the substation. It can also cause momentaries and or brownouts where the turbine attempts a low voltage ride through. The source of the lightning interruption can be many miles away. As the turbine is usually the tallest structure in the area, they can also be challenged. The direct impact will depend upon the quality and type of lightning protection. Most fiberglass blades with lightning protection, will withstand a strike. Some will have holes punched in the fiberglass and require repairs. Occasionally a blade will be destroyed. Lightning protection for carbon fiber blades requires special attention as carbon is a conductor.

Extreme Turbulence – Mountain areas and the front end of a mesa can be very turbulent. Turbulence can be measured as the average standard deviation of the wind speed. There is often a side to side motion as well. The changing direction and speed can cause overspeed and yaw run away faults. Other conditions that can cause problems are microburst and frontal transitions. High turbulence can also be caused by column winds and extreme wind shear.

Temperature Extremes – Wind turbines usually have design temperature limits. Beyond these limits lubricants fail to perform properly and electronic equipment may not function. Understanding these vulnerabilities allow for planning during events like the “Polar Vortex” or air conditioning loads in the summer in Texas. Generally, manufactures will define these operating limits in the sales agreements or system parameters.

Catastrophic events are rare and have the potential to do wide spread damage. Some examples are:

- Fire – Forest fire can cause blade and smoke damage. Also, lightning has been know to cause turbine fires.
- Flood – High water can short circuit feeder circuits and cause structures to fail.
- Hurricane – High wind and water erosion
- Tornado – Tends to cause blade and collection system damage
- Large Hail – Can damage blades and nacelle
- Earthquake – Collection system and potential tower failure

Catastrophic events that impact turbine performance and are OMC.

- Fire – Many wind plants are located in remote locations where forest fires are a real possibility. Damage to fiber glass, transmission poles and other structures can occur. If smoke gets into electronic components it can cause tracking, shorting out the equipment.
- Flood – Spring flooding, summer flash floods and other can take out infrastructure.
- Hurricane – Especially along the east coast and gulf states can cause high winds, tidal surge and flooding.
- Tornado – Tornados can take out blades and infrastructure. Many off-taker conductors will be damaged interrupting power.
- Large Hail – Usually accompanies tornado can physically damage structures. Imagine what golf ball size hail does to running blades.
- Earthquake – Severe shaking can cause towers to collapse, transformers to move on their pads and damage infrastructure.

Transmission

- Line congestion – not enough room or small conductors for the load. This is considered a failure of the off-taker facilities
- Low Voltage – Many sites are built on weak grids. Lines tend to get smaller as they move away from large generating plants. Wind plants tend to be on the end of these lines
- Brown Outs – Lightning strikes on the off-taker lines or objects causing phase to phase or phase to ground contact
- Stability – Excessive generation and Voltage-ampere reactive (Var) control are the usual suspects. Although weather can cause instability when lines come in contact during high winds
- Line outage – This is the most frequent transmission event and usually cause some damage to the turbines. Many of these outages occur under full load
- Line maintenance – All systems require periodic maintenance. This includes any maintenance by the off-taker

Transmission events occur all too often. There are many causes and some of them can cause significant damage to a turbine if they occur under full load.

- Line congestion – probably the most common transmission event can cause low voltage, brown outs and grid instability. To prevent damage to consumer equipment, the controlling agency will reduce output of wind plants, decreasing the line loads and stabilizing the system. Although not a GADS term, within the wind industry, this is one form of curtailment. Another form of curtailment is Reserve Shutdown (RS) which will be talked about later.
- Line outage – In the winter, these are usually caused by weather events. Summer outages are usually caused by lightning and or tornados.
- Line maintenance – Occurs periodically and usually allows for a controlled shutdown of turbines.

Remember all of these events are occurring on the transmission system after the electrons leave the plant boundary.

Legal – Contractual

- Events that are usually terms of the permitting process during development of the plant. They can be part of settlement agreements with non-governmental organization's (NGO's), law suits and even land lease agreements. There can be many and we will probably see more in the future. Some examples are:
 - Environmental – Birds / Bats are the primary issue but other endangered species can come into play at anytime
 - Flicker – This is caused by light passing through the blades as the rotor turns. Sometimes there are agreements with land owners when turbines are placed near homes
 - Noise – Turbines do produce noise and noise tends to travel downwind. There have been several agreements that either reduce power or shut the turbine down when the wind comes from specified directions
 - Tiling – Agreements to tile a field to improve drainage. Helps the farmer and improves access to the wind turbines. This is usually done after the turbine is up and running

Many of these agreements are conditions of the building permit process or made during lease negotiations. As such, they are out of the plant management control. Some unusual agreements have been moving houses and tiling fields for drainage.

Regulatory testing beyond industry accepted practices could be considered OMC.

Labor Strikes – External to the Plant

- These labor strikes are not from the plant employees but outages caused by external labor issues.
 - Transportation – Can cause delays in the delivery of vital equipment. This can come into play with over seas shipments and long shore men labor disputes.
 - Manufacturing – This may dry up the spare parts pipeline.

- When an external labor dispute impacts a plant, it will need to be evaluated on a case by case basis.
 - These events are very rare.
 - The general rule is not to switch outage types once the event has occurred but a severe labor issue may allow for switching from a turbine outage to an external outage.
 - Check with the GADSWG before using this code.

Note: Labor issues within the plant are considered under management control.

Security

- Security is a growing concern within the US, Canada and Mexico. Several areas impact the availability of wind turbines:
 1. Physical – Copper theft of conductors and grounds, bullet holes in blades, breaking into towers and stealing components.
 2. Cyber – Hacking into internet based control systems.
 3. Interruptions to the off-taker facilities interfering with the delivery of power.

- This is an area of growing concern and deserves special tracking.

This is a new code that has been added to the 2018 Wind GADS DRI. Hacking and malicious physical damage is occurring at an increased rate and needs to be accounted for.

- **External Control – Loss of Communications**
 1. Many interconnect contracts require direct control of the facility output. Some are adjusting output as often as every 2 minutes.
 2. When communications between the off-taker and the plant are interrupted there maybe a grace period to restore communications or the plant is tripped off-line remotely.
 3. Communications issues within the plant boundary are considered balance of plant and are not OMC.

More and more off-takers are requiring direct access or visibility of wind plants per interconnect agreements. Damage or failure of external communications may cause a plant shutdown.

Execution Delays – Special circumstances, special requirements

- This is a new code and has special rules for its use. There is concern that the code could be misused, therefore the strict requirements.
- The purpose is to identify long term conditions where delays are introduced into the repair process due to OMC circumstances such as equipment, parts and contractor availability.
- What are the rules:
 1. The turbine or plant must be in FO, MO or PO for **60 days** before switching to this code.
 2. The outage type becomes forced.
 3. The delay is due to external OMC issues such as weather, equipment or supply chain.
 4. Lack of funds or out of budget is not a reason to use this code.

At this time, the Execution Delay OMC code is the only code that allows switching from a non-OMC FO, MO, or PO to an OMC event. The reason for allowing this switch is the rapid growth in the industry and the increase demand on support resources. There are only so many repair shops, cranes and contractors that can do the work. Added to this, wind plants are often subject to local regulations for moving heavy equipment.

So why 60 days? 60 days is also used to qualify for Inactive status. Initially there was no holding period but it was found that the option was abused. For Wind, 60 days is about the maximum that it takes to replace a major component within a turbine if the remediation runs smoothly. Often barriers occur such as equipment availability, parts in stock, road restrictions, soil is too soft to support large equipment and more. This option allows the operator to switch to a code that identifies the true reason for the downtime.

When switching to this code the outage type is always forced. The circumstances have forced the condition.

Notice that lack of funds or site labor is not a reason to switch to this code. Those are business decisions made by the organization.

There are several items that you need to be aware of when dealing with OMC:

1. When dealing with weather OMC the tendency is to blame everything on the weather. There should be a clear link that can be explained between the OMC event and any downtime.
2. With weather OMC, usually many events occur. Not just 1 or 2.
3. OMC may delay repairs. If the turbine is down prior to the OMC event do not change to the OMC. It is delayed work and not OMC
4. Weather events are all FO. Sometimes for the other types of OMC there can be an there can be MO or PO events.
5. Safety Shutdowns for weather events are OMC and are FO.
6. A failure of protective equipment is not OMC. Example: The turbine has deicing equipment to prevent ice on blades. The deicing equipment fails and the turbine ices up. This is an equipment failure and not OMC.

EFOR is often used as a measure of plant performance and incentives. The tendency for plants is to avoid forced outage downtime by pushing downtime to inappropriate categories. This should be avoiding using the following guide lines.

- It is easy to blame weather for everything but there should be a clear link between the weather event and the turbine event that can be explained.
 - Example 1 – A large number of turbine overspeed faults occur during an icing event and high winds. The increased mass of the rotor delays shutdown and triggers an overspeed event.
 - Example 2 – High turbulent winds caused a large increase in yaw runaway faults. Basically the wind was so strong and gusty that it pushed the rotor out of the wind or the turbine could not keep up with the wind direction changes.
 - Example 3 – During an icing event an IGBT blows up in the turbine converter. There was no power outage. This is not an OMC event as there is no clear linkage.

- When abnormal weather events occur generally many faults occur. Single failures may have been close to failure and the event just pushed them over the edge. As an example A gearbox failure would not be part of an icing event.
- Often weather gets in the way of repairs. These are delays and not OMC. The general rule is once in an outage state you stay in that state until the issue is resolved. Sometimes this can cause some pain with large OMC events. As an example:
 - The plant has a turbine down for gearbox repairs and power is required to make those repairs. The off-taker has scheduled a 2 month maintenance outage to make system improvements and the plant will be without power during this time. Can the gearbox FO be changed to the Off-taker OMC event? NO – The gearbox repair must be repaired before the outage can be switched. First in First out rule.
 - Delayed hours are optional in Wind GADS. They do not reduce outage hours but help to explain why repair time was extended.
- All OMC weather events are FO. It would be difficult to plan in advance when a tornado or icing event will occur weeks ahead of time. Transmission OMC is the most often outage that maybe MO or PO. Also, sometimes seasonal environmental events, like shutting down for bird migration during a specified period of time, can be MO or PO.
- Sometimes turbines are shutdown ahead of an OMC event to prevent or minimize damage to systems. This is an OMC event. Example: Tornado or severe lightning storm approaching.
- We need to distinguish between OMC and failure of protective equipment. Examples:
 - An ice storm comes through and some of the windvanes freeze up and the turbines fault. The windvanes have heaters and the temperature did not drop below the heater specifications. This is not OMC, it is a failure of the heaters.
 - Lightning storm comes through and damages a blade. The blade had lightning protection but it was disconnected. Not OMC.
 - A turbine has blade deicing equipment and faults due to ice on the blade. Not OMC but a failure of the deicing equipment.



Questions and Answers