NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

GADS Wind Turbine Generation

Data Reporting Instructions

Effective: January 1, 2024

RELIABILITY | RESILIENCE | SECURITY




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Revision History

Version	Date	Revisions
4.4	3/4/2024	Updated Cause Code table (Appendix J) and removed NCF equation, 2.A.3 in Appendix M (due to redundancy).
4.3	1/02/2024	XML File format clarification Event clarification edits Removal of Appendix M (Frequently Asked Questions) due to reporting changes Renamed former Appendices N, O to Appendices M (Equations), N (Examples) Examples from training added to Appendix N Removal of "Equivalent" (no derates) from pertinent equations and acronyms from Appendix M
4.2	8/22/2023	Corrected typographical error on field name, changing PDTH to ACTH, and all associated points where this field is referenced. Clarified and added event examples. Clarified that all curtailments are considered reserve shut down hours.
4.1	5/31/2023	Updated Event Reporting Criteria. Added grammar and formatting corrections.
4.0	11/16/2022	Board approved changes to GADS Section 1600 Data Request
3.5	9/12/2022	Proposed revisions after second public comment period
3.4	5/20/2021	Revisions to reflect proposed Section 1600 Data Request changes
3.3	05/04/2021	Correction to Subgroup table and adjustment of Pandemic appendix to end of appendices
3.2	10/22/2020	Update of Data Quality Control, Addition of Pandemic Cause Code
3.1	05/07/2019	Updated Table 13 from Texas RE to TRE, the GADS Wind application validates against "TRE".
3.0	10/26/2018	Added clarifying language, updated Regional map, grammar and formatting.
2.0	09/20/2017	Added clarifying language, grammar, and formatting corrections.
1.2	09/15/2016	Updated in response to public comments. Clarifying language added.
1.1	06/02/2015	Updated in response to public comments.
1.0	01/15/2015	Initial Release for Section 1600 Data Request.

Board Approved changes to the GADS Section 1600 Data Request, Effective January 1, 2024: November 16, 2022

Preface

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of the North American Electric Reliability Corporation (NERC) and the six Regional Entities, is a highly reliable and secure North American bulk power system (BPS). Our mission is to ensure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security
Because nearly 400 million citizens in North America are counting on us

The North American BPS is made up of six Regional Entity boundaries as shown in the map and corresponding table below. The multicolored area denotes overlap as some load-serving entities participate in one Region while associated Transmission Owners (TOs)/Operators (TOPs) participate in another.

MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RF	ReliabilityFirst
SERC	SERC Reliability Corporation
Texas RE	Texas Reliability Entity
WECC	WECC

Introduction

These *GADS Wind Turbine Generation (GADS-W) - Data Reporting Instructions* were developed to assist plant personnel in reporting information to NERC's GADS Wind Reporting application. The instructions detail the procedures, schedule, and format to follow when reporting data. Throughout this document, the term "entity" will be used to refer to the principal organization that owns one or more plants.

Who Must Report

Reporting of wind performance data is required for all Generator Owners of NERC registered entities that operate wind plants with a Total Installed Capacity of 75 MW or greater[1] and with a commissioning date of January 1, 2005, or later for any portion of the plant. Total Installed Capacity is the combined capacity of Subgroup Installed Capacity, not including Energy Storage Capacity. Participating organizations must be prepared to commit the necessary effort to provide timely, accurate, and complete data. These reporting instructions detail the data elements collected by the GADS Wind Reporting application and have been identified by the industry as being vital to the understanding and interpretation of wind turbine performance.

Data Release Guidelines

The GADS Wind Reporting Application Data Release Guidelines can be found in **Appendix A**.

What will be reported?

1. Configuration Data:
    a. Plant
    b. Subgroup
    c. Energy Storage
2. Monthly Performance Data
    a. Subgroup
    b. Energy Storage
3. Event Data
    a. Plant

When will Required Reporting Begin?

Entities' data collection will begin January 1, 2024, to be submitted by August 15, 2024.

[1] Total Installed Capacity is defined in **Appendix E**.

Chapter 1: Date Record Types and Format

Data Record Types

Three types of data files will be reported:

1. Configuration Data:
   a. Plant
   b. Subgroup
   c. Energy Storage
2. Monthly Performance Data:
   a. Subgroup
   b. Energy Storage
3. Event Data
   a. Plant

Configuration data are required before reporting performance data an event to the GADS Wind reporting application. Configuration data are provided to establish the assets on which to report. This data provides foundational information regarding installed equipment, design, and operating characteristics that are used when completing special analyses. Configuration data may be updated as needed. Configuration data should be reviewed each quarter to ensure that the information is current.

Format

Data should be submitted to NERC through the GADS Wind reporting application using the Excel-format XML templates available on NERC's website[2] or an XML formatted file that follows the column order of the data reporting templates. Column headers are required for all Excel XML files.[3] Filenames and data in the fields of the import file must not include commas; however, decimal points, dashes, and slashes are permitted.

Multiple NERC entity, plant, subgroup, and energy storage group IDs may be reported within the same file. Each data type and template have specific tab labels.

Reporting Deadline

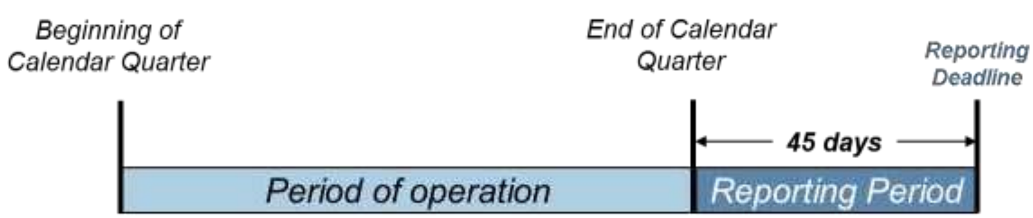


Figure 1.1: Timeline of Reporting Deadline

[2] https://www.nerc.com/pa/RAPA/gads/Pages/GADS-Wind-DRI.aspx
[3] Some third-party vendors will have direct to XML capability.

Data shall be submitted quarterly to NERC through the GADS Wind reporting application within 45 days after the end of each calendar quarter, as specified in the following sections that detail the data to be reported. Reporting deadlines are posted on the NERC website on the GADS web page.[4]

Late Reporting

An entity is required to notify their regional entity contact when they are unable to complete their data reports by the reporting deadline. The regional entity contacts for wind reporting are available on the GADS web page[5].

Questions and Comments

All questions regarding data transmittals and reporting procedures should be directed to gadswind@nerc.net.

[4] https://www.nerc.com/pa/RAPA/gads/Pages/GeneratingAvailabilityDataSystem-(GADS).aspx
[5] https://www.nerc.com/pa/RAPA/gads/Pages/GeneratingAvailabilityDataSystem-(GADS).aspx

Chapter 2: Plants, Groups, Subgroups and Energy Storage Groups

In **Figure 2.1**, the diagram represents a typical plant with the plant boundary at the revenue meter (point of interconnection). Groups usually represent different phases of development. For example, in Group 1 there are two subgroups, where each subgroup contains different turbine types installed the same year. If a subgroup is repowered with different turbine types or manufacturers, the subgroup is retired and a new subgroup created under the same group. The GADS Wind application recognizes that there are many potential layouts of wind plants, so there are no strict rules for group and subgroup layout other than a subgroup can only contain turbines of a specific make, model, and version.

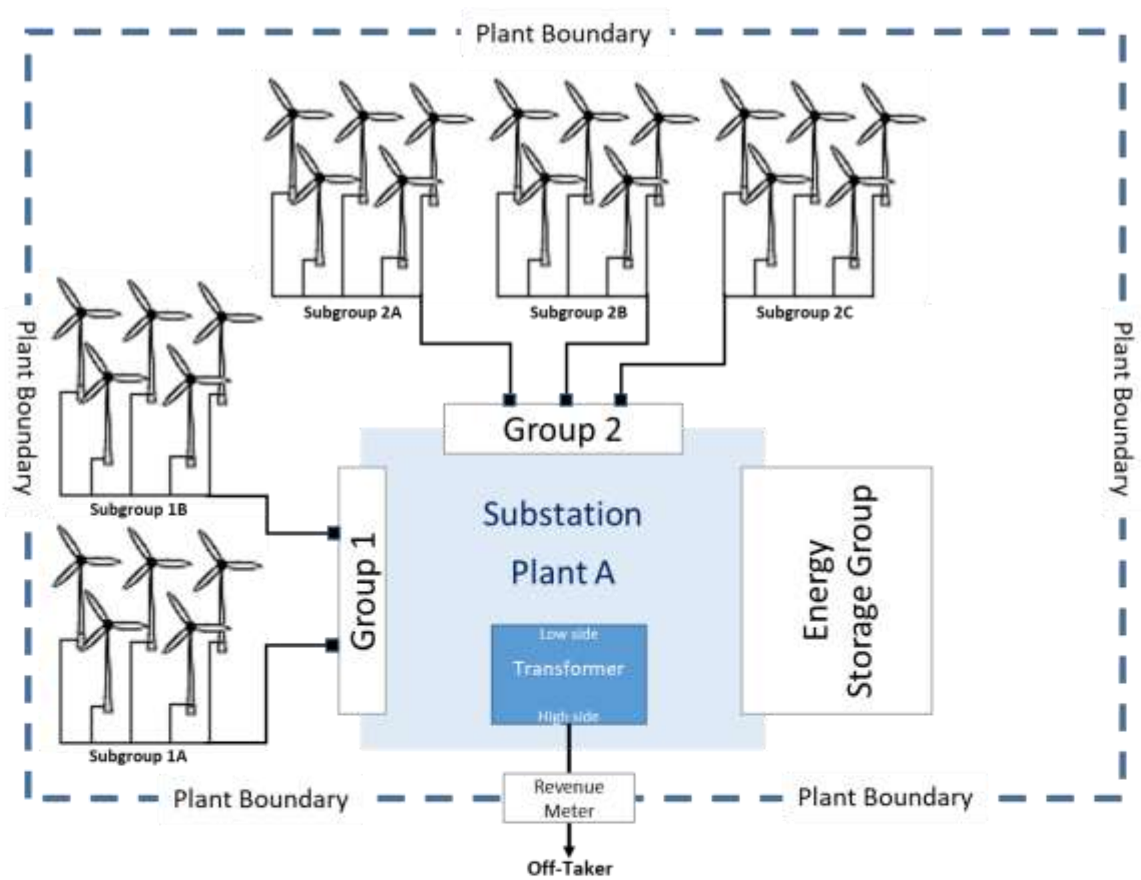


Figure 2.1: Typical Wind Plant Layout

Although **Figure 2.1** shows the subgroups as being electrically isolated, this need not be the case. A feeder may have multiple turbine types. The plant is responsible for allocating production and hourly distributions using feeder meters, turbine meters, SCADA systems, manual logs, or other means into the proper subgroups.

Plant Boundaries

The following describes the plant boundary in preferred order:

1. The preferred plant boundary at the revenue meter is usually at the high-voltage terminals of the generator step-up (GSU) transformer and the station service transformers; or
2. In cases of multiple subgroups, the plant boundary would be at the metering of the low side of the substation transformer (load) side of the generator voltage circuit breakers; or

3. Any equipment boundary that is reasonable considering the design and configuration of the generating unit.

Plant boundaries may not cross the boundary of a NERC region, state, province, or country. Additional guidelines are provided under the Plant entry in the Glossary.

Plants

A plant is defined as a collection of wind turbine groups at a single physical location managed by a single manager and operating out of a common Operations and Management building. Generally, each separate plant is reported to the Energy Information Administration (EIA) and is treated as a single plant within the parent entity. There may be any number of wind turbine groups at a wind plant and there may be connected energy storage within the plant boundary. See **Appendix E** for an enhanced definition of a plant. Each plant will have a unique identifier assigned by NERC through the GADS Wind reporting application.

Groups

A group is one or more subgroups that are contained within a common plant boundary. There may be any number of groups per wind plant. Groups are usually phases that are commissioned during a particular year.

The user-defined Group ID and/or name will be specified on each subgroup record.

Subgroups

A subgroup is a collection of wind turbines with the same manufacturer, design (rotor diameter), turbine system capacity, model number, and phase of construction. Each subgroup will have a unique identifier assigned by NERC through the GADS Wind reporting application. Performance data are reported at the subgroup level.

Energy Storage Groups

An energy storage group is a collection of energy storage devices with the same manufacturer, model number, design characteristics and phase of construction. Each energy storage group will have a unique identifier assigned by NERC through the GADS Wind reporting application. Performance data are reported for energy storage groups.

Chapter 3: Configuration Data

Configuration data contains location, environment, and other design data about the plant, subgroup, or connected energy storage. Configuration data is required prior to reporting performance or event data. During the initial import of configuration data, the GADS Wind reporting application will assign unique IDs to the plant, subgroup(s), and on- site energy storage group(s), if applicable. The assigned IDs remain with the plant throughout its life cycle. Configuration data may be updated at any time and must be reviewed annually. Retirements and transfer of ownership are handled through configuration data updates.

NERC requests that values reported to NERC match any values that are also reported to other governmental or regulatory agencies such as the EIA.

When to Report Configuration Data

Equipment-related (configuration) data, such as plant, subgroup, or energy storage configuration data will be required in the first full month after the Commercial Operating Date (COD), acquisition, or repowering of a subgroup at the plant. Once established, configuration data may be updated by the user as changes occur.

Plant Configuration Data

Plant data is required. Each Plant will be assigned a unique identifier through the GADS Wind Reporting application when the Plant Configuration template is imported. Event data are reported at the Plant level.

Table 3.1: Plant Configuration Record Fields

Column	Field Name	Column Header Label	Entry Type	Required or Voluntary
1	Entity ID	EntityID	Alpha-Numeric-10	Required
2	Region	Region	Alpha-Numeric - 8	Required
3	Plant ID	PlantID	Numeric - 10	Required
4	Plant Name	PlantName	Alpha-Numeric - 45	Required
5	EIA Plant Code	EIACode	Numeric – 6	Required
6	ISO Resource ID	PlantISOID	Alpha-Numeric - 30	Voluntary
7	Country	Country	Alpha-Numeric - 2	Required
8	Nearest City	NearCity	Alpha-Numeric - 40	Required
9	State/Province	State	Alpha-Numeric - 2	Required
10	Time Zone	TimeZone	Alpha-Numeric - 3	Required
11	Plant Location Latitude	PlantLatitude	Numeric - 3 + 4 decimals	Required
12	Plant Location Longitude	PlantLongitude	Numeric - 3 + 4 decimals	Required
13	Connected Energy Storage	OnsiteStorage	Yes/No	Required
14	Plant Capacity at POI (MW)	CPOI	Numeric - 8 + 2 decimals	Required
15	Plant Ownership Status	PlantOwnStatus	Alpha-Numeric-2	Required
16	Plant Effective Date	PlantEffDate	Date (mm/dd/yyyy)	Required
17	Plant Transfer to Entity ID	PlantTransferEntity	Alpha-Numeric – 10	Conditionally Required

Note: The ISO Resource ID is a voluntary field used to provide an identifier assigned by an ISO/RTO market in the event the ISO/RTO requires Required GADS reporting for wind plants.

Table 3.2: Plant Configuration Record Field Description		
Column	**Field Name**	**Description**
1	Entity ID	Enter the NERC Compliance Registry ID number (NCR ID) or voluntary reporting ID assigned by NERC of the organization that owns or operates the Wind plant.
2	Region	Enter the region code for the NERC Region where the Plant, Subgroup or Energy Storage Group is located. Refer to **Appendix C** to identify the correct Region abbreviation.
3	Plant ID	For new plants, this field will be left blank to indicate that a plant ID is being requested. For updates to a plant configuration, enter the Plant ID assigned by the GADS Wind reporting application.
4	Plant Name	Enter the Plant name. Use the same plant name as reported to EIA.
5	EIA Plant Code	Enter the Form 860 EIA Plant Code of the facility as reported to EIA.
6	ISO Resource ID (Voluntary)	If applicable, enter the unique plant identifier assigned by the ISO or RTO.
7	Country	Refer to **Appendix C** and enter the two-letter country abbreviation where the plant is located.
8	Nearest City	Enter the name of the city closest in proximity to the plant.
9	State /Province	Refer to **Appendix C** and enter the two-letter State/Province abbreviation where the plant, subgroup, or energy storage is located.
10	Time Zone	Refer to **Appendix C** and enter the Time Zone in which data are reported for the plant. This time zone will be used to convert Event Start and End Date/Times to UTC.
11	Plant Location Latitude	Enter the degrees of latitude of the physical location of the plant.[6]
12	Plant Location Longitude	Enter the degrees of longitude of the physical location of the plant.
13	Connected Energy Storage	Indicate whether the facility has any type of energy storage that is electrically connected to a renewable energy generating facility and installed on-site as part of the plant.
14	Plant Capacity at POI (MW)	Plant Capacity at Point of Interconnection (MW). This is the capacity of the Interconnection agreement or threshold. This capacity differs from installed capacity of equipment reported at the Subgroup level.
15	Plant Ownership Status	Enter the ownership status of the Plant. Refer to **Appendix C** for ownership status codes. Plant Ownership Status is required for updates to existing configuration data; leave blank for new plants.
16	Plant Effective Date	Effective Date is required for updates to existing configuration data; leave blank for first time plants. Enter the effective date of the Plant ownership status being reported.
17	Plant Transfer to Entity ID	Enter the Entity ID of the Entity to which the Plant is being sold. This field is a required field when the Plant Ownership Status being reported is “Transfer.”

[6] The degrees of longitude, latitude, and elevation may be taken anywhere on the site that is meaningful to the reporting entity. This could be the revenue meter, main structure, or geographic center of the plant.

Subgroup Configuration Data

The subgroup report provides the configuration information that characterizes each subgroup. This data can be used for subgroup comparisons and benchmarking activities. Data is collected on equipment, capacity, reserves, topography, and meteorological characteristics. Use this field list to acquire the subgroup ID and update subgroup configuration.

Table 3.3: Subgroup Configuration Record Fields

Column	Field Name	Column Header Label	Entry Type	Required or Voluntary
1	Entity ID	EntityID	Alpha-Numeric-10	Required
2	Plant ID	PlantID	Numeric – 10	Required
3	Group ID/Name	GroupIDName	Alpha-Numeric - 45	Required
4	Subgroup ID	SubGroupID	Numeric - 10	Required
5	Subgroup Name	SubGroupName	Alpha-Numeric - 45	Required
6	Subgroup Elevation (m)	SubgrpElevation	Numeric - 8	Required
7	Wind Regime (topography)	WRegime	Numeric - 3	Required
8	Annual Average Wind Speed (m/s)	AAWS	Numeric – 3 + 2 decimals	Required
9	SCADA Manufacturer	SCADAMfr	Alpha-Numeric - 5	Required
10	SCADA Model	SCADAMdl	Alpha Numeric - 10	Required
11	Commercial Operation Date	COD	Date (mm/dd/yyyy)	Required
12	Subgroup Total Installed Capacity (MW)	SubgrpTotInstCapacity	***Calculated Field*** (Numeric - 8 + 2 decimals)	Required
13	Total Number of Turbines	TurbineCount	Numeric - 7	Required
14	Turbine System Capacity (MW)	SystemMW	Numeric - 8 + 2 decimals	Required
15	Max Turbine Capacity (MW)	MaxTurbineCap	Numeric - 8 + 2 decimals	Required
16	Turbine Manufacturer	TurbineMfr	Alpha-Numeric - 5	Required
17	Turbine Model	TurbineMdl	Alpha-Numeric - 20	Required
18	Turbine Model Version	TurbineMdlVer	Alpha-Numeric - 20	Required
19	Turbine Type	TurbineType	Alpha-Numeric - 5	Required
20	Rotor Height (m)	RotorHeight	Numeric - 7 + 2 decimals	Required
21	Rotor Diameter (m)	RotorDiam	Numeric - 7 + 2 decimals	Required
22	Cut-in Wind Speed (m/s)	CutinSpd	Numeric - 7 + 2 decimals	Required
23	Low Cut-out Wind Speed (m/s)	LowCutoutSpd	Numeric - 7 + 2 decimals	Required
24	High Cut-out Wind Speed (m/s)	HighCutoutSpd	Numeric - 7 + 2 decimals	Required
25	Turbulence Intensity	TurbIntensity	Numeric - 3	Required
26	Wind Shear	WindShear	Numeric - 3	Voluntary
27	Reference Anemometer Height (m) (Voluntary)	ReferenceAnemom	Numeric - 3	Voluntary
28	Minimal Operating Temperature (C)	MinOpTemp	Numeric - 3	Required

Table 3.3: Subgroup Configuration Record Fields				
Column	**Field Name**	**Column Header Label**	**Entry Type**	**Required or Voluntary**
29	Maximum Operating Temperature (C)	MaxOpTemp	Numeric - 3	Required
30	Subgroup Ownership Status	SubGrpOwnStatus	Alpha-Numeric - 2	Required
31	Effective Date	StatusEffDate	Date (mm/dd/yyyy)	Required
32	Transfer to Entity	TransfertoEntity	Alpha-Numeric - 10	Conditionally Required

Table 3.4: Subgroup Configuration Record Field Descriptions		
Column	**Field Name**	**Description**
1	Entity ID	Enter the NERC Compliance Registry ID number (NCR ID) or voluntary reporting ID assigned by NERC of the organization that owns or operates the wind plant.
2	Plant ID	Enter the Plant ID assigned by the GADS Wind reporting application.
3	Group ID/Name	Enter the Group ID and/or name used by the entity. This will not be assigned by NERC or the GADS Wind reporting application.
4	Subgroup ID	For new subgroups, this field will be left blank to indicate that a subgroup ID is being requested. For subgroup configuration updates, enter the unique subgroup ID as assigned by NERC. This ID will be used in the subgroup, performance, and component records. The subgroup ID does not change throughout the life of the subgroup.
5	Subgroup Name	Enter the name given to the subgroup.
6	Subgroup Elevation	Enter the elevation of the physical location of the subgroup in meters.
7	Wind Regime (topography)	Refer to **Appendix C** and enter the average topography of the area in which the subgroup is located.
8	Annual Average Wind Speed (m/s)	Enter the average annual wind speed (AAWS) at 80m, measured in meters per second.
9	SCADA Manufacturer	Refer to **Appendix C** and enter the manufacturer of the SCADA system.
10	SCADA Model	Enter the model of the SCADA system.
11	Commercial Operation Date	Enter the Date (mm/dd/yyyy) that the subgroup began commercial operations. The commercial operation date (COD) is defined as the date after which all testing and commissioning has been completed and is the initiation date to which the seller can start producing electricity for sale (i.e. when the project has been substantially completed). Monthly performance data will be required beginning with the third full month after COD, acquisition, or repowering. If a reportable event occurs after the commercial operation date, it must be reported, regardless of whether monthly performance data reporting has begun.
12	Subgroup Total Installed Capacity (MW)	Enter the total capacity for subgroup, in megawatts (MW). The Total Installed Capacity is equal to the number of turbines multiplied by the Turbine System MW.
13	Total Number of Turbines	Enter the number of physical turbines reported as the sub-group.
14	Turbine System Capacity (MW)	The System Capacity - MW rating of a single turbine in the sub-group. All turbines in the subgroup are required to be the same manufacturer, model, design, version, and capacity.

Table 3.4: Subgroup Configuration Record Field Descriptions		
Column	**Field Name**	**Description**
		This is not the generator nameplate rating, but the system capacity typically identified in the equipment purchase agreement.
15	Max Turbine Capacity (MW)	The maximum capacity that can be produced from a single turbine in the subgroup. Turbine System Capacity may be increased due to system enhancements that were not part of the original design.
16	Turbine Manufacturer	Refer to **Appendix C** and enter the name of the manufacturer of the turbines in the subgroup.
17	Turbine Model	Enter the model of the turbines in the subgroup.
18	Turbine Model Version	Enter the version name of the turbines in the subgroup. If there is no version number available, enter a place holder such as “999”.
19	Turbine Type	Refer to **Appendix C** and enter the turbine type of the turbines in the subgroup.
20	Rotor Height (m)	Enter the height of the rotor hub, given in meters.
21	Rotor Diameter (m)	Enter the diameter of the rotor, in meters.
22	Cut-in Wind Speed (m/s)	Enter the lowest wind speed at which the turbine will start to generate power, in meters per second. This can be determined from the turbine operating parameters or the turbine power curve.
23	Low Cut-out Wind Speed (m/s)	Enter the lowest wind speed at which the turbine can continue to generate power before cutting out. This can be determined from the turbine operating parameters or the turbine power curve.
24	High Cut-out Wind Speed (m/s)	Enter the highest wind speed at which the turbine can generate power before cutting out. This can be determined from the turbine operating parameters or the turbine power curve.
25	Turbulence Intensity	Refer to **Appendix C** and select the average wind turbulence where the subgroup is located.
26	Wind Shear	Refer to **Appendix C** and select the average strength of the difference between the speeds of wind.
27	Reference Anemometer Height (m)	Height of the highest anemometer on the reference meteorological tower. Often the turbine anemometer is used for reference.
28	Minimal Operating Temperature (C)	Enter the manufacture minimum operating temperature in degrees Celsius.
29	Maximum Operating Temperature (C)	Enter the manufacture maximum operating temperature in degrees Celsius.
30	Subgroup Ownership Status	Enter the ownership status of the subgroup. Refer to **Appendix C** for ownership status codes. Ownership Status is required for updates to existing configuration data; leave blank for new subgroups.
31	Effective Date	Enter the effective date of the subgroup ownership status being reported. Effective Date is required for updates to existing configuration data; leave blank for new subgroups.
32	Transfer to Entity	Enter the Entity ID of the Entity to which the Plant is being sold. This is a required field when the Plant Ownership Status being reported is “Transfer.”

Energy Storage Configuration Data

An Energy Storage Group is a collection of energy storage equipment with the same manufacturer, design, system capacity, model number, and phase of construction. Each Energy Storage Group will have a unique identifier assigned by NERC through the GADS Wind Reporting application. Monthly performance data are reported for Energy Storage Groups.

Table 3.5: Energy Storage Group Configuration Record Fields

Column	Field Name	Column Header Label	Entry Type	Required or Voluntary
1	Entity ID	EntityID	Alpha-Numeric-10	Required
2	Plant ID	PlantID	Numeric - 10	Required
3	Energy Storage Group ID	StorageGroupID	Numeric - 10	Required
4	Energy Storage Group Name	StorageGroupName	Alpha-Numeric - 45	Required
5	Energy Storage Group EIA Code	StorageEIACode	Numeric – 6	Required
6	Energy Storage Group ISO ID	StorageISORID	Alpha-Numeric - 30	Voluntary
7	Energy Storage Type	StorageType	Alpha-Numeric - 20	Required
8	Energy Storage Capacity (MW)	StorageCap	Numeric - 4 + 2 decimals	Required
9	Energy Storage (MWh)	StorageEnergy	Numeric - 5 + 2 decimals	Required
10	Energy Storage Connection (AC or DC)	StorageConnType	Alpha-Numeric - 2	Required
11	Energy Storage Chargeable from Grid	GridCharge	Yes/No	Required
12	Energy Storage Manufacturer	StorageManuf	Alpha-Numeric - 5	Required
13	Energy Storage Model	StorageModl	Alpha-Numeric - 20	Required
14	Storage Group Commissioning Date	StorageCommDate	Date (mm/dd/yyyy)	Required
15	Energy Storage Inverter Manufacturer	StorageInvManuf	Alpha-Numeric - 5	Required
16	Energy Storage Inverter Model	StorageInvModel	Alpha-Numeric - 20	Required
17	Storage Group Ownership Status	StorageOwnStatus	Alpha-Numeric - 2	Required
18	Storage Group Effective Date	StorageStatusEffDate	Date (mm/dd/yyyy)	Required
19	Storage Group Transfer to Entity ID	StorageTrfrtoEntity	Alpha-Numeric - 10	Conditionally Required

Table 3.6: Energy Storage Configuration Record Field Descriptions

Column	Field Name	Description
1	Entity ID	Enter the NERC Compliance Registry ID number (NCR ID) or voluntary reporting ID assigned by NERC of the organization that operates the Wind plant.
2	Plant ID	Enter the Plant ID assigned by the GADS Wind reporting application.
3	Energy Storage Group ID	Enter the Energy Storage Group ID assigned by the GADS Wind reporting application.
4	Energy Storage Group Name	Enter the Energy Storage Group name. This will not be assigned by NERC or the GADS Wind reporting application. Use the same energy storage name as reported to EIA.
5	Energy Storage Group EIA Code	Enter the EIA Plant Code for the Energy Storage Group as assigned by EIA.
6	Energy Storage Group ISO ID	If applicable, enter the unique plant identifier assigned by the ISO or RTO.
7	Energy Storage Type	Enter the storage type from **Appendix C**. Use the same energy storage type as reported to EIA.
8	Energy Storage Capacity (MW)	Enter the capacity (MW) recorded at the group boundary (usually the revenue meter). This is the recorded nameplate capacity of the energy storage group.
9	Energy Storage (MWh)	Enter the actual generating capability (MWh) at the group boundary.

Table 3.6: Energy Storage Configuration Record Field Descriptions		
Column	**Field Name**	**Description**
		This is equal to the installed capacity less any electrical losses such as transformation losses, line losses, and other losses due to transmission between the inverter and the revenue meter.
10	Energy Storage Connection (AC or DC)	Refer to **Appendix C** and enter the Energy Storage Connection type that indicates whether the Energy Storage module is behind the inverter (DC) or between the inverter and grid connection (AC).
11	Energy Storage Chargeable from Grid	Indicate whether the Energy Storage Group may be charged from the grid.
12	Energy Storage Manufacturer	Refer to **Appendix C** and enter the abbreviation for the name of the manufacturer of the energy storage equipment in the Energy Storage Group.
13	Energy Storage Model	Enter the model of the energy storage equipment in the Energy Storage Group. Enter zero (0) if model version is not applicable.
14	Storage Group Commercial Operation Date	Enter the Commercial Operation Date (mm/dd/yyyy) of the Energy Storage Group.
15	Energy Storage Inverter Manufacturer	Refer to **Appendix C** and enter the abbreviation for the name of the manufacturer of the Inverter at the Energy Storage level.
16	Energy Storage Inverter Model	Enter the model of the energy storage Inverter in the Energy Storage Group. Enter zero (0) if model version is not applicable.
17	Storage Group Ownership Status	Enter the ownership status of the Energy Storage Group. Refer to **Appendix C** for ownership status codes.
18	Storage Group Effective Date	Enter the effective date of the Energy Storage Group ownership status being reported.
19	Storage Group Transfer to Entity ID	Enter the Entity ID of the Entity to which the Energy Storage Group is being sold. This is a required field when the Group Ownership Status being reported is "Transfer."

Chapter 4: Performance Reporting

Performance data provides sub-group or energy storage group information, in a summarized format, pertaining to wind plant operations during a given month. This data is used to calculate performance, reliability, and availability statistics. Performance data are required.

When to Report Performance Data

Performance data is summarized at the monthly level and required quarterly within 45 days of the end of the quarter.

Monthly performance data will be required beginning with the third full month after COD, acquisition, or repowering. If a reportable event occurs after the Commercial Operation date, it must be reported, regardless of whether monthly performance reporting has begun.

Subgroup Performance Record

Table 4.1: Subgroup Performance Record Fields

Column	Field Name	Column Header Label	Entry Type	Required or Voluntary
1	Entity ID	EntityID	Alpha-Numeric-10	Required
2	Plant ID	PlantID	Numeric - 10	Required
3	Subgroup ID	SubGroupID	Numeric - 10	Required
4	Report Period (month)	ReptMonth	Numeric - 2	Required
5	Report Year	ReptYear	Numeric - 4	Required
6	Subgroup Status	SGStatus	Alpha-Numeric - 2	Required
7	Gross Actual Generation (GAG)	GAG	Numeric - 12 + 2 decimals	Required
8	Expected Generation (MWh)	EG	Numeric - 12 + 2 decimals	Required
9	Net Actual Generation (NAG)	NAG	Numeric - 10 + 2 decimals	Required
10	Net Maximum Capacity (NMC)	NMC	Numeric - 8 + 2 decimals	Required
11	Active Turbine-Hours (ACTH)	ACTH	Numeric - 10 + 2 decimals	Required
12	Contact Turbine-Hours (CTH)	CTH	Numeric - 12 + 2 decimals	Required
13	Reserve Shutdown Turbine-Hours (RSTH)	RSTH	Numeric - 10 + 2 decimals	Required
14	Forced Turbine-Hours (FTH)	FTH	Numeric - 10 + 2 decimals	Required
15	Maintenance Turbine-Hours (MTH)	MTH	Numeric - 10 + 2 decimals	Required
16	Planned Turbine-Hours (PTH)	PTH	Numeric - 10 + 2 decimals	Required
17	Resource Unavailable Turbine-Hours (RUTH)	RUTH	Numeric - 10 + 2 decimals	Required
18	Inactive Reserve Turbine-Hours (IRTH)	IRTH	Numeric - 10 + 2 decimals	Required
19	Mothballed Turbine-Hours (MBTH)	MBTH	Numeric - 10 + 2 decimals	Required
20	Retired Unit Turbine-Hours (RTH)	RTH	Numeric - 10 + 2 decimals	Required

Table 4.2: Subgroup Performance Record Field Descriptions

Column	Field Name	Description
1	Entity ID	Enter the NERC Compliance Registry ID number (NCR ID) or voluntary reporting ID assigned by NERC of the organization that operates the Wind plant.
2	Plant ID	Enter the Plant ID assigned by the GADS Wind reporting application.
3	Subgroup ID	Enter the unique Subgroup ID as assigned by NERC. This ID will be used in all data reported for the subgroup.

Table 4.2: Subgroup Performance Record Field Descriptions		
Column	**Field Name**	**Description**
4	Report Period (month)	Enter the two-digit month (MM) for which the performance data is being reported. Refer to **Appendix C**.
5	Report Year	Enter the four-digit year (YYYY) for which the performance data is being reported.
6	Subgroup Status	Select the status of the entire subgroup during the period for which the data is being reported. Refer to **Appendix C**.
7	Gross Actual Generation (GAG)	Enter the total wind turbine energy generated at the wind turbine (WTG) for the subgroup (MWh). The Gross Actual Generation is the sum of all individual turbine meters before subtracting station service or auxiliary loads.
8	Expected Generation	Enter the expected output based on the site-specific wind turbine power curve, wind speed and corrected for air density (temperature, barometric pressure, and humidity). It is the effective maximum generation based on the resources available with no adjustments for outages or deratings. Calculations are usually done at the individual wind turbine data point level and rolled up for the subgroup for the reporting period. This metric will be used for weighting and generation equations. The calculation is based on historical data and is not a forecasted estimate.
9	Net Actual Generation (NAG)	Enter the net generation (MWh) recorded at the subgroup boundary (usually the revenue meter). It is possible to have a negative net actual generation value if the group's station service or auxiliary loads are greater than total generation. At times corrections to this value will take place as meter calibration drifts and reporting differences occur.
10	Net Maximum Capacity (NMC)	Enter the actual generating capability (MW) at the subgroup boundary. This is equal to the installed capacity less any electrical losses such as transformation losses, line losses, and other losses due to transmission between the turbine and the revenue meter.
11	Active Turbine-Hours (ACTH)	Enter the number of turbine-hours that the subgroup is in the active state. ACTH can vary in output reports (month, year, etc.) but for GADS Wind reporting purposes, data is collected on the number of turbine-hours in a month.
12	Contact Turbine-Hours (CTH)	Enter the number of turbine-hours the subgroup is synchronized to the system. It is the turbine-hours that the main contactor is closed, and generation is provided to the grid.
13	Reserve Shutdown Turbine-Hours (RSTH)	Enter the sum of all turbine-hours for turbines that are off-line for economic reasons but available for service. If the subgroup is not available due to an outage condition, it is not a reserve shutdown. Do not include RSTH in the same equations with CTH because this would double count turbine-hours.
14	Forced Turbine-Hours (FTH)	Forced Turbine-Hours is the sum of all turbine-hours, in the subgroup, that are off-line due to forced events. FTH are all forced events where the Wind Turbine Generator (WTG) must be removed from service for repairs before the next Sunday at 23:59 (just before Sunday becomes Monday)
15	Maintenance Turbine-Hours (MTH)	Maintenance Turbine-Hours is the sum of all turbine-hours, in the subgroup, that are off-line due to a maintenance event. The turbine must be capable of running until the following week. If the outage occurs on the weekend, the turbine must be capable of running through the following week.

Table 4.2: Subgroup Performance Record Field Descriptions		
Column	**Field Name**	**Description**
16	Planned Turbine-Hours (PTH)	Planned Turbine-Hours is the sum of all turbine-hours, in the subgroup, that are off-line due to a planned event. A PTH event is scheduled well in advance and is of a predetermined duration and can occur several times a year.
17	Resource Unavailable Turbine-Hours (RUTH)	The number of turbine hours that the turbines are available but not producing electricity for environmental conditions that are outside the operating specifications of the wind turbine (i.e., low / high wind) and includes normal systems checks and calibrations (i.e., cable untwisting).
18	Inactive Reserve Turbine-Hours (IRTH)	Total number of turbine-hours in a period being reported that the subgroup is in the inactive reserve state.
19	Mothballed Turbine-Hours (MBTH)	Total number of turbine-hours in a period being reported that the subgroup is in the mothballed state.
20	Retired Turbine-Hours (RTH)	Total number of turbine-hours in a period being reported that the subgroup is in the retired state.

Energy Storage Group Performance Record

Energy Storage group performance data provides information pertaining to Energy Storage Group operations during a given month. Performance data are required for all energy storage groups.

Table 4.3: Energy Storage Performance Record Fields				
Column	**Field Name**	**Column Header Label**	**Entry Type**	**Required or Voluntary**
1	Entity ID	EntityID	Alpha-Numeric-10	Required
2	Plant ID	PlantID	Numeric - 10	Required
3	Energy Storage Group ID	StorageGroupID	Numeric - 10	Required
4	Report Period (month)	ReptMonth	Numeric - 2	Required
5	Report Year	ReptYear	Numeric - 4	Required
6	Storage Group Availability Status	SGAvailStatus	Alpha-Numeric - 2	Required
7	Charge Generation (MWh)	ChgMWh	Numeric - 12	Required
8	Discharge Generation (MWh)	DischgMWh	Numeric - 12	Required
9	Charging Hours	ChgHrs	Numeric - 3 + 2 decimals	Required
10	Discharging Hours	DisChgHrs	Numeric - 3 + 2 decimals	Required
11	Forced Outage Hours	StorageFOH	Numeric - 3 + 2 decimals	Required
12	Maintenance Outage Hours	StorageMOH	Numeric - 3 + 2 decimals	Required
13	Planned Outage Hours	StoragePOH	Numeric - 3 + 2 decimals	Required

Table 4.4: Energy Storage Performance Record Field Descriptions		
Column	**Field Name**	**Description**
1	Entity ID	Enter the NERC Compliance Registry ID number (NCR ID) or voluntary reporting ID assigned by NERC of the organization that operates the Wind plant.
2	Plant ID	Enter the Plant ID assigned by the GADS Wind reporting application.
3	Energy Storage Group ID	Enter the Energy Storage Group ID assigned by the GADS Wind reporting application.
4	Report Period (month)	Enter the two-digit month (MM) in which the performance data is being entered. Refer to Appendix C.
5	Report Year	Enter the four-digit year (YYYY) in which the performance data is being entered.

Table 4.4: Energy Storage Performance Record Field Descriptions		
Column	**Field Name**	**Description**
6	Storage Group Availability Status	Select the status of the entire energy storage group during the year/period for which the data is entered. Refer to **Appendix C**.
7	Charge Generation (MWh)	Enter the MWh of charge to the Energy Storage Group for the month being reported.
8	Discharge Generation (MWh)	Enter the MWh of discharge from the Energy Storage Group for the month being reported.
9	Charging Hours	Enter the number of charging hours to the Energy Storage Group for the month being reported.
10	Discharging Hours	Enter the number of discharge hours from the Energy Storage Group for the month being reported.
11	Forced Outage Hours	Enter the number of hours that the Energy Storage Group is in a Forced Outage State.
12	Maintenance Outage Hours	Enter the number of hours that the Energy Storage Group is in a Maintenance Outage State
13	Planned Outage Hours	Enter the number of hours that the Energy Storage Group is in a Planned Outage State.

Chapter 5: Event Reporting

Event Detail reporting is used to identify outages that are impactful to the grid. Event Detail reporting is required for all plants.

When to Report Event Data

Event data is reported on the same schedule as performance data: within 45 days of the end of each quarter.

For newly commissioned, acquired, or repowered plants: if an event that meets the Event Criteria below occurs after the Commercial Operation or acquisition date of the plant or portion of the plant, it must be reported within 45 days of the end of the quarter in which it occurred, regardless of whether monthly performance reporting has begun.

Event Criteria

Event Start:

An event starts when there is a loss of at least 20 MW of Plant Total Installed Capacity due to a forced outage. [7,8]

Event End:

95% of the Plant Total Installed Capacity that was unavailable due to the forced outage event has been returned to service.

AND

Less than 20 MW of Plant Total Installed Capacity is unavailable due to a forced outage.

Plant Event Record

Table 5.1: Plant Event Record Fields

Column	Field Name	Column Header Label	Entry Type	Required or Voluntary
1	Entity ID	EntityID	Alpha-Numeric-10	Required
2	Plant ID	PlantID	Numeric - 10	Required
3	Event ID	EventID	Alpha-Numeric-20	Required
4	Time Zone	TimeZone	Alpha-3	Required
5	Event Start Date/Time	StartDT	mm/dd/yyyy HH:MM	Required
6	Event End Date/Time	EndDT	mm/dd/yyyy HH:MM	Required
7	Event Type	EventType	Alpha-Numeric-10	Required
8	Cause Code	CauseCode	Numeric - 5	Required
9	Contributing Operating Condition	Condition	Alpha-Numeric – 1	Required
10	Description	Description	Alpha-Numeric-500	Voluntary
11	Potential MWh Production loss	MWHLoss	Numeric - 12	Required

[7] Reduction in Plant Total Installed Capacity due to reserve shutdown, planned outages, and maintenance outages are not considered part of forced outages.

[8] Changes in generating efficiency, such as those due to minor ice accumulation, are not considered outages. This does not include equipment loss due to similar factors. For example, if a turbine is only able to produce at 80% efficiency due to ice accumulation, that would not be reportable. If a turbine has to shut down due to blade imbalance because of ice accumulation, it would be reportable.

Table 5.2: Plant Event Record Field Descriptions		
Column	**Field Name**	**Description**
1	Entity ID	Enter the NERC Compliance Registry ID number (NCR ID) or voluntary reporting ID assigned by NERC of the organization that operates the Wind plant.
2	Plant ID	Enter the Plant ID assigned by the GADS Wind reporting application.
3	Event ID	Enter a unique identification for the event.
4	Time Zone	Refer to **Appendix C** and enter the Time Zone in which data are reported for the plant. This time zone will be used to convert Event Start and End Date/Times to UTC.
5	Event Start Date/Time	Enter the Event Start time (mm/dd/yyyy HH:MM) (24-hour clock format)
6	Event End Date/Time	Enter the Event End time (mm/dd/yyyy HH:MM) (24-hour clock format)
7	Event Type	Enter the type of Event; refer to **Appendix C**
8	Cause Code	Enter the cause for the outage. See **Appendix J** for a complete list of the cause codes and descriptions.
9	Contributing Operating Condition	Enter the underlying environment related to the outage. Refer to Table 5.3 below for a list of Contributing Operating Conditions, descriptions, and examples.
10	Description	Provide text description of the circumstances that caused the event.
11	Potential MWh Production Loss	Enter the number of Potential MWh of Production loss during the duration of the event. See the Potential Production MWh Loss section below for a description of this field.

Guidelines for Determining Event Start and End Times

Events start when they are known to start and end when they are known to end. For example, if equipment shows a fault time when the equipment went out, then that is when the event is known to start. Similarly, if equipment is fixed during a period of no resource, then the event ends at the time the equipment is fixed.

Event Cause Codes

Cause codes indicate the equipment that has caused the outage. This could be equipment related or personnel related.

For events with multiple causes the most impactful code should be identified as the primary cause, with any other causes reported as additional causes.

If a plant has a call to stop generating due to extreme weather, such as a Hurricane, then the Hurricane Cause Code can be used since no equipment was directly the cause of the outage. If equipment goes out during a Hurricane, report the Cause Code as the equipment that is out and report the Hurricane as the Contributing Operating Condition. A list of Cause Codes can be found in **Appendix J**.

Contributing Operating Condition

The Contributing Operating Condition is a required field for event reporting. It provides context for the conditions which led to the event or outage. The Contributing Operating Condition field will be used in analysis of events to distinguish the failure mode (“what failed”) from the failure mechanism (“conditions under which it failed”). The Contributing Operating Condition does not take the place of the Cause Code but complements the overall detail and cause of the event.

Table 5.3: Contributing Operating Condition (Required)		
Contributing Operating Condition	**Code**	**Description**
No Contributing Condition*	0	Outage or damage that occurred during normal operating ("blue-sky") conditions without external influence.
Flood or High Water	1	Outage or damage occurred that is determined to be outside of design considerations due to due to flooding or high-water that occurs due to a natural or man-made event. This includes pre-emptive actions as well.
Drought or Low Water	2	Outage or damage occurred due to drought or low-water conditions that are determined to be outside of design considerations and that occurs due to a natural or man-made event.
Fire, including wildfires	3	Outage or damage occurred due to fire that occurs due to a natural or man-made event or equipment that gets involved from a fire initiated from another system in the plant. This includes pre-emptive actions as well.
Lightning	4	Outage or damage occurred due to lightning striking the equipment during a thunder and lightning storm.
Geomagnetic Disturbance	5	Outage or damage occurred due to a geomagnetic disturbance. This includes pre-emptive actions as well.
Earthquake	6	Outage or damage occurred due to an earthquake.
Tornado	7	Outage or damage occurred due to a tornado. This includes pre-emptive actions as well.
Hurricane	8	Outage or damage occurred due to a hurricane. This includes pre-emptive actions as well.
Cold Weather Conditions	9	Outage or damage occurred due to cold.
Hot Weather Conditions	A	Outage or damage occurred due to heat.
Ice, Hail, and/or Snow	B	Outage or damage occurred due to hail, ice and/or snow accumulation.
Turbulent Wind	C	Outage or damage occurred due to abnormally turbulent winds.
Avalanche or Landslide	D	Outage or damage occurred due to an avalanche or landslide.
State of Emergency declared by applicable authority or Other External Disturbance	Z	Outage or damage occurred due to state of emergency declared by applicable authority or other external disturbance.

When more than one Contributing Operating Condition can be assigned for a single ~~cause~~event, report the most impactful Contributing Operating Condition. If multiple causes are reported, the most impactful Contributing Operating Condition for ~~each~~ the ~~cause~~ event should be selected.

Examples of each Contributing Operating Condition Code

No Contributing Condition (Code 0)

- During normal operations on a fair-weather day, the generator experiences a spontaneous failure due to excessive wear and tear.

Flood or High Water (Code 1)

- Desert storm summer flood exposed high voltage cabling and undermined several pad mount transformers on a wind plant.

Drought or Low Water (Code 2)

- Due to unusual drought conditions, dust clouds cause problems of filter plugging that cause a unit to be derated or shut down for cleaning.

Fire, including wildfires (Code 3)

- Preemptive shutdown of a wind plant to prevent blade damage from burning embers and smoke damage to electronic components.
- Plant shut down due to fire prevention during high wind / low humidity conditions in forested areas.
- During a thunder and lightning storm in the area, dispatch directs that the plant be removed from service so a transmission line can be de-energized to proactively address possible fire ignition from the transmission lines. (The root cause of the shutdown is to prevent fire.)

Lightning (Code 4)

- Preemptive shutdown to prevent damage from lightning, large hail, and voltage overloads on a wind plant.
- During a thunder and lightning storm, a unit tripped offline due to a relay operation. The unit is cleared for return to service relatively quickly as no damage to the unit or to other plant equipment has occurred.
- During a thunder and lightning storm, a pole fire is started on a structure within the plant switchyard. The pole fire caused the plant to be taken offline.

Geomagnetic Disturbance (Code 5)

- Preemptive shutdown of generating units due to a large X-class earth directed solar flare. These types of flares can cause large current excursions on transmission lines, burning out connected equipment.
- A geomagnetic disturbance occurs and can cause the generator field to collapse, likely causing severe overloads and possible winding damage to the generator. To prevent possible damage to the equipment, the generator is taken offline pre-emptively.
  - Generator step up transformers are also susceptible to magnetic field collapse and subsequent overloads.

Earthquake (Code 6)

- Substation and pad mount transformers moved off their concrete pads. Some high voltage connections were damaged.
- After an earthquake, the batteries for the DC system have moved causing a partial loss of DC power that requires a shutdown to correct.

Tornado (Code 7)

- Tornado takes out 40 blades at a wind plant reducing installed capacity.
- Tornado takes out overhead feeder lines to a wind plant.
- Equipment at a plant is damaged by the tornado or by debris from the tornado.

Hurricane (Code 8)

- Hurricane tidal surge damages 2 of 5 underwater power cables
- Heavy rains from a hurricane residual cause flooding or other damage that floods the area and damages plant equipment and requires a derate or shutdown.

Cold Weather Conditions (Code 9)

- Cold weather at a wind plant in a generally mild-climate area causes most of the units to fault. The units in this area are usually not equipped for extreme cold.
- Wind plant outage during -35C temperatures prevents startup when power restored due to cold gearboxes and electronic components. Large load on system to heat up the equipment.

Hot Weather Conditions (Code A)

- The ambient temperatures at a wind plant exceed the turbine design limits resulting in unit shutdowns.
- High ambient temperatures and high generation result in derated output to prevent GSU overheating.

Ice, Hail, or Snow (Code B)

- Freezing rain collects on a wind plant's turbine blades, shutting down units for rotor imbalance for several weeks.
- Freezing rain causes overhead gen tie lines to gallop causing line slaps. Due to the large amount of snow, it took several weeks to manually reset all the units.
- An outage occurs and due to road conditions, the workers are unable to arrive for two days to perform corrective actions and return the unit to service.

Turbulent Wind (Code C)

- High wind takes the roof off an external motor control center leading to the trip of several breakers, loss of key equipment and immediate load reduction.
- Large wind shear at the leading edge of a mesa causes many blades to strike the towers.
- Gusty turbulent winds cause the wind turbines to over speed or yaw run away resulting in most of the wind plant shutdown.
- During severe winds, a trampoline from a nearby house is picked up and blown onto the plant switchyard bus causing a fault and prohibiting a unit from connecting to the grid.

Avalanche/Landslide (Code D)

- Substation and pad mount transformers moved off their concrete pads. Some high voltage connections were damaged.
- After an avalanche, the batteries for the DC system have moved causing a partial loss of DC power that requires a shutdown to correct.
- After an avalanche or landslide, snow and/or displaced earth must be removed before safe operation can continue.

State of Emergency declared by applicable authority or Other External Disturbance (Code Z)

- Any event where a governing authority intervenes with orders that require a unit or a plant to be shutdown.
- A multiple vehicle accident occurs on a highway where transmission lines are involved. Governmental authorities require the transmission lines be de-energized and that requires the plant to be shut down as well.

- During an epidemic, plant staffing is impacted such that a minimal staff can no longer be maintained, and a plant must be shutdown.
- A transportation labor strike occurs impacting the company's ability to acquire fuel or equipment.

Potential Production MWH Loss

The sum of the capacity lost due to forced outage(s) in all intervals during the event period - the MW loss during an interval multiplied by the duration of an interval, shown as the green-shaded area in **Figure 5.1**. The duration of the interval used to calculate Potential Production MWH Loss should be at the finest granularity available, the maximum observation interval should not exceed 10 minutes.

In the example below, the Plant Total Installed Capacity is 100 MW. The event starts when there is a 20 MW difference between Plant Total Installed Capacity (100 MW) and Plant Available Installed Capacity (80 MW). The event reaches its Nadir (Minimum Plant Available Installed Capacity for event) at a loss of 25 MW. The event ends when 95% of the Plant Total Installed Capacity that was unavailable at time of the Nadir (25 MW) has been returned to service, which in this example is 98.75 MW.

The calculations for this event are as follows.

Event start: Plant Total Installed Capacity (100 MW) – Start Plant Available Installed Capacity (80 MW) = 20 MW

Event Nadir: Minimum Plant Available Installed Capacity for event = 25 MW

Event End: End Plant Available Installed Capacity = Plant Total Installed Capacity (100 MW) - (Minimum Plant Available Installed Capacity (25 MW * (1 – 0.95)) = 98.75 MW

End Plant Available Installed Capacity = 100 – (25 * 0.05) = 98.75

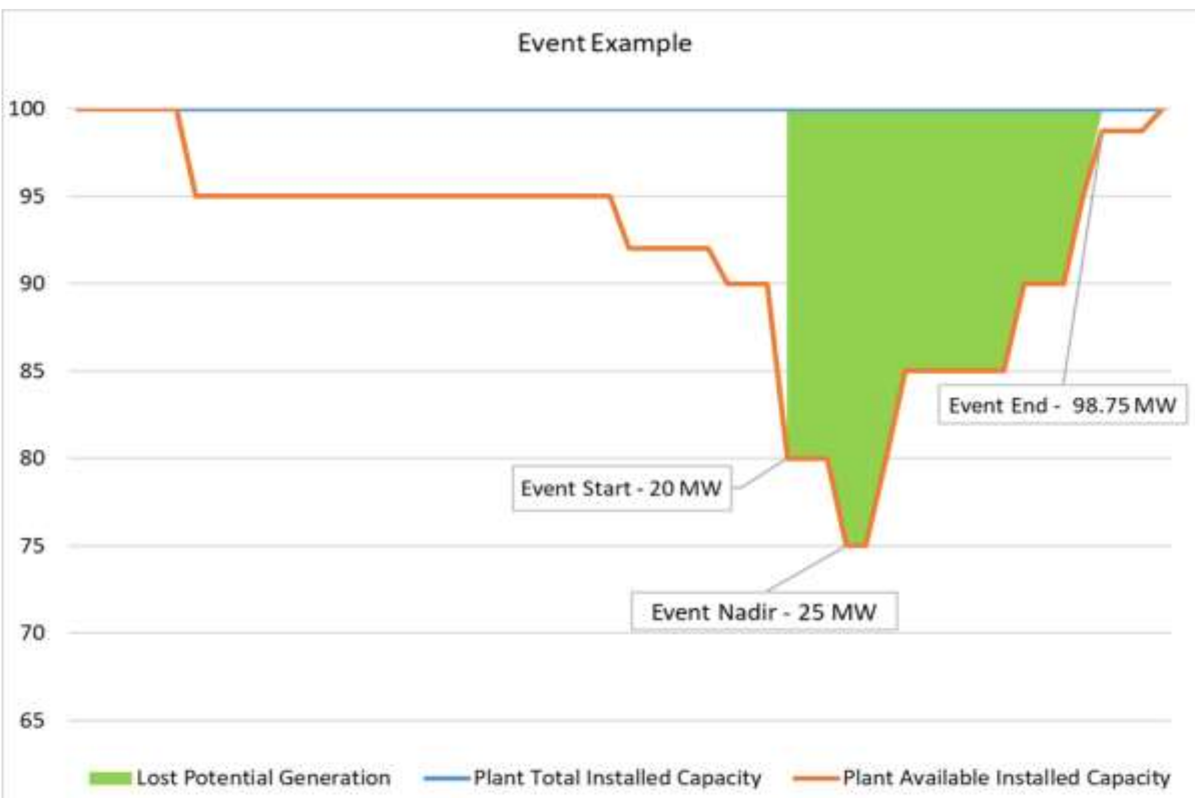


Figure 5.1: Event Example

Appendix A: GADS Wind Reporting Application Data Release Guidelines

Data reported to NERC via a Section 1600 Data Request of the NERC Rules of Procedure will be treated as confidential in accordance with Section 1500 of the NERC Rules of Procedure. Data may be reported publicly in aggregate or otherwise anonymized form to preserve confidentiality.

Appendix B: Entity and Subgroup Identification

Entity Identification

Each entity that reports data into the GADS Wind reporting application will be required to use its NERC Compliance Registry number (NCR #), regardless of whether it is reporting into the GADS Wind reporting application on a mandatory or voluntary basis. Entities that wish to voluntarily provide wind data must request a voluntary reporting ID from NERC.

Getting an Entity Registration ID

NERC Compliance Registry – required for all entities with a NERC compliance obligation.
The process for requesting a NERC Compliance Registry number is available on NERC's website[9]. (Refer to Registration Process Documents)

Entities without a NERC compliance obligation
Entities that do not have a NERC Compliance obligation and wish to provide wind data on a voluntary basis must request a voluntary reporting ID through the automated request ID process[10].

> Note: An entity that has an NCR number may not use a voluntary reporting ID to report into the GADS Wind application. When an entity that has a voluntary reporting ID registers for a NERC Compliance Registry number, it must notify the NERC of its NCR number at gadswind@nerc.net and discontinue reporting under the voluntary reporting ID.

Plant ID

Plant IDs are assigned by NERC and requested through the GADS Wind reporting application using information provided in the Plant configuration import file.

Subgroup ID

Subgroup IDs are assigned by NERC and requested through the GADS Wind reporting application using the subgroup configuration import file.

Energy Storage Group ID

Energy Storage IDs are assigned by NERC and requested through the GADS Wind reporting application using information provided in the energy storage group configuration import file.

Entity Reporter Identification

- The access forms for the NERC wind reporting program will be available on the NERC website[11].
- The NERC Compliance or Voluntary primary contact is responsible for registering individuals requiring access to the GADS Wind application.

[9] http://www.nerc.com/pa/comp/Pages/Registration.aspx
[10] https://gadswind.nerc.net/VRRequest.aspx
[11] https://www.nerc.com/Pages/default.aspx

Appendix C: Reference Tables

Table C.1: Country	
Name	**Abbreviation**
Canada	CA
Mexico	MX
United States	US
Other	OT

Table C.2: States – United States					
Name	**Abb.**	**Name**	**Abb.**	**Name**	**Abb.**
Alabama	AL	Kentucky	KY	Oklahoma	OK
Alaska	AK	Louisiana	LA	Oregon	OR
American Samoa	AS	Maine	ME	Pennsylvania	PA
Arizona	AZ	Maryland	MD	Puerto Rico	PR
Arkansas	AR	Massachusetts	MA	Rhode Island	RI
California	CA	Michigan	MI	South Carolina	SC
Colorado	CO	Minnesota	MN	South Dakota	SD
Connecticut	CT	Mississippi	MS	Tennessee	TN
Delaware	DE	Missouri	MO	Texas	TX
District of Columbia	DC	Montana	MT	Utah	UT
Florida	FL	Nebraska	NE	Vermont	VT
Georgia	GA	Nevada	NV	Virgin Islands	VI
Guam	GU	New Hampshire	NH	Virginia	VA
Hawaii	HI	New Jersey	NJ	Washington	WA
Idaho	ID	New Mexico	NM	West Virginia	WV
Illinois	IL	New York	NY	Wisconsin	WI
Indiana	IN	North Carolina	NC	Wyoming	WY
Iowa	IA	North Dakota	ND		
Kansas	KS	Ohio	OH		

Table C.3: Provinces – Canada			
Name	**Abb.**	**Name**	**Abb.**
Alberta	AB	Nova Scotia	NS
British Columbia	BC	Ontario	ON
Manitoba	MB	Prince Edward Island	PE
New Brunswick	NB	Quebec	QC
Newfoundland and Labrador	NF	Saskatchewan	SK

Table C.4: States – Mexico					
Name	**Abb.**	**Name**	**Abb.**	**Name**	**Abb.**
Aguascalientes	AG	Guerrero	GR	Quintana Room	QR
Baja California	BJ	Hidalgo	HG	San Luis Potosi	SL
Baja California Sur	BS	Jalisco	JA	Sinaloa	SI
Campeche	CP	Mexico	EM	Sonora	SO
Chiapas	CH	Michoacán	MH	Tabasco	TA
Chihuahua	CI	Morelos	MR	Tamaulipas	TM

Table C.4: States – Mexico					
Name	**Abb.**	**Name**	**Abb.**	**Name**	**Abb.**
Coahuila	CU	Nayarit	NA	Tlaxcala	TL
Colima	CL	Nuevo Leon	NL	Veracruz	VZ
Distrito Federal	DF	Oaxaca	OA	Yucatan	YC
Durango	DG	Puebla	PU	Zacatecas	ZT
Guanajuato	GJ	Queretaro	QA		

Table C.5: Wind Regimes	
Wind Regime	**Entry**
Seashore	1
Plain	2
Plateau	3
Hills	4
Mountain	5
Ridge	6
Off Shore	7

Table C.6: SCADA Manufacturers	
SCADA Manufacturer	**Entry**
Acciona	AC
Enercon	EN
Emerson	ES
Fenway	FEN
Gamesa	GAM
General Electric Co.	GE
Garrard Hassan	GH
Honeywell	HON
Mitsubishi	MITS
Mita-Teknik	MTK
Nordex	NOR
Other	OTHER
Proprietary	PRO
Second Wind	SC
Scadabase	SCB
Siemens	SIE
Vestas	VES

Table C.7: Turbine Manufacturers	
Turbine Manufacturer	**Entry**
AAER	AAER
Acciona	AC
Alstom	ALST
AOC	AOC
Bonus	BON
CCWE	CCWE
Clipper	CL
DanWin	DW

Table C.7: Turbine Manufacturers	
Turbine Manufacturer	**Entry**
Denertec S.A.C.	DT
DeWind	DEW
Earth Wind and Power LLC	EWP
Enercon Gmbh	EC
Enertech	ENT
Entegrity Wind Systems	ENTWS
EWT	EWT
Fuhrlander	FHUR
Gamesa	GAM
General Electric	GE
Goldwind	GW
Green Energy Technologies	GET
Guodian United Power	GUP
Hyundai	HYUN
Kenersys	KSYS
Kennetech	KE
Leitwind	LTW
MHI	MHI
Micon	MI
Mitsubishi	MITS
NedWind	NEDW
NEG-Micon	NEGMI
Nordex	NOR
Nordtank	MNORD
Northern Power	NPWR
Other	OTHER
Prime Wind Power International	PW
R.E. Power Systems Ag	REP
Samsung Heavy Industries	SAMS
SANY	SANY
Senvion	SENV
Siemens Corp.	SIE
Sinovel	SINO
Southwest Windpower	SWWP
Stock Equipment Co.	SE
Suzlon	SUZ
Unison	UNI
Urban Green Energy	UGE
VENSYS	VEN
Vestas	VES
Wind Energy Solutions	WES
Winwind	WW
Zond	ZD

Table C.8: Turbine Types		
Turbine Type	**Entry**	**Description**
Type 1 (WT1G1): Limited Variable Speed	WTG1	Squirrel-cage Induction Generator (SCIG) connected directly to the step-up transformer. The turbine speed is fixed (or nearly fixed) to the electrical grid frequency.
Limited Variable Speed (Type 2)	WTG2	Wound rotor induction generators are connected directly to the WTG step-up transformer in a fashion similar to Type 1 with regards to the machine's stator circuit, but also include a variable resistor in the rotor circuit.
Variable Speed with Partial Power Electronics Conversion (Type3)	WTG3	The Type 3 turbine, known commonly as the Doubly Fed Induction Generator (DFIG) or Doubly Fed Asynchronous Generator (DFAG), takes the Type 2 design to the next level, by adding variable frequency ac excitation (instead of simply resistance) to the rotor circuit.
Variable Speed with Full Power Electronics Conversion (Type4)	WTG4	The Type 4 turbine offers a great deal of flexibility in design and operation as the output of the rotating machine is sent to the grid through a full-scale back-to-back frequency converter. The turbine is allowed to rotate at its optimal aerodynamic speed, resulting in a "wild" AC output from the machine.
Variable Speed with Torque/Speed Converter and Synchronous Generator (Type5)	WTG5	Type 5 turbines consist of a typical WTG variable-speed drive train connected to a torque/speed converter coupled with a synchronous generator. The torque/speed converter changes the variable speed of the rotor shaft to a constant output shaft speed.
Additional turbine types may be added as new types become available		

For complete descriptions and illustrations of Turbine Types, refer to Turbine Type document on the GADS website.[12]

Table C.9: Wind Turbulence		
Turbulence	**Entry**	**Intensity**
Low	1	<0.10
Mild	2	>=0.10<0.15
Moderate	3	>=0.15<0.20
Strong	4	>=0.20<0.25
Severe	5	>=0.25

TI is a relative indicator of turbulence with low levels indicated by values less than or equal to 0.10, moderate levels to 0.25, and high levels greater than 0.25. TI is defined as σ /V.

σ = the standard deviation of wind speed

V = the mean wind speed.

Table C.10: Wind Shear		
Turbulence	**Entry**	**Intensity**
Smooth	1	<0.10
Moderately Rough	2	>=0.10<0.20
Rough	3	>=0.20<0.30
Very Rough	4	>=0.30

[12] https://www.nerc.com/pa/RAPA/gads/Pages/GADS-Wind-DRI.aspx

Shear exponent (lower blade tip to hub height)
As a first approximation, the wind shear exponent is often assigned a value of 0.143, known as the 1/7th power law, to predict wind profiles in a well-mixed atmosphere over flat, open terrain. However, higher exponent values are normally observed over vegetated surfaces and when wind speeds are light to moderate (i.e., under 7 m/s or 16 mph).

Per NREL Handbook[13]
Vertical wind shear exponent: Wind shear is defined as the change in horizontal wind speed with a change in height. The wind shear exponent (α) should be determined for each site because its magnitude is influenced by site-specific characteristics. The 1/7th power law (as used in the initial site screening) may not be applied for this purpose, as actual shear values may vary significantly from this value. Solving the power law equation for α gives
$\alpha = \text{Log10}\,[v2/v1]/\text{Log10}\,[z2/z1]$

Where:
$v2$ = the wind speed at height $z2$; and
$v1$ = the wind speed at height $z1$.

Table C.11: Month Reference	
Monthly Summaries	
01 – January	07 – July
02 - February	08 – August
03 – March	09 – September
04 – April	10 – October
05 – May	11 – November
06 - June	12 - December

Table C.12: Availability Status	
Status	**Entry**
Active	AC
Inactive Reserve	IR
Mothballed	MB
Retired	RU

Table C.13: Ownership Status	
Plant, Subgroup, or Energy Storage Ownership Status	**Abbreviation**
Active	AV
Deactivated	DV
Delete	DL
ID Request	ID
Pending*	PE
Reactivate	RV
Retired	RT
Retired-Repowered	RP
Transfer	TR
*Pending is a system-assigned status, not a reportable status (See Appendix D)	

[13] The Wind Resource Assessment Handbook was developed under National Renewable Energy Laboratory (NREL) Subcontract No. TAT-5-15283-01 April 1997

Table C.14: NERC Regional Entity Abbreviations	
NERC Region	**Abbreviation**
Midwest Reliability Organization	MRO
Northeast Power Coordinating Council	NPCC
ReliabilityFirst	RF
SERC Reliability Corporation	SERC
Texas Reliability Entity	TRE
WECC	WECC

Table C.15: Energy Storage System Manufacturer	
Energy Storage Manufacturer	**Abbreviation**
Beacon	BEAC
Build Your Dreams	BYD
EOS	EOS
Lockheed Martin	LKM
Other	OTHM
Samsung SDI	SDI
SolarEdge	SEDG
Sun Catalyx	SCAT
Tesla	TES

Table C.16: Energy Storage Inverter Manufacturer	
Energy Storage Inverter Manufacturer	**Abbreviation**
ABB	ABB
Canadian Solar	CANSO
Chint Power systems	CHINT
Delta Energy Systems	DELT
Fronius International	FRON
General Electric	GE
Ginlong-Solis	GSOL
Huawei Technologies	HUAW
Kaco New Energy	KACO
Other	OTHESM
Selectria	SELT

Table C.17: Energy Storage Type	
Energy Storage Type	**Abbreviation**
Battery - Flow	FLB
Battery – Lithium Ion	LIB
Battery - Other	OTHB
Capacitor	CAP
Compressed Gas	CE
Flywheel	FW
Gravity Weight	GW
Hydrogen Fuel Cell	FC
Other	OTHS
Thermal / Heat	TH

Table C.18: Energy Storage Connection	
Energy Storage Connection	**Abbreviation**
AC – Connection between Inverters and grid connection	AC
DC – Connection behind the Inverters	DC

Table C.19: Event Type	
Event Type	**Entry**
Forced Outage	FO
Maintenance Outage	MO
Planned Outage	PO

Table C.20: Time Zones	
Time Zone	**Entry**
Alaska Daylight Time	AKDT
Alaska Standard Time	AKST
Aleutian Daylight Time	HADT
Atlantic Standard Time	AST
Arizona Mountain Standard Time	MST
Central Daylight Time	CDT
Central Standard Time	CST
Chamorro Standard Time	CHST
Eastern Daylight Time	EDT
Eastern Standard Time	EST
Hawaii Standard Time	HST
Mountain Standard Time	MST
Pacific Daylight Time	PDT
Pacific Standard Time	PDT
Samoa Standard Time	SST

Appendix D: Ownership Status

Ownership status allows the entity to manage the state of each plant, subgroup, or energy storage group through the GADS Wind Reporting application. Ownership status is part of the plant, subgroup, or energy storage configuration data record, which is separate from the reporting of the *operational* status reported in the performance record.

Users will have the ability to view and export a report from the GADS Wind Reporting application that includes the ownership and monthly reporting status of each plant, subgroup, or energy storage group ("reporting group").

The GADS Wind Reporting application will require an effective date for each status change except ID Request. There are seven states of Ownership that may be assigned to a reporting group:

Status	Abbreviation	Assigned by
Active	**AV**	User or System
Deactivated	**DV**	User
Delete	**DL**	User
ID Request	**ID**	User
Pending*	**PE**	System
Reactivate	**RV**	User
Retired	**RT**	User
Retired due to Repower	**RP**	User
Transfer	**TR**	User

*Pending is a system-assigned status, not a reportable status

Active (AV)
Identifies that the reporting group is an active ownership state, even when the performance status defines an inactive state of operation.

A user enters **AV** on the reporting group record any time configuration data for the reporting group is updated, including to reactivate a reporting group, or to associate the purchasing entity with the reporting group after a transfer.

The system assigns the **Active** Ownership status when:

- A reporting group ID is assigned as the result of an ID Request status from the user, or
- When a reporting group ID in a pending state has been updated with reporting group configuration data.

Performance records are expected for each month that a reporting group has an **Active** Ownership status for any portion of the month (applies to subgroups and energy storage groups).

Deactivated (DV)
Identifies that a reporting group is being put into a dormant state.

A user enters **DV** when the entire reporting group has been in an Inactive state for more than 60 days. The effective date of the deactivation may not be in the future.

Performance records indicating the operational reason for the inactive state are required for each month for which a reporting group has a **Deactivated** Ownership status. Event reporting is also required for a reporting group with a **Deactivated** Ownership status.

Delete (DL)
Identifies a reporting group that was created in error and is no longer required.
A user enters **DL** when the reporting group was created in error or otherwise identified as a duplicate.

An error will occur if a reporting group marked with the DL ownership status has performance or event data reported for the reporting group.

ID Request (ID)
Identifies request for a new reporting group ID.

A user enters **ID** when a new reporting group ID is required. This is the only Ownership status where the reporting group ID is left blank.

An ID Request should <u>not</u> be used for an entity to begin reporting for a reporting group that it purchased from another reporting entity.

Upon successful validation of the reporting group configuration record, the GADS Wind Reporting application will assign the reporting group ID and set the Ownership status to **Active**.

Pending* (PE)
Identifies on the Configuration Report that an Ownership transfer is awaiting configuration data from the purchasing entity. Pending is a system-assigned status, not a user-reportable status.

Reactivate (RV)
Identifies a request to reactivate a reporting group that is in a Deactivated state of ownership.

A user enters **RV** when a reporting group becomes operational after a Deactivated state. Updated reporting group configuration data is required. The effective date of the reactivation may be in the future.

The GADS Wind Reporting application updates the reporting group configuration data and sets the Ownership status to **Active**.

Retired (RT)
Identifies the effective date for which a reporting group is no longer operational due to permanent retirement.

A user enters **RT** when a reporting group has been permanently retired. The effective date of retirement may not be in the future.

Performance data records covering the period of operation through the last day of the month for which the reporting group operated are expected. If the reporting group was retired mid-month, the remaining hours of the month are reported as retired on the performance record.

Retired - Repowered (RP)
Identifies the effective date for which a reporting group is no longer operational due to repowering.

A user enters **RP** when a reporting group has been retired as part of a repowering activity. The effective date of repower date may not be in the future.

Performance data records covering the period of operation through the last day of the month for which the reporting group operated are expected. If the reporting group was retired mid-month, the remaining hours of the month are reported as retired on the performance record.

Transfer (TR)
Identifies a request to transfer ownership of a reporting group.

The selling entity enters **TR** when it sells a reporting group to another entity. The selling entity is required to enter the date of sale and entity ID of the purchasing entity in the reporting group record.

Performance data covering the period of operation through the last day of the month for which the reporting group was owned by the selling entity are required to be reported by the selling entity.

Appendix E: Glossary

Active or Commercial State (AC-Active)
Active state is the time from when the subgroup is first declared commercially active until it moves to the inactive state.

Cause Code - Event Reporting
The Cause code describes what happened during an event. See **Appendix J** for a list of Cause Codes. This can be related to the Contributing Operating Condition, depending on the environment when the Event Start Date/Time occurs.

Commercial Operation Date – Subgroup Configuration Reporting
The initiation date on which the seller can start producing electricity for sale (i.e. when the project has been substantially completed). This date must occur after all testing and commissioning has been completed.

Equipment-related (configuration) data, such as plant, subgroup, or energy storage configuration data will be required in the first full month after the Commercial Operating Date (COD), acquisition, or repowering.

Monthly performance data will be required beginning with the third full month after COD, acquisition, or repowering. If a reportable event occurs after the Commercial Operating date, it must be reported, regardless of whether monthly performance reporting has begun.

Example: Jan 15 COD: First full month of commercial operation is February. Inventory (plant, subgroup and/or energy storage group) configuration data is required to be reported for February. The first full month of performance data reporting would begin in May. If a reportable event occurred on March 8, the event would be reported, even though performance data is not required to be tracked until the month of May.

Commissioning Date
The time when the plant, subgroup or energy storage group is first declared commercially active.

- The subgroup is capable of reaching 50% of its generator nameplate MW Capacity (Wind conditions not part of requirement) and
- Dispatch is notified that the subgroup is capable of providing power (Wind conditions not part of requirement).
- Power Purchase Agreement (PPA) or other distribution agreements satisfied.

Contributing Operating Condition - Event Reporting
The Contributing Operating Condition is the underlying reason for an event. When an Event caused by the environment damages equipment, the Cause Code describes the equipment and Contributing Operating Condition describes the environment.

Curtailment
Curtailment is a general term used by the wind and solar industry for the involuntary reduction of plant maximum generation called for by the off-taker or transmission operator for a limited period of time.

Description - Event Reporting
Verbal text expanding on the Cause Code and Contributing Operating Condition to describe the event more fully. This can help NERC investigate common reasons that can be used to improve reliability.

Energy Information Administration (EIA)
EIA information can be found at: www.eia.gov

Energy Storage System Capacity (MW) – Energy Storage Configuration Reporting
This is the rated Capacity of energy storage group. (MW)

Energy Storage System Energy (MWh) – Energy Storage Configuration Reporting
This is how much rated energy can be delivered over time. (MWh)

Entity – Plant, Subgroup, and Energy Storage Configuration Reporting
The principal organization that owns one or more plants. The entity is registered as a GOP (Generator Operator) with NERC and has an NCR number (NERC Compliance Registry), or if voluntarily reporting, a VR number (Voluntary Reporting).

Entity ID – Configuration Reporting
The identifier of the Entity (NERC NCR number) used in Performance and Event reporting to reference owners of the plant.

Event End Date/Time – Event Reporting
The end time and date of an event in the Time Zone that is reported. A 24-hour clock is used for reporting.

Event Start Date/Time – Event Reporting
The start time and date of an event in the Time Zone that is reported. A 24-hour clock is used for reporting.

Event Type – Event Reporting
The type of event. Events are broken down into Forced, Maintenance, and Planned Events. Only Forced events are required to be reported.

Expected Generation (EG) – Performance Reporting
The calculated energy based on the wind turbine power curve corrected for barometric pressure, humidity, and temperature that the wind turbine should have produced over a specified period of time. The turbine power curve should at least be corrected for the average site elevation. (Used in weighted and derate calculations)

Gross Actual Generation (GAG) (MWh) – Performance Reporting
GAG is the total wind turbine generation produced by the subgroup (MWh). GAG is the sum of all individual turbine meters before removing station service or auxiliary loads. GAG should be measured as close to the turbine's generator as possible so that generation is measured before any auxiliary use by the turbine. (Used in the performance report)

Group
Each plant consists of one or more groups. Groups are differentiated by the phase or year they were commissioned. (Used in the subgroup, performance, and component reports. Also helps define plant structure)

Maximum Operating Temperature – Subgroup Reporting
This is the Maximum operating temperature (Celsius) that the turbine will stop producing energy.

Minimal Operating Temperature – Subgroup Reporting
This is the minimal operating temperature (Celsius) that the turbine will stop producing energy.

Maximum Turbine Capacity MW
Maximum Turbine Capacity MW is the maximum system rating for a single turbine system, such as when turbines are enhanced above the turbine system's capacity rating (adding vortex generators or software changes would be examples). If there are no system improvements, then Maximum Turbine Capacity equals TSC. (Used in the subgroup report and helpful for calculating reserve capacity).

Net Actual Generation (NAG) (MWh) – Performance Reporting
NAG is the portion of generation delivered by the subgroup to the revenue meter. It is possible to have a negative NAG value if the group's station service or auxiliary loads are greater than total generation.

Net Dependable Capacity (NDC) (MW) (equivalent to NMC x Capacity Factor) – Calculated Field
NDC is the actual generating capability at the revenue meter minus capacity losses. These losses may include, but are not limited to, losses from no wind, low wind, high wind, derated winds (less than rated capacity), or losses that occur outside the manufacturer's operating specifications (temperature, electrical, etc.). Another way of looking at NDC is the Capacity of the turbine at 100% availability while running within the manufacturer's specification with the fuel source available (wind). (Could be used in weighted calculations)

For example, if the NMC is 100 MW and the losses from all wind problems is 40%, then the NDC can be calculated as 100 MW x (1 - 0.40). Our NDC would be 60 MW.

NDC may also be calculated as follows: [(Actual Generation) + (Turbine specific losses) + (reserve shutdown) + (Site outages such as off-taker problems + balance of plant, not wind related)] / (PH).

Net Maximum Capacity (NMC) (MW) – Performance Reporting
NMC is the actual maximum generating capability at the revenue meter and is equal to the TIC less any electrical losses. These losses may include, but are not limited to, transformation losses, line losses, and other auxiliary losses between the turbine and revenue meter. This is the difference between what is produced and what is delivered. The value will vary from month to month. (Used in the Performance report)

For example, if the TIC is 100 MW and the loss is 2%, then the NMC can be calculated as 100 MW x (1 - 0.02). The NMC is 98 MW.

Off-Taker
The entity that receives the power produced by the plant. This is not necessarily the purchaser of the power, but the entity that takes control of the power when it leaves the plant boundary, such as a transmission operator. The Off-Taker could also be called the transmission provider or balancing authority and is usually defined in the Power Purchase Agreements (PPA) or Interconnect agreements (plant structure).

Plant
A plant is defined as a collection of wind turbine groups at a single physical location. It is managed by a single plant manager that has responsibilities for KPIs, safety, OSHA, hiring, terminations, etc. The plant has a common O&M building, reported to EIA as a single plant, common trucks, crews, inventory, and safety plan. OSHA injury statistics and hazardous waste are handled as a single entity. Multiple plants will have separate budgets, crews, equipment, inventories, insurance policies, managers, etc. Plants may have multiple revenue meters. (Used in the subgroup, energy storage group, performance, and event reports. Also helps define plant structure)

Plant Manager
The plant manager is responsible for the plant key performance indicators, the safety plan, OSHA inspections, hiring, terminations, discipline, etc., for the site.

Potential MWH production Loss (MWh) – Event Reporting
The amount of Megawatt Hours of production that was lost during an event. This is the Plant Total Installed Capacity minus the Installed Capacity Loss during the duration of the outage.

Refurbish
After turbines are offline, bringing them back to service with the same original condition (i.e. same turbine group).

Repower
After some turbines are offline, bringing them back or adding new turbines to meet Federal Energy criteria for energy credit or change to interconnection (retire turbine group and create a new turbine group.)

Resource Capacity Factor
For a plant, calculated by sum of subgroup Net Actual Generation / (sum of subgroup Capacity x Active Turbine hours). This can be used to compare wind generators with each other since generation only happens during periods of resource availability.

Revenue Meter
The revenue meter is a device used to measure the electricity generated from a plant, group, or subgroup, depending on the plant configuration. The revenue meter accounts for the electricity sold to the customer and is normally owned by the off taker. (Plant structure and net generation point)

Reserve Capacity (MW)
Reserve Capacity is the Maximum Turbine Capacity times the number of turbines, less the contracted capacity. It is the capacity of the turbines within a subgroup that are available, but not under contract. These turbines must be available and connected to a subgroup, not in an inactive state, and their output can be temporarily added to the subgroup at a moment's notice if another turbine becomes unavailable. (Used in the subgroup report)

The purpose of reserve capacity is to allow producers to use WTGs that may have been phased out, but are still in good working condition, to improve their availability when turbines in the main generating group are in an unavailable state due to an outage, or to maximize output within contract limits.

For example: Total turbines = 205, Turbine System Capacity = 2MW
Total Installed Capacity = 410 MW (205 * 2MW)
Contracted capacity = 400 MW
Reserve Capacity = 10 MW (410 MW – 400 MW).

Standard Capacity Factor – calculated.
For a plant, calculated by sum of subgroup Net Actual Generation / (sum of subgroup Capacity * month hours (24 hours basis)). With this, a 24-hour comparison can be made to other non-wind generators.

Subgroup
A subgroup is a collection of wind turbine machines with the same manufacturer, design, model number, and phase of construction. (Used in the subgroup, performance, and component reports. Also helps define plant structure)

Time Zone – Configuration and Event Reporting
The Time Zone where the reporting is tracked. If a plant is in one time zone, but the event times are reported in another time zone, use the time zone that is used in reporting.

Total Installed Capacity (TIC) (MW) – Subgroup Configuration Reporting
TIC is the sum of all the wind TSC of the entire turbine system within the subgroup, plant, or otherwise specified grouping. Includes reserve turbines. The TIC of related subgroups may be summed to determine the TIC of a group or plant. (Used in the subgroup report).

For example, suppose that you have two subgroups within the group. The first subgroup is comprised of 20 Type A machines rated at 0.66 MW each, and the second subgroup is comprised of 10 Type B machines rated at 1.5 MW each. The TIC would be (20 x 0.66 MW) + (10 x 1.5 MW), which would be 13.20 MW + 15.0 MW. This would give you a TIC of 28.2 MW.

Turbine Net Maximum Capacity (TNMC) (MW)
TNMC is the average Net Maximum Capacity of each turbine in the subgroup. It is calculated by dividing the NMC of the subgroup by the number of turbines in the subgroup. This value is used in equations so that turbine hours and turbine capacity may be used to arrive at a theoretical net max generation.

When multiple subgroups are being pooled together, this value for the pooled set of turbines is equal to the sum of the capacities divided by the sum number of turbines.

Turbine System Capacity (TSC) (MW) – Subgroup Configuration Reporting
TSC is the rating of the entire wind turbine system. This is dependent on tower loading, the size of the rotor, the ratings on the generator and gearbox. This is the rating on the turbine purchase agreement and is used to define the interconnection and power purchase agreements. It is not the rating of any of the individual components. TSC does not change. If improvements are made that increase the turbine capacity, update the Maximum Turbine Capacity rating. (Used in the subgroup report and used to determining Total Installed Capacity)

Appendix F: Abbreviations

Below is a list of the commonly used abbreviations in this document. They are sorted by common use, reporting and equations. There are additional abbreviations used in the subgroup report listed in **Appendix C**.

Abbreviation	Definition	Category
AC	Alternating Current	General
AAWS	Annual Average Wind Speed	General
ACTH	Active Turbine Hours (Formerly PDTH)	Reporting and Equation Attributes
BOP	Balance of Plant	General
BPS	Bulk Power System	General
C	Celsius	General
CalH	Calendar Hours	Reporting and Equation Attributes
CalTH	Calendar Turbine Hours	Reporting and Equation Attributes
CPOI	Plant Capacity at Point of Interconnection	Reporting and Equation Attributes
COD	Commercial Operating Date	Reporting and Equation Attributes
CSV	Comma Separated Value	General
CT	Current Transformer	General
CTH	Contact Turbine Hours	Reporting and Equation Attributes
DC	Direct Current	General
DRI	Data Reporting Instructions	General
E-ATH	Equipment Available Turbine Hours	Reporting and Equation Attributes
E-AF	Equipment Availability Factor	Equation - 1.B.1
E-FOF	Equipment Forced Outage Factor	Equation - 1.B.5
E-FOR	Equipment Forced Outage Rate	Equation - 1.B.12
E-MOF	Equipment Maintenance Outage Factor	Equation - 1.B.4
E-MOR	Equipment Maintenance Outage Rate	Equation - 1.B.11
E-POF	Equipment Planned Outage Factor	Equation - 1.B.3
E-POR	Equipment Planned Outage Rate	Equation - 1.B.10
E-SOF	Equipment Scheduled Outage Factor	Equation - 1.B.7
E-SOR	Equipment Scheduled Outage Rate	Equation - 1.B.14
E-UF	Equipment Unavailability Factor	Equation - 1.B.2
E-UOF	Equipment Unplanned Outage Factor	Equation - 1.B.6
E-UOR	Equipment Unplanned Outage Rate	Equation - 1.B.13
FOR	Forced Outage Rate	General
EG	Expected Generation	General
E-GF	Equipment Generating Factor	Equation - 1.B.8
EIA	Energy Information Administrator	Organization
E-NCF	Equipment Net Capacity Factor	Equation - 1.B.9
EPA	Environmental Pollution Agency	Organization
ERO	Electric Reliability Organization	Organization
ES	Energy Storage	Reporting and Equation Attributes
E-UTH	Equipment Unavailable Turbine Hours	Reporting and Equation Attributes
FAA	Federal Aviation Administration	Organization
FERC	Federal Energy Regulatory Commission	Organization
FO	Forced Outage	General
FTH	Forced Turbine Hours	Reporting and Equation Attributes
GADS	Generator Availability Data System	General

Abbreviation	Definition	Category
GADS-W	GADS Wind	General
GADSWG	GADS Working Group	General
GAG	Gross Actual Generation	Reporting and Equation Attributes
GMPP	Gross Maximum Potential Production	Reporting and Equation Attributes
GMC	Gross Maximum Capacity	Reporting and Equation Attributes
GMG	Gross Maximum Generation	Reporting and Equation Attributes
GO	Generator Owner	General
GSU	Generator Step Up transformer	General
HV	High Voltage	General
IA	Inactive State	General
ID	Identification	General
IEC	International Electrotechnical Commission	Organization
IEEE	Institute of Electrical and Electronic Engineers	Organization
IPP	Independent Power Producer	General
IR	Inactive Reserve	General
IRTH	Inactive Reserve Turbine Hours	Reporting and Equation Attributes
ISO	Independent System Operator	General
KPI	Key Performance Indicators	General
m	Meter	General
m/s	Meters per Second	General
MB	Mothball	General
MBTH	Mothballed Turbine Hours	Reporting and Equation Attributes
MO	Maintenance Outage	General
MRO	Midwest Reliability Organization	Organization
MTH	Maintenance Turbine Hours	Reporting and Equation Attributes
MW	Megawatt	General
MWh	Megawatt Hours	General
NAG	Net Actual Generation	Reporting and Equation Attributes
NCR#	NERC Compliance Registry Number	General
NDC	Net Dependable Capacity	Reporting and Equation Attributes
NDE	Net Dependable Energy	Reporting and Equation Attributes
NERC	North American Electric Reliability Corporation	Organization
NMC	Net Maximum Capacity	Reporting and Equation Attributes
NOF	Net Output Factor	Equation - 1.A.10
NPCC	Northeast Power Coordinating Council	Organization
NREL	National Renewable Energy Laboratory	Organization
O&M	Operations and Maintenance	General
OMC	Outside Management Control	General
OSHA	Occupation Safety and Health Administration	Organization
PO	Planned Outage	General
PPA	Power Purchase Agreement	General
PT	Potential Transformer	General
PTH	Planned Turbine Hours	Reporting and Equation Attributes
PXDTH	Planned Delay Turbine Hours	Reporting and Equation Attributes
QC	Quality Control	General
RCC	Rotor Current Control	General
RE	Regional Entity	General

Abbreviation	Definition	Category
R-AF	Resource Availability Factor	Equation - 1.A.1 General
R-FOF	Resource Forced Outage Factor	Equation - 1.A.5
R-FOR	Resource Forced Outage Rate	Equation - 1.A.13
R-MOF	Resource Maintenance Outage Factor	Equation - 1.A.4
R-MOR	Resource Maintenance Outage Rate	Equation - 1.A.12
R-POF	Resource Planned Outage Factor	Equation - 1.A.3
R-POR	Resource Planned Outage Rate	Equation - 1.A.11
R-SOF	Resource Scheduled Outage Factor	Equation - 1.A.7
R-SOR	Resource Scheduled Outage Rate	Equation - 1.A.15
R-UF	Resource Unavailability Factor	Equation - 1.A.2
R-UOF	Resource Unplanned Outage Factor	Equation - 1.A.6
R-UOR	Resource Unplanned Outage Rate	Equation - 1.A.14
RF	ReliabilityFirst	Organization
R-GF	Resource Generating Factor	Equation - 1.A.8
R-NCF	Resource Net Capacity Factor	Equation - 1.A.9
RS	Reserve Shutdown	General
RSTH	Reserve Shutdown Turbine Hours	Reporting and Equation Attributes
RTH	Retired Turbine Hours	Reporting and Equation Attributes
RTS	Returned to Service	General
RU	Retired Unit	General
RUTH	Resource Unavailable Turbine Hours	Reporting and Equation Attributes
SATH	Site (Resource) Available Turbine Hours	Reporting and Equation Attributes
SCADA	Supervisory Control and Data Acquisition	General
SERC	SERC Reliability Corporation	Organization
SUTH	Site (Resource) Unavailable Turbine Hours	Reporting and Equation Attributes
Texas RE	Texas Reliability Entity	Organization
TH	Turbine Hours	Reporting and Equation Attributes
TI	Turbulence Intensity	Reporting and Equation Attributes
TIC	Total Installed Capacity	Reporting and Equation Attributes
TNMC	Turbine Net Maximum Capacity	Reporting and Equation Attributes
TSC	Turbine System Capacity	Reporting and Equation Attributes
WECC	WECC	Organization

Appendix G: Turbine States

Turbine States and Hours Collection

Given the nature of wind generation, it would be a very rare occurrence for every turbine in a group, or even a subgroup, to be found in the same state. Therefore, due to the amount of time that turbines spend in various conditions, NERC GADS collects the number of hours as “turbine hours” to enable NERC to calculate meaningful statistics. Using turbine hours allows the operator to report hours simply by adding up the hours reported by each turbine.

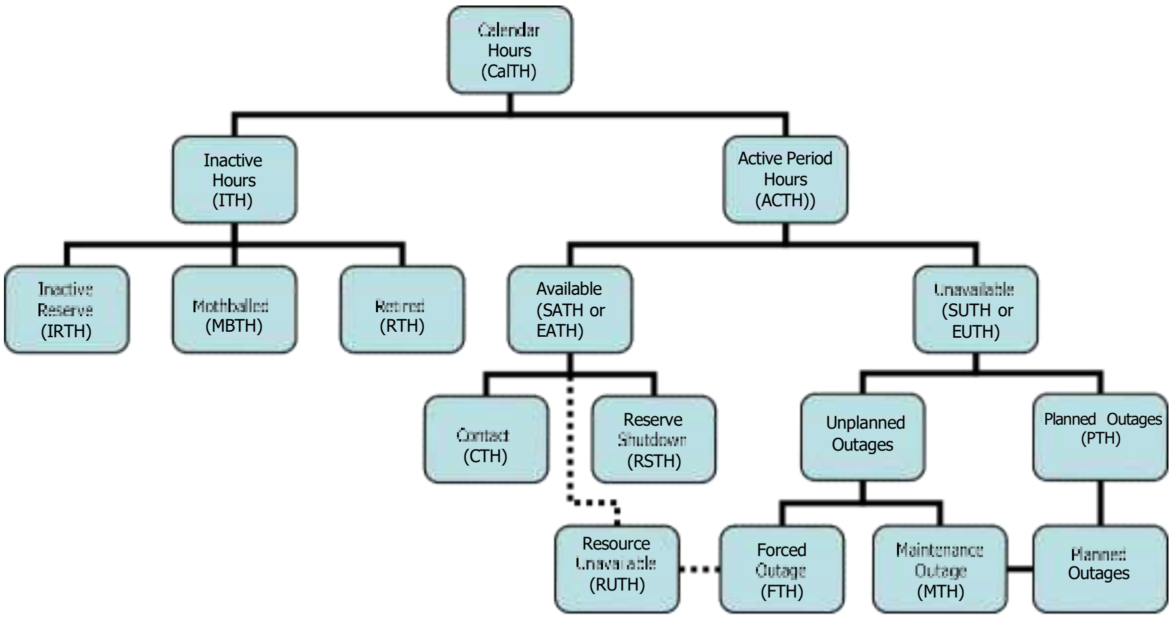


Figure G.1: Time Spent in Various Turbine Unit States

Calendar Hours (CalH)

Calendar Hours are the total number of hours within a given range of dates. These are typically shown as the number of hours in a month, quarter, or year. (Used for calculating the total subgroup Turbine-Hours)

Calendar Turbine-Hours (CalTH)

CalTH is equal to the sum of Active Turbine Hours (ACTH) and Inactive Turbine-Hours (ITH). In most cases, ACTH and CalTH will be the same number. Data is collected on the number of CalTH in a reporting period. The sum of ACTH and ITH must equal CalTH or an error is generated during data submission. The CalTH is equal to the CalH times the number of turbines. (Used as a quality check that all hours are accounted for)

If a subgroup is commissioned after the first of the month, the subgroup reporting obligation begins with the first full calendar month after the subgroup was commissioned.

Contact Turbine-Hours (CTH)

CTH is the number of turbine-hours that turbines within the sub-group are synchronized to the system. It is the number of hours that the contactors are closed and generation is connected to the grid. The term is similar to Service hours used in conventional generation. (Used in the Performance report and Rate equations)

Forced Turbine-Hours (FTH)

FTH is the sum of all turbine-hours that the sub-group turbines are off-line due to forced events. FTH are all forced events where the WTG must be removed from service for repairs *before* the next Sunday at 23:59 (just before Sunday becomes Monday). (Used in the Performance and Component reports and various equations)

Inactive Hours

Inactive Hours are the total number of calendar hours that a unit is in an Inactive State.

Inactive States

For purposes of GADS Wind reporting, any IEEE 762 references to "group" in this section will be reported for the subgroup.

Inactive State: Inactive Reserve (IR)

IR is defined by IEEE 762 and GADS as "The State in which a group is unavailable for service but can be brought back into service after some maintenance in a relatively short duration of time, typically measured in days."

In the IR definition above, GADS added "after some maintenance" and defines this statement to mean that some action may be needed to prepare the plant or unit for service because it had been sitting idle for a period of time and some equipment parts have deteriorated or need replacing before the group can be operated.

The plant or unit should be operable at the time the IR begins. *This does not include plants or units that may be idle because of a failure and dispatch did not call for operation*. A plant or unit that is not operable or is not capable of operation at a moment's notice, should be on a forced, maintenance, or planned outage and remain on that outage until the proper repairs are completed and the plant or group is able to operate. The plant or unit *must be* on Reserve Shutdown (RS) a minimum of 60 days before it can move to IR status.

Inactive State: Mothballed (MB)

MB is defined by IEEE 762 and GADS as "The State in which a plant or unit or individual WTG is unavailable for service but can be brought back into service after some repairs with appropriate amount of notification, typically weeks or months."

In the MB definition above, GADS added "after some repairs" and defines this statement to mean that some action may be needed to prepare the plant or unit for service because it had been sitting idle for a period of time and some equipment parts may have deteriorated or need replacing before the group can be operated. The plant or unit may have also experienced a series of serious mechanical problems such that management may wish to wait for a period of time to determine if the plant or unit should be repaired or retired.

A plant or unit that is not operable or is not capable of operation at a moment's notice *must be* on a forced, maintenance, or planned outage and remain on that outage for at least 60 days before it can be moved to the MB state.

If repairs are being made on the plant or unit to restore the plant or unit to operating status before the 60-day period expires, then the outage must remain a forced, maintenance, or planned outage and not changed to MB.

Ordering equipment, parts or prepping the plant or unit is an indication that the unit is intended to return to service. Times to inspect, secure, dismantle and review are not considered repairs.

Anytime the decision to repair the plant or unit is made and the plant or unit is in MB, the plant or unit immediately reverts back to its original pre-60-day outage status.

Retired Unit (RU)

RU is defined by IEEE 762 and GADS as "the State in which a plant or unit is unavailable for service and not expected to return to service in the future." A plant or unit may go directly into the RU state. There is no waiting period.

Inactive Turbine-Hours (ITH)
ITH is the number of turbine-hours in a period being reported in which the subgroup is in the inactive state. (Not reported and is the sum of IRTH, MBTH and RTH. The value is used in data quality checks)

Maintenance Turbine-Hours (MTH)
MTH is the sum of all turbine-hours that the subgroup turbines are off-line due to a Maintenance Event.

A maintenance event is an event that could be deferred beyond the end of the next weekend (Sunday at 2400) but requires that a wind turbine be removed from service, another outage state, or Reserve Shutdown state before the next Planned event. Characteristically, a maintenance event can occur at any time during the year, has a flexible start date, may or may not have a predetermined duration, and is usually much shorter than a Planned Event. (Used in Performance and Component reporting)

If an event occurs before Friday at 2400, the above definition applies. If the event occurs after Friday at 2400 and before Sunday at 2400, the Maintenance event will only apply if the event could be delayed past the next weekend, not the current one. If the event cannot be deferred, it is a Forced Event.

Outage Reporting Priority
In some instances, there may be more than one event starting at the same time. When events start at the same time, the below list identifies how to select the correct outage type. Once an outage begins, outage types are not changed until the current outage is finished.

1. Contact Turbine-Hours
2. Forced Turbine-Hours
3. Maintenance
4. Resource Unavailable Turbine-Hours

Active Turbine Hours (ACTH)
ACTH accounts for the number of calendar hours that the equipment is in an **active state**. Previously known as Period Turbine hours. ACTH is further divided into Available Turbine-Hours and Unavailable Turbine-Hours which must sum to ACTH, or a submission error is generated. (Used in the Performance report and in the denominator of factor equations)

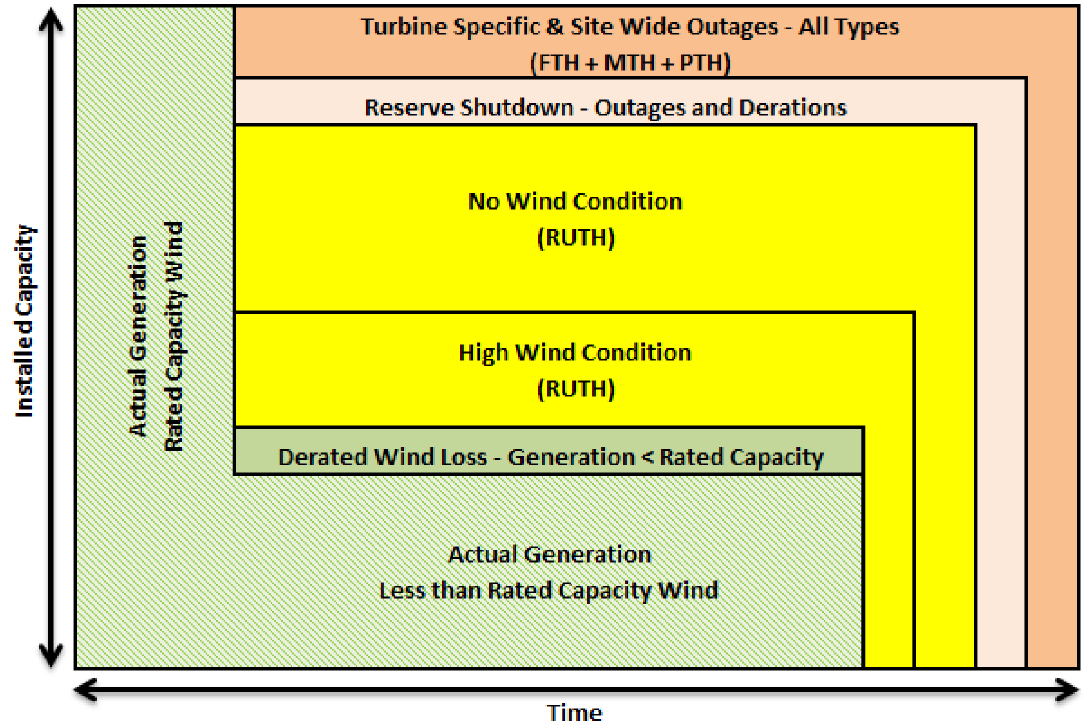


Figure G.2: Relationships between Types of Hours and Capacity

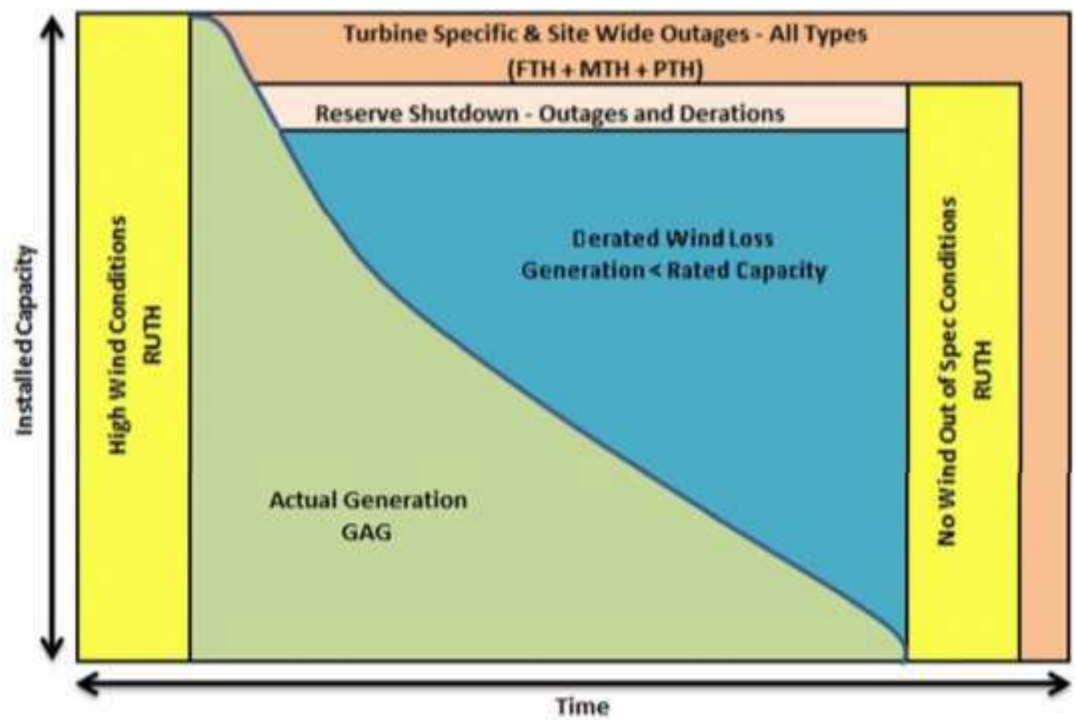


Figure G.3: Relationships between Types of Hours and Capacity

Planned Turbine-Hours (PTH)

PTH is the sum of all Turbine-Hours in which the subgroup turbines are off-line due to a planned event. A Planned Event is scheduled well in advance, is of predetermined duration, and can occur several times a year. (Used in Performance and Component reporting)

Reserve Shutdown Turbine-Hours (RSTH)
RSTH is the sum of all turbine-hours during which the subgroup is not available to the system for economic reasons. Do not include RSTH in the same equations with CTH (this would result in double counting total turbine-hours). IEEE 762 and the NERC GADS DRI for Thermal/Hydro generators define RSTH as a turbine shutdown due to economic reasons. Economic is defined as negative energy pricing or lack of demand. (Used in the Performance report)

To qualify the following must be true:

1. The turbine must be in an active state.
2. The turbine must be available and not in an outage state.
3. The turbine must not be in eminent danger of failure.

Note: Disabling a turbine (such as removing a processor card) immediately puts the turbine in an outage state and makes it no longer available.

Reserve Shutdown (RS)
RS is defined as low or negative energy pricing, lack of demand, or curtailments. Examples:

- Power not needed – reduced demand below available output.
- Energy price below O&M cost
- Regulatory costs exceed income.
- O&M costs rise above income.

Resource Unavailable Turbine-Hours (RUTH)
RUTH is the number of turbine-hours the sub-group is not producing electricity due to low-wind or high-wind conditions RUTH includes normal system startup, calibrations, system checks, ramp-up, cable untwisting, battery checks, etc. RUTH is classified as Available Turbine-Hours for equipment equations and Unavailable Turbine-Hours for resource equations. (Used in the performance report and in various equations)

Turbine-Hours (TH)
THs are equal to the number of turbines in the group or subgroup, times the number of Calendar Hours in the period. TH for any given condition for a given subgroup is equal to the total number of Calendar Hours that each wind turbine (WTG) in the subgroup spent in the given condition.

All the following time/condition classifications are considered to be in turbine-hours. For example, the number of TH for a group of 12 WTG in January (with 744 hours in January) would be 12 x 744 or 8,928 TH. If one of those turbines were mothballed, the Active Turbine-Hours (ACTH) would be 11 x 744 or 8,184 ACTH with 744 Inactive Turbine-Hours.

Additional Turbine State Hour Calculations – Useful for Data Quality of Performance Hours

Equipment Available Turbine-Hours (EATH) – Informational only, not reported.
EATH is the sum of the Contact Turbine-Hours (CTH) and Resource Unavailable Turbine-Hours (RUTH).

Equipment Unavailable Turbine-Hours (EUTH) – Informational only, not reported.
EUTH is the sum of Planned Turbine-Hours (PTH), Forced Turbine-Hours (FTH), and Maintenance Turbine-Hours (MTH).

Site (Resource) Available Turbine-Hours (SATH) – Informational only, not reported.
SATH is the Active Turbine-Hours (ACTH) minus the Resource Unavailable Turbine-Hours (RUTH).

Site (Resource) Unavailable Turbine-Hours (SUTH) – Informational only, not reported.
SUTH is the sum of Planned Turbine-Hours (PTH), Forced Turbine-Hours (FTH), Maintenance Turbine-Hours (MTH) and Resource Unavailable Turbine-Hours (RUTH).

Appendix H: Outage Classification Guidelines

General Considerations

1. Segregating maintenance outages (MO) from forced outages (FO) is the single largest area for misunderstanding and abuse. MOs are defined as outages that could be deferred until the following week or, if they occur on the weekend, they could be deferred through the next (not current) weekend. When equipment breaks, it cannot be deferred and is a FO, so the problem comes when equipment is close to breaking. For example, during an annual maintenance, three teeth were found missing from the gearbox high speed gear. The turbine was running fine before inspection. If it is turned off for repair, is it an MO or a FO? This is where good judgment and engineering support helps. What is the risk of failure if the equipment is allowed to run for another week? If the risk is high, then the event is an FO.
2. Weather downtime is another area for abuse. The tendency is to attribute every event that occurs during Weather OMC to the storm. There should be a clear predefined linkage between the event and the storm. For example, a blade icing event occurs and some of the turbines shut down, so the ice clearly has impacts. Another example would be cable twist faults caused by a frozen wind direction sensor.
3. Equipment failure or Weather OMC can also be tricky. For example, a turbine shuts down on a wind speed error caused by ice on the anemometer. If the anemometer has a heater to prevent ice build-up, then the equipment fails (EFOR). If the anemometer had no heater the event would be classified at Weather OMC. Think about other forms of protection such as blade lightning protection.
4. Recovering from a site wide event like an outage (OMC) or a Plant substation breaker trip can be challenging to classify. Not all turbines will automatically restart when power is restored. The assumption here is that a turbine should be able to handle an unplanned outage without a component failure. Electrical conditions during an outage are complex and turbines may fault due to out-of-spec electrical parameters. The OMC ends when one of the following three conditions occur:
   a. The turbine automatically restarts.
   b. The turbine is reset from SCADA and restarts.
   c. The turbine is visited and restarted locally. If the turbine fails to restart after a local reset, a FO event begins at that point.
5. At times, events will overlap. The first-in-first-out rule should apply in this case. An example of this would be a failed gearbox (FO). Several days later, the Off-Taker takes a two-week maintenance outage (OMC MO). The gearbox remains FO until the repair is completed and then becomes part of the OMC MO.

Forced Outage – FO

An unplanned outage that usually results from a mechanical, electrical, hydraulic, control system trip or an operator-initiated trip in response to a unit alarm. The turbine is not capable of running under the MO rules.

1. **Component failures**: Most FOs will be component failures that require replacement and or repair. Examples are towers, generators, controllers, loose wire, etc.
2. **Trips or faults:** These remove the turbine from availability until corrected. Examples are overproduction, vibration, etc. Events that are part of normal operation, like cable untwisting and battery testing, are considered as available hours (RUTH).
3. **Condition Assessment**: Sometimes failing components are identified through condition assessment. If the component fails before the repair or replacement occurs it is FO. For example, a high-speed gearbox bearing is overheating and is scheduled for replacement. If the bearing fails before the scheduled replacement time, the outage is FO.

4. **Balance of Plant (BOP)**: components like underground cabling failure can cause FO. BOP failures often have parallel and undamaged components that need to be de-energized to complete the repairs safely. BOP failures usually impact many turbines, and their repairs are usually not delayed. Under this condition, the parallel circuits are part of the FO. If the primary repair is delayed for a week or two, the parallel circuit outage could be considered a MO.
5. **No Wind**: Turbine repairs often occur during no or low wind periods. Although there are no production losses, the turbine's FO hours still accumulate. For example, if a turbine fails a hydraulic motor, but there is no wind anywhere in the area, it is still a FO.
6. **Repeating Faults**: Occasionally, turbines fault multiple times from the same problem over a short period of time. For example, imagine that crews are dispatched to repair a turbine, but the turbine is running when the crew arrives. One might think to call this MO because the turbine is running, but due to the repetitive nature of the fault, it is FO. Here is another example. A turbine has been repeatedly faulting on pitch asymmetry. The previous night, it faulted six times. The turbine is later shut down to determine the root cause of the problem and repair it. Therefore, the turbine cannot be restarted until repaired, so it is FO. With repeating faults, there is no expectation that the turbine will meet the MO rules before the fault reoccurs. The abuse comes when a faulted turbine is reset (FO) and 10 minutes later the repair is started and called an MO.
7. **Outside Contractors:** Sometimes non-related contractors have access to the plant to service non- turbine equipment. (Oil equipment, gas lines, telephone) When digging or work occurs around high voltage (HV) or communication lines, it is the responsibility of the plant to be aware of and coordinate these events. Consider this example; a local phone company is installing a new fiber optic line that crosses the plant, and the contractor hits an underground HV cable. The site trips off and the cable requires repair. Were the crossings marked and flagged? Was the digging monitored? The event is FO even if all the proper safeguards are in place (human error).
8. **Human Error:** Human error falls under plant management control. For example, if a technician leaves an oily rag in a nacelle that spontaneously catches fire and burns it up, the event is a FO.
9. **Weather:** Weather events are often difficult to categorize. When labeling an outage as FO, determine what equipment caused the failure. For example, if a turbine has an anemometer with a heater to prevent icing, but it ices up anyway, and the heater fails, then the outage would be FO-Control System. If lightning were to strike a blade with lightning protection and cause damage, and the protection system fails, then the outage would be FO-Rotor. Consideration must be given for circumstances that exceed the protection system design limit.
10. **Safety Shutdown**: Safety shutdowns usually occur when neighboring equipment is in danger of harm. As an example, when a turbine runs away, neighboring turbines may be in danger of damage from flying debris. If they are shut down, they are part of the event and are FO.

Maintenance Events – MO

These are components or systems that are close to failure or in need of modification. The turbine should be capable of running until the following week. For example, if identified on Tuesday, it should be capable of running until the following Monday. If identified on the weekend it should be capable of running through the following week. If the turbine requires maintenance and won't be able to run until the following week, then the outage is FO, not MO. Repairs can take place anytime as long as the turbine can run as stated above.

1. **Condition Assessment:** The condition of the turbine is evaluated using historical trends, inspection, non-destructive testing, etc. When an issue is found, the repair is scheduled.
2. **Inspections:** Inspections by their nature are MO. If the turbine is down prior to the inspection, then it is FO.

3. **Safety Shutdowns:** Sometimes neighboring turbines or parallel circuits need to be shut down for safety. If the safety shutdown is of an immediate nature or less than the MO definition, then it is FO. Examples:
    a. A transformer failed several weeks ago and was bypassed until a replacement could be acquired. (The original event, including parallel circuits was FO). The original transformer failure remains FO, but when the rest of the circuit is de-energized to replace the transformer, the balance of the turbines are MO. All the turbines would have the same system classification, which in this case is Electrical / Individual Turbine Transformer.
    b. A turbine gearbox failed several weeks ago (FO). To safely remove the rotor and gearbox, two neighboring turbines were shutdown. The two neighboring turbines are MO. The system classification for all turbines is Gearbox / Gearbox in this case.
4. **Retrofits and Upgrades:** Most of these types of events will fall into the MO category. They could include anything from upgrading the turbine software to installing a larger rotor. If the items involve long term planning (specifically in the budget), then consider PO.
5. **Economic Repair:** Sometimes it is advantageous to shut down a turbine to minimize costly repairs. In this case, the turbine must clearly meet the MO standards and be able to run for another week. If used inappropriately, an FO event could be disguised as an MO. For example, if a turbine is continuously faulting multiple times a day, then the outage is FO, not MO. It is recommended to have an independent engineering team (not directly associated with the plant) make these decisions. If the engineer says don't run it, it is FO. If the engineer says run at reduced load or replace in six months, it is MO. The following are examples:
    a. A turbine has a trailing edge blade crack and can clearly run, but the crack will propagate over time, eventually leading to a blade failure. Turning the turbine off now will minimize the repair cost and prevent further damage. Plant management could decide to keep the turbine in service for another week, so the outage is MO, not FO Repairs are completed when labor and cranes are available. Code as Rotor / Blades MO.
    b. The main bearing temperature has been rising, and inspection indicates that the bearing should be replaced. Experience has shown that the turbine will run for several months in this condition, but there is a chance that the bearing could spin on the main shaft, significantly increasing the cost of repair. The turbine is shut down under MO and repairs are completed when a bearing and crane are available. Code as Drive Train / Main Bearings MO.
    c. A gearbox is making noise. During inspection, metal flakes are found, and spalding is occurring on the intermediate bearings. Engineering indicates that the gearbox could run for several weeks in this condition, but the risk of a catastrophic failure will become significant (loss of core). The turbine is shutdown under MO, and repairs are completed when a gearbox and crane are available. Code as Gear Box / Gear Box MO.

Planned Events - PO

Planned events are events that are scheduled well in advance and are usually specifically listed in the plant budget.

1. **Substation / HV Maintenance**: HV maintenance schedules are usually determined well in advance by NERC regulations. This is coded as Balance of Plant / Substation PO
2. **Turbine Preventative Maintenance**: Most turbines have a biannual maintenance schedule. This happens every year and is planned well in advance. This is coded as Wind Turbine / Preventative Maintenance PO.
3. **Retrofit**: Some retrofit projects require long term planning. An example could be replacing all the gearboxes at a plant. That would be coded as Gearbox / Gearbox PO.

Reserve Shutdown – RS

RS is a decision by plant management to shut down available turbines that are in an active state and not in outage or in danger of failure. IEEE 762 defines the condition as an economic[14] shutdown. Turbines in this state must remain available. Curtailments are also considered RS for GADS. If they are disabled in any way, like removing the controller, they move into an outage state (PO, MO, or FO). It can be difficult to discern between OMC and RS at times. The following are examples:

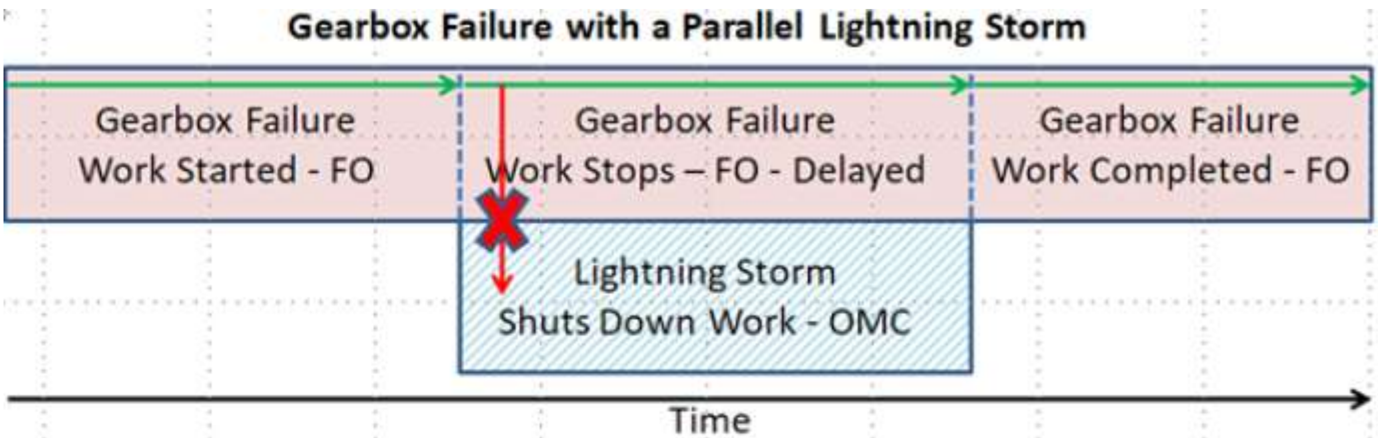
1. Wind Plant A is actively participating in the energy market. During certain times of the day, pricing goes negative (Negative energy pricing), so the revenue from the energy cannot cover the cost of operating the plant. The plant shuts down the turbine during these periods, which is an RS.
2. During an RS due to negative energy pricing, a technician needs a controller board to repair another turbine. As soon as the technician removes the board the turbine is no longer RS and is in an outage state (no longer available).

[14] Economic shutdown is an outage due to market or demand issues.

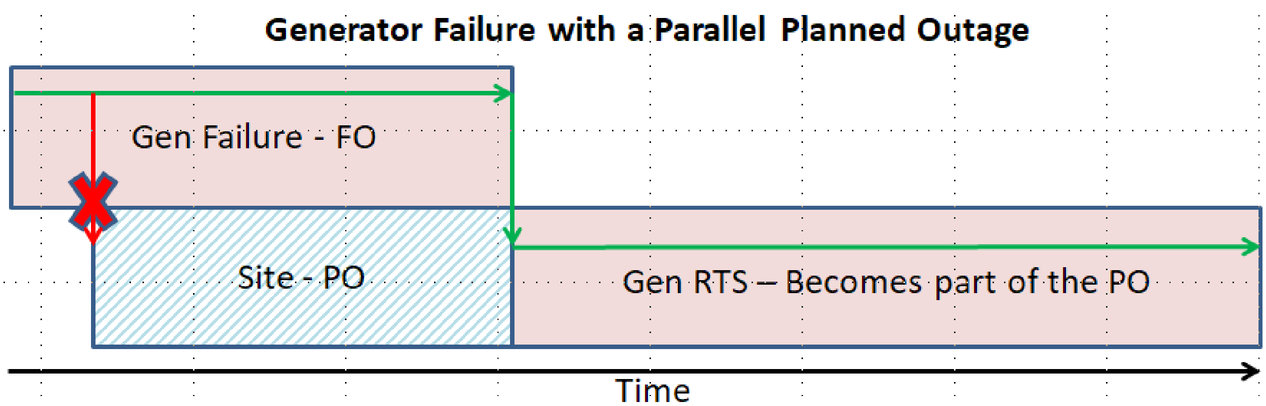
Appendix I: Overlapping Events

Often events overlap and make it confusing to classify them. Sometimes it appears that there is a penalty for something the Plant Management has no control. The general rule for overlapping events is “first in first out.” In other words, the first issue must be resolved before the second issue can take control. Below are some examples:

1. A turbine is in the process of having its gearbox replaced when a lightning storm moves in and delays the work for a day. The forced outage continues through the lightning storm. The outage type does not change but is delayed due to lightning.

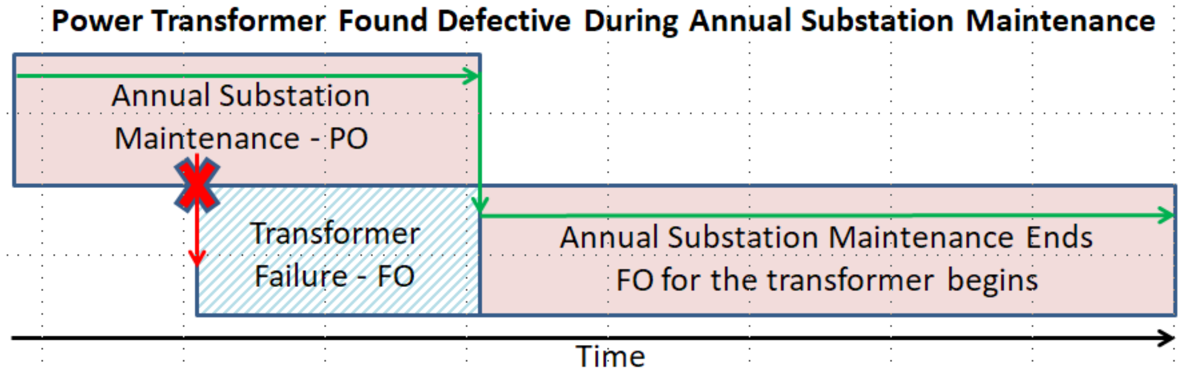


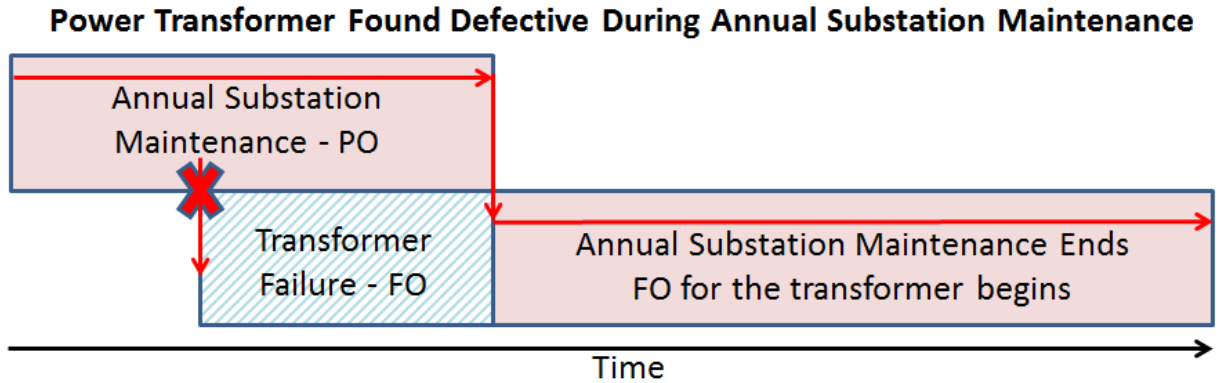
2. The plant is planning a three-week outage for transmission repairs. The day before the outage, the generator rotor shorts out and a generator replacement is required.



The site is de-energized. The site is on a PO except for the turbine with the bad generator which is FO. During the first week of the PO the generator gets replaced and aligned. At the point where the generator turbine is available for service it moves from a FO to PO.

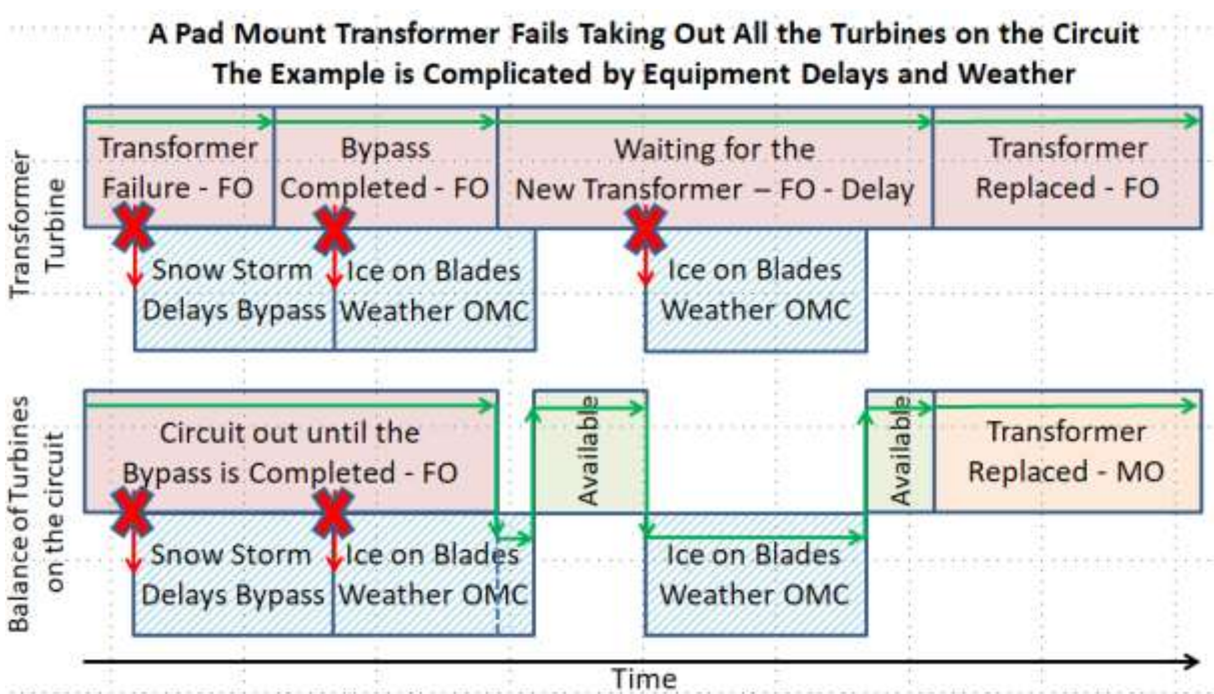
3. The plant will be down for annual substation maintenance. The outage will take three weeks and is a PO event. During inspection, the main transformer failed the Doble test and will need to be replaced.





During a PO, other work can take place. The PO can even be extended if the predefined work is taking longer than expected. If additional items are found in need of repair, an MO or an FO decision needs to be made. At the end of the PO, the new outage type becomes primary.

4. A turbine pad mount transformer fails, de-energizing all the turbines on the circuit. The failed transformer was removed and bypassed, so the remaining turbines could be re-energized. During the repair period, there was a snowstorm followed by an ice storm, and these problems prevented the crews from getting to the site.



Events can be complicated, but if taken in pieces, they are easier to code. The original turbine with the failed transformer is an FO until the transformer is replaced and the turbine is available. This turbine also experienced storms, ice, and equipment delays, but this does not change the outage type classification.

The balance of the turbines on the circuit (collateral FO) is FO until the bypass is complete and the turbines are returned to service (RTS). Once the bypass is complete, the event is coded as External / Weather Ice (OMC). After the weather event, the turbines are available, and then another icing event occurs. When the failed transformer is replaced and the bypass removed, the collateral turbines are placed into MO until repairs are completed.

Appendix J: Cause Codes

The following table lists available cause codes, sorted in ascending order. Select the code that is closest to the failed item or use the “General” category if nothing is close.

Table J.1: Cause Codes

System	Subsystem	Cause Code	Description
Structure		11010	Nacelle
Structure		11020	Towers
Structure		11030	Foundations
Structure		11040	Paint & Coatings
Structure		11050	Nacelle Heating and Cooling
Structure		11060	FAA Lighting
Structure		11070	MASS/Harmonic Damp
Structure		11080	Ladders
Structure		11090	Climb Assist / Elevator
Structure		11100	Tower Filtration
Structure		11110	Lighting
Structure		11120	Hoist
Structure		11190	General
Wind Turbine	Rotor	12010	Blades
Wind Turbine	Rotor	12020	Blade Attachments
Wind Turbine	Rotor	12030	Blade Coatings
Wind Turbine	Rotor	12040	Blade Pitch Bearing
Wind Turbine	Rotor	12050	Hub
Wind Turbine	Rotor	12060	Aerodynamic Brake - Tip Brakes & Spoilers
Wind Turbine	Rotor	12070	Deicing Systems
Wind Turbine	Rotor	12080	Lightning Protection
Wind Turbine	Rotor	12090	Nose Cone
Wind Turbine	Rotor	12190	General
Wind Turbine	Yaw System	12200	Yaw Motors/Hydraulics
Wind Turbine	Yaw System	12210	Slew Ring
Wind Turbine	Yaw System	12220	Yaw Gear
Wind Turbine	Yaw System	12230	Yaw Dampening
Wind Turbine	Yaw System	12240	Yaw Lubrication Systems
Wind Turbine	Yaw System	12290	General
Wind Turbine	Pitch System	12300	Mechanical
Wind Turbine	Pitch System	12310	Pitch Hydraulics
Wind Turbine	Pitch System	12320	Electrical
Wind Turbine	Pitch System	12330	Battery Backup
Wind Turbine	Pitch System	12340	Pitch Controller
Wind Turbine	Pitch System	12350	Pitch Motor
Wind Turbine	Pitch System	12360	Pitch Gearbox
Wind Turbine	Pitch System	12390	General
Wind Turbine	Hydraulic System	12400	Common Pump and Motor
Wind Turbine	Hydraulic System	12410	Hydraulic Accumulator

Table J.1: Cause Codes			
System	**Subsystem**	**Cause Code**	**Description**
Wind Turbine	Hydraulic System	12420	Filtering System
Wind Turbine	Hydraulic System	12430	Hoses, Reservoirs, Valves
Wind Turbine	Hydraulic System	12440	Hydraulic Slip Ring
Wind Turbine	Hydraulic System	12490	General
Wind Turbine	Drive Train	12500	Main Bearings
Wind Turbine	Drive Train	12510	Main Shaft
Wind Turbine	Drive Train	12520	Rotor Coupling
Wind Turbine	Drive Train	12530	Transmission Shaft
Wind Turbine	Drive Train	12590	General
Wind Turbine	Brake	12600	High Speed Shaft Brake
Wind Turbine	Brake	12610	Mechanical Lock
Wind Turbine	Brake	12620	Brake Hydraulic System
Wind Turbine	Brake	12690	General
Wind Turbine	Gear Box	12700	Gears
Wind Turbine	Gear Box	12710	Gear Box Heating/Cooling
Wind Turbine	Gear Box	12720	Gear Box Oil System
Wind Turbine	Gear Box	12730	Gearbox Filtration
Wind Turbine	Gear Box	12740	Torque Arm System
Wind Turbine	Gear Box	12790	General
Electrical	Switchyard	13600	Switchyard Transformers (not GSU) and Associated Cooling Systems - External (not OMC)
Electrical	Switchyard	13601	Switchyard Transformers (not GSU) and Associated Cooling Systems - External (OMC)
Electrical	Switchyard	13610	Switchyard Circuit Breakers - External (not OMC)
Electrical	Switchyard	13611	Switchyard Circuit Breakers - External (OMC)
Electrical	Switchyard	13612	Switchyard System Protection Devices - External (not OMC)
Electrical	Switchyard	13613	Switchyard System Protection Devices - External (OMC)
Electrical	Switchyard	13618	Other Switchyard Equipment - External (not OMC)
Electrical	Switchyard	13619	Other Switchyard Equipment - External (OMC)
Electrical	Switchyard	13620	Main Transformer (GSU)
Electrical	Switchyard	13640	Revenue Meter or Power Meter
Electrical	Switchyard	13650	Site Reactive Power Compensation
Electrical	Switchyard	13660	Transmission Cables/Buss Work
Electrical	Site Electric Collection	13700	Power Converters
Electrical	Site Electric Collection	13710	Converter Cooling
Electrical	Site Electric Collection	13720	Individual/Multiple Turbine Transformers
Electrical	Site Electric Collection	13730	Underground Cables
Electrical	Site Electric Collection	13740	Overhead Lines

Table J.1: Cause Codes			
System	Subsystem	Cause Code	Description
Electrical	Site Electric Collection	13750	Circuit Breakers and Switches
Electrical	Site Electric Collection	13760	Fuses
Electrical	Site Electric Collection	13790	General
Generator		14000	Generator
Generator		14010	Generator Bearings
Generator		14020	Generator Lube Oil Systems
Generator		14030	Generator Shaft
Generator		14040	Generator Field
Generator		14050	Generator Cooling Systems
Generator		14060	Wiring to Gen Terminals
Generator		14070	High Speed Coupling
Generator		14080	Power Slip Rings
Generator		14090	Exciter
Generator		14100	Generator Emergency Trip Devices (includes protective relay)
Generator		14190	General
Control System / Communication		15000	Low Voltage Control Wiring
Control System / Communication		15010	Voltage Regulation
Control System / Communication		15020	Reactive Power Control
Control System / Communication		15030	RCC (Rotor Current Control)
Control System / Communication		15040	Sensors
Control System / Communication		15050	Software
Control System / Communication		15060	Control Communication Links Top and Bottom
Control System / Communication		15070	Processor
Control System / Communication		15080	Processor Cooling
Control System / Communication		15090	Hardware
Control System / Communication		15100	Power Supply
Control System / Communication		15110	Control Cabinet Filtration
Control System / Communication		15120	Cabinet Cooling/Heating
Control System / Communication		15130	SCADA

Table J.1: Cause Codes			
System	**Subsystem**	**Cause Code**	**Description**
Control System / Communication		15140	Wind Park Control System
Control System / Communication		15150	Cold Weather Control
Control System / Communication		15160	Wind Vane and Anemometer
Control System / Communication		15170	Control Slip Rings
Control System / Communication		15190	General
Control System / Communication		15300	Wave Trap (HV Communications)
Control System / Communication		15310	Site Communication
Energy Storage		16010	Lithium Battery
Energy Storage		16020	Flywheel
Energy Storage		16030	Molten Salt
Energy Storage		16040	Compressed Air
Energy Storage		16090	Other
BOP Maintenance		17010	Routine Preventive Maintenance (Not wind turbine)
BOP Maintenance		17020	Routine Preventive Maintenance (Wind Turbine)
BOP Maintenance		17030	Wind Turbine Overhaul
External	Acts of Nature	19000	Flood (OMC)
External	Acts of Nature	19001	Drought (OMC)
External	Acts of Nature	19010	Fire Including Wildfires, not related to a specific component (OMC)
External	Acts of Nature	19015	Pandemic (OMC)
External	Acts of Nature	19020	Lightning (OMC)
External	Acts of Nature	19025	Geomagnetic Disturbance (OMC)
External	Acts of Nature	19030	Earthquake (OMC)
External	Acts of Nature	19031	Tornado (OMC)
External	Acts of Nature	19035	Hurricane (OMC)
External	Acts of Nature	19036	Weather - Ice (OMC)
External	Acts of Nature	19037	Weather - Temperature (OMC)
External	Acts of Nature	19038	Weather - Turbulence (OMC)
External	Acts of Nature	19040	Other catastrophe (OMC)
External	Acts of Man	19050	Off-Taker Transmission & Distribution (OMC)
External	Acts of Man	19060	External Communication (OMC)
External	Acts of Man	19070	Legal, Contractual or Environmental (OMC)

Table J.1: Cause Codes			
System	**Subsystem**	**Cause Code**	**Description**
External	Acts of Man	19080	Execution Delays (OMC) * Special Requirements
External	Acts of Man	19090	Physical Security Incident
External	Acts of Man	19091	Physical Security Incident (OMC)
External	Acts of Man	19092	Cyber Security Incident
External	Acts of Man	19093	Cyber Security Incident (OMC)
External	Acts of Man	19100	External Labor Strikes (OMC)
External	Acts of Man	19110	Regulatory-Environmental
Transmission		19300	Transmission (Gen Tie)
Human Performance		19900	Operator Error
Human Performance		19910	Maintenance Error
Human Performance		19920	Contractor Error
Human Performance		19940	Procedure Error

Appendix K: Pandemic Cause Code and Examples for Wind GADS Reporters

Applicable Data Reporting Instructions (DRI)

COVID-19 is a cause code – Pandemic (OMC) number 9015. This code has special requirements listed below:

- Switching from the initial component code to the Pandemic (OMC) code is allowed when the pandemic stops or prevents work from occurring.
- When work resumes, the unit switches back to the original outage component code.

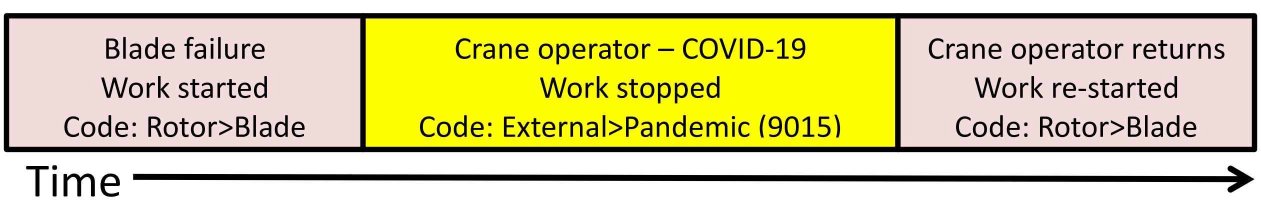
Examples for Usage

Several examples have been created for guidance on how to use the new cause code.

Forced Outage - Crane Operator Sick

A wind unit has experienced a blade failure. During the repair, the crane operator becomes infected with COVID-19 and is not able to operate the crane for 3 weeks. There is no alternate crane operator. The blade replacement resumes when the crane operator returns to work.

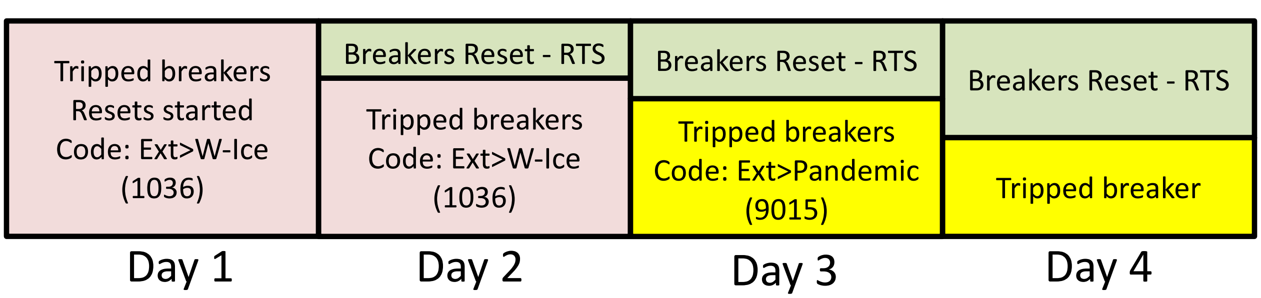
1. Initially, the event is classified as Rotor > Blades (600) | Forced.
2. During the three-week period when the crane operator is recovering the event is classified as External > Pandemic (9015) | Forced.
3. After the crane operator returns to work and work resumes, the event is returned to its original coding – Rotor > Blades (600) | Forced.



Forced Outage – Manpower Limitations

During a winter ice storm, multiple internal transmission line slaps occurred causing multiple phase-to-phase short circuits. This resulted in 264 wind turbines trip their main breakers. This required a manual breaker reset at the wind turbine. At the time, 50% of the maintenance crew were sick with COVID-19. With a full crew, these resets would take about 2 days, but it took 4 days with the reduced crew.

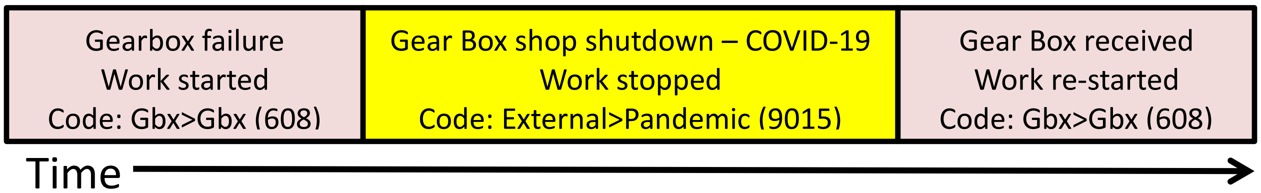
1. For the first 2 days code downtime as External > Weather Ice (OMC) (1036) | Forced
2. For the last 2 days code downtime as External > Pandemic (OMC) (9015)



Forced Outage – Parts Delays

A wind unit fails a gearbox. During the repair, the gearbox repair shop is shut down due to multiple COVID-19 infections.

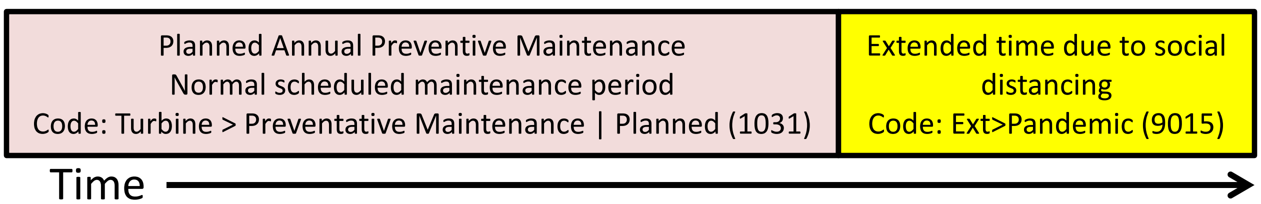
1. Code the initial prep work as Gear Box > Gear Box (608) | Forced
2. Code the time waiting for the Gear box as External > Pandemic (OMC) (9015) | Forced
3. When the gearbox is received code the remaining time as Gear Box > Gear Box (608) | Forced



Planned Outage – Social Distancing

A large wind turbine used a 3-man crew for annual preventative maintenance. Due to social distancing, the crew was limited to 2. This increased the downtime for the maintenance by one third.

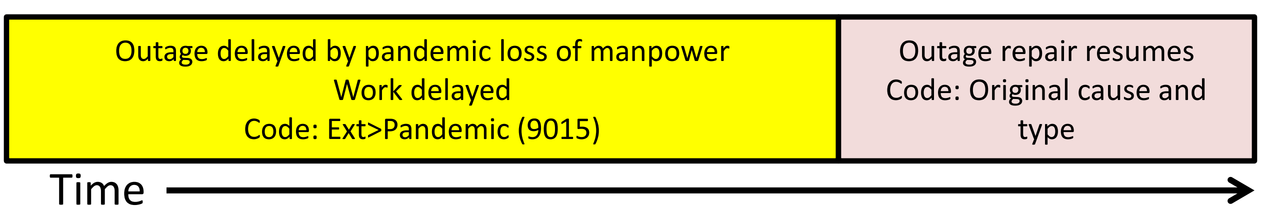
1. If the normal maintenance took 24 hours, code the first 24 hours as Turbine > PM | Planned (1031)
2. Code the next 12 hours as External > Pandemic (1083)



Outage Any Type – Reduced or No Manpower

The wind plant has several maintenance technicians that are quarantined for COVID-19 infections (Pandemic). As a result, the plant is not able to accomplish work in a timely manner.

1. The initial delayed period is classified as External > Pandemic (9015) | PO/MO/FO
2. When work begins the downtime for the unit is changed to its original downtime category.



Appendix L: Data Quality Validations

GADS data should be reviewed for the following potential discrepancies before submission. This list is by no means comprehensive, but data not meeting these minimum requirements will be rejected. Reporting is done monthly, submitted no later than 45 days after the end of the quarter.

1. **Calendar Turbine Hours (CalTH) –** CalTH = (Hours in Month) X (Number of Turbines)
2. **Turbine State** – Turbines are either in an Active state (ACTH) or an Inactive state (ITH). The sum of the two equals the CalTH: CalTH = ACTH + ITH
3. **Inactive State** – The sum of all inactive states should be equal to ITH.
   a. ITH = (Inactive Reserve [IRTH]) + (Mothball [MBTH]) + (Retired [RTH])
4. **Active State** – The sum of all active states should equal ACTH.
   a. CTH – Contactor Turbine Hours
   b. RSTH – Reserve Shutdown Turbine Hours
   c. FTH – Forced Turbine Hours
   d. MTH – Maintenance Turbine Hours
   e. PTH – Planned Turbine Hours
   f. RUTH – Resource Unavailable Turbine Hours
   g. ACTH = CTH + RSTH + FTH + MTH + PTH + RUTH
5. **RUTH Hours** – RUTH is usually calculated by subtracting the known values from ACTH. RUTH = ACTH – (CTH+ RSTH + FTH + MTH + PTH)
6. **Generation** – Generation at the turbine (GAG) >= Net Actual Generation (NAG). GAG is the generation measured at the turbine.
   a. NAG is GAG minus line losses, transformer losses and auxiliary load losses.
7. **Capacity** – Total Installed Capacity >= Net Maximum Capacity (NMC)
   a. Total Installed Capacity is the Wind Turbine Generator (WTG) rated capacity times the number of turbines. NMC is Total Installed Capacity minus line losses, transformer losses and auxiliary load losses.
8. **ID Missing** – An error will be generated if the Entity ID or Sub-group ID is missing.
9. **ID Not Found** – The Entity ID or Sub-Group ID has not been registered with the GADS Wind Reporting application.
10. **Performance ID Not Found** – The performance record is missing an Entity ID, Sub-Group ID, year or period.
11. **Bad Period / Year** – This error may occur when importing Hours or Performance files. This happens when the entered year is earlier than 1980 or greater than the current year, or if the entered period (month) is not within the range of 1-12.
12. **Invalid System** – This happens when the System-Component Code does not match any found within the GADS Wind Reporting application.
13. **No Name or Description** – This error may occur when importing sub-group configuration, Performance or Component Outage files. This happens when the name / description field is blank in the incoming file.
14. **Turbine System (MW) –** The System Capacity - MW rating of a single turbine in the sub-group. The correct Value should be the MW capacity of a single turbine.

15. **Total Number of Turbines –** The actual number of physical turbines that exist in the sub-group. The number of turbines must be greater than zero.
16. **Gross Maximum Potential Production (GMPP) –** Gross maximum wind generation at continuous full-power operation during performance reporting month.

    GMPP = (Hours in Month) X (Number of Turbines) X (Max Turbine System Capacity)
17. **Gross Maximum Potential Production against (GAG) –** Gross Actual Generation (GAG) must be less than or equal to Gross Max Potential Production (GMPP)
18. **Net Maximum Capacity (NMC) –** This is equal to the installed capacity less any electrical losses such as transformation losses, line losses, and other losses due to transmission between the turbine and the revenue meter. Net Maximum Capacity (NMC) may not equal zero when Total Installed Capacity (TIC), Gross Actual Generation (GAG) or Net Actual Generation (NAG) are greater than zero.
19. **Contact Turbine Hours (CTH) –** The number of turbine-hours the sub-group is synchronized to the system. It is the turbine-hours during which the main contactor is closed, and generation is provided to the grid. If reported Contact Turbine Hours (CTH) are equal to zero, then Gross Actual Generation (GAG) and Net Actual Generation (NAG) must be equal to zero.
20. **Gross Actual Generation against Net Actual Generation –** GAG is the sum of all individual turbine meters before removing station service or auxiliary loads. GAG should be measured as close to the turbine's generator as possible so that generation is measured before any auxiliary use by the turbine. NAG is the portion of generation delivered by the subgroup to the revenue meter. It is possible to have a negative NAG value if the group's station service or auxiliary loads are greater than total generation.
21. **Gross Actual Generation should not equal Net Actual Generation due to line losses**. The percentage difference between Gross Actual Generation (GAG) and Net Actual Generation (NAG) should not become greater than 15%.
22. **Contact Turbine Hours Calculations -** The Contact Turbine Hours (CTH) multiplied by Total Installed Capacity must be greater than or equal to the Gross Actual Generation.
23. **High Cut-Out Wind Speed – T**he highest wind speed at which the turbine can generate power before cutting out. This can be determined from the turbine operating parameters or the turbine power curve. A wind turbine is designed to produce power over a range of wind speeds. The High Cut Out Wind speed must range from 16.0–35 m/s.
24. **Low Cut-Out Wind Speed –** The lowest wind speed that the turbine can continue to generate power before cutting out. This can be determined from the turbine operating parameters or the turbine power curve. A wind turbine is designed to produce power over a range of wind speeds. The Low Cut Out Wind speed must range from 2.0–15.9 m/s.
25. **Cut-In Wind Speed –** The lowest wind speed at which the turbine will start to generate power, in meters per second. This can be determined from the turbine operating parameters or the turbine power curve. The Cut-in wind speeds must range from 0 -15 m/s.
26. **Maximum Operating Temperature –** The manufacture maximum operating temperature in degrees Celsius. Maximum Operating Temperature must be within the bounds of 25 to 65° Celsius.
27. **Minimal Operating Temperature–** Enter the manufacture minimum operating temperature in degrees Celsius. Minimal Operating Temperature must be within the bounds of -40 to 0° Celsius.

Appendix M: Equations

Five types of performance equations are listed. A description of these sections is below.

1. **Resource and Equipment Calculations** – These equations calculate the individual resource and equipment performance by turbine sub-group(s) that have similar turbine capacities. These equations also include OMC hours.
2. **Generation Equations** – These equations calculate the performance statistics based on generation measures instead of time measures.

In most cases, "resource" performance factors and rates take all outages and hours into consideration. These include, but are not limited to, outages from resource (wind) unavailability, equipment failures, off-taker events, weather, and any other non-equipment outages. Resource equations are primarily used by resource planners integrating wind energy into the bulk power supply.

Equipment performance factors and rates take into consideration Calendar Hours, Period Hours, and all outages pertaining to equipment that fall within and outside of management control for a given study. Equipment performance equations are used by plant managers to monitor performance behind the plant boundary.

Note: ACTH was previously known as PDTH

Section 1: Resource and Equipment Calculations (for subgroups)

1.A. Resource Performance Factors

These are performance rates and factors that highlight the effect of the resource and are primarily used by planners or from a system view. To do that, Resource Unavailable Turbine-Hours (RUTH) are treated as forced outage hours. This defines the ability of the technology to deliver power to the bulk power system.

1.A.1. Resource Availability Factor (R-AF)
% of the period in which the plant was available.

$$R\text{-}AF = \frac{[ACTH - (FTH + MTH + PTH + RUTH)]}{ACTH} \times 100$$

$$\approx (100 - R\text{-}UF)$$

1.A.2. Resource Unavailability Factor (R-UF)
% of the period in which the plant was unavailable.

$$R\text{-}UF = \frac{(FTH + MTH + PTH + RUTH)}{ACTH} \times 100$$

$$\approx (100 - R\text{-}AF)$$

1.A.3. Resource Planned Outage Factor (R-POF)
% of the period in which the plant was in planned downtime.

$$R\text{-}POF = \frac{(PTH)}{ACTH} \times 100$$

1.A.4. Resource Maintenance Outage Factor (R-MOF)
% of the period in which the plant was in maintenance downtime.

$$R\text{-}MOF = \frac{(MTH)}{ACTH} \times 100$$

1.A.5. Resource Forced Outage Factor (R-FOF)
% of the period in which the plant was forced offline. Including low and high winds.

$$R\text{-}FOF = \frac{(FTH + RUTH)}{ACTH} \times 100$$

1.A.6. Resource Unplanned Outage Factor (R-UOF)
% of the period in which the plant was unavailable due to forced and maintenance downtime. For generation resource planning.

$$R\text{-}UOF = \frac{(FTH + MTH + RUTH)}{ACTH} \times 100$$

1.A.7. Resource Scheduled Outage Factor (R-SOF)
% of the period in which the plant was unavailable due to maintenance and planned downtime.

$$R\text{-}SOF = \frac{(MTH + PTH)}{ACTH} \times 100$$

1.A.8. Resource Generating Factor (R-GF)
% of the period in which the plant was online and in a generating state.

$$R\text{-}GF = \frac{(CTH)}{ACTH} \times 100$$

1.A.9. Resource Net Capacity Factor (R-NCF)
% of actual plant generation.

$$R\text{-}NCF = \frac{NAG}{(ACTH \times TNMC)} \times 100$$

1.A.10. Net Output Factor (NOF)
% of actual plant loading when on-line.

$$NOF = \frac{NAG}{[(CTH) \times TNMC]} \times 100$$

1.A.11. Resource Planned Outage Rate (R-POR)
Probability of planned plant downtime when needed for load.

$$R\text{-}POR = \frac{(PTH)}{[(CTH) + PTH]} \times 100$$

1.A.12. Resource Maintenance Outage Rate (R-MOR)
Probability of maintenance plant downtime when needed for load.

$$R\text{-}MOR = \frac{(MTH + MDTH)}{[CTH + MTH]} \times 100$$

1.A.13. Resource Forced Outage Rate (R-FOR)
Probability of forced plant downtime when needed for load.

$$R\text{-}FOR = \frac{(FTH + RUTH)}{[CTH + FTH + RUTH]} \times 100$$

1.A.14. Resource Unplanned Outage Rate (R-UOR)
Probability of forced or maintenance plant downtime (including high and low winds) when needed for load.

$$R\text{-}UOR = \frac{(FTH + MTH + RUTH)}{[CTH + FTH + MTH + RUTH]} \times 100$$

1.A.15. Resource Scheduled Outage Rate (R-SOR)
Probability of maintenance or planned plant downtime when needed for load.

$$R\text{-}SOR = \frac{(MTH + PTH + MDTH + PDTH)}{[CTH + MTH + PTH]} \times 100$$

1.B. Equipment Performance Factors

These are performance rates and factors that highlight the effect of the equipment and reduce the effect of the resource availability, from the plant view. To do that, Resource Unavailable Turbine-Hours (RUTH) are considered available non-generating hours rather than forced outage hours. This provides for the maximum number of hours the equipment would have operated under normal conditions.

1.B.1. Equipment Availability Factor (E-AF)
% of the period in which the WTG equipment was available.

$$E\text{-}AF = \frac{[ACTH - (FTH + MTH + PTH)]}{ACTH} \times 100$$

$$\approx (100 - E\text{-}UF)$$

1.B.2. Equipment Unavailability Factor (E-UF)
% of the period in which the WTG equipment was unavailable.

$$E\text{-}UF = \frac{(FTH + MTH + PTH)}{ACTH} \times 100$$

$$E\text{-}UF \approx (100 - E\text{-}AF)$$

1.B.3. Equipment Planned Outage Factor (E-POF)
% of the period in which the WTG equipment was in planned downtime.

$$E\text{-}POF = \frac{(PTH)}{ACTH} \times 100$$

1.B.4. Equipment Maintenance Outage Factor (E-MOF)
% of the period in which the WTG equipment was in maintenance downtime.

$$E\text{-}MOF = \frac{(MTH)}{ACTH} \times 100$$

1.B.5. Equipment Forced Outage Factor (E-FOF)
% of the period in which the WTG equipment was forced offline. Including low and high winds.

$$E\text{-}FOF = \frac{(FTH)}{ACTH} \times 100$$

1.B.6. Equipment Unplanned Outage Factor (E-UOF)
% of the period in which the WTG equipment was unavailable due to forced and maintenance downtime. For generation resource planning.

$$E\text{-}UOF = \frac{(FTH + MTH)}{ACTH} \times 100$$

1.B.7. Equipment Scheduled Outage Factor (E-SOF)
% of the period in which the WTG equipment was unavailable due to maintenance and planned downtime.

$$E\text{-}SOF = \frac{(MTH + PTH)}{ACTH} \times 100$$

1.B.8. Equipment Generating Factor (E-GF)
% of the period in which the WTG equipment was online and in a generating state.

$$E\text{-}GF = \frac{(CTH)}{(ACTH - RUTH)} \times 100$$

1.B.9. Equipment Net Capacity Factor (E-NCF)
% of actual WTG equipment generation while online.

$$E\text{-}NCF = \frac{NAG}{[(ACTH - RUTH) \times TNMC]} \times 100$$

1.B.10. Equipment Planned Outage Rate (E-POR)
Probability of planned WTG equipment downtime when needed for load.

$$E\text{-}POR = \frac{(PTH)}{[CTH + PTH + RUTH]} \times 100$$

1.B.11. Equipment Maintenance Outage Rate (E-MOR)
Probability of maintenance WTG equipment downtime when needed for load.

$$E\text{-}MOR = \frac{(MTH)}{[CTH + MTH + RUTH]} \times 100$$

1.B.12. Equipment Forced Outage Rate (E-FOR)
Probability of forced WTG equipment downtime when needed for load.

$$E\text{-}FOR = \frac{(FTH)}{[CTH + FTH + RUTH]} \times 100$$

1.B.13. Equipment Unplanned Outage Rate (E-UOR)
Probability of forced or maintenance WTG equipment downtime (including high or low winds) when needed for load.

$$E\text{-}UOR = \frac{(FTH + MTH)}{[CTH + FTH + MTH + RUTH]} \times 100$$

1.B.14. Equipment Scheduled Outage Rate (E-SOR)
Probability of maintenance or planned WTG equipment downtime when needed for load.

$$E\text{-}SOR = \frac{(MTH + PTH)}{[CTH + MTH + PTH + RUTH]} \times 100$$

Section 2: Generation Metrics

Generation metrics are based on Energy Generation terms in megawatt-hours instead of hours. Since variable generators change capacity continuously, these metrics give better indications of performance than raw hours do. Calculations are based on these data items that are currently collected:

- Expected Generation: EG (Reported in Monthly Performance) (as compared to Gross)
- Gross Maximum Generation: GMG = Active Turbine Hours (reported in Monthly Performance) x Turbine Group Installed Capacity
- Gross Maximum Capacity: GMC = Turbine Group Installed Capacity (Reported in Group Configuration)
- Gross Actual Generation: GAG (Reported in Monthly Performance) (measured at Turbine)
- Net Actual Generation: NAG (Reported in Monthly Performance) (measured at Revenue Meter)
- Net Maximum Capacity: NMC (Reported in Monthly Performance)

2.A Generation Metrics

2.A.1. Unit Performance Index (PI)
The fraction of generation that was produced compared to the expected generation.

$$PI = \frac{GAG}{EG} \times 100$$

2.A.1.b. System Performance Index (SPI)

$$SPI = \frac{GAG}{GMG} \times 100$$

2.A.2. System Resource Available Generation Factor (RAGF)
For resource calculations, Gross Maximum Generation must be in the denominator.

$$RAGF = \frac{EG}{GMG} \times 100$$

Appendix N: Examples

Event Examples

During a summer heat wave, some turbines shut off for protection. At 08:15, the accumulated shutoffs cause a loss of 20 MW of Plant Total Installed Capacity. As the day goes on the number of shutoffs vary, however at 09:40, the Plant Available Installed Capacity reaches its minimum for the event at a loss of 60 MW. At 12:15, 95% of the Plant Total Installed Capacity that was unavailable due to the forced outage, has been returned to service, at which point the event ends.

Event start: Plant Total Installed Capacity (300 MW) – Start Plant Available Installed Capacity (280 MW) = 20 MW

Event Nadir: Minimum value for Plant Available Installed Capacity for event = 60 MW

Event End: End Plant Total Installed Capacity = Plant Total Installed Capacity (300 MW) – (Minimum Plant Available Installed Capacity (60 MW * (1 – 0.095)) = 297 MW

End Plant Available Installed Capacity = 300 – (60 * 0.05) = 297 MW

A snapshot of the lost potential generation from the day of the event is shown in **Figure N.1**.

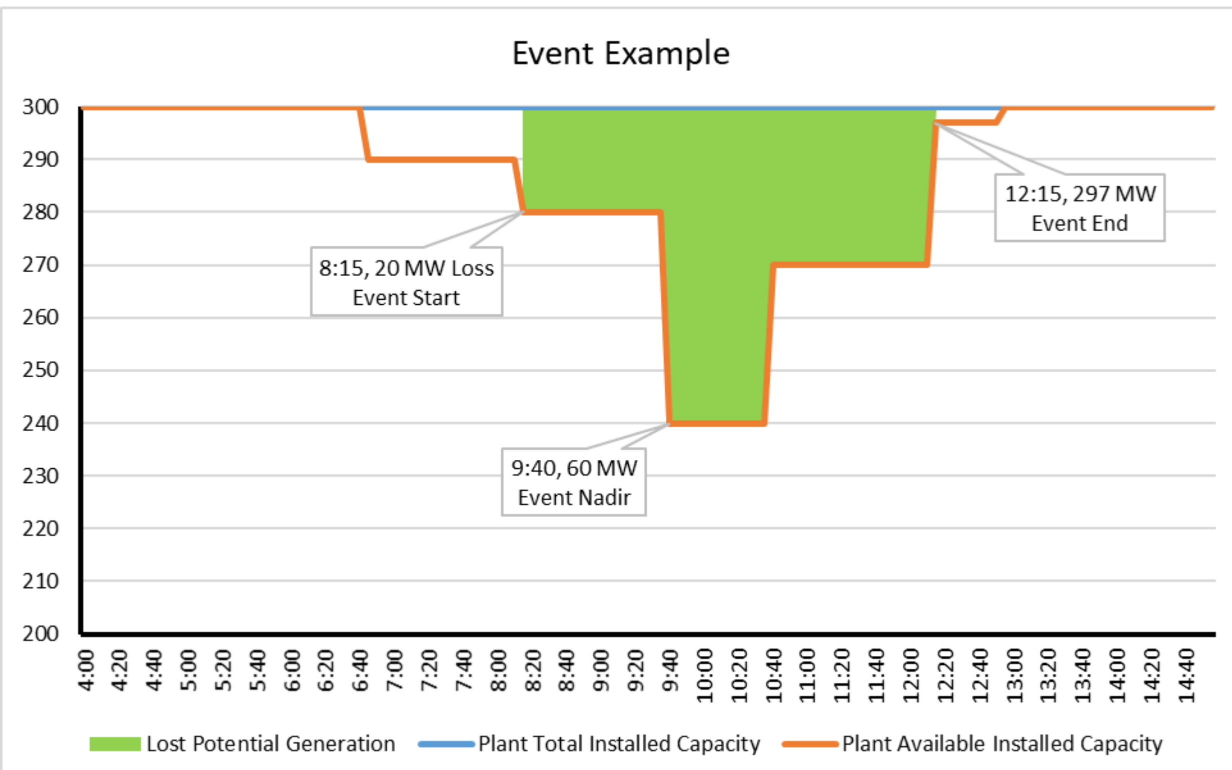


Figure N.1: Event Example

We will go on to show several examples that show how each field is reported, and the flexibility that reporting allows.

Simple Event

The example in **Figure N.2** uses a plant with **100 MW** Of Total Installed Capacity. All turbines are in service, which means that Available Capacity is also 100 MW. In this example, the whole plant is in an outage state. This simple Forced Outage starts at 11 AM and is resolved at 3 PM. The event lasted **Four hours** in duration.

The 20 MW outage threshold is hit at 11 AM, and the 95% return to service threshold is hit at 3 PM. The **Potential MWh Production Loss** for the event must be reported and is calculated as follows. More detail can be found in

.

Potential MWh Production Loss = 4 hours x **100 MW** loss = **400 MWh**

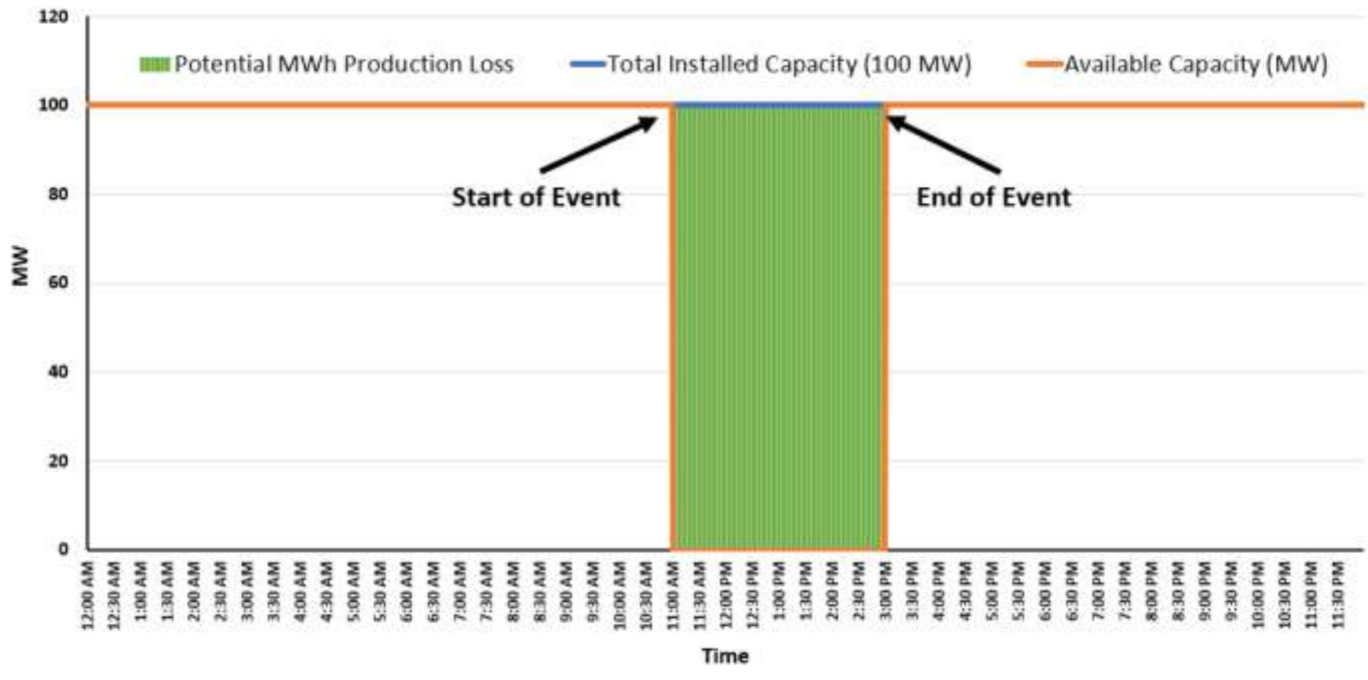


Figure N.2: Simple Event

Table N.1: Simple Event Detail										
Entity ID	**Plant ID**	**Event ID**	**Time Zone**	**Event Start Date / Time**	**Event End Date / Time**	**Event Type**	**Cause Code**	**Contributing Operating Condition**	**Description**	**Potential MWh Production Loss**
1234	5678	18	CPT	10/23/2023 11:00	10/23/2023 15:00	FO	23612	0	A remote power plant went out, resulting in a 100 MW outage, causing grid disturbance and protection devices to trip.	400

Progressive Repairs

Most events will likely have a different number of turbines out throughout the course of the event. This example demonstrates a more complex outage of a plant with **100 MW** of Total Installed Capacity. Some turbines are lost, but do not reach the threshold of starting an event as shown in **Figure N.3**. Then, the loss threshold reaches **20 MW,** and the event starts at 11 AM.

As repairs are completed, the event ends when **95%** of the equipment comes back online, *even though there are still some turbines in an outage state.* This occurs at 3:00 PM, as shown in **Figure N.3**.

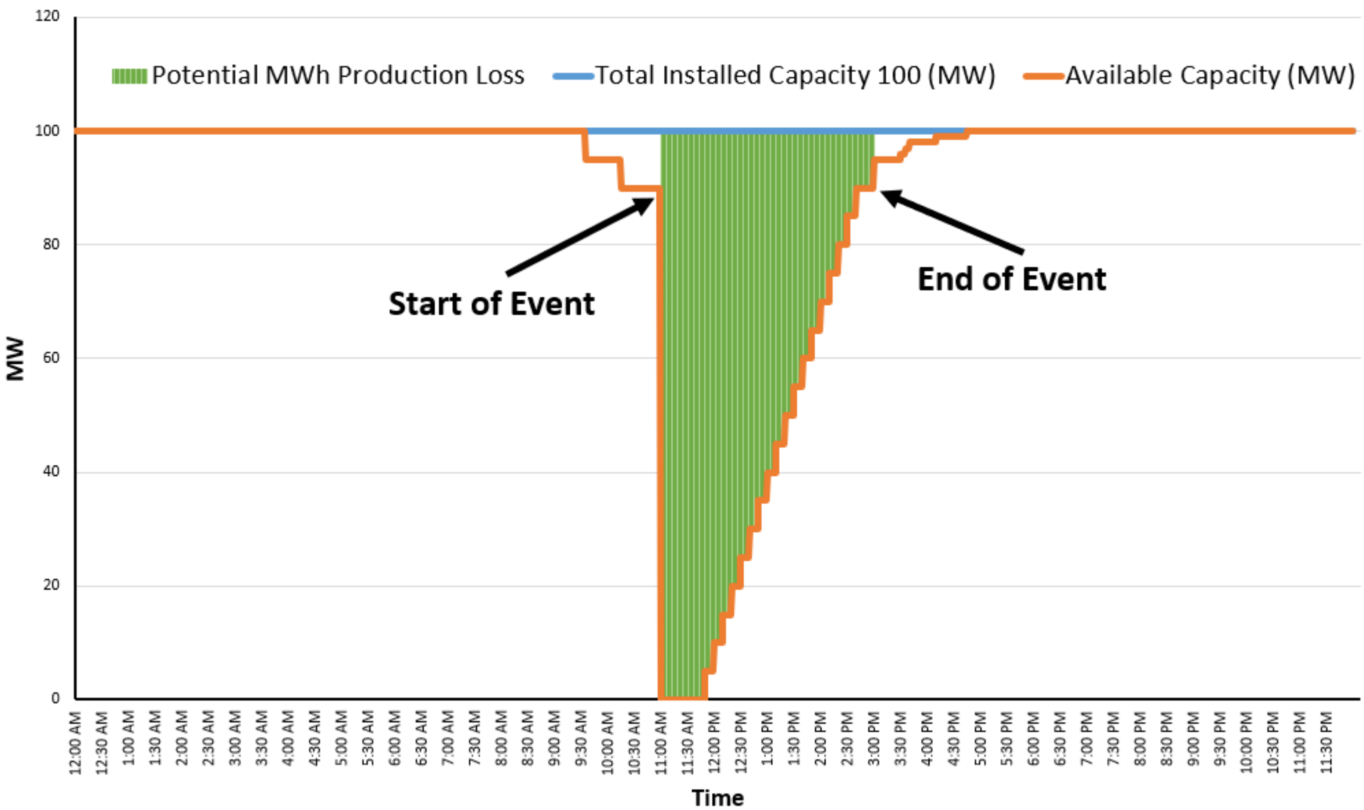


Figure N.3: Progressive Repairs

The event start date/time for this example is the same as in the previous example. However, in this case, the event occurs due to cold weather conditions, as shown in Table N.2 under Contributing Operating Condition ("9" for cold weather).

Table N.2: Progressive Repairs Event Detail										
Entity ID	**Plant ID**	**Event ID**	**Time Zone**	**Event Start Date / Time**	**Event End Date / Time**	**Event Type**	**Cause Code**	**Contributing Operating Condition**	**Description** Progressive Repairs Event Detail	**Potential MWh Production Loss**
1234	5678	22	CPT	10/23/2023 11:00	10/23/2023 15:00	FO	25050	9	Turbines shut down due to cold weather. However, turbine settings were out of date. Updates allow turbines to run in colder weather. Installed updated settings on each turbine, one at a time.	242.50

When summing the intervals of turbines in an outage state over the course of the event, the Potential MWh Production Loss is calculated to be 242. 5 MWh. The calculation is as follows:

Potential MWh Production Loss: $MWh\ Loss = Event\ MW\ Loss\ \times\ Event\ Duration$

MWh Loss = (100 * .83333) + (95 * .16667) + (90 * .16667) + (85 * .16667) + (80 * .16667) + (75 * .16667) + (70 * .16667) + (65 * .16667) + (60 * .16667) + (55 * .16667) + (50 * .16667) + (45 * .16667) + (40 * .16667) + (35 * .16667) + (30 * .16667) + (25 * .16667) + (20 * .16667) + (15 * .16667) + (10 * .33333)
MWh Loss = 242.50

Multiple Turbine Outages as a Single Event

What happens when you have a forced outage during a planned outage event? This example is a continuation of the plant with **100 MW** Of Total Installed Capacity and represents a plant taking 20 MW of installed capacity offline. Several other forced outages occur around the same time.

While the first forced outage is being repaired, more installed capacity goes out. And while that is being worked on, another section of the plant goes out. As recovery proceeds, the forced event ends. The Potential MWh production loss pertains only to the forced outage, not the planned outage. This event is depicted in **Figure N.4.** In addition, there is the capability to use more than one cause code for each event.

As is shown in **Table N.3**, ALL fields must match in this event – especially Event ID. The only field with a different value is the Cause Code. Each event must have a Primary Cause Code. The Primary Cause Code is the main cause of the event that has the most impact to Potential MWh Production Loss. *Any turbines already out for the Planned Outage are not counted in the Forced Outage Event's Potential MWh Production Loss.*

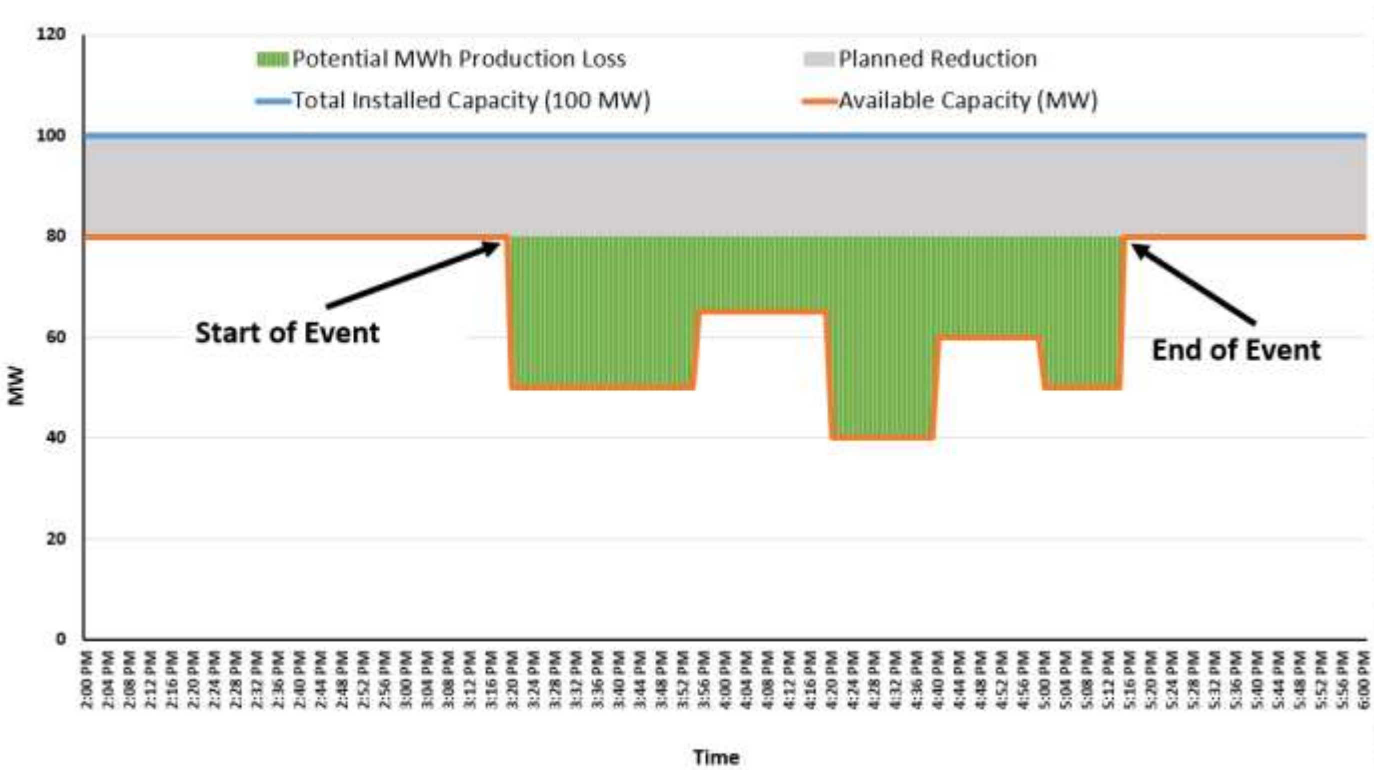


Figure N.4: Multiple Outages as a Single Event

As **Figure N.4** shows, the event starts when the plant has 20 MW of installed capacity go out and ends when 95% of the equipment that was in an outage state returns to service.

Table N.3: Multiple Outages - Single Event Detail										
Entity ID	**Plant ID**	**Event ID**	**Time Zone**	**Event Start Date / Time**	**Event End Date / Time**	**Event Type**	**Cause Code**	**Contributing Operating Condition**	**Description**	**Potential MWh Production Loss**
1234	5678	45	CPT	10/23/2023 06:20	10/23/2023 08:10	FO	**Primary** 25050	0	Section 1 had several turbine rows overheat. During repairs, Section 2 had a cooling failure. While those were being repaired, Section 3 had a short circuit in a cabinet which quickly resolved.	51.25
1234	5678	45	CPT	10/23/2023 06:20	10/23/2023 08:10	FO	Secondary 25080	0	Section 1 had several turbine rows overheat. During repairs, Section 2 had a cooling failure. While those were being repaired, Section 3 had a short circuit in a cabinet which quickly resolved.	51.25
1234	5678	45	CPT	10/23/2023 06:20	10/23/2023 08:10	FO	Tertiary 25110	0	Section 1 had several turbine rows overheat. During repairs, Section 2 had a cooling failure. While those were being repaired, Section 3 had a short circuit in a cabinet which quickly resolved.	51.25

In **Table N.3**, all rows are the same except for the Cause Code Field.   This is to explicitly show that there can be different cause codes for a single event. The Reporting interface may show a different format.

The calculation for the Potential MWh Production Loss is as follows:

Potential MWh Production Loss: $MWh\ Loss = Event\ MW\ Loss \times Event\ Duration$

MWh Loss = (30 * .5833) + (15 * .4167) + (40 * .3333) + (20 * .3333) + (30 * .25)
MWh Loss = 51.25

Overlapping Outages as Multiple Events

The previous example can pose a dilemma for some larger plants, as they may find that some of these events never actually reach the event end threshold (95% of equipment returns to service), due to the sheer volume of equipment they operate. To help resolve this issue, large outage events may be broken up into several single-cause events as shown in **Figure N.5**.

In this scenario, the outage circumstances in **Figure N.5** are the same as in **Figure N.4**. However, the larger event is broken down into smaller sub-events, which are then reported individually. This can only happen if the plant can ascertain how individual turbines are affected by the outages and can assign different cause codes to each smaller sub-event. In **Figure N.5**, the Plant Available Capacity that is unavailable for Event 45 overlaps the unavailable capacity for Event 46.   When calculating the Potential MWh Production loss, only count the turbines that are out for each individual cause code as shown in **Table N.4**.

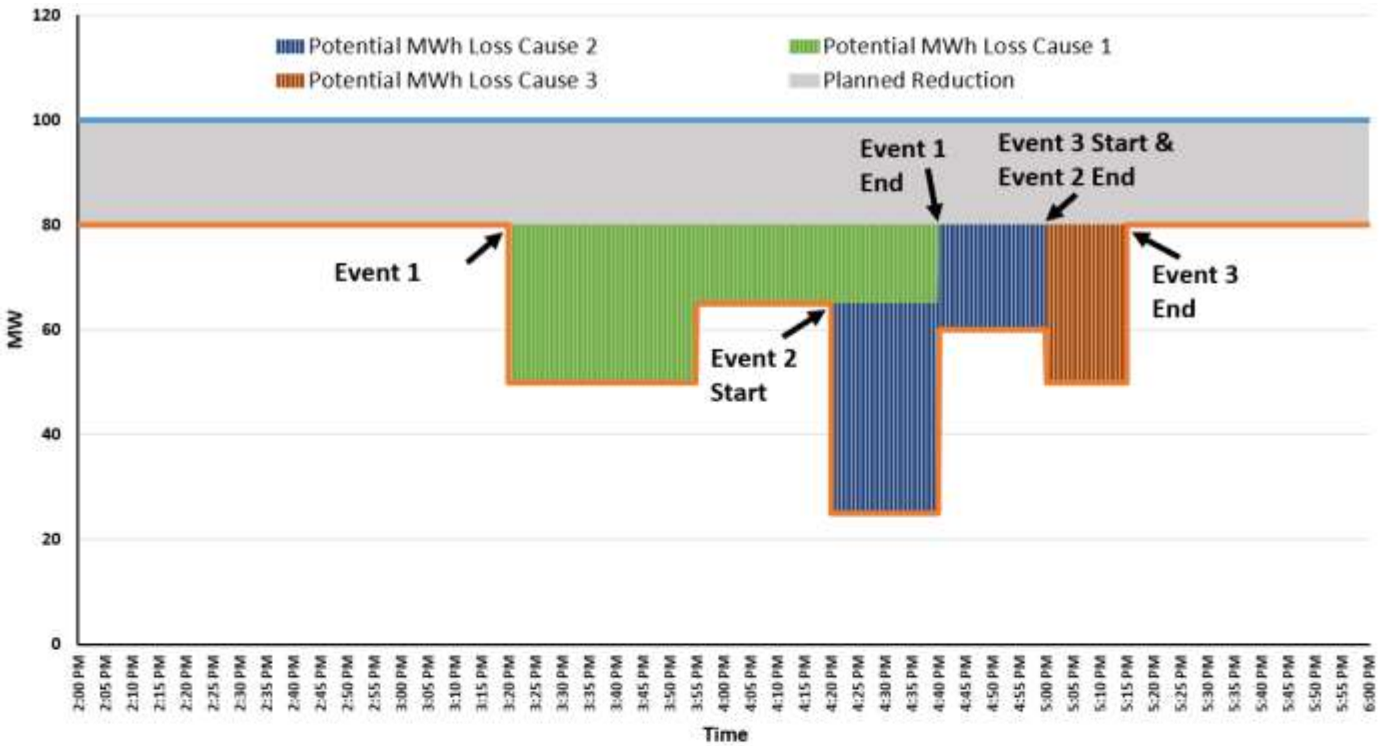


Figure N.5: Overlapping Outages as Multiple Events

We see different shadings for each of the separate set of turbines that are out. This results in separate values for Potential MWh Production Loss (**Table N.4**). However, if you add up each of the separate losses, they will equal the total loss as shown in the previous example (51.25 MWh Loss).

Table N.4: Overlapping Outages – Multiple Event Detail										
Entity ID	Plant ID	Event ID	Time Zone	Event Start Date / Time	Event End Date / Time	Event Type	Cause Code	Contributing Operating Condition	Description	Potential MWh Production Loss
1234	5678	45	CPT	10/23/2023 15:20	10/23/2023 16:40	FO	25050	0	Section 1 had several turbines overheat.	28.75
1234	5678	46	CPT	10/23/2023 16:20	10/23/2023 17:00	FO	25080	0	Section 2 had a Cooling failure.	15.0
1234	5678	47	CPT	10/23/2023 17:00	10/23/2023 17:15	FO	25110	0	Section 3 had a short circuit in a cabinet which quickly resolved itself.	7.5

Note that all the separate cause codes occur on different sets of turbines. The calculation for the Potential MWh Production Loss is as follows:

Potential MWh Production Loss: $MWh\ Loss = Event\ MW\ Loss \times Event\ Duration$
Event 45 MWh Loss = (30 * .5833) + (15 * .75)
Event 45 MWh Loss = 28.75

Event 46 MWh Loss = (25 * .3333) + (20 * .3333)
Event 46 MWh Loss = 15

Event 47 MWh Loss = (30 * .25)
Event 47 MWh Loss = 7.5

Overlapping Outages for the Same Turbines

What if some of the same turbines were out for different reasons? In this example, shown in **Figure N.6**, we still have the same 100 MW plant with 20 MW out for a Planned Outage event. However, two events happen at nearly the same time. The first event takes out part of the plant, removing several turbines from service. The second event takes out many of the *same* turbines as well as others.

There is an important GADS rule that covers this situation: "If equipment is already out of service for a particular outage, it stays in that outage until the outage is fixed." This rule can also apply when tallying turbine-hours in the performance reporting of a turbine group. This means the blue and green overlap should apply to the first outage, and the Potential MWh Production Loss of those turbines applies to that first event.

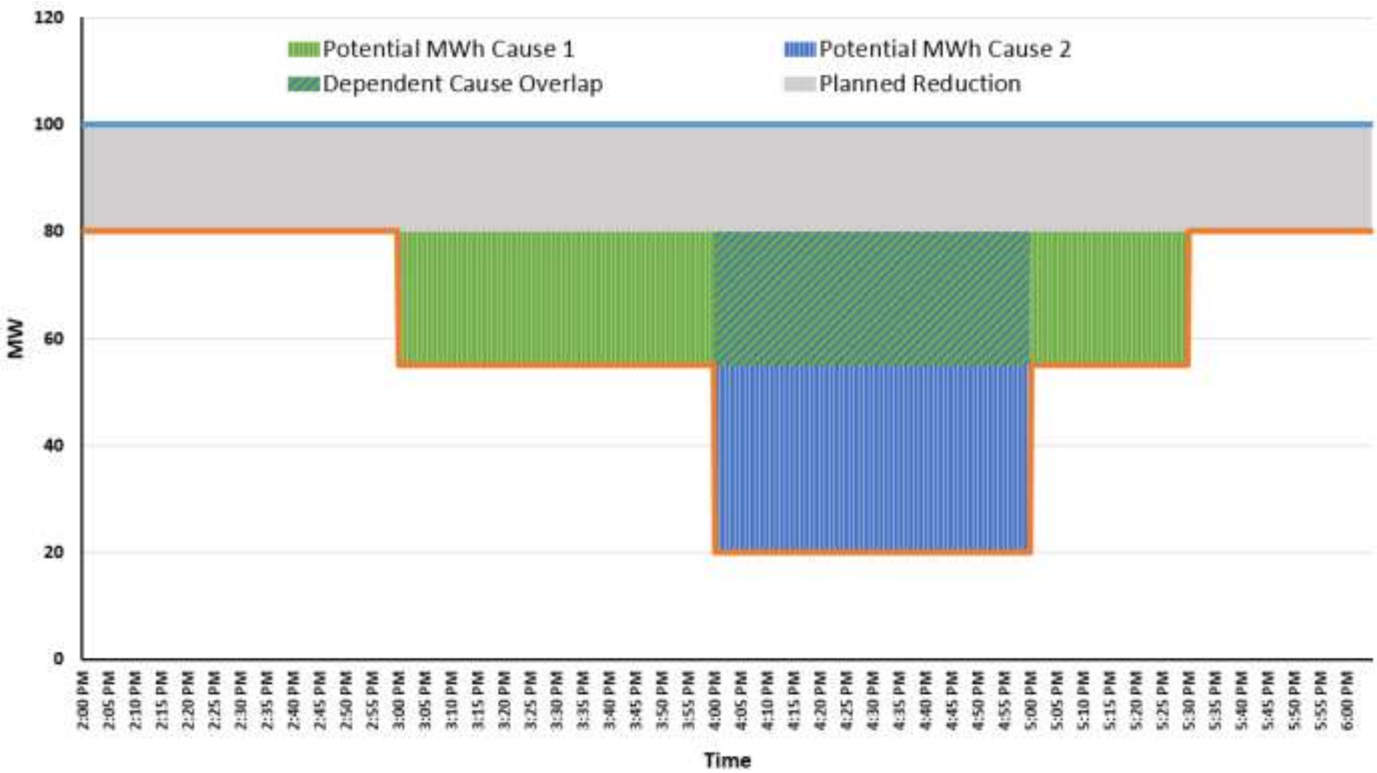


Figure N.6: Overlapping Outages for the Same Turbines

In this example, the summation of Potential MWh Production Loss is higher in the first event than the second event. See **Table N.5** for more detail. The calculation for the Potential MWh Production Loss is as follows:

Potential MWh Production Loss: $MWh\ Loss = Event\ MW\ Loss \times Event\ Duration$
Event 45 MWh Loss = (25 * .25)
Event 45 MWh Loss = 62.5

Event 46 MWh Loss = (35 * 1)
Event 46 MWh Loss = 35

Table N.5: Overlapping Outages - Same Turbines Detail										
Entity ID	Plant ID	Event ID	Time Zone	Event Start Date / Time	Event End Date / Time	Event Type	Cause Code	Contributing Operating Condition	Description	Potential MWh Production Loss
1234	5678	45	CPT	10/23/2023 15:00	10/23/2023 17:30	FO	25050	0	Section 1 had several turbines overheat.	62.5
1234	5678	46	CPT	10/23/2023 16:00	10/23/2023 17:00	FO	23600	0	Transformer 2 failed, causing an outage over a large part of plant, overlapping some turbines already out due to event 45.	35.0

Additional Examples

Maintenance Outages do not count towards an event.

- An underground feeder overheats and fails.
- 25 1.5MW turbines are on the failed circuit for a total of 37.5MW.
- At the time of the overheat, 12 additional turbines were down for a maintenance outage.
- Event start: 37.5 MW event begins as soon as the overheat is detected.
- Event End: When 37.5 * 0.95 = 24 turbines that were part of the outage are restored.
- Note the 12 turbines that were on MO are not part of the outage.

Equipment must be completely unable to inject to the BPS to count towards an event.

- An ice storm causes ice to accumulate on turbine blades at a 100 MW plant.
- The ice accumulates evenly across the plant and reduces all turbines' efficiency by half for 2 hours. No turbines were shut down completely.
- This is NOT an event. The ice did not cause any part of the plant to shut down completely. Event reporting relates to equipment unavailability, not when the equipment is producing at a reduced capacity, due to lack of resource, or efficiency losses.

Equipment with reduced output becomes part of an event when completely shut down.

- Freezing fog causes ice to accumulate on turbine blades at a 100 MW plant, with 50 2 MW turbines.
- The ice accumulates on turbines across the plant. Over several hours, turbine icing causes a reduction in efficiency, but all equipment continues to run.
- After a few hours, 10 turbines shut down due to blade imbalance.
- After another hour, another 10 turbines shut down for the same reason.
- This IS an event. Even though the ice simply 'derated' the turbines initially, as soon as >= 20 MW of total installed capacity is prevented from injecting, the event begins.
- The event will end when 40 MW X .095 = 38 MW is restored. In this case, that would equate to 19 of the 20 turbines.

Expected generation plays no part in identifying an event.

- Based on ambient conditions and historical data, the plant manager expects that his plant should be producing 75 MW at his 100 MW plant.
- The SCADA systems indicate that the plant is only producing 55 MW, but all turbines are producing.
- This is NOT an event. Even though the plant is producing 20 MWs less than the plant manager expected, no part of the plant is damaged or prevented from injecting into the BPS. The gap between expectation and actual production plays no part in defining an event.

Expected generation plays no part, but it can be used to scrutinize plant output.

- Based on conditions and historical data, the plant manager expects that her plant should be producing 75 MW at her 100 MW plant.
- The SCADA systems indicate that the plant is only producing 55 MW. It is determined that 20 MW of installed capacity (turbines) are shut down due to temperature limits.
- This IS an event. 20 MW of installed capacity is completely shut down due to an equipment limitation.