ISO new england

memo

To: Wind Plant Staff Members (DE Operations Management, DE Training Contact, DE Technical Contact, Lead Market Participants)

From: System Operations

Date: September 14, 2016

Subject: Use of Wind High Limit in DNE dispatch

As part of ISO-New England's ongoing effort to evaluate the effectiveness of the Do Not Exceed (DNE) dispatch implementation and respond to DNE-related feedback from Participants, ISO-NE is planning to begin using the wind plant's self-reported Wind High Limit (WHL) in the automatic redeclaration calculation of the Economic Maximum (EcoMax) limit for the current hour and next hour (if within 15 minutes).

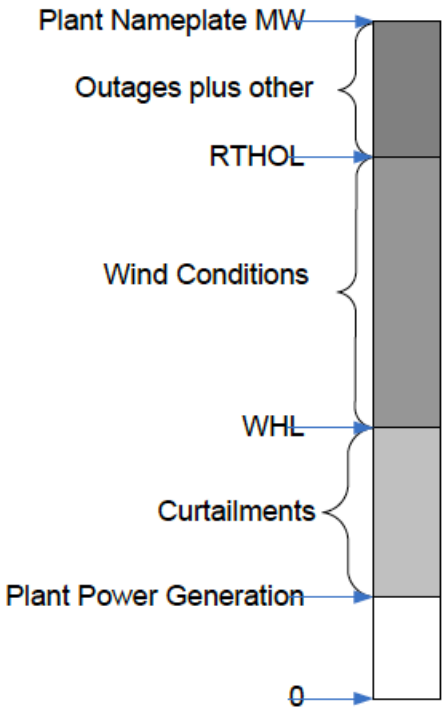
Starting November 1, 2016 ISO will begin automatically redeclaring the current hour and next hour (if within 15 minutes) EcoMax to the average of the WHL and the Short-Term Wind Power Forecast (STWPF). This will replace the current automatic redeclaration process that sets the EcoMax to the STWPF. On occasion (e.g., significant increases in wind speed and output), the STWPF has been shown to slightly lag actual wind plant output which can have the effect of limiting wind plant DNE limit increases during times of transmission constraints and wind upramps. This modification places additional importance on Wind Plant Operators ensuring that the WHL is maintained up to date and is representative of the actual real-time, unconstrained capability of wind plants. In addition, ISO-NE plans to continue to work with the wind forecast vendor to improve the STWPF, especially during times of significant wind ramps.

Because ISO has observed a high level of error in the WHL reported by a number of Wind Plant Operators and this error could lead to unintentional wind plant curtailment, we would encourage all Wind Plant Operators to confirm prior to November 1 that they are calculating their WHL correctly.

Wind Plant Operators report the WHL to ISO-NE automatically via the RTU Reliability Session. To closely paraphrase the WHL (as defined in OP-14F):

> **Wind High Limit** –The estimated total Wind Plant power output (MW) ignoring any Curtailment. Except for Curtailed operations and for conditions immediately following a release from a Curtailment, (i.e., when a Wind Plant is operating in an uncurtailed mode), the Wind High Limit of a Wind Plant shall equal its Plant Power Generation. When a Wind Plant is being Curtailed for any reason, the Wind High Limit will be greater than the Plant Power Generation. Each individual wind turbine will possess its own individual theoretical maximum limit that is a function of wind speed, turbine manufacturer's density corrected power curve, turbine availability, and any loss factors. The Wind High Limit is the sum of the individual wind turbine theoretical maximum limits minus any plant-wide loss factors (e.g., electrical collector system losses) and will approximate the Plant Power Generation were there no Curtailment.

***Note that the reported WHL is expected to include any permit-based restrictions that exist at the Wind Plant**



Curtailed operation means that the plant is being actively controlled (whether manually or automatically) to reduce output to below the maximum amount of power that could be produced by the available equipment given the current weather conditions. Curtailment specifically excludes the effects of physical conditions such as wind speed and/or icing conditions.

In short, when a wind plant is not being curtailed, the WHL should equal its actual net power injection at its Point of Interconnection. When a wind plant is being curtailed, the WHL should be equal to the net output that would be achieved if the curtailment were removed.

As a reminder, the <u>minimum</u> update frequency for WHL (as listed in OP-14F) is once every 5 minutes.

Please consult OP-14F and use the illustrative examples below in verifying that your WHL is being calculated and submitted correctly.

Again, this change will be implemented on November 1, 2016. Any questions or concerns regarding the contents of this memo or the expectations outlined herein should be directed to Bill Henson at 413-540-4716 or Stephen George at 860-683-3299.

System Operations

Illustrative (hypothetical) examples of how to calculate WHL under various conditions are shown below. Wind speeds in the following examples are assumed to be constant. Variability of wind conditions will likely introduce some error into the calculation of WHL; this is expected. Losses between the wind turbine and the Point of Interconnection (POI) are not taken into account in these simplified examples, but should be in the WHL calculation such that the WHL reports the net power injection at the POI rather than the gross production.

Wind plant with two identical 2.25 MW wind turbines, with the following site-specific power curve:

wind speed [m/s]	power [kw]		wind speed [m/s]	power [kw]		wind speed [m/s]	power [kw]
0	0		10	666.67		20	2250
1	0		11	887.33		21	2250
2	0		12	1152		22	2250
3	18		13	1464.67		23	2250
4	42.67		14	1830		24	2250
5	83.33		15	2100.77		25	2250
6	144		16	2250		26	0
7	228.67		17	2250		Above 26	0
8	341.33		18	2250			
9	486		19	2250			

1. Wind speed at turbine 1 is below cut-in and wind speed at turbine 2 is 3 m/s.
    a. WHL is 0 MW + 0.018 MW = 0.018 MW
2. Wind speed at turbine 1 is 8 m/s and wind speed at turbine 2 is 3 m/s.
    a. WHL is 0.341 MW + 0.018 MW = 0.359 MW
3. Wind speed at turbine 1 is 8 m/s and wind speed at turbine 2 is 3 m/s, wind turbine 2 is curtailed to zero output due to permitting restrictions
    a. WHL is 0.341 MW + 0 MW = 0.341 MW
4. Wind speed at turbine 1 is 8 m/s and wind speed at turbine 2 is 3 m/s, wind turbine 2 is curtailed to half output due to permitting restrictions
    a. WHL is 0.341 MW + 0.009 MW = 0.350 MW
5. Wind speed at turbine 1 is 8 m/s and wind speed at turbine 2 is 3 m/s, wind turbine 2 is Out Of Service due to permitting restrictions
    a. WHL is 0.341 MW + 0 MW = 0.341 MW
6. Wind speed at turbine 1 is 15 m/s and wind speed at turbine 2 is 10.5 m/s.
    a. WHL is 2.101 MW + 0.777 MW = 2.878 MW
7. Wind speed at turbine 1 is 15 m/s and wind speed at turbine 2 is 10.5 m/s, but plant is curtailed (due to DNE) to 1 MW
    a. WHL is 2.101 MW + 0.777 MW = 2.878 MW
8. Wind speed at turbine 1 is 15 m/s and wind speed at turbine 2 is 10.5 m/s, but wind turbine 2 is Out Of Service due to failure
    a. WHL is 2.101 MW + 0 MW = 2.101 MW
9. Wind speed at turbine 1 is 20 m/s and wind speed at turbine 2 is 26 m/s
    a. WHL is 2.250 MW + 0 MW = 2.250 MW
10. Wind speed at turbine 1 is 20 m/s and wind speed at turbine 2 is 22 m/s
    a. WHL is 2.250 MW + 2.250 MW = 4.500 MW