

Appendix B - Capability Determination For Thermal, Pumped Storage, and Weekly Cycle Hydro Generator Assets

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I. GENERAL REQUIREMENTS

- A. Two or more assets in a single station and/or two or more stations, or portions of combined-cycle generating stations modeled as Pseudo-Combined Cycle assets, whose capability is limited by common elements and/or commonly assigned staffing should establish capability based on simultaneous CCAs.
- B. Common elements include but are **not** limited to:
- Staffing;
 - Steam headers;
 - Stacks and other boiler auxiliaries;
 - Condenser cooling equipment (spray modules, pumps, screens, inlets, discharge canals, cooling tower, etc.); and
 - Common river flowage or watershed.
- C. The capability of the individual common elements associated with a group of stations or assets should be established recognizing the impact of each element on the capability of the entire group.
- D. Normal station service and unit auxiliaries (such as spray modules, cooling towers, or other auxiliaries required by regulatory or governmental authority) should be in use during the period when a CCA is conducted. Market Participants may use discretion when estimating station service for small (less than five MW), unstaffed hydro and internal combustion stations where station service is **not** accurately metered and/or recorded on an hourly basis.
- E. Multi-Generator stations must self-certify for the individual Generator Assets of the station that the SCC of the Generator Assets at this station are **not** limited in any way by common elements, commonly assigned staffing or any other factors. This certification is provided by submitting the form found in Appendix E of this Operating Procedure.

II. INDIVIDUAL ASSET TYPES

A. In addition to requirements listed in Section I of this Appendix, the following requirements, applicable to specific generator types, will govern capability determination:

1. Steam Turbine Assets With **No** Steam Exports

No adjustments for atmospheric and/or water temperatures, other than those specified in Section III.1.5.1.4 of Market Rule 1, will be made.

2. Steam Turbine Assets, Combined Cycle Assets, or Pseudo-Combined Cycle Assets with Steam Exports

a. In instances where steam is exported for uses external to the electric power facility, an adjustment must be made to the MW output demonstrated during a CCA in order to normalize the SCC for steam exports by adjusting for the difference between actual steam exports and “normal” steam exports. It is expected that when a CCA is conducted or when the asset is being dispatched “in merit” based on its Supply Offer profile (which should be consistent with and reflective of its contractual arrangements), the steam exports of the facility will be managed so as to demonstrate the full level of control by the facility operators over steam export rates which is permitted by contract so as to maximize electric output.

b. All Generator Assets with one or more steam turbine must self-certify that the Generator Assets do **not** have steam exported for uses external to the electric power facility that may affect the SCC by submitting Appendix F of this procedure to ISO.

1) In order to make the adjustment for steam exports, the Lead Market Participant or its agent, shall provide:

i. Statements of its Seasonal Claimed Capability Steam Demand (SCCSD) for both the Winter and Summer Claimed Capability Periods. The SCCSD for each seasonal period is the expected (average) steam export during OP-4 or on-peak hours and is determined as follows:

a) *Fully Interruptible*. If steam exports can be fully interrupted at the direction of the Lead Market Participant or its agent pursuant to dispatch orders of the ISO based on the asset’s Supply Offer profile or during any and all actions of ISO New England Operating Procedure No. 4 - Action During a Capacity Deficiency (OP-4)., the SCCSD shall be equal to zero.

b) *Fixed Amount Interruptible*. If steam exports can be partially curtailed at the direction of the Lead Market Participant or its agent pursuant to dispatch orders of ISO based on the asset Supply Offer profile or during any and all actions of OP-4, the SCCSD shall be equal to the average steam export rate during the on-peak

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hours of the Seasonal Claimed Capability Period which actually occurred during the immediately prior like period less the volume or proportion of steam which can be curtailed based on the asset Supply Offer profile or during any and all actions of OP-4.

- c) *Uninterruptible*. If steam exports **cannot** be curtailed at the direction of the Lead Market Participant or its agent, the SCCSD shall be equal to the average steam export rate during the on-peak hours of the Seasonal Claimed Capability Period that actually occurred during the immediately prior like period.
- ii. For a new asset, if actual average steam export data is **not** available, the Lead Market Participant will provide ISO with its best reasonable estimate of steam exports for each Seasonal Claimed Capability period, consistent with the degree to which steam exports can be interrupted, as described above
- iii. A table is to be provided with the appropriate Asset Registration Form, showing output at various steam export levels (or, for combined cycle or pseudo-combined cycle assets, output at various steam export and temperature levels). This steam-temperature-output table would include expected output at the respective Seasonal (summer and winter) Claimed Capability Steam Demand and, if applicable, respective seasonal (90°F-summer and 20°F-winter) criterion temperatures. (The same requirements on temperature adjustments provided in Attachment A of this manual should be followed). This table must include the full range of possible steam exports, in increments of 5,000 lbs/hr (and temperatures, if applicable) associated with the full range of possible MW output levels of the facility. (If necessary, increments of other than 5,000 lbs/hr may be provided). An abridged example of such a table, which also provides for the submission of SCCSD and Interruptible Steam Export (ISE) data is shown in Table 1.
- 2) ISE for both the Winter and Summer Claimed Capability Periods, is the amount of steam demand contractually available during OP-4, CCAs, and as offered economically. ISE, for each seasonal period, is the amount that is available to be interrupted, while SCCSD is the expected amount of steam export after exports are interrupted. For example, if steam exports are normally 50,000 lbs/hr and are fully interruptible, then ISE =50,000 and SCCSD = 0.
- 3) Within seven business days after a CCA is conducted on an asset for which adjustments must be made for steam exports, the Lead Market Participant or its agent will provide ISO with information on the average steam export rate that occurred during the period of the CCA, including:
- o Actual Steam Export (ASEP) during the hour just prior to the initiation of a CCA
 - o Average Actual Steam Export (AASED) during the period of the CCA.

TABLE 1: TEMPERATURE-STEAM PERFORMANCE (MW) TABLE (EXAMPLE) <i>Process Steam Flow (lbs/hr)</i>						
Temperature (degrees, Fahrenheit)	0	5,000	10,000	15,000	45,000	50,000
0	66.380	66.030	65.680	65.330	63.230	62.880
1	66.098	65.748	65.398	65.048	62.714	62.209
2	65.815	65.465	65.115	64.765	62.199	61.538
3	65.533	65.183	64.833	64.483	61.683	60.866

- 4) ISO will obtain the data for the Demonstrated Capability, Unadjusted (DCU) and, for combined cycle assets, adjust the DCU for the combined steam and combustion turbine components to criterion temperature to derive the Demonstrated Capability Adjusted for Temperature (DCAT); for steam turbine assets, DCAT is equal to DCU. ISO will then use steam export information to normalize the output demonstrated for steam exports to derive the Demonstrated Capability Adjusted for Temperature and Steam Exports (DCATSE).
- 5) The following examples illustrate how DCATSE will be derived in different situations:

Example 1 - Assets with **no** interruptible steam sales (i.e., ISE = 0)

In this example, the normalization process adjusts for the difference between AASED and SCCSD as follows:

$$\text{DCATSE} = \text{DCAT} + (\text{MW@SCCSD} - \text{MW@AASED})$$

Where:

MW@SCCSD = the expected output indicated by the steam-temperature-output table at the criterion temperature and Seasonal Claimed Capability Steam Demand; and

MW@AASED = the expected output indicated by the steam-temperature-output table at criterion temperature and the Actual Average Steam Export during the period of the CCA.

Example 2 - Assets for which steam sales are fully interruptible

In this example, the steam exports are supposed to be interrupted during a CCA or when the asset is dispatched to its Eco Max in economic merit order based on offers that should be consistent and reflective of its

contractual arrangements. Therefore AASED should be equal to SCCSD. If steam exports are **not** interrupted, the CCA result will reflect the failure to interrupt. In this example, there is **no** adjustment for steam exports to be made:

$$\text{DCATSE} = \text{DCAT}$$

Example 3 - Assets for which a fixed quantity of export steam is interruptible

In this example, the normalization process adjusts for the difference between AASED and SCCSD (as in Example 1), but **no** credit is given for failures to interrupt. In this example, the adjustment is as follows:

$$\text{DCATSE} = \text{DCAT} + \text{MW@SCCSD} - \text{MW@AASED} - [\text{MW@SCCSD} - \text{MW@}(\text{SCCSD} + \text{ISE} - (\text{ASEP} - \text{AASED}))] = \text{DCAT} + [\text{MW@}(\text{SCCSD} + \text{ISE} - (\text{ASEP} - \text{AASED}))] - \text{MW@AASED}$$

Where:

MW@SCCSD is defined as in Example 1;
 MW@AASED is defined as in Example 1; and
 MW@(\text{SCCSD} + \text{ISE} - (\text{ASEP} - \text{AASED})) = the expected output indicated by the steam-temperature-output table at the criterion temperature and a steam export reference point which is equal to the Seasonal Claimed Capability Steam Demand (SCCSD) adjusted to reflect the difference between the claimed Interruptible Steam Export (ISE) amount and the amount which was actually interrupted during the CCA where such amount is equal to the difference between the Actual Steam Export just prior to the CCA (ASEP) and the Average Actual Steam Export during the CCA (AASED).

The following examples in Tables 2 and 3 illustrate the steam export adjustment calculations.

**TABLE 2:
STEAM ADJUSTMENT EXAMPLES ASSUMING STEAM EXTRACTED IN SUCH
A WAY THAT IT REDUCES OUTPUT**

	Steam Export (lbs/hr)	50,000	40,000	30,000	20,000	10,000	0	
	Output (MW)	240	243	245	247	249	250	
Steam Export -	SCC	DCAT	SCCSD	ISE	ASEP	AASED	DCATSE	Result
	(MW)	(MW)	(lbs/hr)	(lbs/hr)	(lbs/hr)	(lbs/hr)	(MW)	
<i>Uninterruptible</i>	240	245	50,000	0	30,000	30,000	240	pass
	240	240	50,000	0	30,000	30,000	235	fail
	247	245	20,000	0	30,000	30,000	247	pass
<i>Fully Interruptible</i>	250	250	0	50,000	50,000	0	250	pass
	250	240	0	50,000	50,000	50,000	240	fail
	250	243	0	50,000	50,000	50,000	243	fail
	250	243	0	50,000	50,000	40,000	243	fail
	250	243	0	50,000	50,000	10,000	243	fail
<i>Fixed Amount Interruptible</i>	245	245	30,000	20,000	50,000	30,000	245	pass
	245	240	30,000	20,000	50,000	50,000	240	fail
	249	243	10,000	20,000	50,000	40,000	247	fail
	245	245	30,000	20,000	40,000	20,000	243	fail
	245	240	30,000	20,000	40,000	20,000	238	fail

TABLE 3: STEAM ADJUSTMENT EXAMPLES ASSUMING STEAM EXPORTS INCREASE OUTPUT (TOPPING CYCLE – STEAM IS USED TO PRODUCE ELECTRICITY FIRST AND THEN EXTRACTED AFTER THE STEAM TURBINE)								
	Steam Export (lbs/hr)	50,000	40,000	30,000	20,000	10,000	0	
	Output (MW)	250	249	247	245	243	240	
Steam Export	SCC	DCAT	SCCSD	ISE	ASEP	AASED	DCATSE	Result
	(MW)	(MW)	(lbs/hr)	(MW)	(lbs/hr)	(lbs/hr)	(MW)	
<i>Uninterruptible</i>	250	250	50,000	0	50,000	50,000	250	pass
	247	250	30,000	0	50,000	50,000	247	pass
	250	247	50,000	0	30,000	30,000	250	pass
	250	247	50,000	0	30,000	30,000	250	pass
	250	242	50,000	0	30,000	30,000	245	fail

c. Gas Turbine, Combined Cycle, and Pseudo-Combined Cycle Assets with **No** Steam Exports

1) Additional data that must be submitted to the ISO with the asset registration include a table reflecting the full range (100°F - 0°F, in one degree increments) of temperature versus MW output for the asset. Such tables must be reflective of the asset characteristics and claimed capabilities reflected during initial registration and any subsequent revision submittal.) Specifically:

- The table may be referred to as the assets temperature curve and typically is non-linear by nature showing the degradation of output as the ambient (or inlet) temperature increases. This curve should be an accurate depiction of the assets output at every ambient temperature degree increment.
- The output value associated with the 90°F temperature must equal the initial summer SCC;
- The output value associated with the 20°F temperature must equal the initial winter SCC; and
- All other MW output values must be consistent with those associated with the 90°F and 20°F values.

3. Pumped Storage Hydro Assets

- a. At the time of initial commercial operation for a station and/or asset, a CCA demonstration shall be conducted as a station.
- b. Pumped storage stations that, due to a net head reduction, experience a continuous downward trend in capability exceeding an average of one percent per hour during the first four hours of the commercial operation or subsequent station CCA demonstrations, should base the ratings on a station demonstration rather than individual asset's demonstration. Asset CCA demonstration requests to establish a higher Claimed Capability Rating shall require a station CCA demonstration.
- c. CCA demonstration requests to restore the capability of a single asset, or a subset of assets at the station, can be done individually as long as the resulting capability of the station is less than or equal to the total SCC for the station that had previously been claimed over the past two similar capability periods and **no** previous station demonstrations experienced a downward trend in capability exceeding an average of one percent per hour.
- d. Seasonal Claimed Capability should be established that ensures that the total Energy content of the upper reservoir is sufficient to sustain Seasonal Claimed Capability for four hours and that the upper reservoir can be restored to provide the SCC for that duration during five successive weekdays.
- e. Stations operated on a weekly draw-down cycle should determine SCC based on a station upper reservoir Energy content being **no** greater at the completion of the CCA than 75% of the maximum Energy content when the upper reservoir is full.

4. Conventional Hydro Generators - Weekly

- a. Stations may be considered as operated on a weekly draw-down cycle provided there is on-site Energy storage between normal operating elevations equivalent to at least ten times SCC, assuming zero inflow from natural run-off and upstream station water discharge. Otherwise, stations will be considered as operated on a daily cycle.
- b. Capability should be determined based on:
 - A station CCA demonstration (with all assets within the station operating) rather than individual asset CCA demonstrations conducted at different times.
- c. SCC should be determined based on the stations normal or typical net head at mid-week or mid-season.

III. OP-23 Appendix B Revision History

Rev. No.	Date	Reason
Rev 0	09/01/13	Initial draft
Rev 0.1	07/06/15	Periodic review performed requiring no changes;
Rev 0.2	04/18/17	Periodic review performed by procedure owner requiring no changes; Added required corporate document identity to all page footers;
Rev 0.3	01/-9/19	Periodic review performed by procedure owner requiring no changes; Made administrative changes required to publish a Minor Revision;