NOVEMBER 26, 2020

Market Power Mitigation
Reference Levels and Reference Quantities
Energy Storage Resources

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Agenda

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1. Objectives

- Engage with Energy Storage resources on the reference level and reference quantity methodologies
- Support storage resources in their review of the draft written guide and workbooks
- Answer technical questions on the written guide with the *IESO's* engineering services provider (Hatch)

2. Update on Stakeholder Engagement Process

- Reference level and reference quantity stakeholder engagement kick-off meeting was conducted on August 27, 2020.
- October 30, 2020 – Technology-specific meetings was held with Dispatchable Loads, Wind and Solar resources
- November, 2020 – Technology-specific meetings with Storage, Hydroelectric, Nuclear and Thermal resources
- Next steps in the reference level engagement:
    - Beginning in 2021: 1-on-1 consultation with *market participants* to establish resource-specific reference levels and quantities

3. Refresher: Reference Levels and Reference Quantities

- Reference levels and reference quantities play an important role in the Market Power Mitigation framework
- The Market Power Mitigation detailed design document introduced processes necessary to set, maintain and update reference levels
- Establishing appropriate reference levels is a high priority for both stakeholders and the *IESO*

3. Refresher: Reference Levels and Reference Quantities

Reference levels are *IESO*-approved values for a resource for what would have been offered by a *market participant* in the *energy* and *operating reserve markets* had they been subject to unrestricted competition. The *IESO* will approve reference levels for financial and non-financial *dispatch data* parameters of each resource

- An example of a financial *dispatch data* parameter is *energy offers* ($/MWh)
- An example of a non-financial *dispatch data* parameter is *energy* ramp rates (MW/min)

3. Refresher: Reference Levels and Reference Quantities

Reference quantities are *IESO*-approved values for the quantity of *energy* and *operating reserve* a *market participant* would be expected to offer had they been subject to unrestricted competition

These reference quantities can be modified by active *outages*, de-ratings, external factors such as ambient temperature, humidity, water flow conditions and other resource-specific considerations

4. Feedback Received

Reference Level Review: MPs require enhanced governance, decision-making, and recourse within IAM (especially applicable to the market power mitigation framework within MRP)

IESO response: The *IESO* will be engaging with *market participants* on the independent review process for reference levels and reference quantities in the future

4. Feedback Received

List Expansion: The list of accepted documentation in supporting costs and list of eligible maintenance costs provided by the *IESO* should be expanded

IESO Response: Eligibility of documentation developed by the relevant market participant will be evaluated on a case-by-case basis and the costs list included in the guideline are not exhaustive lists. *Market participants* may submit eligible costs and supporting documentation for review. In determining the eligibility of specific documentation, the *IESO* will consider the reasonableness of the content of the documentation. Section 2.3 of the written guide will be updated to reflect this approach for documentation developed by the relevant *market participant*

4. Feedback Received

Offer Obligation: The *IESO* should clarify expectations and obligations regarding the differences between the derived Reference Price levels and actual Market Participant offer behaviour in the markets. It is not explicitly clear if the *IESO* expects MPs to offer at the price levels specified in the workbooks

IESO Response: Market Power Mitigation does not introduce an obligation to offer at prices consistent with reference levels. The *IESO* will include clarifying language to the written guide to that effect

4. Feedback Received

New Technology: Most *energy* storage technologies in *wholesale markets* are relatively new and *market participants* are interested in how they will be integrated into the markets

IESO response: The *IESO* designed the approach for reference levels and quantities for *energy* storage resources based on how these resources currently participate. New storage technologies or changes to the participation model in the *IESO-administered markets* will be accommodated in the mitigation framework on an as-needed basis

4. Feedback Received

Mitigation Applicability: NYISO, MISO, and ISONE do not subject ESRs to Market Power Mitigation. Given the lack of precedent, please explain the potential abuse of market power by ESRs

IESO response: The Market Power Mitigation framework is applied to all dispatchable resources that supply *energy* or *operating reserve* as suppliers of a product can benefit from exercise of market power for that product

4. Feedback Received

Cost Components: In general, the cost components for *energy* storage align with those for other resources within the market but also those developed in other markets. The one exception is the allocation of station service

IESO response: Section 2.5.6.2 of the written guide describes the two possible approaches for accounting for station service costs for *energy* storage resources in determination of financial reference levels. The first approach is for resources where station service is provided behind the meter and the second approach is for resources where station service is provided using a separate feed with its own revenue meter

4. Feedback Received

Opportunity Costs: The opportunity cost for an *energy* storage resource should be reflected in a real-time reference level. There is no entry available for opportunity costs in the workbook and as with hydroelectric resources, *market participants* should have the chance to defend opportunity cost formulations that differ from the *IESO's* proposal

IESO response: The *IESO* will update the *energy* storage workbook to allow for an entry for opportunity cost. For each cost category, the written guide describes the approach that will be taken to determine the appropriate reference level for each resource

5. Opportunity Costs

Intraday Opportunity Cost:

- Is applicable for resources that are *energy-limited* below their maximum available capacity for each hour in the day within a 24-hour period
- Will be equal to the maximum of the highest DAM LMP for the resource and $0/MWh

5. Opportunity Costs

Additional Opportunity Costs:

Where the provided opportunity costs do not address all relevant aspects of opportunity cost for a particular resource, *market participants* may request that the *IESO* add a resource-specific additional opportunity cost

- In order to do so, *market participants* are required to submit the proposed methodology for any additional opportunity cost, along with supporting materials

6. Example workbooks

- Examples of energy storage resource workbooks, completed for illustrative purposes, are discussed in the following slides
- These example workbooks are for discussion purposes only. The numbers and content found there are not an indication of expected values

6. Example workbooks

- The IESO has provided two example workbooks for *energy* storage resources:
  - An example that shows a resource with a separately metered station service that is requesting a reference level and providing supporting materials
  - An example that shows a resource with a behind-the-meter station service that is requesting a reference level and providing supporting materials

6. Example workbooks: W/Station Service Meter

Reference Level Cost Components

	General Resource Information	I. Units of measurement/Formula Reference	II. Applicability - Resource Type	III. Time-Based Applicability - Seasonality	IV. Input	V. Supporting Documentation Reference	VI. Comments
(A)	**Efficiency Factor**						
A.1	**Efficiency Factor**	Efficiency Factor (%) = MWh Discharged/MWh Charge, measured at meter Using 1 year of average data, updated every year or once per season	All energy storage technologies	Applicable in all time periods. Market Participants may propose seasonal efficiencies if needed	92.59%	IESO Settlement Statements showing injections and withdrawals for 1 year	Assume - 5,000 MWh injected per year and 5,400 MWh withdrawn per year

6. Example workbooks: W/Station Service Meter

	General Resource Information	I. Units of measurement / Formula Reference	II. Applicability - Resource Type	III. Time-Based Applicability - Seasonality	IV. Input	V. Supporting Documentation Reference	VI. Comments
B.1	**Total Fuel Cost ($/MWh) - Charging Costs**	Charging Cost ($/MWh) = Average historic charging costs ($/MWh)/ efficiency factor	All energy storage technologies	Applicable in all time periods.	$21.60	Annual bill data for 1 year, showing average electricity pricing	Assume - annual average electricity price of 20$/MWh
B.2	**Station Services Costs ($/MWh)**	Station Services Costs ($/MWh) = Auxiliary power consumption (MWh)/MWh of electricity discharge*electricity pricing ($/MWh)	All energy storage technologies THIS FORMULA IS ONLY APPLICABLE IF STATION SERVICES IS SUPPLIED ON SEPARATE METER	Applicable in all time periods.	$0.40	Annual meter consumption for auxiliaries - based on bills, meter data* Annual energy injected, based on bills, meter data	Assume - Auxiliary Load of 50 MWh per year, annual average electricity price of 20$/MWh, 5,000 MWh injected per year

*If asset has been in operation less than 1 year, see next slide

6. Example workbooks: W/Station Service Meter

- Station Services Cost:
  - If asset has been in operation less than 1 year, vendor data from the datasheet/product manual should be used to estimate the annual consumption

    For example, (10 kW HVAC, 0.01 kW P&C, 0.02 kW meter, 0.1 kW controls, 0.2 auxiliaries)
    10 kW x 8 hr/day x 365 days + (0.01+0.02+0.1+0.2)kW x 24 hr/day x 365 days = 32090 kWh =32 MWh per year

6. Example workbooks: W/Station Service Meter

	General Resource Information	I. Units of measurement / Formula Reference	II. Applicability - Resource Type	III. Time-Based Applicability - Seasonality	IV. Input	V. Supporting Documentation Reference	VI. Comments
B.3	**Major Maintenance ($/MWh)**	Major Maintenance ($/MWh) = Estimated 10 year capital expenditures($)/estimated 10 year energy sales (MWh) 10 year average	All energy storage technologies Major Maintenance will vary based on technology	Applicable in all time periods.	$4.00	Major replacement costs based on vendor estimates for replacement of critical parts (inverter, batteries, controls, etc.) After asset has operated for 10 years, historic costs should replace vendor estimates	Assume - major maintenance of $200,000 over 10 years, an average of 5,000 MWh injected per year

6. Example workbooks: W/Station Service Meter

	General Resource Information	I. Units of measurement / Formula Reference	II. Applicability - Resource Type	III. Time-Based Applicability - Seasonality	IV. Input	V. Supporting Documentation Reference	VI. Comments
B.5	**Unscheduled Maintenance Costs ($/MWh)**	Unscheduled Maintenance Costs ($/MWh) = Historic unscheduled maintenance costs per MWh ($/MWh) x CPI current year/CPI reference year 5 year average	All energy storage technologies	Applicable in all time periods.	$0.17	Historical costs demonstrated by paid invoices for unplanned parts and labor If historical data is not available, market participant should provide a vendor quote for unscheduled maintenance	Assume - Unscheduled maintenance of $1,000 year 1, $500 year 2 and 3, $1,500 year 4, and $700 year 5, 5,000 MWh injected per year

6. Example workbooks: W/Station Service Meter

Opportunity Costs

	General Resource Information	I. Units of measurement / Formula Reference	II. Applicability - Resource Type	III. Time-Based Applicability - Seasonality	IV. Input	V. Supporting Documentation Reference	VI. Comments
(C)	**Opportunity Cost**						
C.1	**Opportunity Costs ($/MWh)**	Based on opportunity cost methodology in the written guide.	All energy storage technologies	Based on opportunity cost methodology in the written guide.			See opportunity cost methodology for how this value can be determined.

6. Example workbooks: W/Station Service Meter

Operating Reserve

	General Resource Information	I. Units of measurement/Formula Reference	II. Applicability - Resource Type	III. Time-Based Applicability - Seasonality	IV. Input	V. Supporting Documentation Reference	VI. Comments
D.1	**10-minute synchronized (spinning) reserve**	Operating Reserve ($/MW) = (auxiliary energy consumption (MWh) x electricity pricing ($/MWh))/MW of OR offered	All energy storage technologies with a duration > 1 hr.	Applicable for all time periods	$1.00	"Load of auxiliaries during operation validated either by: 1) meter withdrawal data, showing consumption during idling and operation 2) vendor data sheet showing consumption of these auxiliary loads	Assume - Auxiliary consumption of 0.5 MWh of auxiliary consumption associated with being ready to discharge, Asset size of 10 MW, Average Electricity price of $20/MWh
D.2	**10-minute non-synchronized (non-spinning) reserve**				$1.00		
D.3	**30-minute reserve (non-synchronized)**				$1.00		

6. Example workbooks: W/Station Service Meter

Financial Dispatch Parameter

#	Parameter	Unit	Description	Formula	Reference value / cost curve
1	*Energy offer*	$/MWh	The energy offer reference level will be used to create an energy cost curve consisting of up to 20 price-quantity pairs that will describe short run marginal costs across the range of energy production. The energy cost curve will be consistent with energy offer requirements as specified in Market Rules Chapter 7 Section 3.5.3.		$26.37
2	*Operating Reserve (OR) Offer*	$/MWh	For an operating reserve offer, the IESO will establish an operating reserve offer reference level curve for each operating reserve offer block. This will include up to 5 non-decreasing values of the operating reserve reference level to form a monotonically increasing cost curve. This operating reserve reference level curve will be used for the conduct and impact testing of the price quantity pairs submitted by the market participant.		$1.00

6. Example workbooks: W/Station Service Meter

Non Financial Dispatch Parameter

#	Non-Financial Reference Level	Unit	Description	Summer Value	Winter Value	Supporting Documentation
1	*Energy Ramp Rate*	MW/min	The energy ramp rate profile across the dispatchable range that the resource expects to meet during normal operation.	15	15	Vendor datasheets, Vendor specifications manuals
2	*Operating Reserve Ramp Rate*	MW/min	The rate that a resource can respond to an operating reserve activation during normal operation.	15	15	Vendor datasheets, Vendor specifications manuals

6. Example workbooks: W/Station Service Meter

Supporting Documentation List

Attachment #	Supporting Document Name	Supporting Document Description
Attachment 1	Vendor Datasheet 1	Section 5.2 page 3
Attachment 2	Vendor Quote 1	Section 8
Attachment 3	IESO Meter Settlement 1	
Attachment 4	IESO Bill 1	

6. Example workbooks: Station Service Comparison

	General Resource Information	I. Units of measurement/Formula Reference	IV. w/o Station Service Input	IV. w/ Station Service Input
(A)	**Efficiency Factor**			
A.1	**Efficiency Factor**	Efficiency Factor (%) = MWh Discharged/MWh Charge, measured at meter Using 1 year of average data, updated every year or once per season	90.91%	92.59%
(B)	**Total Fuel Related Cost**			
B.1	**Total Fuel Cost ($/MWh) - Charging Costs**	Charging Cost ($/MWh) = Average historic charging costs ($/MWh)/ efficiency factor	$22.00	$21.60
B.2	**Station Services Costs ($/MWh)**	Station Services Costs ($/MWh) = Auxiliary power consumption during operation (e.g. heating/cooling during operation) (MWh)/MWh of electricity discharge*electricity pricing ($/MWh)		$0.40

7. Next Steps

- **Feedback:** Stakeholders should submit written feedback on the presented materials to engagement@ieso.ca by **Friday, December 11**
- **December 2020:** IESO will post final written guide and workbooks based on stakeholder feedback received during technology-specific sessions
- **Q1 2021 onwards**: IESO will start 1-on-1 consultations with market participants to establish resource-specific reference levels and quantities

Questions?

Thank You

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