Reference Levels and Reference Quantities

Workbook Instructions and Frequently Asked Questions
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Disclaimer

This document provides an overview of the steps that must be taken to register reference levels and reference quantities for a resource and must be read in the context of the related market rules and market manuals.

The information in this document shall not be relied upon as a basis for any commitment, expectation, interpretation and/or decision made by any market participant or other interested party and is subject to on-going revision.

The posting of this design document is made exclusively for the convenience of market participants and other interested parties. The market rules and market manuals, applicable laws, and other related documents will govern the future market. In the event of any conflict between this document and the market rules or market manuals, the market rules or market manual shall govern.

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1. Introduction

This document describes the process of how one-on-one consultations will be used to determine reference levels and reference quantities for a resource in support of the IESO's market power mitigation framework prior to go-live of Market Renewal. The enduring processes and solutions that will be used to facilitate one-on-one consultations after go-live of Market Renewal are still in development, including the way that information is exchanged and the timing around exchanges of information.

This document provides instructions for how market participants will communicate reference level and reference quantity submissions to the IESO for one-on-one consultations prior to go-live of Market Renewal. The IESO will provide its preliminary view of a resource's reference levels and reference quantities following the one-on-one consultations.

These instructions are organized into four categories:

i. Financial Reference Levels: How to request financial reference levels using the workbook.

ii. Additional Opportunity Costs: How to request an additional opportunity cost when the provided opportunity costs do not address a relevant operational characteristic of a resource.

iii. Non-Financial Reference Levels: How to request non-financial reference levels using the workbook.

iv. Reference Quantities: How to request a modification to the reference quantity calculation methodology for a particular resource, if that resource has operational characteristics that are not reasonably accounted for in the technology-specific approach to determine reference quantity.

This document also provides a frequently asked questions (FAQ) section for each topic organized by technology type.

This document may be updated by the IESO as the reference level consultation process is carried out. Doing so will allow the IESO and market participants to benefit from lessons learned from the one-on-one consultations and improve the efficiency of the process on an ongoing basis.

The independent review process to address any outstanding technical questions following the IESO's communication of its preliminary of a resource's reference levels and reference quantities is outside the scope of this document. The IESO is currently developing the market rules, market manuals, processes and solutions for the independent review process and for the registration process and will have further discussions with market participants on these items.

2. One-on-One Consultation for Reference levels and Reference Quantities

This section describes the five steps in the one-on-one consultations: (i) the kick-off meeting; (ii) information gathering; (iii) submission of supporting materials; (iv) IESO review; and (v) communication of the IESO's preliminary view. Topics described include the parties involved at each step, the tasks required to complete each step, the time allotted and the output of each step.

2.1. Kick-Off Meeting

This step involves a meeting between the market participant and the IESO.

The purpose of the kick-off meeting is for the IESO to provide the market participant with all the materials required to prepare their reference level and quantity submission and to answer any questions that the market participant may have about the process.

This step is complete once the following activities are done:

the kick-off meeting has occurred;

the IESO has provided all required materials to the market participant; and

if a market participant has multiple facilities, the facility that will be the focus of the reference level consultation has been determined.

The kick-off meeting is expected to last approximately one hour.

2.2. Information Gathering by the Market Participant

This step involves the market participant completing the following tasks:

- determining the cost items that will be included in its reference level submission;
- preparing the required supporting materials;
- inserting the calculated values consistent with the supporting materials into the reference level and quantity workbook;
- preparing any submissions related to additional opportunity costs it wishes to request; and
- preparing any modifications to the reference quantity calculation for the resources at the facility.

The information gathering step is primarily carried out by the market participant. During the information gathering step, IESO staff will be available to answer questions and provide support to enable the market participant to prepare the required submissions.

This step is expected to take approximately eight weeks for the first facility of a particular technology type for each market participant and four weeks for each subsequent facility of the same technology type.

The output of the information gathering step is a complete reference level and reference quantity submission, including the workbook, supporting materials, requests for additional opportunity costs and requests to vary the default methodology for reference quantity.

2.3. Submission of Reference Level and Reference Quantity Materials

The submission will include the workbook, supporting materials, and any requests for additional opportunity costs for reference levels or modifications to the technology-specific methodology for determining reference quantities.

Market participants may make their submissions through email or by flash drive if the submission cannot be emailed. The submission will be provided to the IESO following the information gathering step is complete.

The IESO is obligated to maintain the confidentiality of information in its possession or control under section 5.2.1 of Chapter 3 of the market rules and may not disclose confidential information except in accordance with the market rules.

2.4. IESO Review

The IESO will review the submission for completeness and correctness. The reference levels requested in the reference level and reference quantity workbook will be reviewed to determine if the reference levels requested are consistent with the supplementary information submitted. The IESO will also review the methodology that the market participant used to amortize submitted line item costs into each relevant reference level and will review the eligibility of the submitted line item costs to be included in a reference level. Requests for additional opportunity costs and requests to vary the default methodology for determining reference quantities will also be reviewed.

During this step, the IESO may contact the market participant for clarifications, to identify methodological issues with the reference level and reference quantity submission, or to request additional supporting information.

This step is expected to take approximately eight weeks following receipt of the submission.

2.5. Communication of IESO's Preliminary Views on Reference Levels and Reference Quantities

The purpose of this step is to provide the market participant with the reference levels and reference quantities that the IESO intends to register in the future, given the information reviewed in the above steps.

Once the IESO review step is complete, the IESO will communicate, in writing, a preliminary view of the resource's reference levels and reference quantities. The IESO will provide a rationale to the market participant if the IESO's preliminary determination of a reference level or reference quantity differs from the requested reference level or reference quantity.

Following this communication, the market participant may elect to have the preliminary reference levels or reference quantity reviewed using the independent review process. This process will occur before the IESO registers the reference levels and reference quantities.

3. Financial Reference Levels

This section describes the instructions for completing a submission to request financial reference levels and includes FAQs regarding submissions for financial reference levels.

3.1. Instructions for Financial Reference Levels

The workbook is intended to be used by market participants to submit financial reference levels and cost information to the IESO. This workbook and the supporting materials will be used by the IESO to determine reference levels for dispatch data parameters that are expressed in monetary units of measurement (e.g. $/MWh, $) as part of the IESO's Market Power Mitigation framework.

The financial dispatch data parameters relevant to each technology type are found in the **FinDispatchDataParameters** tab of the workbook. This tab also contains the formulas that will be used to determine Energy Offer Reference Levels. Cost components of the financial dispatch data parameters are listed in the **Reference Level Cost Components** tab.

Market participants are required to fill out each line item and submit the completed workbook for the facility with applicable supporting documentation to the IESO.

The reference level curve for energy or operating reserve will be determined by the $/MW(h) costs in this workbook. If the operations of a resource require cost components to vary relative to energy or operating reserve production, then the market participant must identify the cost component and the range of production that the costs relate to. For example, incremental fuel costs may be $10/MWh for a range of 1-15MW of production and $14/MWh for a range of 16-30MW of production.

Market participants will be required to provide supporting documentation for every non-zero cost that they would like to have reflected in the resource's reference level. No supporting materials are required to establish a $0 reference level.

When completing the workbook, market participants may decide what materials to submit and what reference level to request. At this stage in the process, market participants can opt to request a reference level that is lower than the actual costs of the resource.

Requesting a given financial reference level does not:

- prohibit a market participant from submitting a reference level change request in the future;
- prohibit a market participant from submitting a reference level change request for a higher value in the future where warranted based on the short-run marginal costs of the resource; or

The IESO will assess the costs submitted in a workbook for eligibility. Costs must vary in production of incremental supply to be eligible.

Registering a financial reference level at a particular value does not obligate a market participant to offer at or below that value. Registration of financial reference levels does not create an obligation to offer at a particular value.

When completing the workbook, the market participant should complete or insert values for all fields shaded in yellow. If a requested value is 0, that number should be inserted into the relevant field. If a particular field does not apply to that resource, the market participant should insert "N/A" into the relevant field.

Each non-zero cost in the workbook requires supporting information that include references to attachments and page numbers.

Inputs provided by the market participants are considered provisional and subject to the IESO's verification and acceptance.

3.1.1. Introduction Tab

Market participants must provide the following information in the **Introduction** tab:

Resource name

Resource ID

Technology type of resource (e.g. hydroelectric, combined cycle, solar, energy storage etc.)

Date of the workbook completion (in Year/Month/Date format)

Proposed effective date of the workbook (in Year/Month/Date format)

Figure 1 shows the fields included in this tab and the suggested formats.

Resource Information	
Resource Name	
Resource ID	
Technology type of Resource	
Date of the Cost Workbook Completion	YYYY/MM/DD
Proposed Effective Date of the Cost Workbook	YYYY/MM/DD

Figure 1: Fields under Resource Information in Introduction tab

For the purpose of preparing for go-live of Market Renewal, the proposed effective date can be left blank. This information will be required for requests to change a reference level following go-live of Market Renewal and will be completed as part of the submission by the market participant.

3.1.2. Reference Level Cost Components Tab

The **Reference Level Cost Components** tab includes a list of cost categories that are applicable to a particular technology type. Figure 2 shows the different columns that are present in this tab.

Cost Component	I. Units of measurement/ Additional Information	II. Applicability - Resource Type	III.Time-Based Applicability	IV. Input	V. Supporting Documentation Reference	VI. Comments

Figure 2: Columns in the Reference Level Cost Component tab

For each technology type, market participants must provide the following information:

- In the **Cost Component** column, market participants fill out the different costs that can be used to calculate reference levels for resources of that particular technology type.
- In the **Applicability/Resource Technology Type** column, market participants fill out the applicable resource type (for example, solar, wind, pumped storage, hydro etc.).
- In the **Time-Based Applicability** column, market participants specify if the input values are seasonal or applicable to all time periods. For seasonal applicability, market participants indicate the season for which the input value is applicable.
- In the **Input** column, market participants enter the values for each cost component, as applicable. Where a cost is not applicable, market participants enter "N/A". Where a cost is zero, market participants enter "$0".
- In the **Supporting Documentation Reference** column, market participants submitting non-zero costs include the list of supporting documents that they are using to support that specific cost.

  Where available, market participants should use historical cost information spanning the suggested historical study period from Section 3.3 of Reference Levels and Reference Quantities market manual when determining the contribution of a cost to a reference level. That section also describes the approach to be used if that data sample is not available.

- In the **Comments** column, market participants describe how they calculated the cost, e.g. historical cost for the last 5 years/historical generation over the last 5 years.

3.1.3. Definition of Cost Components Tab

The **Definition of Cost Components** tab includes a description of each cost category listed in the **Reference Level Cost Components** tab. This tab also includes the types of supporting documents that market participants may provide.

Note that this tab is for reference purposes only and market participants are not required to input information into this tab. The information provided in this tab is to help market participants refer to and cross-check the supporting documents required for each cost category.

Figure 3 shows the different columns present in the **Definition of Cost Components** tab.

Figure 3: Columns in the Definition of Cost Components tab

This tab includes the following columns:

- The **Cost Category** column includes the list of different cost categories that are listed in the **Reference Level Cost Components** tab for the technology type of resource.
- The **Description** column includes the detailed description of each cost category. For example, the description of the incremental heat rate cost category includes the components that make up this category (i.e. change in heat going in divided by total energy coming out).
- The **Type of Supporting Documentation** column includes the examples of supporting documents that market participants can refer to when submitting documents to support the

costs for each cost category. For example, a seller's quote or invoice could support the heat content of fuel.

3.1.4. Financial Dispatch Data Parameters Tab

In this tab, the IESO provides the applicable financial dispatch data parameters and the formulas used to derive the reference value or cost curve. Market participants must calculate the relevant reference value using the information and formulas in the **FinDispatchDataParameters** tab.

Figure 4 shows the different columns present in this tab.

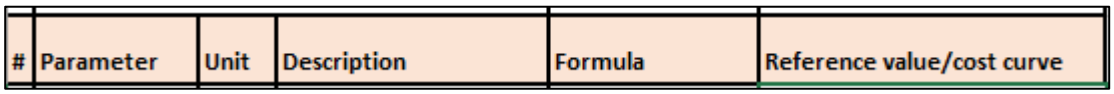

Figure 4: Columns in the Financial Dispatch Data Parameters tab

The **FinDispatchDataParameters** tab includes the following columns:

- The **Parameter** column lists all the financial dispatch data parameters that are applicable to each technology type. Depending on the technology type, one or more of the following dispatch data parameters may be applicable to a resource:
  - Energy offer reference level
  - Speed no-load reference level
  - Start-up reference level
  - Operating reserve offer reference level
- The **Unit** column provides the unit of measurement that corresponds to each parameter.

The **Description** column includes a brief description of each of the parameters.

The **Formula** column includes the formulas that market participants can use to calculate the financial reference levels for each parameter that is applicable to the resource.

The **Reference Value/Cost** column must be filled out by the market participants. Market participants are required to calculate and fill in this information by using the formulas provided in the **Formula** column and the **Input** column values from the **Reference Level Cost Components** tab.

For non-quick start (NQS) thermal resources that are registered as pseudo units (PSU), market participants must establish PSU reference levels for each possible configuration of its resource.

Figure 5 shows that market participants can add information for different configurations for PSUs in the corresponding column of the Financial Dispatch Data Parameters – PSU tab (e.g. 1x1, 2x1). Market participants may add more columns in this tab to represent additional configurations (e.g. 3x1) by adding columns to the right of existing columns in the same tab (for example "Reference value/cost (3x1 PSU) –Summer" and "Reference value/cost (3x1 PSU) –Winter").

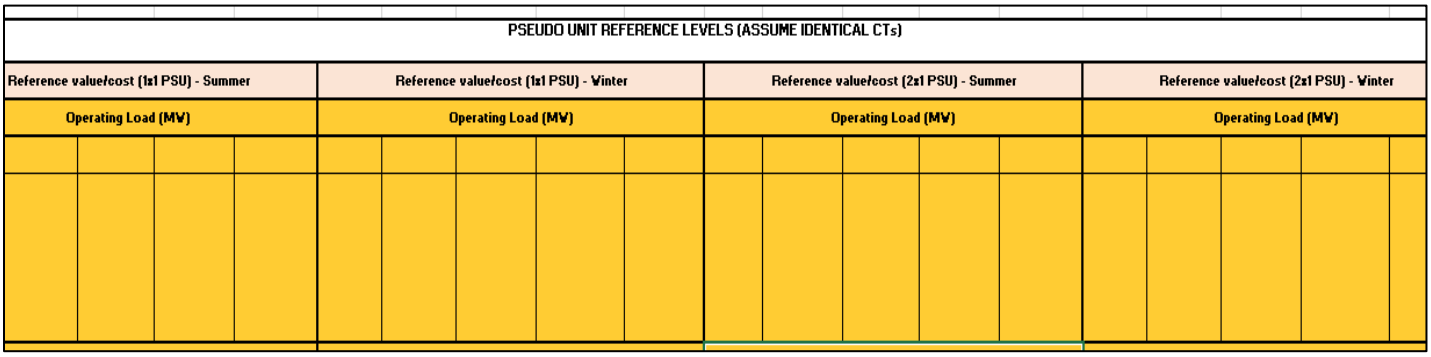

Figure 5: Financial reference levels for different PSU configurations

3.1.5. Supporting Documentation List Tab

The **Supporting Documentation List** tab includes a summary table listing all of the supporting documentation provided by the market participant. In this tab, market participants provide the attachment number, document name and description for each supporting document.

Figure 6 shows an example of how to fill out the list of supporting document name and description.

Attachment #	Supporting Document Name	Supporting Document Description
Attachment 1	Invoice 1.pdf	Refer to page 10, for cost to support input into the behind the meter standby cost
Attachment 2	Invoice 2.pdf	Refer to page 4, for cost to support input into the behind the meter standby cost
Attachment 3	*[etc. to be filled by Market participant to substantiate all inputs into reference levels]*	*[etc. to be filled by Market participant to substantiate all inputs into reference levels]*

Figure 6: Example of a completed Supporting Documentation List tab

This tab includes the following columns:

In **Attachment #** column, market participants are required to fill out the numerical reference number of the attachment. This attachment number should be the same as the value entered in the Supporting Document Reference column of Cost Components tab.

In the **Supporting Document Name** column, market participants must enter the file name of the attachment and extension (for e.g. "Resource AB_OEM.pdf).

In the **Supporting Document Description** column market participants must provide the specific information within an attachment (e.g. page number, line item, etc.) and explain how it supports the inputs for reference levels. Market participants may include information on how this supporting information is used and what cost or reference level the document is used to support. Market participants are encouraged to add supplementary notes and description of the information submitted.

3.2. FAQs for Financial Reference Levels

This section contains FAQs relevant to the process for determining financial reference levels and answer to those questions. There is a general section for questions that are not specific to any one technology type and additional sections for questions specific to a given technology type.

3.2.1. General

Q1: Is there flexibility on the type of supporting documents that will be considered acceptable?

A1: The IESO will consider eligibility on a case-by-case basis. The list of eligible costs found in the written guide is not exhaustive. Eligible documentation that is internal to the submitting organization will be evaluated on a case by case basis. Market participants should discuss the specific internal documentation prior to submission.

Q2: Does major maintenance include fixed and variable major maintenance? What qualifies as major maintenance?

A2: Fixed costs are not eligible to contribute to reference levels. The written guide includes a non-exhaustive list of eligible and ineligible major maintenance costs. Any items that are not specifically addressed in the written guide may be submitted for IESO review. Eligibility of these costs will be evaluated on the same basis as any other cost. Costs must vary with supply of energy or operating reserve to be eligible.

Q3: If a market participant requests a financial reference level of $0/MWh, does that mean that the market participant is stating that they have no costs?

A3: A request for a reference level of $0/MWh does not imply any conclusions regarding the underlying costs of the resource. It does not restrict the market participant from submitting a request to change a reference level to reflect positive costs in the future. Rather, it indicates that the market participant is requesting a reference level of $0/MWh be used.

Q4: Am I obligated to offer at my reference level?

A4: No, registering a reference level of a particular value does not create an obligation in regards to offer prices.

Q5: Once Market Renewal goes live, can market participants update their reference levels whenever they want?

A5: Yes. Market participants may update the reference levels for their resource using the registration process on demand.

~~Q6: What is the station service adder that IESO would apply?~~

~~A5: Price of station service power will be reflected the way station service is built.~~

- ~~Resources with pre-approved RT-GCG values can submit their pre-approved values for station service costs, along with the RT-GCG pre-approved value report as the supporting materials.~~
- ~~Resource that has less than 12 months historical LMPs on record can use RPP (commodity cost + GA + variance line item) for station service price until a resource has 1 year of data.~~
- ~~Resources that have at least 12 months historical LMPs available should use a combination of the following items to determine their station service price: LMP + GA (from RPP report) + variance line item (from RPP report).~~
- ~~If a resource participates in GSSR (generation stations service rebate) program, then they would not submit LMP, and would not include uplift charge in station service cost. In the circumstance that a resource participates in GSSR it would only charge the appropriate commodity cost for the last 12 months. However, if a market participant pays LMP for station service cost of their resource, and the resource does not participate in GSSR program, then the market participant shall use 12 month average for LMP to calculate their station service cost for the reference level.~~
- ~~Resources with pre-approved RT-GCG values can submit their pre-approved values for station service costs, along with the RT-GCG pre-approved value report as the supporting materials.~~

3.2.2. Hydro

[Intentionally left blank.]

3.2.3. Thermal

Q1: How does a market participant determine where to allocate operating and maintenance (O&M) costs for a NQS resource?

A1: The written guide describes which O&M costs can be allocated to which reference levels. Some costs can be allocated according to either the energy reference level, start-up offer reference level or speed-no-load reference level. The approach to allocate these costs to the different reference levels is found in the written guide. Note that the same cost cannot be allocated to more than one reference level.

Q2: If a resource does not qualify for the generator offer guarantee (GOG), which reference levels does a market participant need to submit for that resource?

A2: Thermal resources that do not qualify for GOG will submit average cost energy reference levels and marginal cost reference levels in a single workbook. The average cost energy reference level amortizes eligible start-up costs and is the reference level that the IESO will use to assess ex-ante mitigation. The marginal cost reference level will be used to assess settlement mitigation for one of these resources that has already run for long enough to account for its start-up costs for a specific start.

Q3: If a market participant has final Pre-Approved RT-GCG Values (PAVs), can those dollar values be submitted for start-up O&M reference levels without requiring supporting documentation?

A3: Market participants that have PAVs for start-up costs can choose to submit the ~~same~~ dollar values ~~that are~~ for their pre-approved RT-GCG hot, warm and cold start-up costs as the O&M components of the hot, warm and cold reference levels. If the market participants~~y do so and~~ indicate to the IESO that they are using the PAVs, they ~~market participant is~~ are not required to submit supporting documentation for that component of the start-up reference level~~, as~~ because the IESO already has that information pursuant to the RT-GCG pre-approval process.

For example, consider that the pre-approved dollar value for a hot start under the RT-GCG program is $5,000. If the market participant inserts $5,000 into the cell of the thermal workbook that communicates the desired O&M component for the hot start-up reference level, and communicates to the IESO that this $5,000 O&M value is the PAV in the reference level submission, no other supporting materials are required for that component of that reference level at that point. -The IESO may request further information, as needed, to ensure that the reference level is appropriately set.

If the PAV changes following the reference level submission and before the Market Renewal Program (MRP) goes live, market participants are required to re-submit a value consistent with the updated PAV.

If market participants choose this option, O&M costs that are submitted for the energy reference levels and speed-no-load reference levels will be reviewed to confirm that the same costs have not been included in more than one financial reference level.

This option is afforded in response to requests by market participants~~,~~ in order to determine reference levels in an efficient manner (i.e. reducing additional information burden, where reasonably possible). The IESO notes that the PAVs are prepared for specific use in the current RT-GCG program and that the RT-GCG program is a cost recovery program that differs in many significant ways from the approach to scheduling and settling NQS resources under the MRP. Among the many significant distinguishing features between the RT-GCG program and the commitment and settlement for NQS resources under MRP are the method of committing a resource, the revenue offset that is considered when determining any make-whole payment and the portion of costs considered to be eligible for recovery under RT-GCG program (i.e. the defined recoverable period).- As such, a submitted PAV is still subject to review and validation by the IESO for its specific application within the CBRL framework.

In allowing the use of information derived for the purposes of the RT-GCG program as part of submissions for the reference levels, the IESO is not indicating or agreeing that it has changed its view on costs eligible for recovery under the RT-GCG program or the established PAV(s), unless otherwise expressly stated in respect of those matters.

Q4: If a market participant has a final Pre-Approved RT-GCG Values (PAV) Report that shows the IESO's review of the validated costs submitted to support its PAVs, can that PAV Report be submitted as supporting documentation for a reference level submission?

A4: Market participants may submit the PAV Report as supporting documentation for a reference level submission. If a market participant does so, it can submit the costs that were verified in that

PAV Report for O&M costs in the reference level submission. The PAV Report can be used to identify the dollar value of eligible O&M costs that can be allocated by the market participant to an energy reference level, start-up reference level or speed no load reference level in accordance with section 2.5.1.6 of the written guide. The IESO already has the related supporting information pursuant to the RT-GCG program pre-approval process.

For example, if the PAV Report identifies $200 as a verified cost, then the market participant can include that line item cost, with a value of $200, as the reference level submission, even if only a portion of the $200 verified cost is eligible under the RT-GCG program due to its specific cost recovery parameters in the applicable market rules. The market participant can allocate that $200 in accordance with the written guide to either the energy reference level, start-up reference level or speed no load reference level. The market participant will provide the PAV Report as supporting materials for that line item cost and identify the page reference that shows that verified cost. The IESO may request further information, as needed, to ensure that the reference level is appropriately set.

If the PAV Report is updated following the reference level submission and before the Market Renewal Program (MRP) goes live, market participants are required to re-submit values consistent with the updated PAV Report.

If market participants choose this option, O&M costs that do not rely on the PAV Report that are submitted for financial reference levels will be reviewed to confirm that the same costs have not been included in more than one financial reference level.

This option is afforded in response to requests by market participants, in order to determine reference levels in an efficient manner (i.e. reducing additional information burden, where reasonably possible). The IESO notes that the PAV Reports are prepared for specific use in the current RT-GCG program and that the RT-GCG program is a cost recovery program that differs in many significant ways from the approach to scheduling and settling NQS resources under the MRP. Among the many significant distinguishing features between the RT-GCG program and the commitment and settlement for NQS resources under MRP are the method of committing a resource, the revenue offset that is considered when determining any make-whole payment and the portion of costs considered to be eligible for recovery under RT-GCG program (i.e. the defined recoverable period). As such, a submitted PAV Report is still subject to review and validation by the IESO for its specific application within the CBRL framework.

In allowing the use of information derived for the purposes of the RT-GCG program as part of submissions for the reference levels, the IESO is not indicating or agreeing that it has changed its view on costs eligible for recovery under the RT-GCG program or the established PAV(s), unless otherwise expressly stated in respect of those matters.

Q5: How are the heat rate calculations used when determining the fuel cost component for energy reference levels?

A5: Market participants use the heat rate calculations in two ways: to determine the fuel consumption at each step of the energy reference level and to determine the performance factors that account for seasonal changes in the efficiency of the resource.

Q6: What points on the heat rate curve do market participants set when determining the energy reference level?

A6: Market participants must show a minimum of two data points on the heat rate curve.: Oone at MLP and one at baseload. Where applicable, duct-firing capabilities must also be shown on the heat rate curve as a third data point. Two data points are required in order to show the shape of the heat rate curve. If a market participant used only a single data point, they could set their reference level based on the most inefficient heat rate, which could allow market participants to exercise market power by producing at a more efficient heat rate. Market participants are allowed to use additional data points, if appropriate. A data point is required for each step in the energy reference level, where each data point shows the heat input at that MW output.

~~Q7: What data can be used to determine the heat rate curve?~~

~~A7: Market participants can provide any of the following to support heat rate curves:~~

- ~~Design heat input data provided by the OEM;~~
- ~~Data calculated by heat balance models of the resource; or~~
- ~~Measured data by the market participant under the same ambient conditions or corrected to the same set of ambient conditions using OEM-provided correction curves.~~

Q87: What price should be used when submitting station service costs in the start up reference level?

A87: The price used to determine the eligible cost of station service power will be as follows:

- Resources with pre-approved RT-GCG values can submit their pre-approved values for station service costs, along with the RT-GCG pre-approved value report as the supporting materials.
- Resources that have less than 12 months historical LMPs on record can use RPP (commodity cost + GA + variance line item) to determine their station service price.
- Resources that have at least 12 months of historical LMPs available should use a combination of the following items to determine their station service price: LMP + GA (from RPP report) + variance line item (from RPP report).

Q98: How are performance factor and speed no load fuel costs derived?

A98: The following text shows an illustrative example of how performance factor and speed no load fuel costs can be derived:

Step 1: Developing a Heat Rate Curve

Each resource will develop a heat input curve that will be used as the basis for determining the incremental heat consumption. The following figure provides an example of the heat input curve for a gas turbine resource. In this example, the market participant has decided that the energy reference level will have 3 output steps, one at each of the data points The graph shows the total heat input of the resource required for each hour of operation at each output step of the reference level. The heat input curve will be used a basis to determine the energy reference level after first determining the incremental heat rate curve and the performance factors.

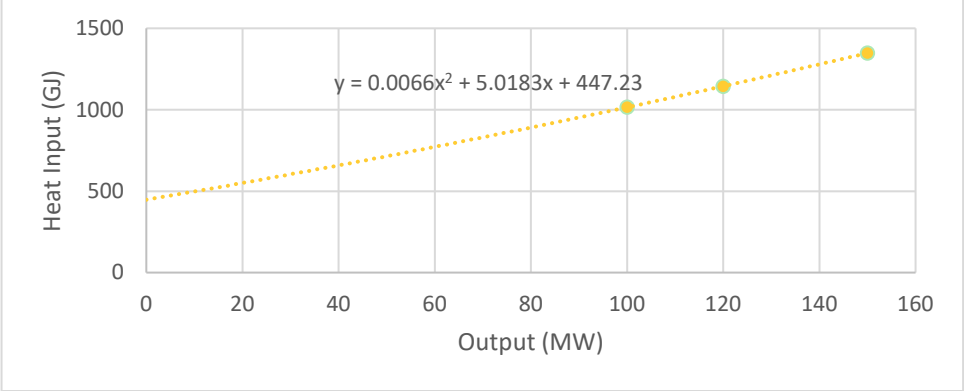

Figure 7: Heat Rate Curve for a Steam Turbine

Each data point from the curve can be determined by market participants based on either:

1. Design heat input data provided by the Original Equipment Manufacturer (OEM)
2. Data Ccalculated by the heat balance models of the resource
3. Measured data by the market participant under the same ambient conditions or corrected to the same set of ambient conditions using OEM provided ambient correction curves.
   Note: The minimum amount of data to determine heat rate curve is 4 hours at a stable and consistent operation at the MW output that the market participant is representing.

In generating the heat rate curve, the market participant ast a minimum must provide the heat input at the minimum loading point and base load. If applicable, duct firing capabilities must also be shown on the incremental heat rate curve with a step-wise change for incremental heat input. Each data point in the curve is meant to represent the heat input for the energy reference level that they wish to represent to reflect their incremental cost curve.

In ~~this~~ the example illustrated in the above figure, a regression analysis ~~was~~ would be conducted to determine the heat rate curve as follows:

$$\textit{Heat input} = 0.066*MW^2 + 5.0183MW + 447.23$$

The heat rate curve is also used to calculate the theoretical fuel consumption for the determination of the performance factor.

Step 2: Calculating the Incremental Heat Rate Curve

Based on the calculated heat rate curve, the incremental heat rate curve can be determined based on heat rate curve determined as defined in the written guideline (Section 2.5.1.4).

Incremental Heat Rate (GJ/MWh) = (Change in Fuel In) / (Change in Energy Out)

= (dy/dx) Heat Rate Curve

Based on the heat input curve determined in Step 1, the incremental heat rate curve will be calculated by determining the derivative function of the equation heat input curve:

Incremental Heat Rate = 0.0132MW + 5.183

Step 3: Determining the Speed No Load Heat Consumption

The Speed No Load Heat consumption can be determined based on the heat rate curve as 447.23 GJ/hr. The speed no load heat consumption is only used for commitment decisions by the calculation engine. The speed no load dispatch data is one of the costs that the dispatch engine evaluates when deciding to commit a non-quick start resource. It does not represent a physical model of operation of the resource – when a non-quick start resource is not committed and injecting, the speed no load cost does not impact scheduling or settlement.

The fuel cost component of the speed no load reference level is determined ~~is~~ by the y-intercept from the results of the regression analysis developed in Step 1.

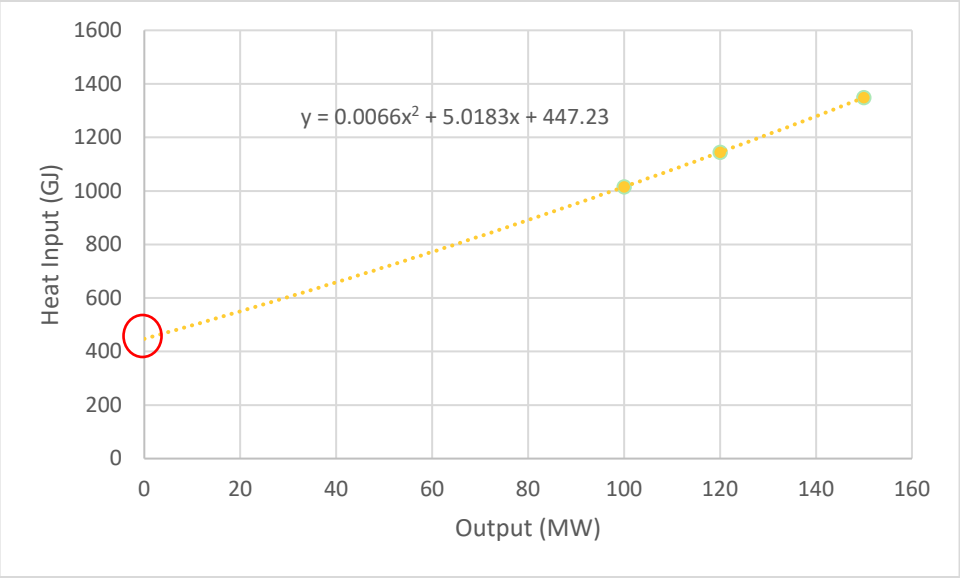

Figure 8: Regression Analysis Results of Heat Rate Curve

Step 4: Calculating the Performance Factor

The performance factor is used to adjust the fuel consumption amount to account for changes in ambient conditions and degradation. The market participant is to use the heat input curve determined in Step 1 and historic information to determine the appropriate performance factor that will be applied in the reference level.

The market participant will provide at least 5 years of historic data of actual fuel consumption and energy output for resource in 5 minute intervals. During each interval, the market participant will calculate a theoretical fuel consumption based on the heat input curve determined in step 1 for both summer and winter.

Table 1: Sample Performance Calculation for Winter Season

Date	Hour Ending	Interval	Quantity of Energy Injected (MWh)	Actual Fuel Consumption (GJ)	Calculated Theoretical Fuel Consumption (GJ)
01/01/2020	12	1	11	94	100
01/01/2020	12	2	11	96	100
01/01/2020	12	3	11	98	100
01/01/2020	12	4	11	95	100
....					
Total				Sum of all periods	Sum of all periods

Table 2: Sample Performance Calculation for Summer Season

Date	Hour Ending	Interval	Quantity of Energy Injected (MWh)	Actual Fuel Consumption (GJ)	Calculated Theoretical Fuel Consumption (GJ)
06/01/2020	12	1	11	102	100
06/01/2020	12	2	11	101	100
06/01/2020	12	3	11	105	100
06/01/2020	12	4	11	103	100
...					
Total				Sum of all periods	Sum of all periods

The market participant will sum the actual fuel consumption and theoretical fuel consumption for each season. The ratio of actual fuel consumption to the theoretical fuel consumption will be used to determine the performance factor.

Q~~10~~9: What break points do market participants need to provide data for in the heat rate curve that is used to form the energy reference level?

A~~1~~09: Market participants must provide data that describes heat rate at MLP, baseload and duct firing for resources that have duct firing capabilities. For resources that do not have duct firing capability, market participants must provide data that describes the heat rate at MLP and baseload. Submitting data that shows at least ~~2~~ two data points for heat rate shows whether the resource is more or less efficient when production increases and allows the IESO to identify whether the reference level should be increased with production.

Q1~~1~~0: How do market participants fill in the workbook to request reference levels for aggregate resources where there is more than one generation facility modeled by the IESO as a single resource?

A1~~1~~0: Market participants should first insert relevant information per generation facility in the physical resource tab of the workbook. ~~Where~~If a resource has more than one generation facility, market participants can insert additional tabs to show information per generation facility or additional columns to show the same. Once the information about each relevant generation facility is in the workbook, the market participant will construct the resources reference level based on aggregating the eligible costs as appropriate for their resource. Market participants should contact the IESO to discuss the specific approach for a resource during the one-on-one consultations as the approach will vary depending on the generation facilities at the resource.

3.2.4. Dispatchable Loads

Q1: Are market participants requesting an operating reserve reference level of $0/MWh for a dispatchable load resource required to submit supporting documentation?

A1: No, market participants requesting an operating reserve reference level of $0/MWh are not required to submit supporting documentation. However, they will still need to submit the reference level workbook to communicate the desired reference levels of $0/MWh.

3.2.5. Wind

[Intentionally left blank.]

3.2.6. Solar

Q1: Market participants may wish to request significantly different reference levels in the future. Are market participants free to do so as they see fit?

A1: Market participants may request a change to their registered reference levels at any time. Registering a $0/MWh reference level does not restrict a market participant's ability to request a positive reference level in the future.

3.2.7. Energy Storage

Q1: Does efficiency factor change with time depending on degradation?

A1: Yes, it could degrade over time. Market participants can request changes to reference levels to reflect changes to efficiency over time. They can use the registration processes to update the efficiency factor.

Q2: What are the requirements to establish reference levels for an energy storage resource that is charging?

A2: The IESO does not test energy storage bids for mitigation and therefore, does not need to set reference levels for bids when an energy storage resource is charging.

3.2.8. Nuclear

[Intentionally left blank.]

4. Opportunity Costs

The following section describes the instructions for completing a submission to request additional opportunity costs and FAQs regarding requests for additional opportunity costs.

4.1. Instructions for Opportunity Costs

Dispatchable resources with intertemporal production limitations, such as hydroelectric and storage resources, may incur an opportunity cost when they offer to inject energy. These resources may sacrifice the opportunity to produce energy in a future interval by producing it in the current one, given operational limitations. For example, a hydroelectric generating station with pondage that is able to shift production to a time when electricity prices are higher may incur opportunity costs. Such intertemporal opportunity costs can be included in the energy reference level. Opportunity costs for these resources represent the expected future revenues that market participants give up when these resources produce a MWh of energy in the current time period.

The storage horizon opportunity cost is applicable for resources that are energy-limited across a multi-day period or a "storage horizon". An intraday opportunity cost is applicable for resources that are energy-limited within a 24-hour period. Resources that meet both of these criteria can apply both of these opportunity costs to their reference levels. A resource that is not a dispatchable hydroelectric or energy storage resource may provide supporting documentation to the IESO to demonstrate that it is an energy-limited resource. Supporting documentation is submitted with the workbook and logged with a description in the **Supporting Documentation List** tab, per Section 3.1.5 of this guide.

Market participants requesting a storage horizon opportunity cost must provide the storage horizon, measured in days. Market participants must perform the storage horizon calculations in accordance with Section 2.2.4.6 of this guide and identify any document communicating the calculations along with any applicable supporting documentation to the **Supporting Documentation** tab.

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

In order to do so, market participants must submit the proposed methodology for any additional opportunity cost, along with supporting materials. The submitted materials must explain:

- why the provided opportunity cost does not address a material opportunity cost that the resource faces when making energy production decisions;
- what additional opportunity cost would address the material opportunity cost identified above; and
- how to calculate the additional opportunity cost.

The IESO may deny the request for an additional opportunity cost if it determines that:

- the identified additional opportunity cost does not address a material opportunity cost;

- the proposed methodology would not address any additional opportunity costs; or
- the calculation and implementation of the additional opportunity cost would prove excessively burdensome.

To request an additional opportunity cost, market participants must attach:

(i) a memo describing the requested opportunity cost and the operational need that it is intended to address;
(ii) spreadsheet calculations; and
(iii) any other necessary supporting documentation, to the workbook. The supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5 of this guide.

4.2. FAQs for Opportunity Costs

4.2.1. General

Q1: How do I demonstrate to the IESO that my resource is eligible for the intraday opportunity cost adder and/or the storage horizon opportunity cost?

A1: By default, dispatchable hydroelectric resources are eligible for the intraday opportunity cost. Dispatchable hydroelectric resources with a storage horizon greater than one day are eligible for the storage horizon opportunity cost as well. Any other dispatchable resource may demonstrate that it is energy-limited by submitting relevant supporting documentation for IESO review.

4.2.2. Hydro

[Intentionally left blank.]

4.2.3. Thermal

[Intentionally left blank.]

4.2.4. Storage

[Intentionally left blank.]

5. Non-Financial Reference Levels

The following section describes the instructions for completing a submission to request non-financial reference levels and FAQs regarding submissions for non-financial reference levels.

5.1. Instructions for Non-Financial Reference Levels

Non-financial reference levels represent a resource's operating characteristics in a competitive environment. The IESO compares the market participants' offered values for dispatch data against the relevant reference level to validate the offers.

Non-financial reference levels describe how a resource performs when competition is not restricted. They describe operational characteristics that are measured in units that are not financial, such as hours (e.g., MGBRT, lead time) and MWs/min (e.g. ramp rates).

Non-financial reference levels are registered on a seasonal basis. The summer period is from May 1st to October 31st and the winter period is from November 1st to April 30th of the following year. If a reference level does not vary according to season, market participants should register the same value for both seasons.

Market participants must complete the following steps to establish non-financial reference level values and provide supporting documentation to the IESO:

- market participants must submit non-financial reference level values using workbook spreadsheets prior to the Market Renewal go-live date;
- supporting documentation for non-financial reference level values must be attached and submitted along with the workbook. Refer to Section 3.1.5 of this guide for more information on logging and attaching supporting documentation with the workbook; and
- for NQS thermal resources that are PSUs, market participants must establish PSU reference levels, combustion turbine reference levels or steam turbine reference levels based on how a market participant submits its dispatch data for PSUs ~~for each possible configuration of its resource. Each configuration will be represented by a new non-financial reference level tab of the PSU resource, which the market participant will create in the workbook.~~

5.1.1. Energy Ramp Rate Reference Level

Energy ramp rate reference levels are required for solar, wind, hydroelectric, energy storage, nuclear and thermal resources.

This reference level contains up to five quantity-ramp rate sets. Each set includes the applicable MW quantity range, and ramp up and down rates (MW/min) for that MW quantity range. The ramp up and ramp down rates are how the resource is expected to operate during normal operation across the MW quantity range – not the fastest ramp rate for this MW quantity range.

If a resource can have different ramp rates depending on some operational configuration – and this configuration is not modeled in the IESO dispatch engines, the reference level should be based on the slowest possible ramp rate for that MW quantity range.

Energy ramp rate reference levels are found in the **Non-finDispatchParameters** tab of the workbook. This workbook enables market participants to establish up to 5 energy ramp-up and 5 energy ramp-down rate reference levels for its resource.

Market participants must update the value in the cell corresponding to the summer and winter value which is a positive number up to one decimal place. A minimum of one quantity-ramp rate set must be established and the requested ramp rate must be no greater than the maximum offer ramp rate registered parameter of the resource.

Figure 7 shows an example of a resource that has one energy ramp rate reference level value (MW/min) for its entire MW range, entered in the Summer Value and Winter Value columns. An empty MW Quantity input means the applicable ramp rate applies to the entire generation capability of a resource.

#	Non-Financial Reference Level	Unit	Description	MW Quantity	Summer Value	Winter Value	Supporting Documentation Required
1	***Energy Ramp Up Rate 1***	MW/min	The energy ramp up rate profile across the dispatchable range that the resource expects to meet during normal operation.		25	25	Market participants to provide supporting documentation such as resource specifications, that show the ramp rate (MW/min) at which a resource can reach its active power capability.
2	***Energy Ramp Down Rate 1***	MW/min	The energy ramp down rate profile across the dispatchable range that the resource expects to meet during normal operation.		25	25	Market participants to provide supporting documentation such as resource specifications, that show the ramp rate (MW/min) at which a resource can reach its active power capability.

Figure 9: Example of a resource with single energy ramp rate

Figure 8 shows an example of a resource that has varying energy ramp rates for a given level of MW quantity. When multiple ramp rate sets are required, a MW quantity column is used to indicate the MW quantity to which the ramp rates apply. The MW quantity is a point where the specified energy ramp rates will start to apply. The MW quantity values must increase monotonically and the last MW quantity for the energy ramp rate reference level must be equal to the maximum generating capability of the resource.

	A	B	C	D	E	F	G
1	#	Non-Financial Reference Level	Unit	Description	Quantity (MW)	Summer Value	Winter Value
2	1	***Energy Ramp Up Rate 1***	MW/min	The energy ramp rate profile across the dispatchable range that the resource expects to meet during normal operation.	50	10	10
3	2	***Energy Ramp Down Rate 1***	MW/min	The energy ramp rate profile across the dispatchable range that the resource expects to meet during normal operation.	50	10	10
4	3	***Energy Ramp Up Rate 2***	MW/min	The energy ramp rate profile across the dispatchable range that the resource expects to meet during normal operation.	75	12	12
5	4	***Energy Ramp Down Rate 2***	MW/min	The energy ramp rate profile across the dispatchable range that the resource expects to meet during normal operation.	75	12	12

Figure 10: Example of a resource with varying energy ramp rates

The energy ramp rate reference level must be accompanied by supporting documentation unless a resource is able to ramp its full capability in 5 minutes. Market participants that request ramp rate reference levels that are at least 1/5 of the resource's maximum generating capacity are not required to submit supporting documentation.

5.1.2. Operating Reserve Ramp Rate Reference Level

Operating reserve ramp rate reference levels are applicable for dispatchable loads, hydroelectric, thermal (excluding nuclear resources) and energy storage resources.

The operating reserve ramp rate reference level has one quantity-ramp rate set for the entire dispatchable range. This set is the ramp up and down rate (MW/min), during normal operation, at which a resource can increase or decrease its output upon the activation of operating reserve. The operating reserve ramp rate reference level is applicable to the three classes of operating reserve: 10-minute synchronized (10S), 10-minute non-synchronized (10N) and 30-minute synchronized (30R).

Operating reserve ramp rate reference levels are found in the **Non-finDispatchParameters** tab on the workbook. The workbook defaults to having one operating reserve ramp rate value for the summer and winter period for the entire MW range of the resource.

Market participants must update the value in the cell corresponding to the summer and winter value to a positive number with up to one decimal place. The requested operating reserve ramp rate must be no greater than the maximum offer ramp rate registered parameter of the resource.

Figure 9 shows the operating reserve ramp rate value is entered in the **Summer Value** and **Winter Value** columns.

A	B	C	D	E	F
#	Non-Financial Reference Level	Unit	Description	Summer Value	Winter Value
2	***Operating Reserve Ramp Rate***	MW/min	The rate that a resource can respond to an operating reserve activation during normal operation.	20	25

Figure 11: Example of operating reserve ramp rate value of a resource

The operating reserve ramp rate values can be the same as the energy ramp rate and the market participant may provide the same supporting documentation to validate both ramp rates. The market participant must provide the description in the **Supporting Documentation List** tab so the IESO reviewer is made aware that the same document supports the energy ramp rate and the operating reserve ramp rate.

A requested operating reserve ramp rate value shall be accompanied with supporting materials demonstrating the operating reserve ramp rate for a dispatchable range. If a market participant requests a ramp rate reference level that is equal to or greater than 1/5 of the resource's 5-minute capacity, then no supporting materials are required. If the operating reserve ramp rates are different than the energy ramp rates, then the market participant must submit supporting documentation to substantiate the operating reserve ramp rate values.

5.1.3. Lead Time Reference Level

Lead time reference levels are required for dispatchable NQS resources. For NQS resources that are PSUs, each lead time reference level is equal to the lead time reference level of the combustion turbine from each PSU.

In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST** ~~**Non-finDispatchParameters - CT**~~ tab shows the **Lead Time – Hot/Warm/Cold** parameter for the physical combustion and steam turbines~~turbine~~. Market participants must update the value in the cell corresponding to the summer and winter value to a positive whole number less than or equal to 18 hours. ~~Because the PSU lead time reference level is based on the lead time reference level of the combustion turbine, market participants must also enter the lead time reference levels for PSUs in the **Non-finDispatchParameters - PSU** tab.~~

Supporting documentation are to be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5.

Non-Financial Reference Level	Unit	Description	MW Quantity	Summer Value	Winter Value	Types of Supporting Documentation
Lead Time - Hot	Hours	The amount of time needed during normal operation for a NQS to start up and reach its MLP from an offline state if the thermal state of the unit is hot.	N/A	6	6	Manufacturer data from contract or performance test
Lead Time - Warm	Hours	The amount of time needed during normal operation for a NQS to start up and reach its MLP from an offline state if the thermal state of the unit is warm.	N/A	12	12	Manufacturer data from contract or performance test
Lead Time - Cold	Hours	The amount of time needed during normal operation for a NQS to start up and reach its MLP from an offline state if the thermal state of the unit is cold.	N/A	18	18	Manufacturer data from contract or performance test

Figure 12: Example of lead time reference value for a resource

Figure 10 shows an example of input values for a thermal resource in three states: hot, warm and cold. Lead time values are entered for both the summer and winter seasons.

5.1.4. Minimum Loading Point Reference Level

A minimum loading point (MLP) reference level is required for dispatchable NQS thermal resources (excluding nuclear resources) ~~that are eligible to submit MLP~~. MLP is the minimum MW output that a resource must maintain to remain stable without the support of ignition. For NQS resources registered with a PSU, the MLP reference level is ~~first~~ established for the combustion turbine and steam turbine. The MLP ~~reference level~~ of the PSU is equal to the MLP ~~reference level~~ of the combustion turbine, plus the relevant portion of the MLP ~~reference level~~ of the steam turbine.

Supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5 of this guide.

In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST**' tabs list the **Minimum Loading Point** reference level parameter for the physical combustion and steam turbines. Market participants must update the value in the cell corresponding to the summer and winter values, which must be positive numbers between 0.0 and the maximum generation capability and must not exceed one decimal place. ~~Because the PSU MLP reference level is based on the MLP of the combustion and steam turbines, market participants must enter the calculated MLP reference level values in the **Non-finDispatchParameters - PSU** tab also. The PSU MLP reference level value is the sum of the combustion turbine MLP reference levels plus the portion of the steam turbine MLP reference level according to its PSU configuration.~~The market participant will also be required to create minimum loading point reference levels for all ~~ST~~possible configurations in the **Non-finDispatchParameters - ST**' tab. Additional rows may be added to reflect different ~~MLP~~ configurations (i.e. 1-on-1, 2-on-1…etc.).

Figure 11 shows that the requested values for MLP reference levels may be different for the summer and winter periods.

Non-Financial Reference Level	Unit	Description	MW Quantity	Summer Value	Winter Value	Types of Supporting Documentation
Minimum Loading Point	MW	The minimum MW output that a resource must maintain to remain stable without the support of ignition during normal operation.		33.8	39.4	Manufacturer data from contract or performance test

Figure 13: Example of minimum loading point reference level for a resource

5.1.5. Minimum Generation Block Run Time Reference Level

A minimum generation block run-time (MGBRT) reference level is required for dispatchable NQS thermal resources~~,~~ (excluding nuclear resources). It represents the minimum number of consecutive hours a resource must be scheduled to its MLP, in accordance with the technical requirements of the resource. For NQS resources registered with a PSU, the MGBRT reference level is ~~first~~ established for the combustion turbine~~, and then used for the PSU~~.

In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST** ~~**Non-finDispatchParameters - CT**~~ tab lists the **Minimum Generation Block Run-Time** reference level parameter for the physical combustion and steam turbines. Market participants must update the value in the cell corresponding to the summer and winter values to a positive whole number less than or equal to 24 hours. Supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5. If a registered **Minimum Generation Block Run Time**

parameter already exists and satisfies both the summer and winter values for use in reference levels, market participants are not required to submit supporting documentation in support of the MGBRT reference level value. ~~Because the PSU MGBRT reference level is based on the MGBRT of the combustion turbine, market participants are also required to fill out the MGBRT reference level in the **Non-FinDispatchDataParameters – PSU** tab with the relevant reference level value.~~

Figure 12 shows that the MGBRT values are entered in these cells for the summer and winter period.

Non-Financial Reference Level	Unit	Description	Load Range	Summer Value	Winter Value
Minimum Generation Block Run Time	Hours	The minimum number of consecutive hours a generation unit must be scheduled to its MLP during normal operation.		5	5

Figure 14: Example of minimum generation block run time reference level for a resource

5.1.6. Minimum Generation Block Down Time Reference Level

The minimum generation block down time (MGBDT) reference level is required for dispatchable NQS thermal resources (excluding nuclear resources). It is the time between when a resource was last at its MLP before de-synchronization and the time the resource can be scheduled back to its MLP after re-synchronizing. The MGBDT reference level is defined for the three thermal operating states of a resource: hot, warm and cold. For NQS resources registered with a PSU, the MGBDT reference level ~~the MNSPD reference level~~ is ~~first~~ established for the combustion turbine~~, and then used for the PSU~~.

Supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5 of this guide.

In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST** ~~**Non-finDispatchParameters - CT**~~ tab lists the **Minimum Generation Block Down-Time Reference Level** parameter for the physical combustion and steam turbines. Market participants must update the value in the cell corresponding to the summer and winter values to a positive whole number less than or equal to 24 hours. The MGBDT is a value that is equal to or greater than the lead time for an associated thermal state. ~~Because the PSU MGBDT reference level is based on the MGBDT of the combustion turbine, market participants must also complete the MGBDT reference level in the **Non-finDispatchParameters - PSU** tab with the relevant reference level value.~~

Figure 13 shows that minimum generation block down time requested values must be entered in these cells for the summer and winter periods.

#	Non-Financial Reference Level	Unit	Description	MW Quantity	Summer Value	Winter Value	Types of Supporting Documentation
17	***Minimum Generation Block Down Time (Hot)***	Hours	The minimum number of hours between the time when a generation unit was last at its MLP before de-synchronization and the time the generation unit can be scheduled back to its MLP after re-synchronizing during normal operation.	N/A	6	6	Relevant extract from the operating and maintenance manual for their resource that states the minimum time after shutdown when the resource can be restarted.
18	***Minimum Generation Block Down Time (Warm)***	Hours	The minimum number of hours between the time when a generation unit was last at its MLP before de-synchronization and the time the generation unit can be scheduled back to its MLP after re-synchronizing during normal operation.	N/A	10	10	Relevant extract from the operating and maintenance manual for their resource that states the minimum time after shutdown when the resource can be restarted.
19	***Minimum Generation Block Down Time (Cold)***	Hours	The minimum number of hours between the time when a generation unit was last at its MLP before de-synchronization and the time the generation unit can be scheduled back to its MLP after re-synchronizing during normal operation.	N/A	13	13	Relevant extract from the operating and maintenance manual for their resource that states the minimum time after shutdown when the resource can be restarted.

Figure 15: Example of minimum generation block down time for a resource

5.1.7. Maximum Number of Starts per Day Reference Level

The maximum number of starts per day (MNSPD) reference level is required for dispatchable hydroelectric resources and all dispatchable NQS thermal resources (except nuclear resources). This reference level is the maximum number of times a resource can be physically started within a dispatch day. For NQS resources registered with a PSU, the MNSPD reference level is ~~first~~ established for the combustion turbine~~, and then used for the PSU~~.

MNSPD submitted as dispatch data must be a number between 1 and 24 starts per day and as such, the MNSPD reference level must also be a number between 1 and 24 starts per day. NQS thermal resources do not need to provide a MNSPD value as the formula outlined in Section 3.4.1.7 of this guide calculates the value automatically. In the hydroelectric workbook, the **Non-finDispatchParameters** tab lists the **Maximum Number of Starts** reference level parameter for the resource. Market participants must update the value in the cell corresponding to the summer and winter reference level value to a positive whole number between 1 and 24 starts. If a resource can start more than 24 times day, a default value of 24 times is used as the maximum reference level. ~~Because the PSU MNSPD reference level is based on the MNSPD of the combustion turbine, market participants must also complete the MNSPD reference level cell in the **Non-finDispatchParameters - PSU** tab with the relevant reference level value.~~

Figure 14 shows that the MNSPD requested values must be entered in these cells for the summer and winter periods.

Non-Financial Reference Level	Unit	Description	Summer Value	Winter Value
Maximum Number of Starts per Day	#	The maximum number of times a generation unit can be started within a dispatch day during normal operation.	1	1

Figure 16: Example of maximum number of starts per day for a resource

~~In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST** tabs show the **Ramp Up Energy to MLP Upper/Lower Bound** parameter for the combustion and steam turbines. Market participants must set the values in the cells corresponding to the summer and winter values for each thermal state up to one decimal place. The PSU uses the ramp up energy to MLP (upper bound) reference level from the combustion turbine and steam turbine. Therefore, market participants must also complete the ramp up energy to MLP (upper bound) reference level in the **Non-finDispatchParameters - PSU** as the summation of the combustion turbine and the portion of the steam turbine ramp up energy to MLP (upper bound) according to its PSU configuration. Supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5 of this guide.~~

5.1.8. Ramp Up Energy to Minimum Loading Point (Upper Bound) Reference Level

Ramp up energy to the MLP (upper bound) reference level is required for dispatchable NQS thermal resources (excluding nuclear resources). It is the maximum quantity of energy, in MWh, a resource is expected to produce from the time of synchronization to the time it reaches its MLP during normal operation. Ramp up energy to MLP (upper bound) is required for the hot, warm and cold thermal operating states of the resource. For NQS resources registered with a PSU, the ramp up energy to MLP (upper bound) reference level is established for the combustion turbine and steam turbine.

#	Non-Financial Reference Level	Unit	Description	MW Quantity	Summer Value	Winter Value	Types of Supporting Documentation
21	***Ramp Up Energy to MLP***						
	Ramp hours to MLP - Hot	Hours	The number of hours required for the resource to ramp from synchronization to its MLP during normal operation when the resource is in a hot thermal state.	N/A	1	1	Manufacturer data from contract or performance test
	Energy per ramp hour - Hot (Upper Bound)	MW	The upper bound average quantity of energy in MWh that the resource is expected to produce in each ramp hour during normal operation when the resource is in a hot thermal state.	N/A	60	60	Manufacturer data from contract or performance test
	Energy per ramp hour - Hot (Lower Bound)	MW	The lower bound average quantity of energy in MWh that the resource is expected to produce in each ramp hour during normal operation when the resource is in a hot thermal state.	N/A	55	55	Manufacturer data from contract or performance test

Figure 17: Example of ramp up energy to MLP (upper bound) reference level for a resource

In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST** tabs show the **Ramp Up Energy to MLP Upper Bound** parameter for the combustion and steam turbines. Market participants must set the values in the cells corresponding to the summer and winter values for each thermal state up to one decimal place. The PSU uses the ramp up energy to MLP (upper bound) from the combustion turbine and steam turbine.

Supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5 of this guide.

5.1.9. Ramp Up Energy to Minimum Loading Point (Lower Bound) Reference Level

The ramp up energy to the MLP (lower bound) reference level is required for dispatchable non-quick start thermal resources (excluding nuclear resources). It is the minimum quantity of energy, in MWh, a resource is expected to produce from the time of synchronization to the time it reaches its MLP during normal operation. Ramp up energy to MLP (lower bound) is required for the hot, warm and cold thermal operating states of the resource. For NQS resources registered with a PSU, the ramp up energy to MLP (lower bound) reference level is ~~first~~ established for the combustion turbine and steam turbine. ~~The ramp up energy to MLP (lower bound) reference level of the PSU is equal to the reference level of the combustion turbine, plus the relevant portion of the reference level of the steam turbine~~

#	Non-Financial Reference Level	Unit	Description	MW Quantity	Summer Value	Winter Value	Types of Supporting Documentation
21	*Ramp Up Energy to MLP*						
	Ramp hours to MLP - Hot	Hours	The number of hours required for the resource to ramp from synchronization to its MLP during normal operation when the resource is in a hot thermal state.	N/A	1	1	Manufacturer data from contract or performance test
	Energy per ramp hour - Hot (Upper Bound)	MW	The upper bound average quantity of energy in MWh that the resource is expected to produce in each ramp hour during normal operation when the resource is in a hot thermal state.	N/A	60	60	Manufacturer data from contract or performance test
	Energy per ramp hour - Hot (Lower Bound)	MW	The lower bound average quantity of energy in MWh that the resource is expected to produce in each ramp hour during normal operation when the resource is in a hot thermal state.	N/A	55	55	Manufacturer data from contract or performance test

Figure 18: Example of ramp up energy to MLP (lower bound) reference level for a resource

In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST** tabs show the **Ramp Up Energy to ~~MLP Upper/~~Lower Bound** parameter for the combustion and steam turbines. Market participants must update the values in the cells corresponding to the summer and winter values up to one decimal place for each thermal state. ~~The PSU uses the ramp up energy to MLP (lower bound) reference level from the combustion turbine and steam turbine. Therefore, market participants are also required to fill out the ramp up energy to MLP (lower bound) reference level in the **Non-finDispatchParameters - PSU** as the summation of the combustion turbine and the portion of the steam turbine ramp up energy to MLP (lower bound) according to its PSU configuration.~~ Supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5.

5.1.10. Ramp Hours to Minimum Loading Point Reference Level

The ~~R~~ramp hours to MLP reference level is required for dispatchable non-quick start thermal resources (except nuclear resources). It is the number of hours required for the resource to ramp from synchronization to its MLP during normal operation. Ramp hours to MLP is required for the hot, warm and cold thermal operating states of the resource.

In the thermal combined cycle workbook, the **Non-finDispatchParameters - CT** and **Non-finDispatchParameters - ST** tabs show the **Ramp Up Hours to MLP** parameter for the combustion and steam turbines. Market participants must update the value in the cell corresponding to the summer and winter value and the number of hours to ramp from synchronization to its MLP must be a positive integer between the values of 0 and 24 and be less than or equal to the number of hours for lead time reference level. ~~Because the PSU ramp hours to MLP reference level is based on the ramp hours to MLP of the combustion turbine, market participants must update the ramp hours to MLP reference level in the **Non-finDispatchParameters - PSU** tab with the relevant reference level value.~~

Supporting documentation must be listed in the **Supporting Documentation List** tab of the workbook and identified in the format described in Section 3.1.5.

Figure 17 shows that the ramp hours to MLP and energy per ramp hour of each thermal state must be entered in these cells for the summer and winter periods.

#	Non-Financial Reference Level	Unit	Description	MW Quantity	Summer Value	Winter Value	Types of Supporting Documentation
21	*Ramp Up Energy to MLP*						
	Ramp hours to MLP - Hot	Hours	The number of hours required for the resource to ramp from synchronization to its MLP during normal operation when the resource is in a hot thermal state.	N/A	1	1	Manufacturer data from contract or performance test
	Energy per ramp hour - Hot (Upper Bound)	MW	The upper bound average quantity of energy in MWh that the resource is expected to produce in each ramp hour during normal operation when the resource is in a hot thermal state.	N/A	60	60	Manufacturer data from contract or performance test
	Energy per ramp hour - Hot (Lower Bound)	MW	The lower bound average quantity of energy in MWh that the resource is expected to produce in each ramp hour during normal operation when the resource is in a hot thermal state.	N/A	55	55	Manufacturer data from contract or performance test

Figure 19: Example of ramp up hours to MLP reference level for a resource

5.2. FAQs for Non-Financial Reference Levels

5.2.1. General

Q1: If the required supporting documentation is outdated or unavailable (e.g. original equipment manufacturers' manuals), what alternative supporting documentation may be submitted?

A1: In cases where the prescribed supporting documents are unavailable, market participants may request to submit alternative supporting information. The IESO will review the eligibility of the submitted supporting documentation on a case-by-case basis. Market participants are asked to submit clear and succinct information to aide in the IESO's assessment of the eligibility of alternative supporting documentation.

Q2: Are there any examples where no supporting documentation is required for ~~Non-Financial Dispatch Parameters~~energy ramp rate reference levels?

A2: Supporting documentation is not required to establish non-financial reference levels where the requested value does not limit the resource to producing energy ~~or operating reserve~~ below its maximum generating capability for an interval. ~~An example of this is ramp rates where a resource can ramp very quickly to its dispatch instruction – i~~If the submitted energy ramp rate reference level

value is greater than or equal to 1/5th of the hourly capacity, then supporting documents are not needed (see Section 3.3. of written guide).

Q3: Are there any examples where no supporting documentation is required for operating reserve ramp rate reference levels?

A3: Supporting documentation is not required to establish non-financial reference levels where the requested value does not limit the resource to producing operating reserve below its maximum generating capability for an interval.

For a resource that is registered as being able to supply 10-minute operating reserve, if the submitted operating reserve ramp rate reference level value is greater than or equal to 1/10th of the maximum operating reserve that the resource can provide, then supporting documents are not needed (see Section 3.3. of written guide).

For a resource that is registered as being able to supply only 30-minute operating reserve, if the submitted operating reserve ramp rate reference level value is greater than or equal to 1/30th of the maximum operating reserve that the resource can provide, then supporting documents are not needed (see Section 3.3. of written guide).

~~Q3~~Q4: As some operating parameters vary across the day, do non-financial reference levels vary across the day as well?

~~A3~~A4: Daily variations are captured by the conduct thresholds used in the mitigation of non-financial reference levels. For more information of these conduct thresholds, see Section 3.5 of the Market Power Mitigation Detailed Design. Market participants can set seasonal values (winter and summer) for non-financial reference levels and update non-financial reference levels via the registration process where the underlying operation capability of the resource changes over time.

~~Q4~~Q5: For each technology, will the IESO use a list of pre-set site conditions in reviewing a market participant-requested non-financial reference level?

~~A4~~A5: The IESO will consider a resource's site condition as necessary when reviewing a requested reference level value. Participants must submit their reference levels and any underlying assumptions used to determine that value.

~~Q5: Could market participants be exempt from providing documentation for a resource if they submitted an operating reserve ramp rate of at least (OR capacity/10) for 10 minute OR or at least (OR capacity/30)?~~

~~A5: When a resource that is registered to provide 10 minute OR submits a request for OR ramp rate that is at least 1/10th of the maximum resource capacity the resource is exempt from providing supporting documentation for their OR ramp rate reference level.~~

~~When a resource that is registered to provide 30 minute OR (but is not registered to provide 10 minute OR) submits a request for OR ramp rate that is at least 1/30th of the maximum resource~~

~~capacity the resource is exempt from providing supporting documentation for their OR ramp rate reference level.~~Q6: If the energy ramp rates at a resource can vary depending on ambient conditions, configuration of the resource or other relevant factors that are not inputs to the DSO, what ramp rates should be requested for that resource?

A6: For all MWs from 0 to the maximum capacity of the resource, market participants should request the slowest possible ramp rate that could apply, accounting for ambient conditions, configuration of the resource or other relevant factors that are not inputs to the DSO. For example, if a 100 MW resource can ramp in the following manner depending on ambient conditions, then the ramp rate reference levels should be requested as reflected in this table:

Table 3: Ramp Rate Capability and Reference Level

MW range	Ramp Capability (Under condition A)	Ramp Capability (Under condition B)	Ramp rate reference level that should be requested
0 - 50	2 MW/min	4 MW/min	2 MW/min
51 - 100	3 MW/min	3 MW/min	3 MW/min

5.2.2. Hydro

[Intentionally left blank.]

5.2.3. Thermal

Q1: In what OEM documentation can market participants find the supporting documentation to support a minimum generation block run-time reference level value?

A1: The documentation provided to support a MGBRT reference level should be consistent with the documentation that is submitted today to register the MGBRT of a resource. For more information, refer to Section 3.4.1.5 of this guide.

Q2: If a market participant wants to use its registered MLP or MGBRT as its MLP or MGBRT reference level, does it need to submit any additional supporting material?

A2: ~~Where~~If a market participant already has a registered MLP or MGBRT and is satisfied with the same MLP or MGBRT reference value for winter and summer, no additional supporting materials need to be submitted. The IESO will use the currently-registered value of MLP or MGBRT as the summer and winter MLP reference level.

~~Q2: Is ramp hours to minimum loading point determined for the whole facility or is it determined on a per-resource basis?~~

~~A2: Reference levels are set at the resource level. Resources that are part of a facility that can operate in either simple cycle or combined cycle mode will have reference levels for both modes of operation. For these resources, the non-financial reference levels for combined cycle operation will be based on the most restrictive configuration for that facility. For example, if the MLP of the resource when the facility is operating in a 1x1 configuration is the highest (i.e. higher than the MLP of the resource in 2x1 or 3x1 configuration), the 1x1 MLP reference level will be the MLP reference level registered for use when in combined cycle mode of operation.~~

5.2.4. Dispatchable Loads

[Intentionally left blank.]

5.2.5. Wind

[Intentionally left blank.]

5.2.6. Solar

[Intentionally left blank.]

5.2.7. Storage

[Intentionally left blank.]

5.2.8. Nuclear

Q1: Nuclear ramp rates can vary substantially based on reactor conditions, so how is this set ahead of time?

A1: Nuclear resource ramp rate reference levels are established for incremental change in energy production and not the profile for start. If nuclear ramp rate capabilities can be very different for the same range of production depending on reactor conditions, the energy ramp rate reference level for nuclear resources will be set based on least flexible profile of the resource.

6. Reference Quantities

The following section describes the instructions for completing a submission to request a variance from the default technology-specific methodology for determining reference quantities and FAQs regarding such requests.

6.1. Instructions for Reference Quantities

Section 4 of the written guide describes the methodologies that the IESO uses to determine reference quantities for resources of different generation technologies.

Market participants must provide information about a resource that the IESO requires to determine the reference quantity for the resource as per the default approach for that technology type provided in the written guide.

6.1.1. Additional Information Required to Calculate Reference Quantities According to the Default Methodology

The following sections describe the minimum requirement for each technology type that market participants must submit to the IESO for the establishment of energy and operating reserve reference quantities according to the default methodology found in the written guide.

Inputs required for the calculation of reference quantities may vary seasonally. Market participants must provide summer and winter values for parameters and inputs used in the determination of reference quantities where applicable.

Technology types with a description that 'no additional information is required' means that the IESO has no need for additional data to create reference quantities in accordance with the default methodology found in the written guide.

6.1.1.1 Thermal

No additional information is required.

6.1.1.2 Hydroelectric

For energy reference quantities, market participants must indicate and provide documentation that shows the minimum head-based capability for each generation resource. This documentation is used by the IESO to verify the indicated numerical value of the maximum production for each resource when the head is at its minimum level. Market participants must provide the supporting documentation as an attachment to the workbook. In the **Supporting Documentation List** tab, indicate the title of the document and provide a description of what this documentation is, the requested value and what pages or sections the IESO can refer to find this value.

Hydroelectric operating reserve reference quantities are also equal to the minimum head-based capability approach discussed above.

6.1.1.3 Solar

No additional information is required.

6.1.1.4 Wind

No additional information is required.

6.1.1.5 Nuclear

No additional information is required.

6.1.1.6 Dispatchable Load

No additional information is required if the resource is eligible to provide operating reserve of a quantity equal to its full load reduction capacity. Market participants who are not able to provide their full load reduction capacity shall provide the IESO with an explanation of the limitations for the provision of operating reserve and the relevant supporting documentation that can be used to calculate a resource-specific reference quantity.

Market participants must provide the relevant supporting documentation as an attachment to the workbook. In the **Supporting Documentation List** tab, the market participant must indicate the title of the document and provide a description of what this documentation is, the limitation value and what pages or sections the IESO can refer to find this value.

6.1.2. Request to Vary the Default Methodology

If the default methodology for calculating reference quantity in the written guide does not account for the specific operational characteristics of a resource in a reasonably complete manner, market participants may submit requests for incremental modifications to this methodology to be applied on a resource-specific basis. These requests may be for incremental modifications required to improve the accuracy of how specific operational characteristics are modeled – rather than requests to use an entirely different methodology that the market participant prefers.

Examples of an incremental request to modify a reference quantity methodology include legal and environmental restrictions that may limit a resource's ability to provide generation capability such as flow restrictions at certain times of year for a hydroelectric resource and different resource configurations.

Any such requests must be accompanied by supporting documentation to the IESO during the Facility Registration process.

6.2. FAQs for Reference Quantities

6.2.1. General

Q1: My resource has constraints where, at certain periods of the year, the energy and or operating reserve capability is not at its maximum potential output.

A1: Market participants will be able to discuss with the IESO if seasonality constraints are expected to occur and reference quantities should be reflective of such constraints.

Q2: Are reference quantities for day-ahead market (DAM) the same reference quantities in real-time (RT)?

A2: DAM reference quantities are calculated based on current information available at the initiation of the DAM engine. RT reference quantities are calculated after the dispatch day and accounts for unforeseen RT events which may have affected a resource's generating capability such as forced outages and actual delivered energy.

Q3: What information in the Generator Output and Capability report will be used to determine reference quantities for thermal and nuclear resources?

A3: To establish the reference quantity for the available capacity of thermal and nuclear resources, the IESO uses the same approach as the methodology to determine resource capability of the Generator Output and Capability report as published on the public IESO reports website. This report, and the determination of reference quantities will rely on the maximum active power capability of a resource, less the active power load, less the maximum outaged MWs.

6.2.2. Hydro

[Intentionally left blank.]

6.2.3. Thermal

[Intentionally left blank.]

6.2.4. Dispatchable Loads

[Intentionally left blank.]

6.2.5. Wind

[Intentionally left blank.]

6.2.6. Solar

[Intentionally left blank.]

6.2.7. Storage

[Intentionally left blank.]

6.2.8. Nuclear

[Intentionally left blank.]

Appendix A: Overview of the WatchDox Process

To complete a reference level and reference quantity submission to the IESO, the market participant will be required to register for a WatchDox account. ~~at~~ The IESO recommends the use of ~~the~~ Google Chrome browser when using WatchDox.

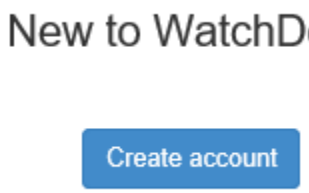

Figure 20: Create WatchDox account button

If market participant has an existing WatchDox account, they may use the existing account. The IESO will create a new Workspace for the submission.

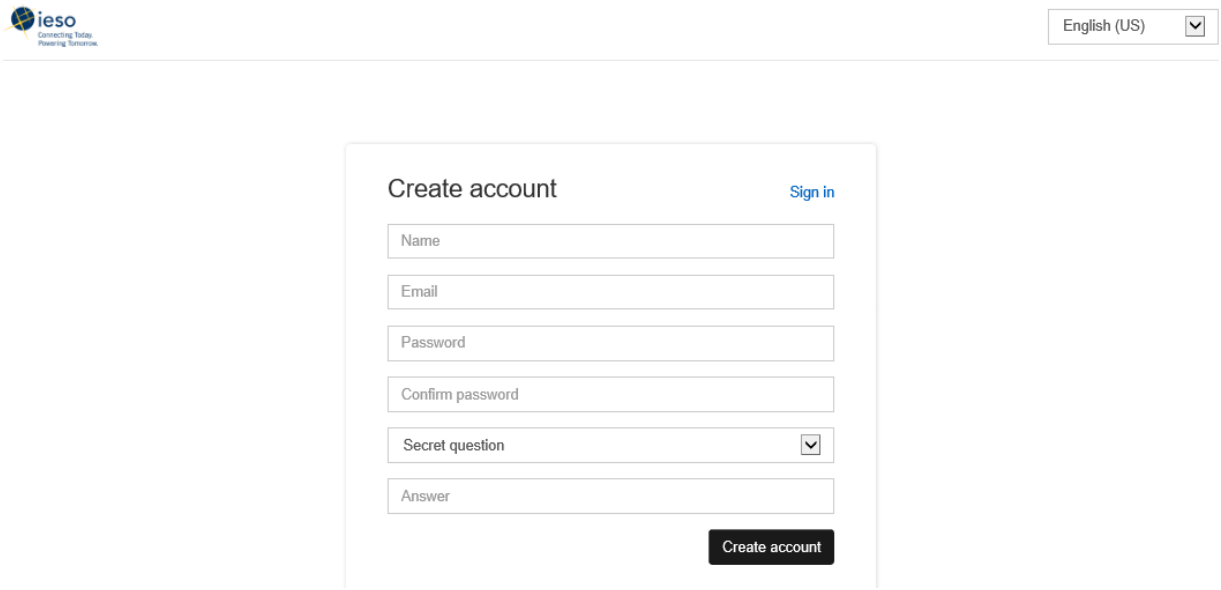

Figure 21: Create WatchDox account dialog box

To gain access to a workspace, the market participant is required to provide the IESO the email address registered with a WatchDox account. ~~Once provided, t~~The IESO will share a ~~W~~workspace created specifically for the market participant's email address. The IESO is requesting for one person from the market participant's side to do all submissions for its facility.

~~Once~~ When you receive the workspace ~~is shared,~~ information in your email inbox, click the WatchDox link of the name of the workspace shared with you. The name of this example workspace is titled **'Test Workspace'**.

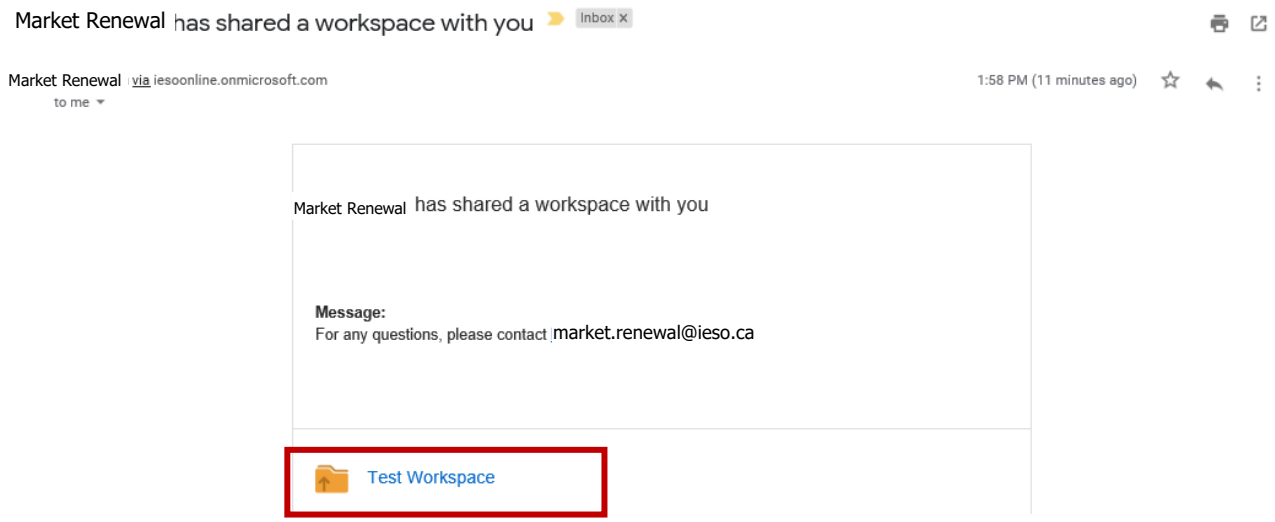

Figure 22: Shared Workspace link

If the IESO has not granted you permission to access the workspace, ~~there~~ you may need to perform ~~be~~ an additional step to request permission to access the workspace. Once you are able to access the workspace for your organization, you will see that your role is listed as a Contributor. This means that you can upload documents to the relevant folders in the workspace. Please do not change the folder structure by adding or removing any folders.

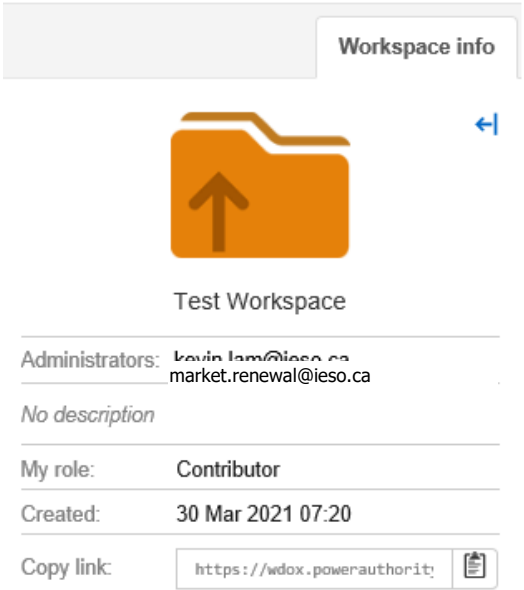

Figure 23: Workspace info tab

The folder structure first lists the organization name and the next level lists the facilities and sub-folders. Market participants may upload a completed workbook to the **Workbook** sub-folder~~: Workbook~~ and may also upload any relevant supporting documentation in the **Supporting Documentation** sub-folder.~~: Supporting Documentation.~~ The **Supporting Documentation** folder ~~splits~~ separates out materials relevant to reference levels for financial dispatch data parameters and reference levels for non-financial dispatch data parameters in different sub-folders.

Figure 24: Shared Workspace folder structure

Click **Upload** ~~once~~ inside the folder where you want to upload the documents~~ should be uploaded to~~. In the dialog box, ~~S~~select the required files, and then click ~~Ok~~ **OK** to upload.

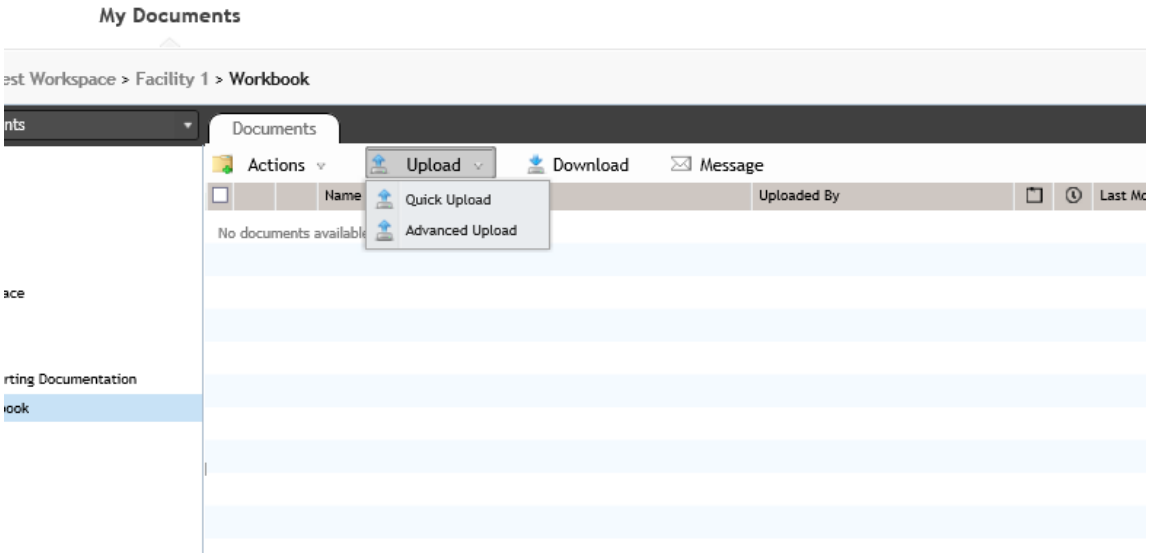

Figure 25: Upload menu option in workspace folder

When you upload a document ~~is uploaded~~, the IESO will receive a notification that a document has been shared.

For any questions related to gaining access to WatchDox or uploading files, please contact the Market Power Mitigation team.

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