

Notice of Market Rules Modification

Paper No.: EMC/RCP/126/2021/373
Rule Reference: App 6D Sec D.7
Proposer: EMC, Market Admin
Date Received by EMC: 14 October 2021
Category Allocated: 4
Status: Approved by EMA
Effective Date: 04 March 2022

This paper proposes to allow the PSO to designate the main default bus and alternate default bus of a generation settlement facility (GSF) to be in different substations.

In a scenario where a GSF and both of its default buses are disconnected, the Market Clearing Engine (MCE) produces anomalous ex-ante prices that necessitates ex-post MCE re-runs with redesignation of default buses of the GSF. Nevertheless, when network status information leading to GSFs being islanded can be pre-empted, allowing the PSO to designate the main and alternate default buses of the GSFs to be in different substations such that at least one of the substations are connected, can eliminate such re-runs. The proposal improves price certainty and saves cost for the market, especially if the substation to which the main default bus is connected is on maintenance for multiple consecutive periods.

At the 126th RCP meeting, the RCP unanimously supported the proposed modifications.

Date considered by Rules Change Panel: 10 November 2021

Date considered by EMC Board: 19 January 2022

Date considered by Energy Market Authority: 03 March 2022

Proposed rule modification:

See attached paper.

Reasons for rejection/referral back to Rules Change Panel (if applicable):

PAPER NO : **EMC/BD/01/2022/05c**

RCP PAPER NO. : **EMC/RCP/126/2021/373**

SUBJECT : **DESIGNATION OF DEFAULT BUS OF GENERATION SETTLEMENT FACILITIES**

FOR : **DECISION**

PREPARED BY : **QIN WEIXIAO**
SENIOR ECONOMIST

REVIEWED BY : **POA TIONG SIAW**
SVP, MARKET ADMINISTRATION

DATE OF MEETING : **10 NOVEMBER 2021**

Executive Summary

This paper proposes to allow the PSO to designate the main default bus and alternate default bus of a generation settlement facility (GSF) to be in different substations.

In a scenario where a GSF and both of its default buses are disconnected, the Market Clearing Engine (MCE) produces anomalous ex-ante prices that necessitates ex-post MCE re-runs with redesignation of default buses of the GSF. Nevertheless, when network status information leading to GSFs being islanded can be pre-empted, allowing the PSO to designate the main and alternate default buses of the GSFs to be in different substations such that at least one of the substations are connected, can eliminate such re-runs. The proposal improves price certainty and saves cost for the market, especially if the substation to which the main default bus is connected is on maintenance for multiple consecutive periods.

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1. Introduction

This paper proposes to allow the PSO to designate the main default bus and alternate default bus of a generation settlement facility (GSF) to be in different substations to reduce the need for price revisions and improve price certainty, especially if the substation to which the main default bus is connected is on maintenance for multiple consecutive periods.

2. Background

2.1 Pricing principles and price re-runs

In the Singapore Wholesale Electricity Market (SWEM), the Market Clearing Engine (MCE) uses **locational marginal pricing** to determine energy purchase prices and dispatch at each node in the market network. Each nodal price incorporates the effects of transmission losses and constraints such as security constraints and regulation or reserve co-optimisation, to reflect the cost incurred by the system to meet the incremental or decremental demand at the respective location. For settlement, generators are paid for their generation and charged for their station/auxiliary load consumption at their respective nodal prices. It is believed that locational pricing for generators can contribute to economic efficiency by optimally guiding market behaviour and decision-making by market participants (MPs).

The SWEM also adopts **ex-ante pricing** where the MCE determines spot prices before the start of each half-hour dispatch period. The rationale for ex-ante pricing is certainty in the prices used for settlement by MPs before purchase and sale. Nevertheless, there are provisions in the market rules for **ex-post price revisions** under specified circumstances. Ex-post revisions of ex-ante prices ensure equity and fairness such that MPs do not receive or pay the wrong prices through no fault of their own. Pricing accuracy improves because revised prices reflect prevailing market conditions.

2.2 What is a default bus?

According to section D.7.2 of Appendix 6D of the market rules, the PSO is required to designate a main default bus and an alternate default bus, **both in the same substation**, for each generation registered facility (GRF)¹ and generation settlement facility (GSF)². When the real-time network connection status shows that a GRF or GSF is not connected to the main grid, the MCE will artificially connect the GRF/GSF to the default buses so that it will be able to schedule the disconnected facility and produce its corresponding nodal price. The default buses represent the most likely connection point (“node”) for that facility in the network and are therefore pivotal in determining the nodal price of the facility.

In this paper, all references to a GSF exclude a pseudo GSF, since the PSO does not designate the main or alternate default bus for a pseudo GSF.

2.3 What happens when the facility is islanded?

The requirement for the PSO to designate an additional alternate default bus to the main default bus was introduced in 2004 in RC232: Alternate Default Bus. By introducing an additional alternate default bus for all GRFs and GSFs in the MCE, it has led to fewer price re-runs caused by a disconnected generator whose main default bus is disconnected. This is because when the main default bus is represented as disconnected in the dispatch network data, the alternate default bus will be considered for scheduling and dispatch³.

¹ Except GRFs that are multi-unit facilities

² Except GSFs that are classified as pseudo GSFs

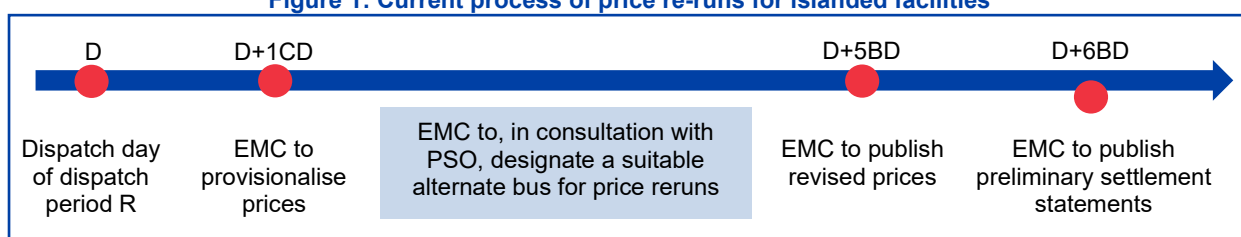
³ The market network node for a GSF is the dispatch network node corresponding to the main default bus or the alternate default bus (if the main default bus is represented as disconnected in the dispatch network data) designated by the PSO.

However, it was also recognised in the paper that both the designated main and alternate default buses could be disconnected from the PSO controlled system. A facility is considered “islanded” when the facility, and both its main and alternate default buses are represented as disconnected in the dispatch network data. For example, this occurs when the substation to which the main and alternate default buses are connected is disconnected.

Recall in para 2.1 that the market rules provide for ex-post price revisions under specified circumstances⁴. When the MCE produces prices that do not reflect the respective locational system marginal price(s), ex-post price revisions are required.

When a facility is islanded, the MCE generates anomalous nodal prices associated with the islanded facility in its dispatch schedules. Such anomalous prices, often taking extreme values such as \$4,500/MWh, \$0/MWh or -\$4,500/MWh, are not reflective of the locational marginal prices for energy and would warrant a price revision. In this instance, the EMC and the PSO will select a suitable bus (such that the facility is connected) to be used for MCE re-run for settlement. The detailed process is illustrated in Figure 1 below.

Figure 1: Current process of price re-runs for islanded facilities



2.4 Description of the 21 Jan 2021 and 4 Feb 2021 episodes

On 21 Jan 2021, anomalous nodal prices of \$0/MWh from Period 26 to Period 32 were observed for 3 GSFs. Investigation revealed that the main and alternate default buses of these three facilities were disconnected from the main grid due to a planned maintenance of the substation, which resulted in the three facilities being in an islanded mode. After consultation with the PSO, re-runs were conducted by changing the alternate default bus of the three facilities to a nearby bus that was connected to the main grid. Prices were revised and finalised accordingly.

The episode was repeated on 4 Feb 2021 from Period 26 to Period 31 for the same 3 GSFs, resulting in a total of 13 price revisions due to islanded facilities in the first two months of 2021.

The re-runs revised the nodal prices of the 3 islanded GSFs from \$0/MWh to between \$81.95/MWh and \$140.33/MWh. They had **no impact on other aspects of the overall schedule**, specifically:

- no changes to the objective values;
- no changes to overall system results, including the Uniform Singapore Energy Price (USEP), losses and quantities scheduled for each product; and
- for the other GSFs and all the GRFs, there was no change in their nodal prices or scheduled quantities in respect of the GRFs.

Although the problem happens infrequently, when facilities are islanded due to the default buses, or worse, when the entire substation is on maintenance and disconnected from the main grid, the need for price revisions could persist for multiple consecutive periods. As evidenced in the 21 Jan 2021 and 4 Feb 2021 episodes, the 13 re-runs make up 52% of the price revisions in the first 3 quarters of 2021.

⁴ A comprehensive list of such circumstances could be found in section 2.1 of RC346: Compensation for Generators Adversely Affected by Price Revision.

2.5 Proposal Received

At the 121st Rules Change Panel (RCP) meeting on 10 Mar 2021, the Panel noted the increased number of MCE re-runs in the Monitoring list. Mr Henry Gan (Representative of the EMC) further explained that under the current rules, the designation of the main and alternate default buses must be within the same substation. He proposed to avoid such re-runs by **allowing the main and alternate default buses of a GSF to be sited in different substations**.

3. Analysis and Proposal

3.1 Scope of the proposal

While the problem affects GRFs and GSFs similarly by producing anomalous nodal prices associated with the islanded facilities, the implications and impacts are less significant in the case of GSFs. Considering that GSFs in the SWEM are:

- small generation facilities with name-plate ratings of less than 10MW⁵,
- mostly solar photovoltaic systems, and
- not subject to dispatch by the MCE,

any MCE re-runs by redesignating the default buses of islanded GSFs tend to have little or no impact on the overall system results (such as the USEP) or the dispatch outcome of GRFs.

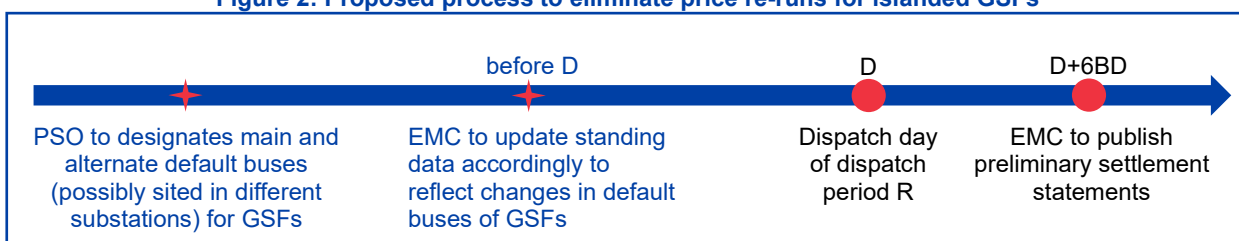
In 2016, CP63: Price Assignment for Islanded Generation Facilities extensively discussed options of price assignment to reduce the need for ex-post price revisions when GRFs and/or GSFs are islanded, including approximating their nodal prices using the prices of neighbouring buses. The Panel then considered the costs, risks and complexities associated with implementing the proposal and decided not to make any change.

This paper focuses on allowing more flexible designation of default buses for **GSFs only** to provide a quick fix with minimal or no impact to other facilities and the market as a whole.

The proposal involves allowing ex-ante redesignation of default buses of GSFs to a different substation **if network status information can be pre-empted**. For example, for a planned maintenance of a substation, GSFs with both main and alternate default buses connecting to that substation can have one of their default buses redesignated to a neighbouring substation by the PSO beforehand and avoid price revisions. However, if the default buses cannot be updated in time for the real-time dispatch run, the proposal cannot eliminate the need for ex-post price revisions.

Figure 2 below illustrates the proposed process to eliminate the need for price revisions for islanded GSFs.

Figure 2: Proposed process to eliminate price re-runs for islanded GSFs



⁵ Except a few intermittent generation facilities, e.g., solar photovoltaic systems, which could have name-plate ratings of more than 10MW.

3.2 Benefits of the proposal

By simply allowing the PSO to designate main and alternate default buses of a GSF to be sited in different substations, the proposal **substantially eliminates the need for ex-post price revisions** and **preserves ex-ante pricing** in the SWEM. Market participants avoid price uncertainties due to re-runs and the EMC can save cost and effort to conduct price re-run⁶.

3.3 Costs of the proposal

Implementation of the proposal does not require any system change from the EMC or the PSO. It is a mere rule change to allow the EMC and the PSO to update the default bus information of GSFs whenever applicable.

4. Proposed modifications to the market rules and market manuals

To effect the proposal in section 2.5 of this paper, modifications to Section D.7.2 of Appendix 6 of Market Rules are proposed to be made. Please refer to Annex 1 for the proposed modification.

5. Conclusion

When the network status information leading to GSFs being islanded could be pre-empted, the recommended approach is to allow ex-ante redesignation of default buses to be sited in different substations for a GSF to reduce islanded scenarios.

This simple and straightforward proposal would effectively eliminate the need for price re-runs in such a scenario and provide more price certainty and cost savings to the market.

6. Legal sign off

The text of the proposed modifications to the Market Rules set out in Annex 1 has been vetted by EMC’s internal legal counsel, whose opinion is that the proposed modifications reflect the intent of the modification proposals as expressed in the third column of the table in Annex 1.

7. Consultation

The proposed modifications were published for consultation on 14 October 2021 and we have received comments from Senoko Energy.

Table 1: Comments Received and EMC’s response

S/N	Reference	Comments	EMC’s Response
Senoko Energy			
1	Page 4, 3.1 Scope of the proposal Considering that GSFs in the SWEM are: <ul style="list-style-type: none"> small generation facilities with name-plate ratings of less than 10MW, 	Though we agree that the price impact will be minimal if it’s just a Single GSF that is connected to a substation, we should consider the compounded effect of this change should multiple GSFs be connected to a single substation. <ul style="list-style-type: none"> What are the implications on Nodal prices and USEP in this situation? 	Based on current capacity data in the SWEM, except for 4 GSFs, all other 47 GSFs are modelled to be connected to distinct substations. The pattern is not expected to change much as most of the smaller generations in Singapore are embedded and will be modelled in aggregate under the Enhanced Central Intermediary Scheme going forward. As set out in the re-run results in para 2.4 of this paper, EMC’s assessment is that the

⁶ It was estimated to incur about 20 manhours and \$1,162.50 internal costs per incident by the EMC in 2016 in CP63: Price Assignment for Islanded Generation Facilities.

S/N	Reference	Comments	EMC's Response
	<ul style="list-style-type: none"> ▪ mostly solar photovoltaic systems, and ▪ not subject to dispatch by the MCE, 	<ul style="list-style-type: none"> - Is there a threshold on the combined GSF MW connection to a substation that will be applicable to this proposal? 	<p>proposal will have little to no impact on nodal prices and USEP.</p> <p>Although the capacity of some GSFs that are intermittent could exceed 10MW, all GSFs are not subject to dispatch regardless of capacity. The proposal intends to provide flexibility in designation of default buses of all GSFs.</p>
2	<p>Page 5, 5. Conclusion</p> <p>This simple and straightforward proposal would effectively eliminate the need for price re-runs in such a scenario and provide more price certainty and cost savings to the market.</p>	<p>Seeking for additional information on:</p> <ul style="list-style-type: none"> - The forecasted cost savings through this implementation - How will the savings be passed on to Market Participants 	<p>While we are unable to forecast the frequency of occurrence of such re-runs, EMC has earlier assessed that it costs about 20 manhours and \$1,162.50 for each re-run incident.</p> <p>The savings in manpower and costs will allow EMC to better allocate its resources to other tasks and projects. EMC is also a regulated entity where any efficiency gain that exceeds the threshold set by the EMA will be returned to market.</p>

8. Decision at the 126th RCP Meeting

At the 126th RCP meeting, the RCP unanimously supported the the proposed rule modifications as set out in Annex 1.

ANNEX 1: Proposed Changes to the Market Rules

Existing Market Rules (1 Jan 2021)	Proposed Rules Changes (Deletions represented by strikethrough text and additions represented by double underlined text)	Reasons for Rule Changes
Appendix 6	Appendix 6	
APPENDIX D - MARKET CLEARING FORMULATION	APPENDIX D - MARKET CLEARING FORMULATION	
<p>D.7 MARKET NETWORK NODES</p> <p>D.7.2 The <i>PSO</i> shall designate a main default bus, and an alternate default bus which is in the same substation/switchhouse as the main default bus, for each <i>generation registered facility</i> that is not a <i>multi-unit facility</i> and each <i>generation settlement facility</i> that is not a <i>pseudo generation settlement facility</i>, representing the most likely connection point for that <i>generation facility</i>.</p>	<p>D.7 MARKET NETWORK NODES</p> <p>D.7.2 The <i>PSO</i> shall:</p> <p><u>D.7.2.1</u> designate a main default bus, and an alternate default bus which is in the same substation/switchhouse as the main default bus, for each <i>generation registered facility</i> that is not a <i>multi-unit facility</i>; and</p> <p><u>D.7.2.2</u> <u>designate a main default bus and an alternate default bus (whether in the same substation/switchhouse or otherwise) for each <i>generation settlement facility</i> that is not a <i>pseudo generation settlement facility</i>,</u> representing the most likely connection point for that <i>generation facility</i>.</p>	<p>To allow the <i>PSO</i> to designate a main and an alternate default bus for a generation settlement facility that is not a pseudo generation settlement facility, without the requirement of having the alternate default bus to be in the same substation / switchhouse as the main default bus.</p>