Market Operator
Generating Unit Tie Break Procedure

Version 2.0
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PowerWater

Contents

1 Purpose of Procedure

This procedure specifies the principles in applying a *tie-break* to competing *generating units* when operating in the *I-NTEM* to ensure an orderly merit order *dispatch process* by the *Power System Controller*.

2 Scope

2.1 The procedure only applies to the *I-NTEM*.

2.2 The procedure is prepared under the authority of Section 4.4B(e) of the System Control Technical Code.

2.3 The procedure covers those parts of the commitment and *dispatch process*[1] that involve:

2.3.1 The priority of the off-load order when comparing *generating units* (whose offer price is zero) from more than one *Generator*; and

2.3.2 The dispatch of *generating units* from two or more *Generators* when the offer prices are equal at the *Pool Price Point* and section 2.3.1 does not apply.

2.4 The procedure does not cover other parts of the commitment and *dispatch process*.

3 Roles and Responsibilities

Role / Title	Responsibility
Power and Water / Market Operator	• Ensure that the requirements of Section 4.4B(e) have been correctly actioned. • Ensure that this procedure is fit for purpose. • Ensure compliance with this procedure. • Receive and process Offers in accordance with this procedure. • Advise *Generator* representatives of any instance that an Offer is not consistent with this procedure. • Review and revise the procedure from time to time and no later than the review date to maintain its relevance.
Generator representative	• Perform the duties required of a *Generator* Market Participant as required by this procedure.

[1] The commitment and dispatch process is referred to in Section 4.4B(c) of the System Control Technical Code.

4 Definitions

The definitions of words recorded in the Glossary of the System Control Technical Code apply to this document, in addition to the words recorded in the table below, as shown in italics throughout the document.

DEFINITIONS		
No.	**Term**	**Meaning**
1	*Decommitment Order*	The order in which a *Generator* nominates to have its fast start *generating units* come off-line after 18:00 on a given trading day. If there are any other on-line *generating units* belonging to the same *Generator* identified in the decommitment order, then the *generating unit* with the lowest decommitment order that is not required to remain on for security reasons is to be decommitted. The order is applied until all the *generating units* identified have been decommitted (or prevented from being taken off-line by security requirements), with any *generating units* with no number specified being decommitted based on normal bid prices. Notes: This feature effectively moves these *generating units* to the top (what would normally be the highest price end) of the merit order for units to come off. Where a generating unit would, if not for the application of the decommitment order, be decommitted, that unit will not be able to set price. Normal scheduling and tie-break logic operates without regard for this order and will identify the next *generating unit* that would normally be taken off-line.
2	*Dispatch process*	A process that includes forming a pre-dispatch schedule or determining the real-time dispatch
3	*Energy tie*	An energy tie exists where equal price offers from band 2 for which the prices submitted in *Generator Offers* for a particular *trading interval* result in identical prices at their *Pool Price Point.* The MW quantities specified in the relevant *price bands* of those *dispatch bids* or *dispatch offers* must be *dispatched* using the *random day selection process*, where this can be achieved without violating other constraints.
4	*Fast-start-commitment tie*	A fast-start-commitment tie exists where either: • one of two or more fast-start *generating units* from more than one *Generator* is to be started based on set 1 (long run) Band 2 prices and the *generating units* all have the same set 1 Band 2 price. or

		• one of two or more fast-start *generating units* from more than one *Generator* is either to be started or to have Band 3 scheduled, based on any combination of set 2 (short run) Band 2 prices (for those units to be started) and/or Band 3 prices (in the case of scheduling Band 3) which all have the same value. A fast-start commitment tie is to be resolved using the *random day selection process*, where this can be achieved without violating other constraints. NOTE –The units are to come off in the same order they are started.
5	*Generating Unit tie break*	Generating unit tie break is the term given to the methodologies used to resolve *self-commitment ties, fast-start commitment ties* and *energy ties*.
6	*Off-load order*	The term specified in the relevant column of the commitment and dispatch template shown in Attachment 4 of the System Control Technical Code, as superseded by the Generator Offer procedure.
7	*Pool Price Point (PPP)*	Pool Price Point. The reference supply point for all *generating units* in respect to power system losses
8	*Random day*	The trading day assigned to a specific *Generator* for assigning a marginal price priority order, as nominated in the *random day selection process* (refer to Attachment B).
9	*Random day selection process*	The process where each *Generator* is assigned a series of trading days in a period and on any one of those trading days, that *Generator's generating units* whose offer price is greater than zero and marginal will be dispatched by the *Power System Controller* before any other *Generator's generating unit* with an equal marginal price is dispatched. Examples are provided in Attachment C.
10	*Random period*	The period allocated to a specific *Generator* for assigning the off-load priority order, as nominated in the *random period selection process* (refer to Attachment A). The duration of the period is specified in Attachment A.
11	*Random period selection process*	The process where each *Generator* is assigned a period (consisting of multiple consecutive trading days) where the *Generator's generating units* with an *off-load order* may be instructed to be taken off-line by the *Power System Controller* before any other *Generator's generating unit* with an identical *off-load order* is instructed to be taken off line (refer to Attachment B). Examples are provided in Attachment C.

12	*Self-commitment tie*	A self-commitment tie exists where either: • one of the self-committed *generating units* from more than one *Generator* must be taken off-line as a result of the total of all Band 1 quantities exceeding system load but these *generating units* have the same *off-load order*. or • one of the self-committed *generating units* within a congested area of the network from more than one *Generator* must be decommitted as a result of the total of all Band 1 quantities of *generating units* within that area exceeding the load plus net imports in that area but these *generating units* have the same *off-load order*. A self-commitment tie is to be resolved using the *random period selection process*, where this can be achieved without violating other constraints.

5 Principles

The following principles are to be used to guide the application of the *generating unit tie break* methodologies:

Off-load order for self-commitment ties

5.1 During the *dispatch process*, if the *power system* load falls to the level where a *generating unit* Band 1 has to be taken off-line, the *Power System Controller* is to:

5.1.1 select the on-line *generating unit* that has the lowest *off-load order*; and

5.1.2 instruct that *generating unit* to be taken off-line.

5.2 If in paragraph 5.1 the *Power System Controller* identifies *generating units* from two or more Generator Offers who have the same *off-load order* number, such that a *self-commitment tie* exists, the *Power System Controller* must instruct one of the *Generators* to take off-line their *generating unit* that has the lowest *off-load order* according to the methodology specified in paragraph 5.1.

5.2.1 For the removal of doubt, once the first *generating unit* has been taken off-line in accordance with the *random period selection process*, the next *generating unit* to be chosen will be from the remaining *Generator(s)* that have the lowest *off-load order*.

5.3 The *Generator* to be instructed in paragraph 5.1 must be chosen in accordance with the *random period selection process*.

5.3.1 The days in a year that are allocated to each *Generator* for the purpose of activating the *random period selection process* are to be those days specified in Attachment A.

5.3.2 Refer to Attachment C for an example of the *random day selection process* when applied to the *off-load order*.

5.4 Once the system load bottoms and starts increasing, the *Power System Controller* must request the *Generator(s)* who have been the subject of a *random period* instruction to either place their *generating unit(s)* on-line and to increase output in accordance with the pre-dispatch schedule before other *generating units* or bands are dispatched.

5.4.1 A *Generator* whose *generating unit* has been the subject of a *random period* instruction may, at that *Generator's* discretion, decide not to return the affected *generating unit* to service, in which case the *Generator* must advise the *Power System Controller* of this decision at the earliest possible time, and no later than in immediate response to the request to place the *generating unit* on-line.

5.4.2 When requesting *Generators* to place their *generating unit(s)* on-line under this paragraph 5.4 the *Power System Controller* must request the units on-line in the same order to how *Generators* were instructed to take them off-line unless prevented from doing so by the need to satisfy constraints (first off / first on).

Fast start units subject to fast-start-commitment ties

5.5 During the *dispatch process*, if the *Power System Controller* identifies the need to start fast start *generating units* based on set 1 (long run) band 2 prices but there is more than one fast start *generating units* belonging to two or more Generators that could address the need, such that *a fast start commitment tie* exists, the *Generator* to be instructed to bring on-line a fast start *generating unit* is to be chosen in accordance with the *random day selection process*.

5.5.1 The days in a year that are allocated to each *Generator* for the purpose of activating the *random day selection process* are to be those days specified in Attachment A.

5.6 During the *dispatch process*, if the *Power System Controller* identifies the need to either start fast start *generating units* based on set 2 (short run) Band 2 prices or to start scheduling from Band 3 based on Band 3 prices for one or more fast start *generating units*, but there is more than one fast start *generating units* belonging to two or more *Generators* that could address the need, such that *a fast start commitment tie* exists, the *Generator* to be instructed to bring on-line a fast start *generating unit* or Band 3 from a running fast start *generating unit* is to be chosen in accordance with the *random day selection process*.

5.6.1 The days in a year that are allocated to each *Generator* for the purpose of activating the *random day selection process* are to be those days specified in Attachment A.

5.7 When instructing fast start *generating units* brought on-line under paragraph 5.5 or 5.6 to be taken off-line, or supply from Band 3 capacity scheduled under paragraph 5.6 to be

taken off-line, the *Power System Controller* must do so in the same order to how *Generators* were instructed to bring that capacity on-line, or where appliable a replacement *generating unit* determined through the application of a *decommitment order*, unless prevented from doing so by the need to satisfy constraints.

Equal Band 2 price offers subject to an energy tie

5.8 If in performing the *dispatch process* and subject to paragraph 5.9, the *Power System Controller* finds that two or more *generating units* have the same Band 2 offer prices at the *Pool Price Point*, the *Power System Controller* must apply the *random day selection process* to each of the *generating units* when allocating quantities to the price stack, as follows:

5.8.1 The Band 2 quantities of each these *generating units* are to be divided into a sequence of quantity steps, numbered, 1, 2, 3,…. which add up to the Band 2 quantity with each quantity step being for 5 MW except at most one which must have a capacity less than 5 MW and which shall be the last in the sequence;

5.8.2 The quantity steps with the same sequence number are to be treated as if they are separate *generating units* in determining their order of allocation to the price stack;

5.8.3 Quantity steps with higher sequence numbers are to be added to the price stack only after quantity steps with lower sequence numbers have been added;

5.8.4 Quantity steps from different *generating units* with the same sequence number will be assigned to the price stack based on the order of allocating each *Generator* to the price stack;

5.8.5 The *Generator* allocated first, based on the *random day,* will have a quantity step of a given sequence number from its *generating unit* assigned to the price stack in preference to a quantity step with the same sequence number from a *generating unit* from another *Generator*.

5.8.6 Once the first *Generator's* quantity step of a given sequence number from its *generating unit* has been assigned to the price stack, the quantity step with the same sequence number from the *generating unit* of the *Generator* allocated second, based on the *random day,* will be assigned to the price stack, and so on for the *Generators'* allocated third, fourth, etc until all their quantity steps with the same sequence number are allocated.

5.8.7 Refer to Attachment C for an example of the *random day selection process* when applied to energy ties.

5.9 In the application of paragraph 5.8 and only for *generating units* with a zero Band 1 quantity, the *Power System Controller* may, at its discretion, treat a small increment of the Band 2 quantity as not being part of the price stack where required to allow the *generating unit* to be available for dispatch if the alternative is to isolate it from the power system.

6 References

#	Document	Date	Location
1	Systems Control Technical Code V6	30/03/2020	D2020/134187
2	Market Timetable V1.0	27/05/2016	D2016/93559
3	System Secure Guidelines V4.2	30/04/2020	D2020/197868
4	Consultation Paper – Revision of Generator Offer Procedure and Tie Break Procedure	12/06/2020	D2020/262247

7 Attachments

7.1 Attachment A: Random period selection process

7.2 Attachment B: Random day selection process.

7.3 Attachment C: Examples.

8 Records

This document is to be stored in Power and Water's Records Management System (TRIM) in accordance with the Document and Record Control Procedure.

9 Review

This document is to be reviewed in accordance with changes to the System Control Technical Code.

10 Document History

Date of Issue	Version	Prepared By	Description of Changes
11/03/2016	V1.0	Andrew Roberts	Initial version
01/07/2020	Draft 2.0	Zaeen Khan	Revision for consultation
04/09/2020	V2.0	Zaeen Khan	Approved after consultation

For clarification on the use of this document, please contact Power and Water Corporation in the role of Market Operator (email: market.operator@powerwater.com.au).

Attachment A: Random Period Selection Process

The *random period selection process* has the following attributes:

A.1 The *random period* is four calendar weeks commencing on a Monday and finishing on a Sunday in the cycle.

A.2 The *Power System Controller* assigns days in a period to *Generators* in accordance with their registration sequence with the *Market Operator*.

A.3 Based on this principle, TGen is assigned every trading day in the four week period until a second *Generator* has been registered with the *Market Operator*.

a. The period commenced on 27 May 2015 and will end on the trading day prior to the commencement of the second *Generator* in the *I-NTEM*.

A.4 When the second *Generator* registers with the *Market Operator*, that *Generator* will be assigned a four week period commencing on the first Monday after its commencement date (or if the commencement day is a Monday, that day).

A.5 When the third *Generator* registers with the *Market Operator*:

a. that *Generator* will be assigned a four week period commencing on the first Monday after its commencement date (or if the commencement day is a Monday, that day); and

b. TGen is to be assigned the four week period commencing on the trading day after the third *Generator* completes its *random period*; and

c. the second *Generator* is to be assigned the four week period commencing on the trading day after TGen completes its *random period*.

d. the choice between the *generating units* of the remaining *Generators* during any one *random period* is to be based solely on the first/second/third market registration sequence. That is:

- if the *random period* applies to the first *Generator*, the choice between the second and third *Generators* will be: second *Generator* followed by the third *Generator*.
- if the *random period* applies to the second *Generator*, the choice between the remaining two *Generators* will be: third *Generator* followed by the first *Generator*.
- if the *random period* applies to the third *Generator*, the choice between the remaining two *Generators* will be: first *Generator* followed by the second *Generator*.

A.6 The re-assignment of the *random period* is to be replicated for four and subsequent *Generators* registering in the *I-NTEM*.

A.7 On any nominated day, the *generating unit tie-break* principle for the *off-load order* will apply to the *Generator* who has been assigned the *random period*.

A.8 The *random period selection process* will be terminated when superseded by a new *NTEM generating unit tie-break* principle.

Attachment B: Random Day Selection Process

The *random day selection process* has the following attributes:

B.1 The *Power System Controller* assigns days in a period to *Generators* in accordance with their registration sequence with the *Market Operator*.

B.2 Based on this principle, TGen is assigned every trading day in the period until a second *Generator* has been registered with the *Market Operator*.

a. The period commenced on 27 May 2015 and will end on the trading day prior to the commencement of the second *Generator* in the *I-NTEM*.

B.3 When the second *Generator* registers with the *Market Operator*, TGen is to be assigned every second trading day in the subsequent period commencing with the trading day on which the second *Generator* commences trading in the *I-NTEM*, and the second *Generator* is assigned every second trading day commencing on the trading day after it commences trading in the *I-NTEM* (the second day of trading).

B.4 When the third *Generator* registers with the *Market Operator*:

a. TGen is assigned every third trading day in the subsequent period commencing with the trading day on which the third *Generator* commences trading in the *I-NTEM*; and

b. the second *Generator* is assigned every third trading day commencing on the trading day after the third *Generator* commences trading in the *I-NTEM* (the second day of trading); and

c. the third *Generator* is assigned every third trading day commencing two trading days after it commences trading in the *I-NTEM* (the third day of trading).

B.5 The re-assignment of the *random day* is to be replicated for four and subsequent *Generators* registering in the *I-NTEM*.

B.6 On any nominated day, the *generating unit tie-break* principle will allocate an order of inclusion of *Generators* in the price stack such that:

a. the *Generator* who has been assigned the *random day* is allocated first.

b. the choice between subsequent *Generators* is to be based on their order of registration. That is, if the first *Generator* is denoted by n=1, the second *Generator* by n=2, the third *Generator* by n=3, etc, with the last and Nth subsequent *Generator* to register by n=N then:

- if the *random day* applies to the first *Generator* (n=1), the choice between the subsequent *Generators* to register will be resolved by allocating an order of inclusion of each *Generator* in the price stack in the order of increasing n from 2 to N.

- if the *random day* applies to the second *Generator* (n=2), the choice between the subsequent *Generators* to register will be resolved by allocating an order of inclusion of each *Generator* in the price stack in the order of increasing n from 3 to N and then =1.
- If N exceeds 3 the *random day* applies to the m^{th} *Generator* to register (n=m), where m> 2, the choice between the subsequent *Generators* to register will be resolved by allocating an order of inclusion of each *Generator* in the price stack in the order of increasing n from m+1 to N and then in the order of increasing n from 1 to m-1.

B.7 The methodology of paragraph B.6 shall be modified during any period where the number of participants (N) is a multiple of seven so as to avoid the tie-breaking order being linked to the day of the week. The following variation of the method is to apply:

a. The method of paragraph B.6 shall apply normally through to and including the day on which the *random day* applies to the last participant to register where N is a multiple of seven, but one additional day should elapse before the method of paragraph B.6 resumes with the *random day* applying o the first participant to register;

b. For the one additional day the tie breaking order shall on its first occurrence have the *random day* apply to the first *Generator* (n=1), on its second occurrence the second *Generator,* and so on to the Nth *Generator* before returning to the first *Generator*, with in each case the choice between subsequent *Generators* being in the same order as specified in paragraph B.6 given the generator assigned first;

B.8 The *random day selection process* will be terminated when superseded by a new *NTEM tie-break* principle.

Attachment C: Examples

The following examples are provided to clarify the application of the random selection process:

Example 1 – minimum system load condition (*random period selection process*):

An example of the *random period selection process* when two *Generators* are registered to operate in the *I-NTEM* under low system load is as follows.

Assumptions:

1. It is assumed that *Generator* 2 commences trading in the *I-NTEM* on Friday 01 April 2016.

Random period allocation:

1. 2nd Gen *random period* >>Monday 4 April 16; Monday 30 May 16; etc
2. TGen *random period* >>Monday 2 May 16; Monday 27 June 16; etc
3. Note that the trading days will be *published* in a 12 month calendar format once the procedure is approved.

Application:

4. On trading day 05 Apr 2016, the system load has fallen to the point where the following units are on line at their minimum loads:
   - TGen U1, U2, U3 and U4 (where U1 and U2 are OCGT and U3 is a steam unit, and U4 is constrained on-line for frequency regulation and hence is constrained ON for system security purpose)
   - Gen#2 U1, U2, U3 (where U1 and U2 are OCGT and U3 is a steam unit).
5. On that trading day the load falls by another 10 MW. One of the on-line units has to be taken off-line.
6. TGen has nominated U1 as off-load order #1a, and U2 as off-load order #2. Gen#2 has nominated U1 as off-load order #1a, and U2 as off-load order #2.
7. In choosing between TGen U1 and Gen#2 U1 (both with off-load orders #1), the *Power System Controller* defers to the *random period* in which day 05 Apr 2016 falls. This is allocated to Gen#2. Consequently, the *Power System Controller* instructs Gen#2 to transfer U1 to OCGT mode (meaning it is decoupled from the steam unit) and the output of U1 is reduced to minimum load. A reduction of the output of the steam unit is also achieved at this time due to its operation on one gas turbine only. However, the total reduction is only 6 MW.
8. The Power System Controller is required to off-load a further 4 MWs, and consequently requests TGen to move U1 to open cycle mode at minimum load.

9. With Gen#2 and TGen U1 in Open Cycle mode at minimum load, these *generating units* are still available to the *Power System Controller* to take off-line should the system load fall further.

10. The system load keeps falling and forty minutes later the *Power System Controller* requests Gen#2 U1 to be taken off-line (the balance of off-load order #1a). The next *off-load order* available to the *Power System Controller* is TGen U1 (the balance of off-load order #1a).

11. The system load reaches a minimum for the day before the *Power System Controller* is required to request TGen U1 to be taken off-line.

12. As the system load increases, the *Power System Controller* requests Gen#2 to place U1 on-line. Gen#2 has the choice as to when U1 is placed on-line, but must inform the *Power System Controller* if any delay is required in order for the *Power System Controller* to request another *generating unit* to be placed on-line.

Note 1: this example is intended to make it clear that the *random period* only influences the *Power System Controller* when two *generating units* from different *Generators* have the same *off-load order* number. Once the method for choosing the tied number has been exercised, the remaining identical off-load number is the next number in the off-load sequence to be chosen from all *Generators*.

Note 2: For the removal of doubt, the *random period* is not applied solely to all the *off-load orders* recorded in any one *Generator's* offer before the *off-load order* of another *Generator* becomes available for choice by the *Power System Controller*.

Example 2 – equal offer prices (random day selection process):

An example of the *random day selection process* when two *Generators* (who have registered to operate in the *I-NTEM*) present equal offer prices is as follows:

Assumptions:

1. It is assumed that *Generator* 2 commences trading in the *I-NTEM* on 01 April 2016.

Random day allocation:

2. TGen *random day* >> 01 Apr 16; 03 Apr 16; 05 Apr 16; 07 Apr 16; 09 Apr 16; 11 Apr 16; etc
3. 2nd Gen *random day* >> 02 Apr 16; 04 Apr 16; 06 Apr 16; 08 Apr 16; 10 Apr 16; 12 Apr 16; etc
4. Note that the trading days will be *published* in a 12 month calendar format once the procedure is approved.

Application:

5. At gate closure on 04 Apr 2016, the *Power System Controller* identifies the following equal price offers (for trading day 05 Apr 2016) from two *Generators*:

- TGen U#12 offered as fast start with a band 1 price of $60.00/MWh at the PPP and a band 1+2 capacity of 42 MW.
- Gen#2 U4 offered as fast start with a band 1 price of $80.00/MWh at the PPP and a band 1+2 capacity of 12 MW.

6. If the price of $80.00/MWh is below the marginal *generating unit* for one or more trading intervals in the trading day, the *Power System Controller* must invoke the *random day selection process* for the selection of the capacity from the two *generating units*.

7. In preparing the pre-dispatch schedule, the *Power System Controller* identifies which *Generator* is assigned to the *random day* for 05 April 2016 in the *random day selection process*. The full capacity of that *Generator's generating unit* is chosen as the first capacity to be applied to the price stack.
    - When more capacity is required, the second *Generator's generating unit* capacity is to be chosen and assigned to the price stack. Note that no change has been made to the offer prices, meaning that the identical marginal price is extended over two generating unit capacities.