FAST-START INFLEXIBILITY PROFILE

PROCESS DESCRIPTION

Published: **October 2014**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared this document to provide information on the fast-start inflexibility profile and how AEMO's market management system processes the profile, as at the date of publication.

Disclaimer

This document or the information in it may be subsequently updated or amended. This document does not constitute legal or business advice, and should not be relied on as a substitute for obtaining detailed advice about the National Electricity Law (NEL), the National Electricity Rules (Rules), or any other applicable laws, procedures or policies. AEMO has made every effort to ensure the quality of the information in this document but cannot guarantee its accuracy or completeness.

Accordingly, to the maximum extent permitted by law, AEMO and its officers, employees and consultants involved in the preparation of this document:

- make no representation or warranty, express or implied, as to the currency, accuracy, reliability or completeness of the information in this document; and
- are not liable (whether by reason of negligence or otherwise) for any statements or representations in this document, or any omissions from it, or for any use or reliance on the information in it.

VERSION CONTROL

VER.REL	DATE	AUTHOR	AUTHORISED BY	ACTION
1.0	09/02/2010	Gary Huang	Basilisa Choi	Initial Release
1.1	10/10/2014	Duncan Swijnenburg / Michael Sanders	Basilisa Choi	Apply new AEMO template and include omitted sections

CONTENTS

1 – INTRODUCTION 4

2 – FAST-START GENERATING UNITS 5

3 – PRE-PROCESSING OF FAST-START PARAMETERS 7

3.1 A fast-start unit offers to run as slow-start 7
3.2 A fast-start unit previously running as slow-start changes to fast-start 7
3.3 A fast-start unit operating in an inflexible mode re-offers unavailable 7

4 – TWO-PASS SOLUTION SCHEME FOR FAST-START COMMITMENT 9

4.1 Step 1 9
4.2 Step 2 9
4.2.1 Continuation 9
4.2.2 Decommitment 9
4.2.3 Commitment 10
4.3 Step 3 10
4.4 Basslink Switch Run and Intervention Constraints 10

1 – INTRODUCTION

This document provides information on the dispatch inflexibility profile associated with fast-start plant, and explains how AEMO's market management system uses these profiles in dispatching and pricing the National Electricity Market (NEM).

Section 2 discusses the characteristics of fast-start generating units. It focuses on the dispatch inflexibility profile and the various operating modes that a fast-start unit might occupy. The dispatch inflexibility profile is introduced in section 3.8.19 of the National Electricity Rules (Rules). The dispatch inflexibility profile is commonly referred to within AEMO's market management systems as the fast-start inflexibility profile.

Section 3 discusses the pre-processing of fast-start parameters at the start of each dispatch interval. Pre-processing consists of passing the NEM Dispatch Engine (NEMDE) the necessary information in the appropriate format in order to commit and dispatch fast-start units. This section focuses on some non-standard scenarios for fast-start plant in which their operating mode and times might need to be reset before passing to NEMDE.

Section 4 discusses the commitment and dispatch of fast-start plant in NEMDE. It describes the two-pass solution scheme designed to overcome the possible over-commitment of fast-start units, and how dispatch inflexibility profiles and operating modes are used in this process.

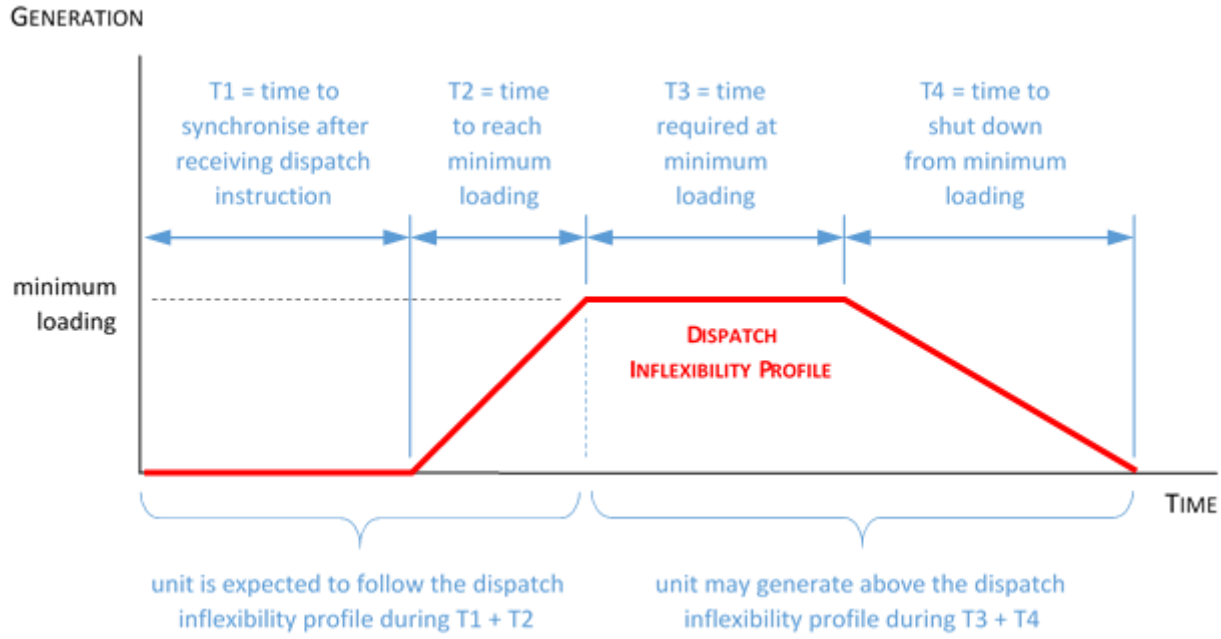
2 – FAST-START GENERATING UNITS

This section discusses the characteristics of fast-start generating units. In particular, it focuses on the dispatch inflexibility profile, and the various operating modes that a fast-start unit might occupy.

A fast-start generating unit is a unit that can synchronise and reach its minimum loading within 30 minutes, and can synchronise, reach minimum loading, and shut down in less than 60 minutes. It must register with AEMO as a fast-start unit in order to participate in the NEM as a fast-start unit, but can submit offers as a fast-start or slow-start unit.

A fast-start generating unit must submit a dispatch inflexibility profile in order to be dispatched as a fast-start unit. The format of the dispatch inflexibility profile is defined in section 3.8.19(e) of the Rules, and consists of a number of parameters shown schematically in Figure 1.

Figure 1: Characteristics of a dispatch inflexibility profile



where

T1, T2, T3, T4 ≥ 0

T1 + T2 ≤ 30 minutes

T1 + T2 + T3 + T4 < 60 minutes

T1, T2, T3, T4 are all measured in minutes

At the start of each dispatch interval NEMDE must also be told which segment of the inflexibility profile the unit is sitting on, and how long the unit has been there, in order to commit and dispatch fast-start units. The position of a unit on the inflexibility profile is known as its mode. Fast-start units can be assigned any one of the operating modes shown in Table 1.

Table 1: Fast-start modes and descriptions

Mode	Mode Title	Mode Description
Mode 0	Offline Mode	The fast-start unit is offline.
Mode 1	Synchronising Mode	The fast-start unit has received a dispatch instruction to generate. This mode lasts for T1.
Mode 2	Start Up Mode	The fast-start unit is generating but has not reached minimum loading. It is on fixed-dispatch. This mode lasts for T2.
Mode 3	Minimum Loading	The fast-start unit has reached minimum loading but has not operated at or above this level for the required period of time. This mode lasts for T3.
Mode 4	Normal Operation (Time in Mode < T4)	The fast-start unit has been running at or above minimum loading for more than T3 but not longer than T3+T4. Energy dispatch is still lower bounded by the dispatch inflexibility profile.
Mode 4	Normal Operation (Time in mode ≥ T4)	The fast-start unit is dispatched the same as any other scheduled unit until the dispatch target becomes ≤ 0.005 MW, in which case the fast-start unit is placed into the Offline mode.

Dispatch inflexibility profiles are used only in real-time dispatch. They are not used in pre-dispatch. The Rules also allow dispatch inflexibility profiles to be applied to scheduled loads. This facility is not currently being used.

3 – PRE-PROCESSING OF FAST-START PARAMETERS

This section discusses the pre-processing of fast-start parameters at the start of each dispatch interval. Pre-processing consists of passing NEMDE the necessary information in the appropriate format in order to commit and dispatch fast-start units. The previous chapter discussed the standard operation of fast-start units from synchronisation to shutdown. In that case NEMDE needed to know the mode that a fast-start unit was operating in, and how long it had been in that mode at the start of the dispatch interval. This chapter discusses three non-standard scenarios for fast-start plant in which the operating mode and times might need to be reset before passing to NEMDE.

3.1 A fast-start unit offers to run as slow-start

If a fast-start unit offers in all fast-start timing parameters (T1, T2, T3, and T4) as zero or null, then the unit will be dispatched by NEMDE as a slow-start unit i.e. without a dispatch inflexibility profile.

3.2 A fast-start unit previously running as slow-start changes to fast-start

A fast-start unit is deemed to be making a transition from slow-start to fast-start if the following conditions are met:

- The unit has offered a non-zero fast-start timing parameter (T1, T2, T3, or T4).
- The unit was scheduled for energy in the previous dispatch interval (TotalCleared > 0).
- The unit was not operating in a fast-start dispatch mode in the previous dispatch interval (DispatchMode = 0).
- The unit is available to produce energy in the current dispatch interval (MaxAvail > 0).

In this case the unit is dispatched by NEMDE as a fast-start unit with an operating mode and time determined by the following logic:

IF InitialMW < 1 MW

THEN Reset CurrentMode to 0 and CurrentModeTime to 0

ELSE Reset CurrentMode to 4 and CurrentModeTime to T4

During intervention pricing, the above logic should be applied to the What-If pricing run to reset the What-If Current Mode and What-If Current Mode Time.

If the conditions for making a transition from running as slow-start to fast-start are not met, then the unit remains in slow-start, and no pre-processing is required to reset the operating mode and time.

3.3 A fast-start unit operating in an inflexible mode re-offers unavailable

If a fast-start unit operating in one of the fast-start modes is re-offered as unavailable then the unit should be de-committed. A fast-start unit is deemed to be making this transition if:

- The unit has offered a non-zero fast-start timing parameter (T1, T2, T3, or T4).
- The unit was operating in fast-start dispatch mode 0, 1, 2, 3, or 4 in the previous dispatch interval.
- The unit is offered unavailable (MaxAvail = 0).

In this case the unit is dispatched by NEMDE as a fast-start unit with an operating mode and time determined by the following logic:

IF InitialMW < 1 MW and CurrentMode is 0

THEN Reset CurrentMode to 0 and CurrentModeTime to 0

ELSE Reset CurrentMode to 4 and CurrentModeTime to T4

During intervention pricing, the above logic should be applied to the What-If pricing run to reset the What-If Current Mode and What-If Current Mode Time.

If the conditions for the fast-start unit to re-offer as unavailable are not met, then the unit remains in fast-start, and no pre-processing is required to reset the operating mode and time.

4 – TWO-PASS SOLUTION SCHEME FOR FAST-START COMMITMENT

This section discusses the commitment and dispatch of fast-start plant in NEMDE. In particular, it focuses on the two-pass solution scheme designed to overcome the possible over-commitment of fast-start units. The two-pass solution is summarised in Table 2.

Table 2: Summary of two-pass solution scheme for fast-start commitment

Step	Sub-Step	Description
Step 1	Step 1a	The dispatch inflexibility profiles for all fast-start units are ignored in the first pass of NEMDE
	Step 1b	If non-physical losses (NPL) are detected the first pass is rerun using NPL clamping
Step 2		Fast-start units are committed based on the results from Step 1 and their operating mode at the start of the dispatch interval
Step 3	Step 3a	The dispatch inflexibility profiles for all fast-start units committed in Step 2 are enforced in the second pass of NEMDE
	Step 3b	If non-physical losses (NPL) are detected the second pass is rerun using NPL clamping

4.1 Step 1

A fast-start commitment solve is performed in the first pass. In this solve all fast-start units are modelled with their dispatch inflexibility profile constraints ignored. Any bid and SCADA-metered energy ramp rate constraints and joint ramping constraints for fast-start units that are in modes 0, 1, or 2 at the start of the current dispatch interval are also ignored.

The primary purpose of Step 1 is to estimate the amount of energy that would be dispatched from fully flexible fast-start units. A secondary purpose of Step 1 is to determine if any NPL are present. If NPL are detected, the standard NPL-mitigation logic is invoked, and the first-pass fast-start commitment solve is repeated.

4.2 Step 2

Step 2 determines the target operating mode for all fast-start units at the end of the current dispatch interval, based on their operating mode at the start of the dispatch interval and their MW target from Step 1.

4.2.1 Continuation

All fast-start units that were committed at the start of the current dispatch interval have their target operating modes set to follow their dispatch inflexibility profile (these are the profile constraints during T1 and T2, and a minimum loading – or “greater than or equal to” – constraint in T3 and T4). The exception is for decommiting fast-start units that progress beyond T4 at the end of the current dispatch interval, as described below.

4.2.2 Decommitment

Once a fast-start unit has operated at or above minimum loading for T3 the unit enters normal operation mode. The minimum loading constraint is removed and the unit becomes flexible, subject to a lower bound which is the most restrictive of the bid/telemetered down ramp rates and the T4 profile. The T4 lower bound is proportional to the time spent in the normal operating mode and reduces to zero after T4 minutes, leaving the unit constrained by the bid/telemetered down ramp rates only. At the end of T4 units will be decommitted the first time their dispatch target

is less than or equal to the fast-start threshold of 0.005 MW. They will resume their fast-start status at Mode 0 after they have ramped down to zero at the most restrictive of their bid/telemetered ramp down rates.

4.2.3 Commitment

Units in Mode 0 at the start of the current dispatch interval are candidates for start-up (entering into Mode 1). A unit will be started if its MW result from Step 1 is greater than the fast-start threshold of 0.005 MW. The target mode for the end of current dispatch interval, which is used in Step 3, is calculated according to its start-up profile. For example, units having T1+T2 < 5 minutes will enter into Mode 3. Step 3 may then determine non-zero MW generation targets for the end of the current dispatch period.

4.3 Step 3

A second-pass dispatch and pricing solve is performed with all the constraints of the fast-start units set in accordance with their dispatch inflexibility profile and their target operating mode as determined in Step 2. If NPL are detected, the standard NPL-mitigation logic is invoked, and the second-pass dispatch and pricing solve is repeated. This solve produces the final real-time MW targets and regional prices for the current dispatch interval.

4.4 Basslink Switch Run and Intervention Constraints

NEMDE is required to perform a Basslink switch-run every dispatch interval. In unusual circumstances NEMDE may also be required to perform intervention pricing runs. These requirements add to the potential number of NEMDE runs required each dispatch interval. However, they do not change the logic used in the two-pass solution scheme for committing and decommitting fast-start plant.