

WA Independent Market Operator

Compliance of the IMO's market software
systems and processes for software
management

30 September 2010

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Prepared by: PA Team

PA Consulting Group
PO Box 1659
Lambton Quay
Wellington
Tel: +64 4 499 9053
Fax: +64 4 473 1630
www.paconsulting.com

FOREWORD

This report sets out the results of the market audit by PA Consulting Group in carrying out its assessment of the compliance of the IMO's market software with the Western Australia Wholesale Electricity Market Rules.

This market audit has been carried out under Market Rule 2.14.3.(c) which requires that;

The IMO must ensure that the Market Auditor carries out the audits of such matters as the IMO considers appropriate, which must include:

(a) the compliance of the IMO's internal procedures and business processes with the Market Rules

(b) the IMO's compliance with the Market Rules and Market Procedures

(c) the IMO's market software systems and processes for software management.

This report concludes the IMO's market software systems and processes for software management comply with the Market Rules.

TABLE OF CONTENTS

Foreword	i
1. Introduction.....	1-1
1.1 Approach taken to reviewing the market software	1-1
2. Software management systems and controls	2-1
2.1 IMO policy with respect to market software systems audit...2-1	
2.2 IMO compliance with the Market Rules	2-1
2.3 Opinion	2-1
3. Summary of previous results	3-2
3.1 Compliance of the IMO Market Systems	3-2
3.2 Summary of previous tests conducted	3-2
3.3 Opinion	3-5
4. 2009-10 Market software tests conducted	4-1
4.1 Market software changes made	4-1
4.2 Opinion	4-1

1. INTRODUCTION

The market software testing certification process assesses whether the mathematical formulations of the Western Australia wholesale electricity market systems have been correctly implemented by the software, so that the energy and reserve dispatch schedules and related prices and settlement values are correctly calculated with respect to the Wholesale Electricity Market Rules¹ (the Rules) and associated Market Procedures (the Procedures).

The certification process, tests and results are documented in this report. This document is divided and sectioned in the following manner:

- *Section 1 Introduction* – sets out the structure of this document and provides an overview of the approach adopted in conducting the market audit;
- *Section 2 Software management processes* – reports on the compliance of the market software management processes;
- *Section 3 Summary of previous results* – provides an overview of the key findings from the certification process and provides a summary of the previous certification tests and their outcomes; and
- *Section 4 2009-10 market software tests conducted* – provides information on the tests made to changed software since the last market audit.

1.1 APPROACH TAKEN TO REVIEWING THE MARKET SOFTWARE

1.1.1 Initial software testing

Verification of the market software results is generally conducted using one, or commonly more, of the following methods:

1. Directly comparing the software results to our understanding of the formulation. This may involve answering questions such as:
 - Are the appropriate constraints binding?
 - Does the set of calculations change as we expect when input values are altered and the software is re-run?
 - Does the software make optimal trade-offs between alternative resources, given their costs and associated constraints?
2. Constructing spreadsheet models of the specific case. The spreadsheet model may perform a set of calculations (such as pre-processing of data or quantity allocations, as defined by the formulation), or it may include an optimisation procedure designed to replicate a portion of the software's formulation.

In testing the IMO's market software, we use both approaches.

Because much of the software tested is embedded in the market software systems, the tests to be performed have been specified by PA and then conducted by IMO staff. PA

¹ Version dated 31 July 2008

has then reviewed the test results to determine whether the results are in accordance with the requirements of the market rules.

1.1.2 Repeat software testing

Once software has been tested and shown to be compliant, it is not necessary to retest the software unless:

- Changes have been known to be made to the software which render the previous testing no longer valid;
- It is believed that unapproved changes have been made to the software.

The first circumstance is readily picked up where there is a rigorous software change control procedure. The second exists where such a change control procedure is lacking.

In carrying out the 2006-7 and 2007-8 annual audit of the IMO's market software systems we have carried out full regression tests to verify that the market software systems comply with the requirements of the Market Rules. In the 2008-09 year and for the current year, the IMO requested that we determined the status of the market software by:

- examining the market software change procedures to ensure that they are robust;
- examining the changes made to the market systems software to determine whether the changes required independent testing and certification; and
- carrying out such testing and certification on those software changes as required.

Under this regime, should there be no changes made to the software since the 2008-9 annual audit, we may deduce that the software continues to comply with the Market Rules.

PA has agreed to this approach which is in line with the approach we use when verifying software compliance in other jurisdictions.

2. SOFTWARE MANAGEMENT SYSTEMS AND CONTROLS

Management of the market software in an appropriate manner by the IMO given the nature of the business risk to both the IMO and the Western Australia Electricity Market is essential and is recognised as such by the IMO.

2.1 IMO POLICY WITH RESPECT TO MARKET SOFTWARE SYSTEMS AUDIT

The IMO policy with regard to certification by an independent auditor of changes to its market software is that²:

- Software changes that do not result from Market Rule changes and are not expected to have a material effect on the prices or quantities will be regression tested by IMO staff and the Market Auditor is not required to test/certify the changes.
- Software changes that do result from Market Rule changes and/or are expected to have a material effect on the prices or quantities:
 - Will be tested/certified as part of the next Six Monthly or Annual Audit, if the software can be rerun and market or other outcomes corrected if the software is found to be defective during the next Six Monthly or Annual Audit; and
 - Will be tested and certified before they are applied to production, if the software cannot be rerun and market or other outcomes cannot be corrected if the software is found to be defective during the next Audit.

2.2 IMO COMPLIANCE WITH THE MARKET RULES

The IMO continues to have a clear software management and change control processes for its market software systems. In the 2009-10 year, the software management and control processes for market software systems has been further enhanced by:

- Adoption of the *Jira* software for the management and tracking of the change process; and
- The move to a 3 monthly software release cycle.

We have examined the IMO's market software systems management and change control processes and found them to be able to ensure:

- Certification of the software change, as required by the above IMO policy, is carried out; and
- Changes to market software are required to be appropriately authorised.

2.3 OPINION

The software management processes employed by the IMO, as documented, comply with the requirements of the Market Rules and compare favourably with industry practice.

² IMO Internal Procedure: Market Audits, Version No: 2, Date Issued: 17/02/2009

3. SUMMARY OF PREVIOUS RESULTS

3.1 COMPLIANCE OF THE IMO MARKET SYSTEMS

The software systems covered by this section of the review include:

- The Reserve Capacity system;
- The Energy Market systems (including STEM); and
- The Settlements systems.

Our tests indicated that the IMO market software systems produce answers consistent with the Market Rules under operating conditions that could be reasonably expected to occur over the life of the market.

3.2 SUMMARY OF PREVIOUS TESTS CONDUCTED

This section provides a summary for the full set of tests conducted on the IMO market systems previously along with our conclusion of those tests.

This detail is provided in tabular form below and covers:

- The features of Market Systems software which have been tested;
- The nature of the tests conducted; and
- A statement of conclusion, being either:
 - PASS, meaning the test returned the expected result (i.e. consistent with our interpretation of the Rules),
 - FAIL, meaning the test didn't return the expected result and that this unexpected result was likely to have a material effect on the market outcomes, or
 - CONDITIONAL, conditional status is given on the provision that the corrective action put forward is accepted and implemented within the proposed timeframes

Table 1: Summary of previous tests conducted

System	Subject	Test	Result	Year
Market Systems	Reserve Capacity	Test RC1: Maximum Reserve Capacity Price	PASS	2008
		Test RC2: Reserve Capacity Base Case	PASS	2008
		Test RC3: Bilateral clearing, Auction Requirements	PASS	2008
		Test RC4: Cascading between classes	PASS	2008
		Test RC5: Auction Tie Break	PASS	2008
		Test RC6: Valid Exchange	PASS	2008

System	Subject	Test	Result	Year
		Test RC7: Auction Shortfall, no valid offers	PASS	2008
		Test RC8: Max RCP Cap	PASS	2008
Market Systems	STEM & Non-STEM	STEM ST1: Two Participants	PASS	2008
		STEM ST2: Multiple Optima Clearing Quantities	PASS	2008
		STEM ST3: Multiple Optima Clearing Prices	PASS	2008
		STEM ST4: Price set at Min-STEM price by default bid	PASS	2008
		STEM ST5: Price set at Alt-Max-STEM price by default bid	PASS	2008
		STEM ST6: Bilateral position outside of Price Curve	PASS	2008
		STEM ST7: Three Participants	PASS	2008
		NST 1 Dispatch Merit Order	PASS	2008
		NST 2 Dispatch Instructions	PASS	2008
		NST 3 Administered Balancing Prices	PASS	2008
		NST 4 Reserve Capacity Obligation Quantities	PASS	2008
Settlement	Ancillary services Settlements	Test AS1: USHARE and Reserve Share	PASS	2008
		Test AS2: Reserve Cost Share	PASS	2008
		Test AS3 Availability Cost Spinning Reserve	PASS	2008
		Test AS4: Consumer Share	PASS	2008
		Test AS5: Load Following Share	PASS	2008
		Test AS6: Ancillary Services Settlement Amount	PASS	2008
Settlement	STEM Settlement	Test SS1: Calculating STEM Settlement Amounts	PASS	2008
Settlement	Reserve Capacity Settlement	Test RCS1: Calculating Reserve Capacity Settlement Amount for Supply	PASS	2008
		Test RCS2: Calculating Reserve Capacity Settlement Amount for Demand	PASS	2008
		Test RCS3: Calculating Reserve Capacity Refund Settlement Amount	PASS	2008
		Test RCS4: Calculating Reserve Capacity Rebates and Offsets	PASS	2008

3. Summary of previous results. . .



System	Subject	Test	Result	Year
Settlement	Balancing Settlement	Test BS1: Authorised Deviation Settlement Amounts	PASS	2008
		Test BS2: Authorised Deviation Settlement Amounts for Verve Energy	PASS	2008
		Test BS3: Unauthorised Deviation Settlement Amounts	PASS	2008
		Test BS4: Resource Plan Deviation Settlement Amount	PASS	2008
		Test BS5: Dispatch Instruction Settlement Amounts	PASS	2008
Settlement	Other Settlement	Test OS1: Reconciliation Settlement Amount	PASS	2008
		Test OS2: Market Fee Settlement Amount	PASS	2008
		Test OS3: NCS, CO and NCC Settlement Amounts	PASS	2007
Settlement	Other Settlement	Test OS1: Reconciliation Settlement Amount	PASS	2008
		Test OS2: Market Fee Settlement Amount	PASS	2008
		Test OS3: NCS, CO and NCC Settlement Amounts	PASS	2008
Settlement	Other Settlement	Test OS1: Reconciliation Settlement Amount	PASS	2008
		Test OS2: Market Fee Settlement Amount	PASS	2008
		Test OS3: NCS, CO and NCC Settlement Amounts	PASS	2008
Settlement	Meter Data Warehouse	Peak determination methodology relating to Temperature Dependent Loads	PASS	2008
Excel	Reserve Capacity	Maximum Reserve Capacity Price calculation	PASS	2008
Market Systems	Non-STEM	Maximum Alternative Maximum Stem Price calculation	PASS	2008
Market Systems	Non-STEM	Incremental Reserve Capacity Ratio calculation	PASS	2008
Market Systems	Non-STEM	Prudential Requirements calculation	PASS	2008
Market Systems	STEM & Non-STEM	Change to the resource plan calculation	PASS	2009
Settlement	Other Settlement	Settlement of intermittent load generators	PASS	2009

System	Subject	Test	Result	Year
Market Systems	Reserve Capacity	Supplementary Reserve Capacity calculation	PASS	2009

We have reviewed the relevant IMO IT system change control logs and have confirmed that the above software has not been materially changed since the referenced tests were performed.

3.3 OPINION

The above previously tested software continues to comply with the requirements of the Market Rules.

4. 2009-10 MARKET SOFTWARE TESTS CONDUCTED

4.1 MARKET SOFTWARE CHANGES MADE

There have been six software changes made to the market systems since the last annual audit. As has been notified to the market by the IMO, these changes have been to the following software. Table 2: 2009-2010 software changes

Software tested	Date certified	Comment
SABLE software (window of entry)	20 November 2009	Change of Reserve Capacity date range from August - 30 November inclusive to 1 June - 30 September
Protected Excel workbook	27 November 2009	Maximum Reserve Capacity Price calculation
SABLE software (Early certified reserve capacity)	15 February 2010	Early Certified Reserve Capacity calculation
SABLE software (Settlement of ancillary services)	September 2010	Treatment of negative MCAP on the settlement of Ancillary Services
SABLE software (Reserve capacity shortfall)	September 2010	Determination of capacity shortfall for curtailable loads
SABLE software (Reserve capacity shortfall)	September 2010	Calculation of net STEM shortfall

All of the above software has either been tested by PA or the IMO testing has been reviewed and accepted by the IMO. PA has then certified that the above software complies with the requirements of the Market Rules.

4.2 OPINION

The above tested software has been certified to comply with the requirements of the Market Rules.