

Notice of Market Rules Modification

Paper No.:	EMC/RCP/25/2006/252
Rule reference:	Chapter 6, Appendix 6D and 6G and Chapter 8
Proposer:	Market Operation, EMC
Date received by EMC:	12 January 2006
Category allocated:	2
Status:	Approved by EMA
Effective Date:	27 July 2006

Summary of proposed rule modification:

The purpose of this proposal is to update the formulations in the Market Clearing Engine so that it can model Phase-Shifting Transformers (PST).

The SP PowerAssets is targeting to install a PST in the grid in the middle of this year. This will be the first PST in the grid. The PST can change line flows significantly. The existing MCE formulation cannot reflect such changes. This will affect the accuracy of the dispatch schedules. Thus, it is important that PSTs be correctly modeled in MCE.

The PST is able to increase or reduce flows on the line through adjustment of voltage phase angle. By doing so, flows on other lines can be controlled to a certain extent and this can serve the objective of reducing line constraints on some particular line(s). The PST is to be installed in the north-eastern block.

SP PowerGrid has conducted simulation of line flows under some scenarios with the PST operating at different levels. The simulation tool (PSSE) that they use is more accurate than the MCE in describing the actual system. Hence, their simulation results are used to gauge the accuracy of the modified MCE. With the proposed formulation change to the MCE, EMC conducted simulation of line flows using the same scenarios. The comparison showed that MCE results are close to SP PowerGrid's results. Thus, the modified MCE is effective in modeling the PST.

Simulations were also conducted under selected scenarios to demonstrate how the PST can help alleviate line constraints. Under these scenarios, some lines will become binding and constraint(s) will occur without the use of PST. The simulations showed that, with proper adjustment of PST settings, power flows on the binding lines can be reduced to desired levels. Line constraints were thus alleviated.

Note: the RCP has agreed that the rule change paper not be published because of the presence of information on transmission facilities which the EMA had instructed should not be released to the public domain. Thus, only the proposed change to the text of the Market Rules is published.

Date considered by Rules Change Panel: 14 March 2006

Date considered by EMC Board: 30 March 2006

Date considered by Energy Market Authority: 20 April 2006

Proposed rule modification:

See Annex 1

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

Annex 1

Existing Rule/Comments	Proposed Rules (Deletion represented by strikethrough text and addition underlined.)				
<p>CHAPTER 6</p> <p>APPENDIX D MARKET CLEARING FORMULATION</p>	<p>CHAPTER 6</p> <p>APPENDIX D MARKET CLEARING FORMULATION</p>				
	<p>D.2 SETS</p> <table border="1"> <tr> <td><u>PSTLINES</u></td> <td>The set of <i>pst lines</i>. A subset of LINES.</td> </tr> </table>	<u>PSTLINES</u>	The set of <i>pst lines</i> . A subset of LINES.		
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	<p>D.3 PARAMETERS</p> <table border="1"> <tr> <td><u>PSTTapPosition_k</u></td> <td>The integer value assigned to the tap position of the phase-shifting transformer of <i>pst line k</i>. Used in accordance with Appendix 6D section D.13C.</td> </tr> <tr> <td><u>DegreeShiftPerTap_k</u></td> <td>The degree of phase angle shift in radian units that will result from a change from one tap position to the next immediate tap position of the phase-shifting transformer of <i>pst line k</i> at no load condition. Received from the <i>PSO</i> in accordance with Appendix 6G section G.4.4A.</td> </tr> </table>	<u>PSTTapPosition_k</u>	The integer value assigned to the tap position of the phase-shifting transformer of <i>pst line k</i> . Used in accordance with Appendix 6D section D.13C.	<u>DegreeShiftPerTap_k</u>	The degree of phase angle shift in radian units that will result from a change from one tap position to the next immediate tap position of the phase-shifting transformer of <i>pst line k</i> at no load condition. Received from the <i>PSO</i> in accordance with Appendix 6G section G.4.4A.
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	<p>D.9 LINE ADMITTANCE AND LINE LOSS APPROXIMATION</p>
	<p><u>D.9.1A</u> $\text{PhaseAngleShift}_k = \text{PSTTapOffset}_k \times \text{DegreeShiftPerTap}_k$ $\{k \in \text{PSTLINES}, k \notin \text{ARTIFICIALLINES}\}$</p> <p>where $\text{PSTTapOffset}_k = \text{PSTTapPosition}_k - \text{TapZero}_k$ $\{k \in \text{PSTLINES}, k \notin \text{ARTIFICIALLINES}\}$</p> <p>$\text{PhaseAngleShift}_k = 0$ $\{k \notin \text{PSTLINES}\}$</p>
	<p><u>D.13C LINES WITH PHASE-SHIFTING TRANSFORMERS</u></p>
	<p><u>D.13C.1</u> The <i>EMC</i> shall use the latest tap position of a phase-shifting transformer of a <i>pst line</i> advised by the <i>PSO</i> in accordance with Section G.4.4A of Appendix 6G when determining the <i>real-time schedule</i>. The <i>EMC</i> shall also use the latest tap position for <i>short-term schedule, pre-dispatch schedule scenarios</i> and the <i>market outlook scenarios</i> unless advised otherwise by the <i>PSO</i> from time to time.</p>

Existing Rule/Comments	Proposed Rules (Deletion represented by strikethrough text and addition underlined.)
<p>D.16 TRANSMISSION</p> <p>6D.16.2.3 Node Angle Constraint:</p> $\text{LineFlow}_k = \text{LineAdmittance}_k \times (\text{NodeAngle}_{\text{NodeAtStartOf}(k)} - \text{NodeAngle}_{\text{NodeAtEndOf}(k)})$ <p style="text-align: center;">$\{k \in \text{LINES}, k \notin \text{ARTIFICIALLINES}\}$</p> <p>However, in the case where the constraint in this section D.16.2.3 corresponds to a notional line connecting two electrically equivalent buses introduced to the dispatch network in accordance with section D.6.3.4, then the following constraint shall be substituted:</p> $0 = (\text{NodeAngle}_{\text{NodeAtStartOf}(k)} - \text{NodeAngle}_{\text{NodeAtEndOf}(k)})$ <p style="text-align: center;">$\{k \in \text{ARTIFICIALLINES3}\}$</p>	<p>D.16 TRANSMISSION</p> <p>6D.16.2.3 Node Angle Constraint:</p> $\text{LineFlow}_k = \text{LineAdmittance}_k \times (\text{NodeAngle}_{\text{NodeAtStartOf}(k)} - \text{NodeAngle}_{\text{NodeAtEndOf}(k)} + \text{PhaseAngleShift}_k)$ <p style="text-align: center;">$\{k \in \text{LINES}, k \notin \text{ARTIFICIALLINES}\}$</p> <p>However, in the case where the constraint in this section D.16.2.3 corresponds to a notional line connecting two electrically equivalent buses introduced to the dispatch network in accordance with section D.6.3.4, then the following constraint shall be substituted:</p> $0 = (\text{NodeAngle}_{\text{NodeAtStartOf}(k)} - \text{NodeAngle}_{\text{NodeAtEndOf}(k)})$ <p style="text-align: center;">$\{k \in \text{ARTIFICIALLINES3}\}$</p>

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	<p>CHAPTER 6</p> <p>APPENDIX G DISPATCH RELATED DATA</p>
	<p>G.4 TRANSMISSION DATA</p> <p><u>G.4.4A For the phase-shifting transformer of each <i>pst line</i>:</u></p> <ul style="list-style-type: none"> <u>(i) the phase angle shift per one tap position change;</u> <u>(ii) the minimum and maximum tap positions; and</u> <u>(iii) the tap position that results in zero degree phase angle shift, for each <i>dispatch period</i> of the <i>market outlook horizon</i>; and</u> <u>(iv) the latest tap position of the phase-shifting transformer. The <i>PSO</i> shall provide this value to the <i>EMC</i> before the start of each <i>dispatch period</i>.</u>
	<p>CHAPTER 8 Definitions</p> <p><u>1.1.181A</u> <u><i>pst line</i> means a <i>dispatch network line</i> with a phase-shifting transformer;</u></p>