



**CONSULTATION PAPER FOR  
PROPOSED MODIFICATIONS TO THE TRANSMISSION  
CODE**

Closing date for submissions of comments and feedback:  
19 January 2011

21 DEC 2010 ENERGY MARKET AUTHORITY  
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The information in this Consultation Paper is not to be treated by any person as any kind of advice. The Energy Market Authority shall not be liable for any damage or loss suffered as a result of the use of or reliance on the information given in this Consultation Paper.

## **1 Introduction**

- 1.1. The Transmission Code sets out the rights and obligations of the Transmission Licensee, together with the rights and obligations of users of the Transmission System. The Code also sets out the technical requirements to be met by those who seek to connect and operate installations on the Transmission System.

## **2 Proposed Modifications**

- 2.1. Pursuant to Section 1.6 of the Transmission Code, EMA seeks feedback on the proposed modifications as set out in Appendix 1.
- 2.2. The aim of the proposed modifications is primarily to introduce a “Distributed Resources” category to cover smaller generators and other energy devices, which are capable of injecting energy into the transmission system at a level not exceeding 30 MW. The requirements for Distributed Resources are less stringent than those for large generators.

## **3 Request for comments and feedback**

- 3.1. EMA invites comments and feedback on the proposed modifications to the Transmission Code as set out in Appendix 1.
- 3.2. Please send your submission by e-mail to:

[seah\\_kwang\\_hwee@ema.gov.sg](mailto:seah_kwang_hwee@ema.gov.sg) and [chee\\_mei\\_ling@ema.gov.sg](mailto:chee_mei_ling@ema.gov.sg)

Alternatively, you may send your submission by post/fax to the following address:

*Director  
Electricity Industry Regulation Department  
Regulation Division  
Energy Market Authority  
991G Alexandra Road, #01-29  
Singapore 119975.  
Fax: (65) 6 835 8020*

Please use the form given in Appendix 2 for your submission.

- 3.3. Anonymous submission will not be considered.

- 3.4. All comments and feedback must reach EMA by 5 pm on 19 January 2011.
- 3.5. EMA will acknowledge receipt of all submissions electronically. Please contact Ms Chee Mei Ling at 6376 7573 or Mr Seah Kwang Hwee at 6376 7624 if you have not received an acknowledgement of your submission within two business days.
- 3.6. EMA reserves the right to make public all or parts of any written submissions made in response to this Consultation Paper and to disclose the identity of the source. Any part of the submission, which is considered by respondents to be confidential, should be clearly marked and placed as an annex. EMA will take this into account regarding disclosure of the information submitted.

~ End ~

**APPENDIX 1**  
**PROPOSED MODIFICATIONS TO THE TRANSMISSION CODE**

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/1	1.3.1	New definition	<p><u>“Distributed resource” (DR) means any device, or group of devices, which are not under wide area group control, connected at a single point of common coupling, which may be used singly or in aggregate, to inject energy at power levels of 30 MW or less into the transmission system.</u></p> <p><u>“Distributed resource” excludes any device that injects power into the transmission system for the sole purpose of system stabilisation or control.</u></p>	Definition of distributed resource. The term “distributed resource” provides alignment with international codes.
TC/2010/4	1.3.1	New definition	<u>“Distributed resource facility” means an installation comprising one or more distributed resources including associated equipment such as switchgear, transformers, and all auxiliary equipment.</u>	
TC/2010/5	1.3.1	New definition	<u>“Distributed resource rated capacity” means the combined MW (or kW) capacity of one or more distributed resources operating through a single connection to the transmission system determined by summing the individual rated capacities of the connected distributed resources.</u>	
TC/2010/6	1.3.1	New Definition	<u>“Distributed resource average expected production” means the combined MW (or kW) production of more than one distributed resource operating through a single connection to the transmission system determined by summing the individual average expected production of the connected distributed resources.</u>	
TC/2010/7	1.3.1	New Definition	<u>“Distributed resources coincident minimum expected production” means the minimum MW (or kW) production of one or more distributed resources operating through a single connection to the transmission system determined by summing the individual minimum expected average production of the connected distributed resources over any half hour period when the transmission system is experiencing maximum demand.</u>	

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/8	1.3.1	New Definition	<p><u>“Distributed resources contingent minimum production” means the “expected average production” minus the production of the individual, largest capacity distributed resource, which may be connected through a single point of common coupling with the transmission system.</u></p> <p><u>The contingent minimum production of a single distributed resource shall be assessed to be zero.</u></p>	
TC/2010/9	1.3.1	New definition	<p><u>“Group control” means control of more than one device from a common source by means of a common control system.</u></p> <p><u>“Wide area group control” means control of more than one device from a common source, which are connected to the transmission system at more than one connection points.</u></p>	Definition is introduced in conjunction with the definition of DR, to regulate the possibility of controlling many DRs from a common source of control which may undermine the technical considerations underlying the DR definition, which is to maintain diversity in the behaviour of DRs over the system and ensure that in this respect they behave similarly to distributed load.
TC/2010/10	1.3.1	New, third bullet point under “energise” means	<ul style="list-style-type: none"> <li>• <u>in the case of a distributed resource it shall also mean commencement of energy outflow capability, and “cease to energise” shall mean that the device shall cease to provide voltage to the system.</u></li> </ul>	Small DRs will not have circuit breakers and so ceasing to energise will comprise voltage blocking or other means of zeroing the device voltage.
TC/2010/11		New definition	<p><u>“Handbook for Interconnecting Distributed Resources with the Transmission System” means the handbook published, maintained and administered by the Transmission Licensee as set out in Clause 6.11. It is also known as “Distributed Resources Handbook” and “The Handbook”.</u></p>	

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/12	1.3.1	New definition	<p><u>“Evaluate” means to undertake a technical review of information submitted by a <i>connection applicant</i> for a <i>distributed resource</i> to form a view on whether it is designed to be compliant with <i>this Code</i>.</u></p>	<p>During the application process for connection of DR, the applicant will provide technical descriptions including drawings, schematics and specifications as set out in the Distributed Resources Handbook so that the Transmission Licensee can evaluate the soundness of any scheme. The Transmission Licensee may or may not advise on the scheme’s technical merits and is not obliged to do so, because compliance with the requirements of the Distributed Resources Handbook will be ultimately verified by testing.</p>
TC/2010/13	1.3.1	New definition	<p><u>“Verify” means determining by testing, witnessing of testing, and / or the review of test results that the operation of a <i>distributed resource</i> complies with <i>this Code</i>.</u></p>	<p>Once the DR installation has been completed and is ready for commissioning, its compliance with the requirements of The Handbook will be verified by undertaking suitable testing within the parameters set out in The Handbook. Full testing may not be required in every case, especially when the DR is a standard type which has been commissioned previously in the Transmission System.</p>

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/14	4.2.1	Insertion of additional provision at the end of the existing clause 4.2.1	<u>Where the <i>connection applicant</i> is applying to connect a consumer installation that includes one or more <i>distributed resources</i>, the application shall also include information required in <i>The Handbook</i>.</u>	Procedural.
TC/2010/15	4.3 (New)	New paragraph 4.3, to follow existing paragraph number 4.2. <sup>1</sup>	<p><b><u>4.3 Application for a New or Modified Distributed Resource Connection - General Conditions</u></b></p> <p><u>4.3.1 A <i>connection applicant</i> applying to connect its <i>distributed resource facility</i> to the <i>transmission system</i> or modify its existing consumer <i>installation</i> connected to the <i>transmission system</i> by including a <i>distributed resource facility</i>, or significantly modifying an existing <i>distributed resource facility</i> is required to submit a formal application through an <i>authorised person</i>, together with the <i>application fee</i> payable, to the Transmission Licensee. The application shall contain the information described in <i>The Handbook</i>. After having submitted the application, the <i>connection applicant</i> shall promptly notify the Transmission Licensee in writing of any material additions or changes to the information submitted.</u></p> <p><u>4.3.2 Upon receipt of the application from the <i>connection applicant</i>, the Transmission Licensee:</u></p> <p><u>(a) may require additional information to be submitted by the <i>connection applicant</i>:</u></p> <p><u>(b) shall <i>evaluate</i> the connection application to determine a connection scheme that will not have any adverse effect on the secure, stable and reliable operation of the <i>transmission system</i> and any other installation, or external party already connected or seeking connection to the</u></p>	<p>Application for, and connection of a distributed resource is required to follow a process that is analogous to the connection of a new or modified installation.</p> <p>This Transmission Code modification introduces the general technical requirements for DR connections, following the IEEE 1547 - 2003.</p> <p>This modification also defines the two stages of determining compliance. The first stage is evaluation, in which the connection applicant submits technical design material to the Transmission Licensee for evaluation. The modification is written specifically in a way such that technical compliance is determined by verification (as defined) rather than by evaluation, to avoid technical</p>

<sup>1</sup> All succeeding paragraphs to be renumbered accordingly; - e.g. 4.3 Connection Agreement now becomes 4.4 Connection Agreement, etcetera. For clarity of interpretation, proposed modifications to the sections of the Code with numbers 4.2 onwards, will be referred to in this Consultation Paper, using the paragraph numbers as they appear in the original January 2008 Transmission Code document. Proposed, new numbered text, will cite the new numbers, as they will appear in the new Transmission Code.

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
			<p><u>transmission system</u>;</p> <p><u>(c) shall advise the connection applicant of the indicative connection charges, connection scheme (including connection voltages) and the connection facilities to be provided; and,</u></p> <p><u>(d) shall ensure that any requirements expressed by the Power System Operator have been satisfied.</u></p> <p><u>4.3.3 Evaluation shall include (but not be limited to) determination that the characteristics of the applicant's distributed resource will comply with the following general technical requirements. The detailed technical requirements are set out in the Handbook.</u></p> <ul style="list-style-type: none"> <li><u>(a) Distributed resources shall not operate in active voltage control mode</u></li> <li><u>(b) Their grounding scheme shall not cause over-voltages on the transmission system.</u></li> <li><u>(c) Their operation shall not disrupt earth fault relay coordination</u></li> <li><u>(d) Their operation shall not infringe Voltage or Flicker Standards</u></li> <li><u>(e) They shall not rely on transmission system circuit breakers for protection or switching.</u></li> <li><u>(f) They shall not energise the transmission system when it is de-energised from its central source.</u></li> <li><u>(g) Distributed Resources shall have means of real-time monitoring of circuit breaker status, magnitude of real and reactive power, frequency and voltage by Transmission Licensee. Such information shall then be provided to PSO by Transmission Licensee.</u></li> <li><u>(h) When required by the operating practices of The Transmission Licensee, they shall have lockable "visible break" isolation at their point of common coupling (PCC) with the transmission system</u></li> <li><u>(i) They shall have surge &amp; electromagnetic</u></li> </ul>	preconceptions.

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
			<p>compatibility to the same standards as the <u>transmission system</u> in the locality of their PCC.</p> <p>(j) <u>They shall cease to energise the transmission system:</u></p> <ol style="list-style-type: none"> <li>i. <u>for faults on the circuit which connects the distributed resource to the PCC.</u></li> <li>ii. <u>prior to re-closure of the interconnecting transmission system circuit breaker.</u></li> <li>iii. <u>if any phase of the transmission system is under or over voltage.</u></li> <li>iv. <u>if the frequency of the transmission system is over or under its normal range</u></li> </ol> <p>(k) <u>Distributed resources shall not inject an amount of direct current into the transmission system greater than 0.5% of their rated current.</u></p> <p>(l) <u>They shall not cause the harmonics standard to be exceeded at the point of common coupling</u></p> <p>(m) <u>They shall not continue to energise any islanded portion of the transmission system.</u></p> <p>4.3.4 <u>The Transmission Licensee may offer technical opinions to the applicant based on the results of the evaluation but it shall not be responsible for determining if the design of the distributed resource will comply with the Code.</u></p> <p>4.3.5 <u>The Transmission Licensee shall have no powers to determine that any connection applicant's design of the distributed resource will comply or not be based on its evaluation of the said design of the distributed resource.</u></p> <p>4.3.6 <u>The Transmission Licensee shall use its best endeavours to respond to the connection applicant within 10 business days.</u></p>	

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
			<p>4.3.7 The Transmission Licensee shall notify the <u>connection applicant</u> of the terms and conditions of <u>connection</u> or modification to the existing <u>connection</u> and of the charges, if any, payable to the Transmission Licensee to carry out the relevant works under the <u>Connection Agreement</u>, and shall provide to the <u>connection applicant</u> a copy of the <u>Connection Agreement</u>.</p> <p>4.3.8 The Transmission Licensee shall <u>verify compliance</u> of the <u>connection applicant's distributed resource</u> and shall not connect any installation to the <u>transmission system</u> if the <u>connection applicant</u> fails to comply, or the Transmission Licensee determines on reasonable grounds that the <u>connection applicant</u> is not capable of complying, with the procedures and requirements for <u>connection</u> to and use of the <u>transmission system</u> set forth in this Code and the <u>Connection Agreement</u>.</p> <p>4.3.5 The conditions for <u>reconnection</u> of a consumer's <u>installation</u>, which includes one or more <u>distributed resource</u>, shall be in accordance with the requirements developed by the Transmission Licensee.</p>	
TC/2010/16	4.4.1 (b)	..Appendix B and/or Appendix C and/or Appendix D, where applicable.	..Appendix B and/or Appendix C and/or Appendix D and/or <u>The Handbook</u> , where applicable.	Procedural.
TC/2010/17	4.7 (New)	New paragraph 4.7, to follow existing paragraph number 4.5. All Succeeding paragraphs to be renumbered; - e.g. 4.6 Electrical Commissioning of Generation Facilities now becomes 4.8 Electrical Commissioning of Generation Facilities, et cetera. <sup>2</sup>	<p><b><u>4.7 Electrical Commissioning of a Distributed Resource</u></b></p> <p>4.7.1 Where a <u>distributed resource</u> is to be commissioned as part of a new <u>installation</u>, the <u>distributed resource</u> is to be commissioned and <u>turned on</u> at least two business days after commissioning of the <u>installation</u> without the <u>distributed resource</u>.</p>	The Transmission Licensee replaces the Power System Operator as the administrative and approving authority for DR connections as the point of technical compliance for DR is solely at the point of connection with the transmission system,

<sup>2</sup> For clarity of interpretation, modifications to existing text will continue to refer to the paragraph numbers as they appear in the original January 2008 Transmission Code document. New numbered text will cite the new numbers as they will appear in the new Transmission Code.

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
			<p><u>4.7.2 For the commissioning of a <i>distributed resource</i>, the <i>connection applicant</i> shall, through the <i>authorised person</i>, (if applicable) submit to The Transmission Licensee, 14 <i>business days</i> in advance from the date its <i>distributed resource</i> is scheduled for synchronisation to the <i>power system</i>, a tentative commissioning tests program including those tests which are required for <i>verification</i> and which are described in <i>The Handbook</i>. A final version of the commissioning program shall be established one week before the commencement of the commissioning. The Transmission Licensee shall have the authority to re-schedule any of the required tests to minimise system risk and the reason for such re-scheduling shall be given to the <i>connection applicant</i>.</u></p> <p><u>4.7.3 The Transmission Licensee shall allow a <i>connection applicant</i> to proceed with commissioning of its <i>distributed resource</i> connected to the <i>transmission system</i> if the <i>connection applicant</i> has a commissioning program established in accordance with the provision set out in section 4.7.2 of this <i>Code</i>.</u></p> <p><u>4.7.4 Upon completion of the testing and commissioning of the <i>distributed resource</i>, the <i>connection applicant</i> shall submit and update the Transmission Licensee with the final site setting of the <i>distributed resource</i>, as well as the testing and commissioning reports as set forth in <i>The Handbook</i>.</u></p> <p><u>4.7.5 The Transmission Licensee shall, at its sole discretion, witness part or all of the electrical commissioning, and review test results and shall <i>verify</i> compliance with The Transmission Code.</u></p>	<p>which is under the day to day jurisdiction of The Transmission Licensee. Moderate Levels of infusion of DR has no effect on the overall stability and security of the power system, and so should not be the day to day concern of the Power System Operator.</p>

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/18	6.3.3	The Transmission Licensee and <i>connected person</i> shall ensure that their <i>protection systems</i> and operating time comply with the requirements set out in Appendix F.	The Transmission Licensee and <i>connected person</i> shall ensure that their <i>protection systems</i> and operating time comply with the requirements set out in Appendix F. <u>In instances of <i>protection systems</i> associated with <i>distributed</i> resources, the Transmission Licensee and <i>connected person</i> shall ensure that such <i>protection systems</i> and operating times comply with the requirements set out in <i>The Handbook</i>.</u>	To include the requirements for DR.  Note the plural of “operating time” has been used because multiple distributed resources may have protection systems with different operating times.
TC/2010/19	6.11	New clause to follow existing clause number 6.10. All succeeding clauses to be renumbered accordingly. <sup>3</sup>	<u>The Transmission Licensee shall publish, maintain and administer the “Handbook for Interconnecting Distributed Resources with the Transmission System” setting out the detailed technical requirements for connection and operation of <i>distributed resources</i>. <i>The Handbook</i> shall document the minimum acceptable technical performance characteristics required of <i>distributed resources</i> that may be <i>connected</i> to the <i>transmission system</i>. <i>The Handbook</i> shall also document the testing required to <i>verify</i> that any <i>distributed resource</i> is technically acceptable for <i>connection</i> to the <i>transmission system</i>.</u>  <u><i>The Handbook</i> shall be made available free of charge to any <i>connection applicant</i> or associated <i>authorised person</i>.</u>  <u>The performance requirements of <i>the Handbook</i> shall not be retroactively applied to existing <i>installations</i>, except in cases where, <i>the Transmission licensee</i> determines that a clear safety concern, or power quality issue may be presented in an installation due to its non-compliance with the requirements of <i>the Handbook</i>.</u>	To prescribe the Transmission Licensee as the entity responsible for ensuring up to date information is provided to DR applicants and operators.

<sup>3</sup> For clarity of interpretation, modifications to existing text will continue to refer to the clause numbers as they appear in the original January 2008 Transmission Code document. New numbered text will cite the new numbers as they will appear in the new Transmission Code.

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/20	6.11.1	The <i>generating unit's</i> step-up transformers and <i>generating unit's</i> switchboard (or switchgear) for connecting the <i>high voltage</i> side of the <i>generating unit's</i> step-up transformers and the associated switching and protection/control equipment shall be designed such that no single failure/ <i>outage</i> shall cause simultaneous <i>outage</i> of two or more <i>generating units</i> connected to the switchboard. All switchboards shall be designed with one-and-half breakers configuration, unless the Generation Licensees submit with justifications the use of a different switchboard configuration for the <i>Power System Operator's</i> consideration.	The <i>generating unit's</i> step-up transformers and <i>generating unit's</i> switchboard (or switchgear) for connecting the <i>high voltage</i> side of the <i>generating unit's</i> step-up transformers and the associated switching and protection/control equipment shall be designed such that no single failure/ <i>outage</i> shall cause simultaneous <i>outage</i> of two or more <i>generating units</i> connected to the switchboard. All switchboards shall be designed <u>in accordance to Appendix 11.4</u> <del>with one and half breakers configuration</del> , unless the Generation Licensees submit with justifications the use of a different switchboard configuration for the <i>Power System Operator's</i> consideration.	For consistency with current Code requirement as set forth in Appendix 11.4.
TC/2010/21	6.11.2  (b)	All <i>generating units</i> shall be designed such that:  the <i>generating station</i> has Black Start Capability unless exempted by <i>Power System Operator</i> ;	All <i>generating units</i> shall be designed such that:  the <i>generating station with generating unit of capacity 100MW &amp; above</i> has Black Start Capability unless exempted by <i>Power System Operator</i> ;	Small size generating unit need not have blackstart capability, only those generating stations with generating unit capacity of 100MW & above must have blackstart capability.
TC/2010/22	6.12.1 through 6.12.5	The Transmission Licensee and Generation Licensee...	The Transmission Licensee and Generation Licensee <u>who operates, or intends to operate a <i>generation facility</i>...</u>	To exclude Generation Licensees who operate DR only and are required to comply with The Handbook.
TC/2010/23	B1.1	.... shall provide to the Transmission Licensee the following information with respect to growth in <i>demand</i> by those <i>installations</i> :	.... shall provide to the Transmission Licensee the following information with respect to growth in <i>demand</i> by those <i>installations</i> <u>net of the effect of any <i>distributed resources</i> which may be connected to the <i>transmission system</i> through the same <i>connection</i>:</u>	Demand is to be reported net of embedded generation :- "distributed resources".  The contribution of the DRs is required to be reported separately (see below).

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/24	B1.3	New paragraph.	<p><u>Each <i>connected person</i>, who operates, or intends to operate one or more <i>distributed resources</i> through a <i>connection</i> to the <i>transmission system</i>, shall provide to the Transmission Licensee the following information with respect to the developments at that <i>installation</i> that are anticipated to increase generation by 5 MW or more:</u></p> <p>a) <u>Location of the development;</u>            b) <u><i>Distributed resources</i> rated capacity</u>            c) <u>Anticipated <i>reactive power demand</i>;</u>            d) <u>Type(s) of <i>distributed resources</i>;</u>            e) <u><i>Distributed resources</i> average expected production;</u>            f) <u><i>Distributed resources</i> coincident expected minimum production; and</u>            g) <u><i>Distributed resources</i> contingent minimum production.</u></p>	The expected secure contribution of DRs shall be reported for planning purposes.
TC/2010/25	C1.3	<p><i>Generating unit</i> performance parameters</p> <p>(h) Gas Turbine Units (Open Cycle and Closed Cycle)</p> <ul style="list-style-type: none"> <li>• Control design               <ul style="list-style-type: none"> <li>– Functional description and block diagram showing transfer function of individual element of gas turbines units (including effect of Ambient Temperature) in PSSE format</li> </ul> </li> </ul>	<p><i>Generating unit</i> performance parameters</p> <p>(h) Gas Turbine Units (Open Cycle and Closed Cycle)</p> <ul style="list-style-type: none"> <li>• Control design               <ul style="list-style-type: none"> <li>– Functional description and block diagram showing transfer function of individual element of gas turbines units (including effect of Ambient Temperature) in PSSE <u>source code (i.e. flecs code) format</u></li> </ul> </li> </ul>	For clarity that submission should in programming language source code format and not binary/object code.

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/26	C4.1	All <i>generating units</i> of gross generating capacity exceeding 10 MW or registered with the Energy Market Company as a <i>generation registered facility</i> shall be centrally dispatched.	Any <i>generating unit</i> of gross generating capacity exceeding 4030 MW, <u>which is or registered with the Energy Market Company as a <i>generation registered facility</i>, and which is not defined as <i>distributed resources</i>, or part thereof</u> , shall be centrally dispatched.  <u><i>Distributed resources</i> shall not be required to be centrally dispatched. <i>Distributed resources</i> may be centrally dispatched if so desired by the <i>connected person</i>.</u>	To align with DR definition and with principles set out, that DR is in effect “negative load”.  Not being centrally dispatched (or dispatchable in the routine sense) means that capability attributes (a) through (j) are not applicable to DR (as they are not applicable to loads, be they rotating plant loads).
TC/2010/27	C4.1	(a) Power System Stabilizer (PSS)  For each <i>generating unit</i> with Rated MW Capacity at or above 60MW, a PSS shall be incorporated to provide additional damping of power oscillations. Proper operation of the PSS shall be confirmed by test. The preferred input signal for the PSS is accelerating power which can be synthesized from measured electrical power and speed. PSS transducers (i.e., for measuring input signals) shall be linear over their operational range and its time constant shall not exceed 100 milliseconds. <i>Power System Operator</i> shall make available the system characteristic to Generation Licensees for tuning of PSS. Generation Licensees shall submit a report incorporating the methodology in deriving the setting of the PSS parameters, as well as the tuning techniques, to <i>PSO</i> for review before implementation on site.	(a) Power System Stabilizer (PSS)  For each <i>generating unit</i> with Rated MW Capacity at or above 60MW, a PSS shall be incorporated to provide additional damping of power oscillations. Proper operation of the PSS shall be confirmed by test. <u>The PSS shall be of dual inputs preferred input signal for the PSS is accelerating power type</u> which can be synthesized from measured electrical power and speed. PSS transducers (i.e., for measuring input signals) shall be linear over their operational range and its time constant shall not exceed 100 milliseconds. <i>Power System Operator</i> shall make available the system characteristic to Generation Licensees for tuning of PSS. Generation Licensees shall submit a report incorporating the methodology in deriving the setting of the PSS parameters, as well as the tuning techniques, to <i>PSO</i> for review before implementation on site.	To align with current practice of dual-input PSS which is commonly available nowadays.

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/28	F8.2	The primary and secondary <i>reserve</i> requirements for each <i>generating unit</i> MW output between 75% and 90% of its rated MW Capacity shall be linearly extrapolated from the requirements for the <i>generating unit</i> MW outputs at 75% and 90% of its rated MW Capacity <sup>2</sup> . Additional details are provided in the System Operation Manual.	The primary and secondary <i>reserve</i> requirements for each <i>generating unit</i> MW output between 75% and 90% of its rated MW Capacity shall be linearly <del>extrapolated</del> <u>interpolated</u> from the requirements for the <i>generating unit</i> MW outputs at 75% and 90% of its rated MW Capacity <sup>2</sup> . <u>Likewise, the primary and secondary reserve requirements for each generating unit MW output between 90% and 100% of its rated MW Capacity shall be linearly interpolated from the requirements for the generating unit MW output at 90% of its rated MW Capacity and zero.</u> Additional details are provided in the System Operation Manual.	Rectify “extrapolate” to “interpolate”. Additionally, extend description to explicitly cover MW output between 90% and 100% of rated MW capacity.
TC/2010/29	H2.1(b)	An AGC station shall have a dedicated <i>RTU</i> with the condition that the <i>RTU</i> shall not be controlling more than 4 <i>generating units</i> or a total of more than 1000MW. Should the number of <i>generating units</i> or total generating capacity exceed this, then a second <i>RTU</i> shall be provided.	<del>An AGC station</del> <u>A generating station</u> shall have a dedicated <i>RTU</i> with the condition that the <i>RTU</i> shall not be controlling more than 4 <i>generating units</i> or a total of more than 1000MW. Should the number of <i>generating units</i> or total generating capacity exceed this, then a second <i>RTU</i> shall be provided.	To rectify an AGC station to a generating station.
TC/2010/30	H3.3	New Existing H3.3 will be renumber to H3.4	<u>Status and measurements sent to the EMS shall be flagged as “invalid” whenever there is failure of hardware or software in the remote terminal equipment that prevents the values to be updated to the EMS.</u>	New requirement to indicate if the status and measurements sent to the EMS is healthy/unhealthy so that proper action can be carried out.
TC/2010/31	H3.4 Renumber from existing H3.3.	It is the responsibility of the Transmission Licensee and Generation Licensee to provide all the equipment at the remote site including the communication equipment and the communication line up to the surge arrestor located at the <i>PSO</i> control centres.	It is the responsibility of the Transmission Licensee and Generation Licensee to provide all the equipment at the remote site including the communication equipment and the communication line up to the surge arrestor located at the <i>PSO</i> control centres. <u>The communication equipment shall include encryption devices to secure communication on the communication lines. These encryption devices shall be of the same make and model as the devices installed at the <i>PSO</i> control centres.</u>	New requirement to include encryptors.

## Energy Market Authority of Singapore

Modification Ref. No.	Clause	Original Text	Modification	Reason
TC/2010/32	H4.2	AGC Station	<del>AGC Station</del> <u>Generating station</u>	Rename the title to align with the proposed change in Appendix H2.1 (b)
TC/2010/33	H4.2 (d)	New	<u>Status of frequency response switch</u>	New requirement to include the status of the frequency response switch.
TC/2010/34	H4.2 (e)	H4.2 (d)	H4.2 (e)	To renumber from existing H4.2 (d)
TC/2010/35	H4.2 (f)	H4.2 (e)	H4.2 (f)	To renumber from existing H4.2 (e)
TC/2010/36	H4.2 (g)	New	<u>For a CCGT, the unit ambient temperature and the hot switch activation signal when hot switch is initiated, manually or automatically, from natural gas to its alternate fuel.</u>	New requirement to include ambient temperature and hot-switch signal for CCGTs.
TC/2010/37	H4.2 (h)	H4.2 (f)	H4.2 (h)	To renumber from existing H4.2 (f).
TC/2010/38	H5.3 (d)	New	<u>All measurements shall be tagged as not topical in the event of a failure to update them.</u>	New requirement to align with the proposed modification in Appendix H3.3
TC/2010/39	H8 (d)	Compliance table with the IEC 870-5-101 Interoperability List (Appendix H10)	Compliance table with the IEC 870-5-101 Interoperability List ( <del>Appendix H10</del> ) <u>(PSO will provide the Interoperability List during the detailed implementation stage)</u>	This is to align with the proposed modification to Appendix H10.
TC/2010/40	H8 (e)	IEC 870-5-101 Protocol Information Object Address Assignments (Appendix H11)	IEC 870-5-101 Protocol Information Object Address Assignments ( <del>Appendix H11</del> ) <u>(PSO will provide the Protocol Information Object Address Assignments during the detailed implementation stage)</u>	This is to align with the proposed modification to Appendix H11.

## Energy Market Authority of Singapore

<b>Modification Ref. No.</b>	<b>Clause</b>	<b>Original Text</b>	<b>Modification</b>	<b>Reason</b>
TC/2010/41	H10	IEC 870-5-101 Interoperability List	Delete the paragraph	The details in this section will be provided during implementation stage.
TC/2010/42	H11	IEC 870-5-101 Protocol Information Object Address Assignments	Delete the paragraph	The details in this section will be provided during implementation stage.

# Energy Market Authority of Singapore

## Appendix 2

### Industry Comments on the Proposed Modification to the Transmission Code

Name: \_\_\_\_\_

Designation: \_\_\_\_\_

Company: \_\_\_\_\_

Email: \_\_\_\_\_

Role (Generation Licensee/ Retailer/ Consumer/Transmission Licensee/Transmission Licensee Agent):

\_\_\_\_\_

Submission Date: \_\_\_\_\_ (dd/mm/yy)

Modification Ref. No.	Section*	Comments

\* Reference to the section of the Transmission Code where change has been made in the version dated on January 2008 as published on the EMA website.