



**DECISION PAPER**

**PROPOSED MODIFICATIONS TO THE TRANSMISSION CODE**

21 JULY 2021

ENERGY MARKET AUTHORITY  
991G Alexandra Road  
#01-29 Singapore 119975  
[www.ema.gov.sg](http://www.ema.gov.sg)

Please direct any enquiries by e-mail to: [EMA\\_ES@ema.gov.sg](mailto:EMA_ES@ema.gov.sg)

**Disclaimer:**

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 Transmission 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 to the Transmission Code**

- 2.1 Pursuant to Section 1.6 of the Transmission Code, EMA has sought representations on the proposed modifications to the Transmission Code to provide updates and clarity to the technical requirements relating to, among other things, generation facility design pertaining to fuel changeover capability, accuracy of Transmission Licensee's plans, safety procedures while carrying out works, power sector cyber security measures and Licensees' adequacy of manpower, critical spares and essential consumables.
- 2.2 Feedback was received from 9 respondents when the consultation closed on 1 December 2020. EMA has carefully considered the feedback and our responses are in [Appendix 1](#).

## **3 EMA's Decision**

- 3.1 Taking into account the feedback received, EMA has decided to modify the Transmission Code as set out in [Appendix 2](#). The proposed modifications will come into effect on [06 August 2021](#).

**EMA's Response to Written Representations**

<b>Modification Ref. No.</b>	<b>Clause</b>	<b>Public/ Industry</b>	<b>Comments</b>	<b>EMA's Response</b>
TC/2020/02	8.1.2	SP Group	The completion date of a project can be subject to many factors, some of which are beyond SP's control. SP proposes to establish a clear process to engage EMA on specific reasons for project delays and mitigating measures to maintain network reliability. If these delays are not caused by SP, we seek EMA's understanding to extend the completion timeline accordingly.	<p>EMA notes SP's feedback that project delays may be caused by factors beyond SP's control. As such, EMA will assess each delayed project on a case-by-case basis and consider the mitigating factors presented.</p> <p>Notwithstanding the above, EMA will retain the original wordings of the proposed modification as SP is still expected to complete projects on schedule, to the best of SP's abilities.</p> <p>This response also applies to SP's feedback on TC/2020/03, regarding completion dates.</p>
TC/2020/03	8.1.9	SP Group	<p>As distribution projects are voluminous and dynamic, it is not practical to track project by project. Therefore, we would like to seek EMA's clarification on the "<u>proposed distribution network projects that are required by the Authority for the Authority's approval</u>", the approval time and submission requirements.</p> <p>With regards to completion dates, our comments to Clause 8.1.2 above applies.</p>	<p>It is not the intention of EMA to track implementation of every distribution projects, rather only selected major/critical distribution projects will be tracked. EMA has started engaging SP on the submission of distribution network projects for the Authority's approval. EMA will continue to work with SP to formalize the submission process.</p> <p>Please see EMA's response to SP's feedback regarding project completion dates in TC/2020/02.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
TC/2020/04	Appendix K2(c)	Energy Market Company (EMC)	<p>EMC understands the objective of this clause and supports its intent to prevent cross-contamination of malwares between the different environments. As EMC is an IT system, we do not use the proposed measure but we have a more efficient, alternative approach which will meet the same objective of this clause. We will brief EMA on this alternative solution.</p> <p>We would like to highlight to EMA's regulation and policy department that the cost and efforts to implement and subsequently maintain separate laptops dedicated for CII administration of servers and equipment was not factored in the previous exogenous claims for the CCoP.</p>	<p>EMA noted that EMC would be proposing an alternative solution. Regardless of the exact details, EMC is required to ensure the necessary measures are implemented to ensure its system complies with the technical requirements as set out in Appendix K2(c).</p> <p>EMA also noted EMC's comment on cost of separate laptops had not been included its exogenous claims for CCoP, and would review if EMC submits new claim.</p>
		Tuas Power	<p>Proposed to revise the sentence to "CII shall be <del>owned and maintained</del> managed by the CII Owners"</p> <p>This applies to GT OEM laptop and RTU OEM laptop with proprietary software will be connected to the control systems during combustion tuning and RTU testing and maintenance respectively. This laptop will be managed by the CII owner. Prior to connection into the control system, strict check such as virus scan and USB Blocked will be implemented.</p>	<p>EMA's intent for the maintenance laptops "to be owned and managed by the CIIO" is to ensure that CIIOs track and are fully aware of the usage of such devices within the CII environment. Virus scan and blocking USBs may not be sufficient to detect malware in the laptop especially if the laptop has been used in multiple and unsecured systems or contains software which may not be in the scan-list of a virus program.</p> <p>OEMs and vendors often use common maintenance laptops that contain various types and versions of software and on multiple customer sites with varying degrees of cyber hygiene. This is a serious risk of malwares cross-contamination from less/un-secured environments. Tuas is to work with its OEM to provide a maintenance laptop dedicated for Tuas and to put in place robust SOPs to manage these devices.</p> <p>Hence, EMA will retain the original wordings of the proposed modification, except to replace "maintained" with "managed".</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		Senoko Energy	<p>We have consent to restrict only to laptop owned by CII owners. Reason being some engineering software and tools may be proprietary to system vendor that may not be released to CII owners. Maintaining the laptop also requires CII owners to own and maintain additional software and licenses that CII owner do not use frequently or does not have the expertise in the use. These will lead to higher operating and maintenance cost.</p> <p>With regards to the use of removable media devices, system vendors that are based oversea may require to provide files with huge file size for use on the CII system and therefore not viable to own all removable media devices. We suggest removing "...Owned and..." in the proposed changes.</p>	<p>OEMs and vendors often use common maintenance laptops that contain various types and versions of software and on multiple customer sites with varying degrees of cyber hygiene. This is a serious risk of malwares cross-contamination from less/un-secured environments. Senoko is to work with its OEM to provide a maintenance laptop dedicated for Senoko and to put in place robust SOPs to manage these devices.</p> <p>It is also important that only authorised and dedicated removable media devices can be used within a CII environment. Any external media such as hard disks, USB devices etc. must be scanned, checked and verified by antivirus software before the required data or information is transferred to the authorised and dedicated removable media for use in the CII environment.</p> <p>Hence, EMA will retain the original wordings of the proposed modification, except to replace "maintained" with "managed".</p>
		KMC	<p>OEM may not supply the tools to CII Owners due to proprietary issue, it is not reasonable to ask CII Owners to "own" the tools.</p>	<p>OEMs and vendors often use common maintenance laptops that contain various types and versions of software and on multiple customer sites with varying degrees of cyber hygiene. This is a serious risk of malwares cross-contamination from less/un-secured environments. KMC is to work with its OEM to provide a maintenance laptop dedicated for KMC and to put in place robust SOPs to manage these devices.</p> <p>Hence, EMA will retain the original wordings of the proposed modification, except to replace "maintained" with "managed".</p>

<b>Modification Ref. No.</b>	<b>Clause</b>	<b>Public/ Industry</b>	<b>Comments</b>	<b>EMA's Response</b>
TC/2020/05	Appendix K3e	Tuas Power	Proposed to revise the sentence to "all patches, after validated by OEM, are up to date,"  All patches are to be validated by the OEM to ensure it does not impact the existing control system.	EMA would like to remind Licensees that ensuring validation by the OEM should already be part of the process by the CIIOs before the patch is applied to the production system. Hence the proposed revision is not accepted.  EMA will retain the original wordings of the proposed modification.
		Senoko Energy	We suggest instead of putting in interim control, assess the risk and existing safeguards and put in place additional interim controls where necessary	EMA would like to clarify that risk assessments of existing safeguards should already be part of the risk management process of the CIIOs before additional interim controls, where necessary, are implemented.
TC/2020/06	Appendix K4 (b)	Tuaspring	What is the purpose of providing the network diagram and asset inventory lists including the Band/Model, Network Zone, IP Address (Internal) and MAC Address to CSA?  Instead of annually could the Gencos submit only when there are changes to the network equipment. Generally, changes are rare & annual submission consumes a lot manpower resources.	In order for EMA to promptly determine the severity of each alerts flagged by EMA's Sectorial Detection and Early Warning System (SDEWS) and to perform threat analysis, it is important for EMA to have an updated overview of all the CIIs' network and assets. In addition, it is a requirement under ISO 27001 to update assets list and network diagrams on a regular basis.  Since Tuaspring has achieved ISO 27001 certification, Tuaspring should be able to comply with this requirement. Furthermore, as highlighted by Tuaspring, changes are rare, hence annual submission should not be onerous in-terms of manpower resources. EMA has also assessed that having annual submission will also serve as reminders to the CIIOs to update EMA with changes that might be inadvertently missed.
TC/2020/07	Clause 9.4.2	SP Group	Survey data submitted under contracts called after 2018 (the launched of the SLA Utility Standards) will comply with the new SLA's utilities standards.	As stated in the consultation paper, the Utility Survey Standard shall not apply to cables installed prior to the introduction of the Standard.

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
			We would like to clarify if the requirement to maintain up-to-date and accurate digital mappings and records that meet the SLA's requirements would also apply to all existing cables installed before the date of this licence modification as this will require an extensive site survey to be performed on all existing cables laid before 2018 to ensure compliance.	
TC/2020/10	Clause 6.2.3 - New Clause	SP Group	<p>We propose the following amendments:            "The Transmission Licensee and Generation Licensees shall ensure that their plants and equipment comply with the <u>relevant</u> requirements set forth under sections 8.4.1 and 8.4.2 respectively <u>at the time of system design</u>."</p> <p>Equipment purchased comply with prevailing relevant standards, while standards may change over the life of the equipment. The relevance of the standards to Singapore's context should be determined, before their compliance is enforced. There should be a reasonable allowance for Licensees to adapt to the changes in the applicable standards in sections 8.4.1 and Appendix I, while equipment purchased installed before the imposition of additional standards or change in existing standards should not be penalised.</p>	<p>The standards listed in Appendix I are well established international guidelines which Licensees should already be adhering to the prevailing standards at the time of system design. There are no proposed changes to the list of standards and requirements in Appendix I in this current round of Transmission Code modifications. If there are amendments to the list of standards and requirements in the future, EMA will consult the industry before formal implementation.</p> <p>Hence, EMA will retain the original wordings of the proposed modification.</p>
TC/2020/16	Clause 9.1.6 – New clause	SP Group	A defined list of critical spares and consumables have been provided in EPP submission. This should be agreed ex-ante with EMA, while reasonable timelines should be allowed for their subsequent replenishment.	EMA has noted the Transmission Licensee's list of critical spares and essential consumables that was submitted to EMA as part of COVID-19 emergency planning. The Transmission Licensee should put in place a process to periodically review the list of critical spares and essential consumables, and mitigate against potential supply disruption.

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
TC/2020/17	9.2.5	YTL Power Seraya	<p>The intent for the proposed change is to extend the requirement for keeping sufficient inventory to consumables so as to ensure that Generation Licensees' facilities can return to service in the shortest possible time in the event of depleting.</p> <p>However, the proposed modified text imposed a higher standard to comply than was intended.</p> <p>We would like to propose the following amendments to reflect the intent of the change:</p> <p>"The Generation Licensee shall ensure that it has sufficient inventory of critical spares for timely replacement of faulty parts and <b><u>sufficient inventory of consumables</u></b> of any generation facility, <b><u>that a reasonable and prudent operator would be able to arrange with its available suppliers and site conditions</u></b>, so that the generation facility can be returned to service in the shortest possible time. Without prejudice to the generality of the foregoing, the Generation Licensee shall in particular ensure that each generation facility which is a combined-cycle plant or gas turbine shall have one complete set of spare air filters within Singapore at all times."</p>	<p>EMA understands that there could be limitation beyond Licensees' control to meet this requirement. Licensees should inform EMA of such instances promptly and EMA will assess on a case-by-case basis. Licensees will not be penalised for circumstances beyond their control.</p> <p>On storing hazardous consumable such as hydrogen in excess of the licensed storage capacity of the facility, we had earlier noted Generation Licensees' safety concerns and decided not to require Generation Licensees' to stockpile additional amount of hydrogen.</p> <p>The Generation Licensee shall ensure that it has sufficient inventory of critical spares for timely replacement of faulty parts of any <i>generation facility</i> so that the <i>generation facility</i> can be returned to service in the shortest possible time. <u>The Generation Licensee shall also ensure that it has sufficient inventory of essential consumables to enable continual operation of the Generation Licensee's generation facilities.</u> Without prejudice to the generality of the foregoing, the Generation Licensee shall in particular ensure that each <i>generation facility</i> which is a <i>combined-cycle plant</i> or gas turbine shall have one complete set of spare air filters within Singapore at all times.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
			<p>It is important that the obligations imposed on Generation Licensee should take into account the available suppliers and site conditions to provide the consumables. For example, hazardous consumable such as hydrogen is stored on site in quantity in accordance to normal consumption for day to day operation of the generation facility and to be replenished from time to time. The storage facility for this hazardous consumable is designed and constructed in accordance to local regulatory requirements. As such, it is not possible to stockpile this hazardous consumable in excess of the licensed storage capacity of the facility without violating the regulatory and safety requirements.</p> <p>The ability of the Generation Licensee to comply depends on whether the supplier is able to replenish the consumable continually. There may be times, such as during a pandemic situation, whereby the access to the consumables could be restricted due to extensive lockdown locally and globally. The Generation Licensee shall not be penalised for situation that is beyond its control.</p>	

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		Senoko Energy	More clarity is needed on what is deemed "sufficient". Compliance with this new clause may require additional huge capital investment, which would not be viable for Senoko without support from EMA at present. We would urge EMA reconsider this, or at least have deeper consultations with all Generation Licensee on this.	<p>EMA notes that licensees are already keeping substantial amounts of critical spares and essential consumables for its respective assets and facilities to enable continual operation of their plants. This is evident from licensees' reporting of stockpiles to EMA in the course of COVID-19. As such, licensees are not expected to incur huge capital investment to meet this requirement</p> <p>Licensees should work with its suppliers to determine the inventory level of critical spares and essential consumables required to ensure that their facilities or assets can continue to remain in operation or be brought back to service as soon as possible. Among other things, the time taken for suppliers to bring in critical spares and essential consumables, and the availability of alternative suppliers should be taken into consideration in determining the appropriate inventory level.</p> <p>EMA may require Licensees to increase their inventory of critical spares and essential consumables in anticipation of potential disruption of supplies. Licensees will be informed in advance of any changes in required level of inventory.</p> <p>As the inventory is needed to ensure Licensees' facilities/plants can continue to be in operation, Licensees should bear the costs of the inventory as part of its business costs.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		KMC	<p>1. The coverage of 'consumables' is too broad</p> <p>2. Most of consumables have fixed shelf life</p>	<p>Through the course of COVID-19, EMA has worked with Licensees to identify the critical spares and essential consumables for its respective assets and facilities. Licensees should therefore already be aware of what their critical spares and essential consumables are.</p> <p>We note that most consumables have fixed shelf life. Licensees are therefore advised to work with their suppliers to manage their inventory of essential consumables to ensure that consumables nearing their end of shelf life are refreshed. This is needed to ensure Licensees' facilities and assets can continue to remain in operation, Licensees should bear the costs of the inventory as part of its business costs.</p>
TC/2020/18	Clause 6.1.5 – New clause	SP Group	<p>We propose the following amendments:</p> <p>“The Transmission Licensee, Generation Licensee and any connected person shall ensure that they have adequate and sufficiently trained and qualified manpower, to maintain and operate their installations, generation facilities and auxiliaries at all times <u>for planned activities</u>.”</p> <p>To address manpower demands arising from unplanned activities, there would be customised manpower plan developed and implemented on a need basis if existing resources are assessed not to be adequate.</p>	<p>EMA noted SP Group would also develop and implement manpower plans to cater for ad-hoc activities, where necessary. However, EMA will change the proposed modification to as follow:</p> <p>“The Transmission Licensee, Generation Licensee and any connected person shall ensure that they have adequate and sufficiently trained and qualified manpower, to maintain and operate their installations, generation facilities and auxiliaries at all times. Where there is attrition of manpower, they should be replenished as soon as reasonably possible.”</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		YTL Power Seraya	<p>Generation Licensee provides a Business Continuity Plan to EMA that stipulated the required manpower during different scenarios.</p> <p>For clarity, we would like to propose the following amendments:</p> <p>The Transmission Licensee, Generation Licensee and any connected person shall ensure that they have adequate and sufficiently trained and qualified manpower, to maintain and operate their installations, generation facilities and auxiliaries at all times <b><u>in accordance with the Business Continuity Plan submitted to EMA.</u></b></p>	<p>Insufficient skilled manpower to operate and maintain Licensee' assets, will have an adverse impact on the reliability and security of the power system. While Licensees may have to operate on reduced manpower under extreme scenarios as per their Business Continuity Plan, they should replenish their manpower as soon as reasonably possible. Increasing depletion of manpower would put the power system at risk of a major outage. Hence, EMA will change the proposed modification to as follow:</p> <p>"The Transmission Licensee, Generation Licensee and any connected person shall ensure that they have adequate and sufficiently trained and qualified manpower, to maintain and operate their installations, generation facilities and auxiliaries at all times. Where there is attrition of manpower, they should be replenished as soon as reasonably possible."</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		Tuaspring	Having adequate and sufficiently trained and qualified manpower, to maintain and operate their installations, generation facilities and auxiliaries at all times is too erroneous. It should be applicable only to certain situations & not at all times otherwise it will be very costly to Gencos. As it is most Gencos are currently not in good financial position to withstand these additional cost.	<p>Insufficient skilled manpower to operate and maintain Licensee' assets, will have an adverse impact on the reliability and security of the power system. While Licensees may have to operate on a reduced manpower under extreme scenarios as per their Business Continuity Plan, they should replenish their manpower as soon as reasonably possible. Increasing depletion of manpower would put the power system at risk of a major outage. Hence, EMA will change the proposed modification to as follow:</p> <p>"The Transmission Licensee, Generation Licensee and any connected person shall ensure that they have adequate and sufficiently trained and qualified manpower, to maintain and operate their installations, generation facilities and auxiliaries at all times. Where there is attrition of manpower, they should be replenished as soon as reasonably possible."</p>
		Senoko Energy	More clarity on what would be deemed "adequate and sufficiently trained and qualified"	Licensees should assess this based on their own operational requirements and needs, to ensure that their critical operations will not be disrupted. It would not be practical for EMA to mandate a prescriptive list, given that there are variations in Licensee's operational needs.
TC/2020/23	6.11.2	YTL Power Seraya	We would like to seek clarification whether this proposed change is intended to apply to an existing dedicated LNG regasification facility that is not connected to the gas supply system or is a provision for such facility in the future.	Yes. The proposed modifications are applicable to any dedicated LNG regasification facility supplying natural gas to its own generating facility for power generation, without any connection to the gas transmission network. While there is no such LNG regasification facilities at this moment, such facilities may exist in the future.

<b>Modification Ref. No.</b>	<b>Clause</b>	<b>Public/ Industry</b>	<b>Comments</b>	<b>EMA's Response</b>
		Tuas Power	Proposed to insert "critical" consumables to enable continual operation of the Generation Licensee's generation facilities.	Transmission and Generation Licensees' critical spares and essential consumables requirements are found in Clause 9 of the Transmission Code for the respective Licensees' compliance.
TC/2020/28	Appendix C1	YTL Power Seraya	All existing generation facilities that has been commissioned before the effective date of this proposed transmission code change shall be exempted from this proposed change because they were commissioned and registered based on the primary fuel operation. The required information when operating with alternate fuel is not available.	<p>After taking into consideration the industries' feedback, EMA assessed that the proposed changes shall be applicable to (a) each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021.</p> <p>These generation facilities shall be required to comply with the reserve capability requirements when operating on alternate fuel (i.e. diesel).</p>
TC/2020/29	6.11.3(f)	YTL Power Seraya	<p>The proposed change requires generation facilities registered with EMC on or after 1 January 2020 to adhere to the requirements as set forth in Appendix F13.</p> <p>For avoidance of doubt, the new requirements should apply to only newly commissioned generation facilities registered with EMC. Existing generation facilities that is being re-registered arising from change in ownership should be excluded from the requirement set forth in Appendix F13 because these existing generation facilities have already been commissioned before knowing about the new requirement.</p>	<p>See response to TC/2020/28.</p> <p>Please also refer to the revised Appendix F13 on Appendix 2 of this paper.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
			Proposed changes should also not be applied retrospectively because it would be unreasonable to impose a non-compliance on a person who has done the act in good faith before the proposed change has been made. We urged EMA to apply the new requirements only to newly commissioned generation facilities registered with EMC after the effective date of this proposed change.	
TC/2020/30	Appendix F8	YTL Power Seraya	<p>Existing generating facilities are not able to comply to the requirement of providing primary reserve for alternate fuel (i.e. diesel).</p> <p>Please refer to the Gencos' joint representation letter on "The Implementation of Governor Control (GC) and Automatic Generation Control (AGC)" to EMA dated 3 Oct 2019 and 15 Feb 2020.</p> <p>This clause should only be applicable to only newly commissioned generation facilities.</p>	<p>See response to TC/2020/28.</p> <p>Please also refer to the revised Appendix F8 on Appendix 2 of this paper.</p>
		Tuaspring	<p>Providing minimum primary reserve for alternate fuel for existing units may not be feasible or cost prohibitive for Gencos. Even if after spending huge amount of money, there no guarantee of positive outcome. No OEM will guarantee of meeting the outcome.</p>	<p>See response to TC/2020/28.</p> <p>Please also refer to the revised Appendix F8 on Appendix 2 of this paper.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		Tuas Power	<p>Proposed that this requirement should not retrospectively apply to existing operating CCP. A joint representative letter was sent to EMA on Gencos concern on the spinning reserve requirement of frequency sensitive plant on alternate fuel (backup fuel or diesel) in Oct 2019 and Feb 2020. TPG confirmed with OEM – MHPs, GE – that the current Mitsubishi and Alstom/GE GT26 are not designed for this capability. We wish to reiterate that the above will involve significant costs and time for engagement of OEMs to carry out technical feasibility study, modifications if technically feasible, testing and validation as mentioned in the joint representative letter.</p> <p>The primary reserve requirement for alternative fuel is too stringent. Generally, in fuel oil firing, due to the characteristic of the combustor, the ramping rate is not as fast as gas firing.</p>	<p>See response to TC/2020/28.</p> <p>Please also refer to the revised Appendix F8 on Appendix 2 of this paper.</p>
		Keppel Shipyard Ltd	<p>We would like to note that its challenging for larger machines to meet primary reserves under alternate fuel, hence request to remove. We shall work with regulators to understand the limitations of larger machines to meet the requirements under clause F8.1 and to find the best suitable solution.</p> <p>Proposed representation:</p> <p>F8.1 Each generating unit must be capable of providing minimum primary reserve for <del>both</del> primary <del>and alternate</del> fuel. The Spinning Reserve Requirements for primary is <del>and alternate fuel are</del> as follows:</p>	<p>See response to TC/2020/28.</p> <p>Please also refer to the revised Appendix F8 on Appendix 2 of this paper.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments			EMA's Response
				<i>Generating unit MW Output as a % of Rated MW capacity</i>	Primary reserve as a % of Rated MW Capacity	
			(i)	90	5	
			(ii)	75 to 9 Minimum Stable Load	9	
		KMC	<p>1. Existing technology on combined cycle power plant not able to support reliable frequency response on fuel oil operation</p> <p>2. Even if frequency response on fuel oil operation maybe feasible in the future, the fuel gas and fuel oil frequency response would be different therefore, primary reserve for 5% and 9% of rated MW capacity requirement cannot be the same.</p> <p>3. The criteria for fuel oil shall be stated as just unit capability (minimum requirement) and not make referenced to any %, this is due to rated MW Capacity of fuel gas and fuel oil would be different.</p>			<p>See response to TC/2020/28.</p> <p>EMA also noted the feedback on the differences in rated MW Capacity depending on the type of fuel used by the <i>Combined-Cycle Plant</i>. Please refer to the revised Appendix F8 on Appendix 2 of this paper.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
TC/2020/31	Appendix F	YTL Power Seraya	<p>For avoidance of doubt, the new requirements should apply to only newly commissioned generation facilities registered with EMC. Existing generation facilities that is being re-registered arising from change in ownership should be excluded from the requirement set forth in Appendix F13 because these existing generation facilities have already been commissioned before knowing about the new requirement.</p> <p>Proposed changes should also not be applied retrospectively because it would be unreasonable to impose a non-compliance on a person who has done the act in good faith before the proposed change has been made. We urged EMA to apply the new requirements only to newly commissioned generation facilities registered with EMC after the effective date of this proposed change.</p> <p>We would like to seek confirmation that EMA has consulted all reputable GT OEMs and they have confirmed with EMA that their GTs are able to comply with the new requirement in Appendix F13.</p>	<p>See response to TC/2020/28.</p> <p>EMA would like to reiterate that given the limited line-pack within the gas transmission networks, the additional requirements shall be applicable to (a) each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021, to enable successful completion of fuel changeover (FCO) operation to alternate fuel (i.e. diesel) via a low gas trip pressure setting.</p> <p>Generation Licensees are to work with the Original Equipment Manufacturer (OEM) to comply with the stipulated requirements. Please refer to the revised Appendix F13 on Appendix 2 of this paper.</p>
		Tuaspring	<p>CCP units to comply with the requirements in Table 13.1.b for fuel changeover (FCO) operations is practically impossible. By design CCP have only a certain window to FCO for safety &amp; stability reasons.</p>	<p>See response to TC/2020/28.</p> <p>EMA would advise Generation Licensees to work with the Original Equipment Manufacturer (OEM) to comply with the stipulated requirements. Please refer to the revised Appendix F13 on Appendix 2 of this paper.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		Tuas Power	<p>This requirement will limit the number of new Gas Turbine able to operate in Singapore market which will inadvertently increase the project cost of building new power plant without competition.</p> <p>Could you share with us the reason or background information of this requirement, i.e. 16barg, for us to plan the schedule of new CCGT project, for example installation, construction and operation.</p> <p><u>Fuel changeover requirement:</u> Two OEMs feedback their H class machines are not able to meet the fuel changeover time requirement of 10mins. Longer time is required to complete the FCO, i.e. one requires approximately 12mins while the other requires approximately 16mins.</p> <p>One OEM also feedback that their H class machine fuel switch over is below 60% GT load, and F class at 70% GT load max for fuel switchover. (Please note that the above feedback is strictly on GT loadings and not for overall CCP).</p> <p>Given the feedback from the OEMs, we are of the view that the fuel switchover requirement is stringent for the H class CCGTs. We understand that it is the government's direction and plan to introduce advanced CCGTs into power market to improve the overall efficiency of the system. As such, we would like to request PSO to review the grid stability margin capacity, and whether the timing and loading during the fuel changeover can be relaxed.</p> <p><u>Frequency response:</u></p>	<p>EMA would like to reiterate that given the limited line-pack within the gas transmission networks, the additional requirements shall be applicable to (a) each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021, to enable successful completion of fuel changeover (FCO) operation to alternate fuel (i.e. diesel) via a low gas trip pressure setting.</p> <p>The requirements relating to generation facility FCO capabilities are to ensure that there is no significant loss in generation output (MW) due to de-loading. Each FCO process has to be completed within ten (10) minutes to ensure the secure and reliable operation of the power system in the event of a natural gas supply disruption.</p> <p>EMA would advise Generation Licensees to work with the Original Equipment Manufacturer (OEM) to comply with the stipulated requirements. Please refer to the revised Appendix F13 on Appendix 2 of this paper.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response		
			<p>We would like to share that some OEMs has feedback that it is a challenge to meet the frequency response requirement when the GT is running on fuel oil and further investigation is required. Please review the requirement on the alternate fuel, as such requirement would narrow the OEMs that new investors can select for the new advanced CCGTs.</p>			
		<p>Keppel Shipyard Ltd</p>	<p>We shall work with regulators to understand the limitations of larger machines to meet the requirements under clause F13.1 and to find the best suitable solution.</p> <p>Proposed representation:  F13.1 This section states the design and technical requirements for new/repowered generation facility registered with EMC as a generation registered facility on or after 1 January 2020. Each generation facility,  (a) that uses natural gas as primary fuel shall be designed to operate at its rated MW Capacity with a low gas pressure trip setting no greater than 16barg measured at the System Offtake Point in accordance to the definition of the Gas Network Code (GNC) Section A. Refer to Figure F13.1.a. for an illustration.  (b) shall comply with the requirements in Table 13.1.b for fuel changeover (FCO) operations. Refer to Figure 13.1.b for an illustration.</p> <p>Table 13.1b</p> <table border="1"> <tr> <td>Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation</td> <td>Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required)<sup>1</sup> (%)</td> </tr> </table>	Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation	Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required) <sup>1</sup> (%)	<p>See response to TC/2020/28.</p> <p>The requirements relating to generation facility FCO capabilities are to ensure that there is no significant loss in generation output (MW) due to de-loading. Each FCO process has to be completed within ten (10) minutes to ensure the secure and reliable operation of the power system in the event of a natural gas supply disruption.</p> <p>EMA would advise Generation Licensees to work with the Original Equipment Manufacturer (OEM) to comply with the stipulated requirements. Please refer to the revised Appendix F13 on Appendix 2 of this paper.</p>
Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation	Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required) <sup>1</sup> (%)					

Modification Ref. No.	Clause	Public/ Industry	Comments		EMA's Response	
			Above <del>80%</del> 60%	Deload to not lower than <del>80%-60%</del> loading		
			<del>Between 60% to 80%</del>	No change in loading		
			Below 60%	Load to not more than 60% loading		
			<p><sup>1</sup>FCO can be initiated and performed without any loading and/or de-loading within these range of MW loading level while operating under primary fuel.</p> <p>(c) shall complete the FCO operation, including loading or deloading to the designated loading level to enable FCO to commence if required, starting up of other support systems such as alternative fuel auxiliary system and etc., <del>within ten (10) minutes upon initiation of fuel changeover process.</del></p> <p>(d) Upon completion of the FCO, the generating facility shall be capable of ramping up to its NEMS scheduled load prior to the initiation of the FCO process or to the maximum loading level of the generation facility operating in alternate fuel, whichever is lower. Subsequently, the generation facility shall be put on Automatic Generation Control (AGC) and free governor mode immediately.</p>			

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response								
		Senoko Energy	<p>For "(a) that uses natural gas as primary fuel shall be designed to operate at its rated MW Capacity with a low gas pressure trip setting no greater than 16barg measured at the System Offtake Point in accordance to the definition of the Gas Network Code (GNC) Section A. Refer to Figure F13.1.a. for an illustration.", Senoko will be able to comply with the requirement.</p> <p>For table13.1.b, Senoko is unable to comply with this requirement.</p> <p>To perform fuel change over, GTs are required to down below 50% load. It will require huge investment to comply with new requirement.</p> <p style="text-align: center;"><b>Table 13.1.b</b></p> <table border="1"> <thead> <tr> <th><u>Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation</u></th> <th><u>Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required)' (%)</u></th> </tr> </thead> <tbody> <tr> <td>Above 80%</td> <td>Deload to not lower than 80% loading</td> </tr> <tr> <td>Between 60% to 80%</td> <td>No change in loading</td> </tr> <tr> <td>Below 60%</td> <td>Load to not more than 60% loading</td> </tr> </tbody> </table>	<u>Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation</u>	<u>Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required)' (%)</u>	Above 80%	Deload to not lower than 80% loading	Between 60% to 80%	No change in loading	Below 60%	Load to not more than 60% loading	<p>EMA would like to reiterate that given the limited line-pack within the gas transmission networks, the additional requirements shall be applicable to (a) each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021, to enable successful completion of fuel changeover (FCO) operation to alternate fuel (i.e. diesel) via a low gas trip pressure setting.</p> <p>The requirements relating to generation facility FCO capabilities are to ensure that there is no significant loss in generation output (MW) due to de-loading. Each FCO process has to be completed within ten (10) minutes to ensure the secure and reliable operation of the power system in the event of a natural gas supply disruption.</p> <p>EMA would advise Generation Licensees to work with the Original Equipment Manufacturer (OEM) to comply with the stipulated requirements. Please refer to the revised Appendix F13 on Appendix 2 of this paper.</p> <p>With regard to Senoko's comments on F8.1, please see response to TC/2020/28.</p>
<u>Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation</u>	<u>Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required)' (%)</u>											
Above 80%	Deload to not lower than 80% loading											
Between 60% to 80%	No change in loading											
Below 60%	Load to not more than 60% loading											

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response									
			<p>For "Upon completion of the FCO, the generating facility shall be capable of ramping up to its NEMS scheduled load prior to the initiation of the FCO process or to the maximum loading level of the generation facility operating in alternate fuel, whichever is lower. Subsequently, the generation facility shall be put on Automatic Generation Control (AGC) and free governor mode immediately", Senoko is unable to meet the requirement.</p> <p>For F8.1 (shown below), Senoko is unable to meet the requirement. It will require huge investment to comply with new requirement.</p> <p><u>F8.1 Each generating unit must be capable of providing minimum primary reserve for both primary and alternate fuel. The Spinning Reserve Requirements for primary and alternate fuel are as follows:</u></p> <table border="1"> <thead> <tr> <th></th> <th><i>Generating unit MW Output as a % of Rated MW capacity</i></th> <th><i>Primary reserve as a % of Rated MW Capacity</i></th> </tr> </thead> <tbody> <tr> <td>(i)</td> <td>90</td> <td>5</td> </tr> <tr> <td>(ii)</td> <td>75 Minimum Stable Load to</td> <td>9</td> </tr> </tbody> </table>		<i>Generating unit MW Output as a % of Rated MW capacity</i>	<i>Primary reserve as a % of Rated MW Capacity</i>	(i)	90	5	(ii)	75 Minimum Stable Load to	9	
	<i>Generating unit MW Output as a % of Rated MW capacity</i>	<i>Primary reserve as a % of Rated MW Capacity</i>											
(i)	90	5											
(ii)	75 Minimum Stable Load to	9											

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
		KMC	<p>1. If normal operating gas pressure at system offtake point is much higher than 16 barg, and gas compressor has to be designed oversize to cope with the low pressure situation ( 16 barg), the efficiency will be low (high energy consumption), it will be waste of energy, which is not in line with the country's initiatives to reduce carbon footprint.</p> <p>2. The requirement on Table 13.1.b might restrict number of vendors qualified in the market (such requirements may bias to certain vendor in the market), not healthy for market competition.</p> <p>3. Frequency response on fuel oil is not a proven technology, reliability is a major concern.</p>	<p>EMA would like to reiterate that given the limited line-pack within the gas transmission networks, the additional requirements shall be applicable to (a) each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021, to enable successful completion of fuel changeover (FCO) operation to alternate fuel (i.e. diesel) via a low gas trip pressure setting.</p> <p>The requirements relating to generation facility FCO capabilities are to ensure that there is no significant loss in generation output (MW) due to de-loading. Each FCO process has to be completed within ten (10) minutes to ensure the secure and reliable operation of the power system in the event of a natural gas supply disruption.</p> <p>EMA would advise Generation Licensees to work with the Original Equipment Manufacturer (OEM) to comply with the stipulated requirements. Please refer to the revised Appendix F13 on Appendix 2 of this paper.</p>

Modification Ref. No.	Clause	Public/ Industry	Comments	EMA's Response
General	Appendix C1.3(h)	PacificLight Power	We refer to the EMA's response letter dated 4 Dec 2019 addressed to all Gencos regarding the implementation of Governor Control and Automatic Generation Control for CCP operation on diesel fuel. Under para 5 of the response letter, several tests were deemed applicable to verify the performance capability of CCPs under diesel operation, namely, Performance Test, Primary Reserve Test, Contingency Reserve Test, and AGC Test. For Primary Reserve Test, it was highlighted that submission of validated models (e.g. alternate dual (diesel) capability model) is not required for diesel operation. We would therefore propose that said exclusion be aligned under the test data/reports requirements under Appendix C 1.3(h) of the amended Transmission Code.	With reference to EMA's response letter dated 4 December 2019, EMA has clarified that the submission of validated models (in PSS/E and MATLAB) is not required for diesel operation. However, test data and reports are still required to be submitted for diesel operation.

**Modifications to the Transmission Code**

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
<b>To amend 1.2.1 (f) – to change “electricity installation” to “electrical installation”</b>				
TC/2020/01	1.2.1 (f)	A <i>connected person</i> who is required to comply with this Code or certain provisions of this Code under the terms of a Connection Agreement or Retailer Use of System Agreement with the Transmission Licensee or by a condition of its electricity installation licence; and	A <i>connected person</i> who is required to comply with this Code or certain provisions of this Code under the terms of a Connection Agreement or Retailer Use of System Agreement with the Transmission Licensee or by a condition of its <del>electricity</del> <u>electrical</u> installation licence; and	To use the proper term “electrical installation”.
<b>Requirement for Transmission Licensee to complete approved projects within EMA approved completion dates</b>				
TC/2020/02	8.1.2	The Transmission Licensee, in formulating, its Ten-Year Transmission Development Plan, shall ensure that the <i>network</i> design and any addition of <i>network</i> elements shall not jeopardise the <i>security, reliability</i> , stability and adequacy of the <i>power system</i> . The Transmission Licensee shall prepare and submit, each year, a Ten-Year Transmission Development Plan to the <i>Authority</i> for approval.	The Transmission Licensee, in formulating, its Ten-Year Transmission Development Plan <u>or any adhoc transmission network development proposal (including but not limited to any proposal for asset renewal or network enhancement)</u> , shall ensure that the <i>network</i> design and any addition of <i>network</i> elements shall not jeopardise the <i>security, reliability</i> , stability and adequacy of the <i>power system</i> . The Transmission Licensee shall prepare and submit, each year, a Ten-Year Transmission Development Plan to the <i>Authority</i> for approval. <u>As and when necessary, or as and when required by the Authority, the Transmission Licensee shall submit such adhoc transmission network development proposal to the Power System Operator and the Authority for endorsement and approval</u>	Transmission Licensee shall submit ad-hoc transmission projects as and when required or as required by EMA, as per the current process. The Transmission Licensee is required to complete approved projects within EMA approved completion dates.

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
			<p><u>respectively. The Authority may grant approval subject to such conditions as it deems necessary. The Transmission Licensee shall complete approved proposals in the Ten-Year Transmission Development Plan and approved adhoc transmission network development proposals in accordance with such conditions as may be imposed by the Authority by the approved completion dates, unless otherwise specified by the Authority.</u></p>	
TC/2020/03	8.1.9	New Clause	<p><u>On an annual basis or as and when required by the Authority, the Transmission Licensee shall submit such proposed distribution network projects that are required by the Authority for the Authority's approval. The Authority may grant approval subject to such conditions as it deems necessary. The proposed distribution network projects shall include but shall not be limited to asset renewal and network enhancement projects. The Transmission Licensee shall complete the approved distribution network projects in accordance with such conditions as may be imposed by the Authority by the approved completion dates, unless otherwise specified by the Authority.</u></p>	<p>The Transmission Licensee is required to submit certain proposed distribution network projects as specified by EMA. This is to ensure that any proposed enhancement or renewal in the distribution network is adequate and cost-effective for the security and reliability of electricity supply.</p> <p>The Transmission Licensees shall also complete approved distribution network projects within EMA approved completion dates, so as to ensure timely completion of the projects for the security and reliability of electricity supply.</p>

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
<b>Cyber Security Measures</b>				
TC/2020/04	Appendix K2(c)	Implement stringent controls on use of all removable media and laptops in CII environment. Any removable media used in the CII shall be authorised only for dedicated use between specific servers, workstations and end-point devices.	Implement stringent controls on use of all removable media and laptops in CII environment. <del>Any</del> <u>All</u> removable media devices and laptops used in the CII shall be <u>owned and managed by the CII Owners, and must be authorised only for dedicated use between specific servers, workstations, end-point devices, Programmable Logic Controllers (PLCs), RTUs, network switches and routers.</u>	To ensure all removable media devices and laptops used in the CII environment are owned and properly managed by the CII Owners based on prevailing cyber security requirements imposed by CSA.
TC/2020/05	Appendix K3(e)	Ensure that all CIIs shall be regularly patched to resolve software applications and operating system vulnerabilities and that all patches are up to date.	Ensure that all CIIs shall be regularly patched to resolve software applications and operating system vulnerabilities and that all patches are up to date, <u>and ensure that interim mitigating controls shall be in place to address the vulnerabilities if the patches cannot be implemented promptly.</u>	Systems that might not be able to implement patches timely due to operational constraints, interim mitigating measures must be put in place until patches can be implemented.
TC/2020/06	Appendix K4(b)	CII Owners shall provide updated copy of CII's network diagram annually or as and when there are changes to the network equipment in machine readable PDF format showing the following information but not limited to;...	CII Owners shall provide updated copy of CII's network diagram <u>and asset inventory lists</u> annually or as and when there are changes to the network equipment in machine readable PDF format showing the following information but not limited to;...	To better align with CSA's requirements under the Cybersecurity Code of Practice, section 4.1, where CIIOs have to identify and maintain a list of CII assets.

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
<b>Accuracy of cable plans</b>				
TC/2020/07	9.4.2	The Transmission Licensee shall keep up-to-date digital mapping or records of their high voltage cables installed in and under public places, in such form as is accessible by other utilities service providers or such other persons who require such information for locating the high voltage cables prior to commencement of earthworks.	The Transmission Licensee shall keep up-to-date digital mapping or records of their high <u>and low</u> voltage cables installed in and under public places, in such form as is accessible by <u>government agencies</u> , other utilities service providers, or such other persons who require such information for locating the high and low voltage cables prior to commencement of earthworks, <u>or for infrastructure planning works or for other purposes as required by government agencies and agreed to by the Authority.</u> The Transmission Licensee shall also ensure that its digital mapping or records of high and low voltage cables are accurate and comply with the relevant requirements in the <u>Singapore Land Authority's Utility Survey Standard.</u>	<p>The Transmission Licensee is responsible to keep an up-to-date and accurate digital mapping or records of all its cables in the network (i.e. for both high and low voltage cables).</p> <p>Such digital mapping or records are provided to various parties such as government agencies and Licensed Cable Detection Workers, so as to facilitate their infrastructure planning works and cable detection works respectively. Inaccurate digital mapping or records could directly or indirectly cause project delays and cable damages. It is thus critical that the Transmission Licensee ensures that its digital mapping or records of high and low voltage cables are accurate and comply with the relevant requirements stipulated in the Utility Survey Standard). The Utility Survey Standard shall not apply to cables installed prior to the introduction of the Standard.</p>

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
<b>Standards and Standing Operating Procedures</b>				
TC/2020/08	6.2.1 (c)	where applicable, comply with the standards set forth in Appendix I, or such other standards as may be acceptable to the Transmission Licensee.	<del>where applicable, comply with the standards set forth in Appendix I, or such other standards as may be acceptable to the Transmission Licensee.</del>	For clarity, section 6.2.1 (c) is proposed to be broken down into two parts – one of the requirements is applicable to connected persons' electrical installations (as proposed under section 6.2.2 below) while the other requirement is for the Transmission Licensee and Generation Licensees (as proposed under sections 6.2.3). With the proposed introduction of sections 6.2.2 and 6.2.3, section 6.2.1 (c) is no longer required and is proposed to be removed.
TC/2020/09	6.2.2	New Clause	<u>All <i>connected persons</i> shall ensure that their electrical installations comply with the standards set forth in Appendix I where applicable, or such other standards as may be acceptable to the Transmission Licensee.</u>	This is the same requirement as the existing clause 6.2.1 (c).
TC/2020/10	6.2.3	New Clause	<u>The Transmission Licensee and Generation Licensees shall ensure that their plants and equipment comply with the requirements set forth under sections 8.4.1 and 8.4.2 respectively.</u>	To better align with the equipment design standards that the Transmission and Generation Licensees are required to comply with under the existing sections 8.4.1 and 8.4.2

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
TC/2020/11	6.2.2	6.2.2  The <i>Power System Operator</i> shall develop a system level Standing Operating Procedure.....	<u>6.2.24</u>  The <i>Power System Operator</i> shall develop a system level Standing Operating Procedure.....	Amended the numbering sequence
<b>Safety Procedures</b>				
TC/2020/12	10.1.15	The Transmission Licensee, Generation Licensee or <i>connected person</i> shall comply with all applicable or relevant safety procedures and practices to ensure the safety of personnel and/or plant at any time that work and/or testing is carried out.	<del>The Transmission Licensee, Generation Licensee or <i>connected person</i> shall comply with all applicable or relevant safety procedures and practices to ensure the safety of personnel and/or plant at any time that work and/or testing is carried out.</del>	To be deleted and replaced with the new section 10.7.2.
TC/2020/13	10.7	<b>New sub-section added in Transmission Code</b>	<b><u>Safety Procedures</u></b>	To include an additional sub-section to address the safety procedures when works or testing is carried out.
TC/2020/14	10.7.1	New clause added in Transmission Code	<u>The Transmission Licensee, Generation Licensee or <i>connected person</i> shall establish and maintain adequate safety measures and procedures to ensure the safety of the public or personnel and/or prevention of death/injury to any person or damage to any property for any work or testing carried out on any electric line or equipment belonging to or under the management or control of the Transmission</u>	To ensure the Transmission Licensee, Generation Licensee or connected person establish and maintain adequate safety procedures.

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
			<u>Licensee, Generation Licensee or <i>connected person</i>.</u>	
TC/2020/15	10.7.2	New clause added in Transmission Code	<u>The Transmission Licensee, Generation Licensee or <i>connected person</i> shall comply with all applicable or relevant safety procedures, requirements and practices to ensure the safety of the public or personnel and/or prevention of death/injury to any person or damage to any property when any work or testing is carried out on any electric line or equipment belonging to or under the management or control of the Transmission Licensee, Generation Licensee or <i>connected person</i>.</u>	To ensure the Transmission Licensee, Generation Licensee or connected person comply with all applicable or relevant safety procedures.
<b>Transmission and Generation Licensees' critical spares and essential consumables</b>				
TC/2020/16	9.1.6	New clause added in Transmission Code	<u>The Transmission Licensee shall ensure that it has sufficient inventory of critical spares for the timely replacement of faulty parts of any of its network facilities or assets so that the facility or asset can be returned to service in the shortest possible time. The Transmission Licensee shall also ensure that it has sufficient inventory of essential consumables to enable continual operation of the Transmission Licensee's network facilities and assets.</u>	To ensure that Transmission Licensee's facility or asset can return to service in the shortest possible in the event of faulty parts or depleting consumables.

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
TC/2020/17	9.2.5	<p>The Generation Licensee shall ensure that it has sufficient inventory of critical spares for timely replacement of faulty parts of any <i>generation facility</i> so that the <i>generation facility</i> can be returned to service in the shortest possible time.</p> <p>Without prejudice to the generality of the foregoing, the Generation Licensee shall in particular ensure that each <i>generation facility</i> which is a <i>combined-cycle plant</i> or gas turbine shall have one complete set of spare air filters within Singapore at all times.</p>	<p>The Generation Licensee shall ensure that it has sufficient inventory of critical spares for timely replacement of faulty parts of any <i>generation facility</i> so that the <i>generation facility</i> can be returned to service in the shortest possible time. <u>The Generation Licensee shall also ensure that it has sufficient inventory of essential consumables to enable continual operation of the Generation Licensee's <i>generation facilities</i>.</u> Without prejudice to the generality of the foregoing, the Generation Licensee shall in particular ensure that each <i>generation facility</i> which is a <i>combined-cycle plant</i> or gas turbine shall have one complete set of spare air filters within Singapore at all times.</p>	<p>To extend the requirement in keeping sufficient inventory of essential consumables so as to ensure that Generation Licensees' facilities can return to service in the shortest possible time in the event of depleting consumables.</p>
<b>Licensees' manpower adequacy</b>				
TC/2020/18	6.1.5	New clause added in Transmission Code	<p><u>The Transmission Licensee, Generation Licensee and any connected person shall ensure that they have adequate and sufficiently trained and qualified manpower, to maintain and operate their <i>installations, generation facilities</i> and <i>auxiliaries</i> at all times. Where there is attrition of manpower, they should be replenished as soon as reasonably possible.</u></p>	<p>To ensure that Licensees and connected persons have sufficient skilled manpower to operate and maintain their assets in such a manner that it will not cause an adverse impact on the reliability and security of the power system.</p>
<b>Switchhouse Facilities, Gas Receiving Facilities and Generation Facility Design</b>				

<b>Modification Ref. No.</b>	<b>Clause</b>	<b>Original Text</b>	<b>Modified Text</b>	<b>Reasons</b>
TC/2020/19	1.3	New Definition	"LNG" means Liquefied Natural Gas	
TC/2020/20	6.11	Switchhouse Facilities, Gas Receiving Facilities and Generation Facility Design	Switchhouse Facilities, Gas Receiving Facilities and Generation Facility Design <u>by Generation Licensee</u>	To make it clear that the Generation Licensee is required to comply with all the requirements set forth in section 6.11.
TC/2020/21	6.11.1	New Clause	<u>The Generation Licensee shall comply with the requirements set forth in sections. 6.11.2 to 6.11.4.</u>	To make it clear that the Generation Licensee is required to comply with all the requirements set forth in section 6.11.
TC/2020/22	6.11.1	6.11.1  The generating unit's step-up transformers and generating unit's switchboard.....	6.11.42  The generating unit's step-up transformers and generating unit's switchboard.....	Amended the numbering sequence

<b>Modification Ref. No.</b>	<b>Clause</b>	<b>Original Text</b>	<b>Modified Text</b>	<b>Reasons</b>
TC/2020/23	6.11.2	6.11.2  The gas receiving facility, including its associated equipment, fuel gas compressor(s) and protection/control equipment for the supply of natural gas to the generating station for power generation shall be designed and operated in such manner that no single failure/outage shall cause simultaneous outage of two or more generating units at the generating station.	6.11. <del>23</del>  The gas receiving facility <u>and/or dedicated LNG regasification facility that is not connected to the gas supply system</u> , including its associated equipment, such as fuel gas compressor(s), <u>LNG regasification equipment/systems</u> and protection/control equipment for the supply of natural gas to the generating station for power generation shall be designed and operated in such manner that no single failure/outage shall cause simultaneous outage of two or more generating units at the generating station.	Amended the numbering sequence.  To include new dimension of LNG regasification facility for supplying natural gas to the generating station for power generation.
TC/2020/24	6.11.3	6.11.3  All generating units shall be designed such that: .....	6.11. <del>34</del>  All generating units shall be designed such that: .....	Amended the numbering sequence
<b>Generation Facility Relating to Fuel Changeover Capability</b>				
TC/2020/25	1.3	New Definition	“alternate fuel” means a fuel type other than primary fuel (including natural gas).	To provide clarity on the definition of alternate fuel in the Code.
TC/2020/26	1.3	New Definition	“NEMS” means National Electricity Market of Singapore.	

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
TC/2020/27	1.3	New Definition	“EMC” means Energy Market Company.	
TC/2020/28	Appendix C1	<p><b>Preliminary Generating Unit Data to be Submitted for Consideration of Connection to the Transmission System</b></p> <p>Each Generation Licensee or Wholesaler (Generation) Licensee responsible for the <i>generation facility</i>, with the exception of solar photovoltaic systems, and seeking connection to the <i>transmission system</i> shall provide the information required in accordance with the format set forth in C.1.1 to C.1.3 of this Appendix. For solar photovoltaic <i>generating unit</i>, the Generation Licensee or Wholesaler (Generation) Licensee shall provide the information required in accordance with the format set forth in C7 of this Appendix.</p>	<p>Each Generation Licensee or Wholesaler (Generation) Licensee responsible for the <i>generation facility</i>, with the exception of solar photovoltaic systems, and seeking connection to the <i>transmission system</i> shall provide the information required in accordance with the format set forth in C.1.1 to C.1.3 of this Appendix <u>for both primary and alternate fuel</u> (for <i>generating units</i> that are capable of operating and required to operate on <i>alternate fuel</i>). For solar photovoltaic <i>generating unit</i>, the Generation Licensee or Wholesaler (Generation) Licensee shall provide the information required in accordance with the format set forth in C7 of this Appendix.</p>	To provide clarity for <i>generation facility</i> that uses natural gas as the primary fuel and alternate fuel as listed in Appendix C of the Code.
TC/2020/29	6.11.3(f)	(f) each <i>generation facility</i> that uses natural gas as the primary fuel shall be designed with the capability of initiating on-load changeover either automatically through gas pressure setting or manually to <i>alternate fuel</i> that is stockpiled on-site. The fuel changeover trigger setting shall have sufficient margin above that of the <i>generation facility's</i> low gas pressure trip setting to ensure that the <i>generation facility</i> remains connected to the power system and operates at or above its	(f) each <i>generation facility</i> that uses natural gas as the primary fuel shall be designed with the capability of initiating on-load changeover either automatically through gas pressure setting or manually to <i>alternate fuel</i> that is stockpiled on-site. The fuel changeover trigger setting shall have sufficient margin above that of the <i>generation facility's</i> low gas pressure trip setting to ensure that the <i>generation facility</i> remains connected to the power system and operates at or above its minimum stable loading level during the entire process of fuel	To reference and include the requirements set forth in Appendix F13 of the Code.

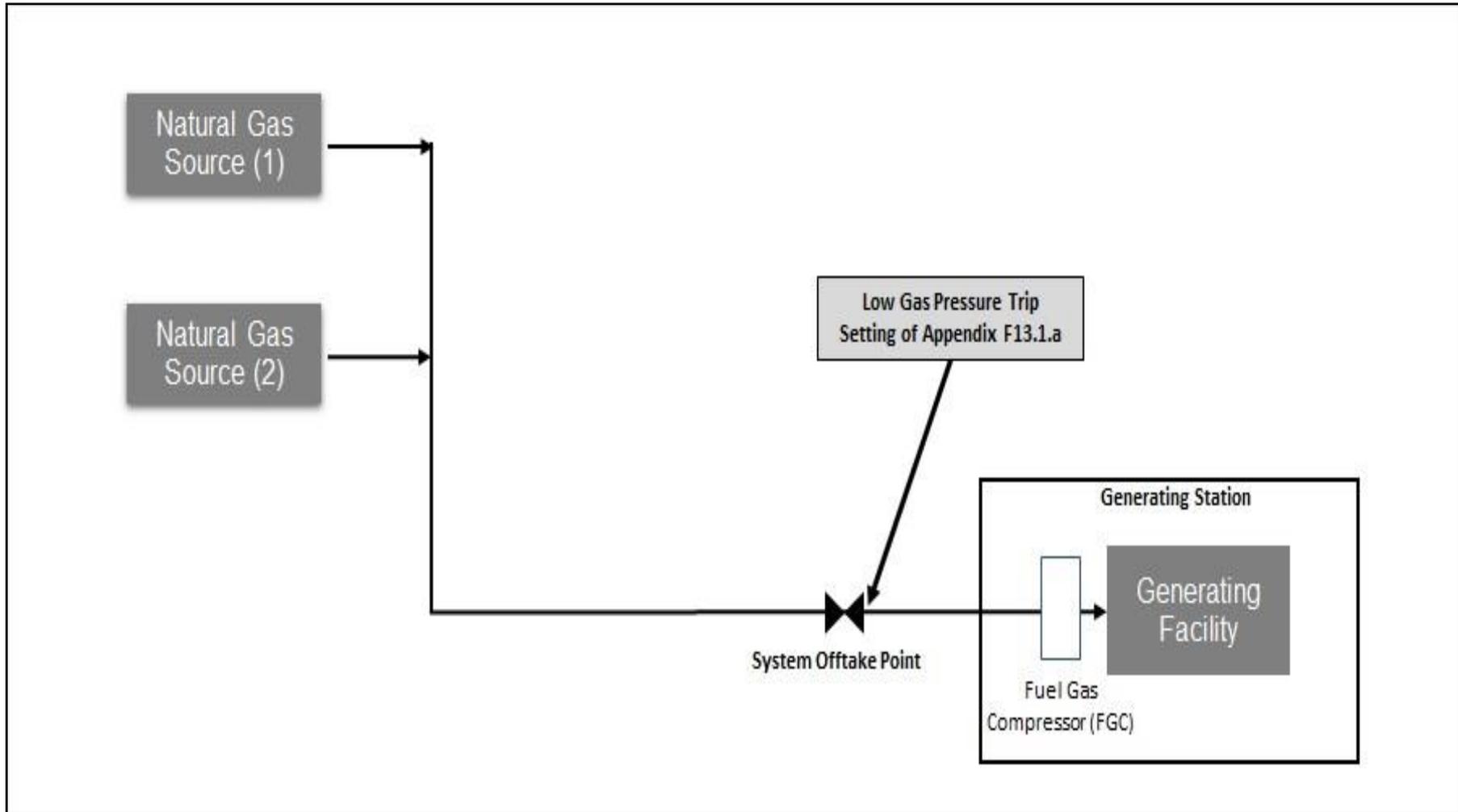
Modification Ref. No.	Clause	Original Text	Modified Text	Reasons																		
		<p>minimum stable loading level during the entire process of fuel changeover operation. The <i>generation facility</i> shall continue to supply electricity to the power system after completion of the fuel changeover process.</p>	<p>changeover operation. The <i>generation facility</i> shall continue to supply electricity to the power system after completion of the fuel changeover process. <u>In addition, each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021 shall also adhere to requirements as set forth in Appendix F13.</u></p>																			
TC/2020/30	Appendix F8	<p><b>Spinning Reserve Requirements of Frequency Sensitive Plant</b></p> <p>F8.1 Each <i>generating unit</i> must be capable of providing minimum primary reserve as follows:</p> <table border="1"> <thead> <tr> <th></th> <th><i>Generating unit</i> MW Output as a % of Rated MW capacity</th> <th>Primary reserve as a % of Rated MW Capacity</th> </tr> </thead> <tbody> <tr> <td>(i)</td> <td>90</td> <td>5</td> </tr> <tr> <td>(ii)</td> <td>75 to Minimum Stable Load</td> <td>9</td> </tr> </tbody> </table> <p><sup>2</sup> For <i>Combined-Cycle Plant</i>, Rated MW capacity shall be based on aggregated declared Rated MW Capacity of each <i>generating unit</i>.</p>		<i>Generating unit</i> MW Output as a % of Rated MW capacity	Primary reserve as a % of Rated MW Capacity	(i)	90	5	(ii)	75 to Minimum Stable Load	9	<p>F8.1 Each <i>generating unit</i> must be capable of providing minimum primary reserve <u>for both primary and alternate fuel. The Spinning Reserve Requirements for primary and alternate fuel are</u> as follows:</p> <table border="1"> <thead> <tr> <th></th> <th><i>Generating unit</i> MW Output as a % of Rated MW Capacity<sup>2</sup></th> <th>Primary reserve as a % of Rated MW Capacity<sup>2</sup></th> </tr> </thead> <tbody> <tr> <td>(i)</td> <td>90</td> <td>5</td> </tr> <tr> <td>(ii)</td> <td>75 to Minimum Stable Load</td> <td>9</td> </tr> </tbody> </table> <p><sup>2</sup> For <i>Combined-Cycle Plant</i>, Rated MW Capacity shall be based on aggregated declared <u>referenced to the rated Rated</u> MW Capacity of each <i>generating unit</i> operating at</p>		<i>Generating unit</i> MW Output as a % of Rated MW Capacity <sup>2</sup>	Primary reserve as a % of Rated MW Capacity <sup>2</sup>	(i)	90	5	(ii)	75 to Minimum Stable Load	9	<p>To provide clarity for generation facility to be capable of providing minimum primary reserve for both primary and alternate fuel. The Spinning Reserve Requirements for primary and alternate fuel.</p>
	<i>Generating unit</i> MW Output as a % of Rated MW capacity	Primary reserve as a % of Rated MW Capacity																				
(i)	90	5																				
(ii)	75 to Minimum Stable Load	9																				
	<i>Generating unit</i> MW Output as a % of Rated MW Capacity <sup>2</sup>	Primary reserve as a % of Rated MW Capacity <sup>2</sup>																				
(i)	90	5																				
(ii)	75 to Minimum Stable Load	9																				

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
			<p>full load (i.e. the base load) while in operation under primary and <i>alternate fuel</i>.</p>	
TC/2020/31	Appendix F	New insertion of F13	<p><b><u>F13 Fuel Changeover Requirements</u></b></p> <p><u>F13.1 This section states the design and technical requirements for each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021. Each <i>generation facility</i> that uses natural gas as primary fuel shall-</u></p> <p><u>(a) be designed to operate at its rated MW Capacity with a low gas pressure trip setting no greater than 16barg measured at the System Offtake Point in accordance to the definition of the Gas Network Code (GNC) Section A (refer to Figure F13.1.a for illustration);</u></p> <p><u>(b) comply with the requirements in Table 13.1.b for fuel changeover (FCO) operations (refer to Figure 13.1.b for illustration).</u></p>	<p>Given the limited line-pack within the gas transmission networks, the additional requirements set out for each newly commissioned generation facility, (b) any existing generation facility under-going life extension of 5 years or longer or (c) repowering, which is to be registered with EMC on or after 1 January 2021 are necessary in order to provide sufficient time for a successful completion of fuel changeover (FCO) operation to alternate fuel (i.e. diesel) via a low gas trip pressure setting.</p> <p>The requirements relating to <i>generation facility</i> FCO capabilities are necessary to ensure there is no significant loss in generation output due to de-loading. Each FCO process has to be completed within ten (10) minutes to ensure the secure operation of the power system in the event of a natural gas</p>

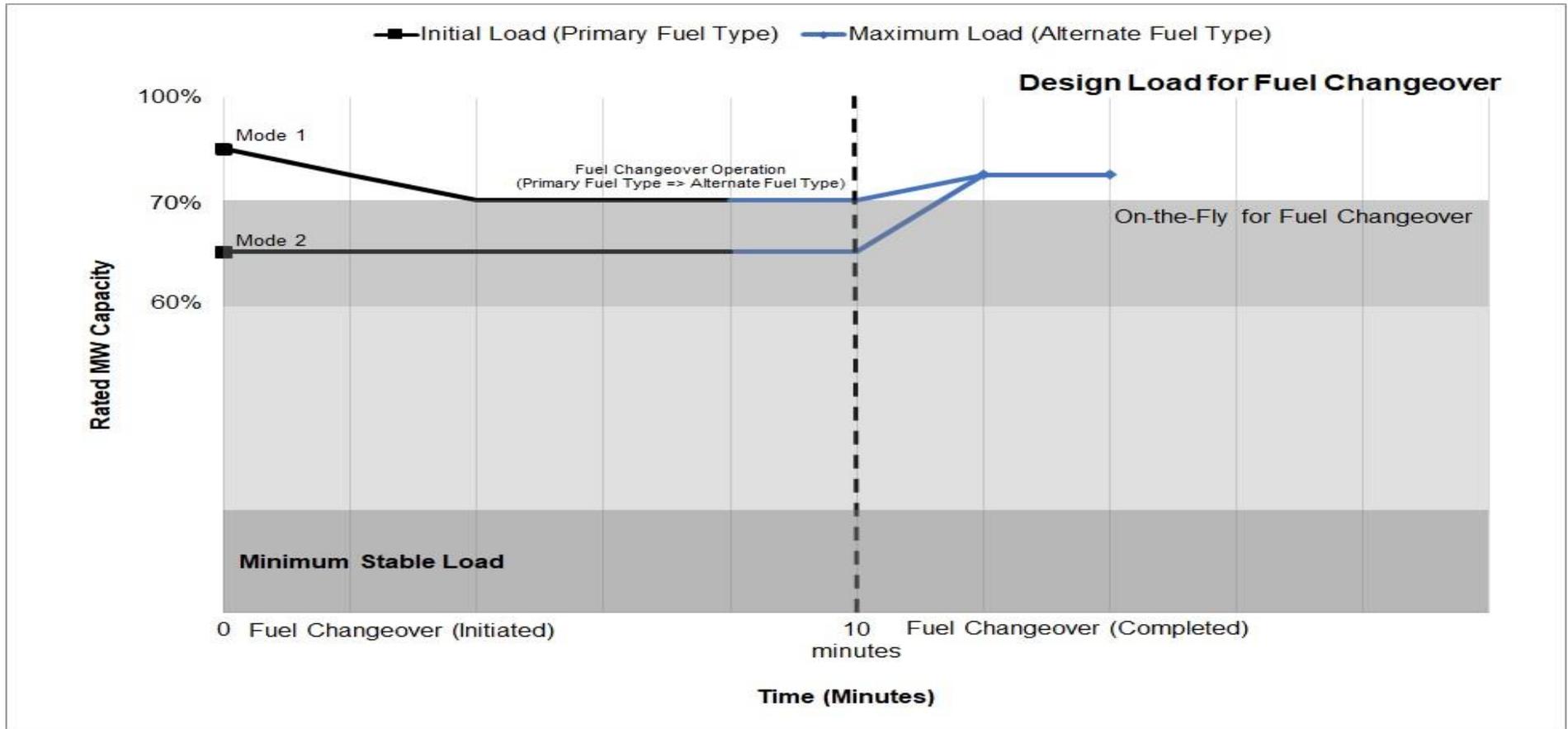
Modification Ref. No.	Clause	Original Text	Modified Text	Reasons						
			<p style="text-align: center;"><b><u>Table 13.1.b</u></b></p> <table border="1"> <thead> <tr> <th><b><u>Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation</u></b></th> <th><b><u>Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required) <sup>1</sup> (%)</u></b></th> </tr> </thead> <tbody> <tr> <td>Above 80%</td> <td>Deload to not lower than 70% loading</td> </tr> <tr> <td>Between 60% to 70%</td> <td>No change in loading</td> </tr> </tbody> </table> <p><sup>1</sup> FCO can be initiated and performed without any loading and/or de-loading within these range of MW loading level while operating under primary fuel.</p> <p><u>(c) complete the FCO operation, including deloading to the designated loading level to enable FCO to commence if required, starting up of other support systems such as alternative fuel auxiliary system and etc., within ten (10) minutes upon initiation of fuel changeover process; and</u></p> <p><u>(d) upon completion of the FCO, the <i>generating facility</i> shall be capable of ramping up to its NEMS scheduled load prior to the initiation of the FCO process or to the maximum loading level of the <i>generation facility</i> operating in <i>alternate fuel</i>, whichever is lower; and subsequently, the <i>generation facility</i> shall be</u></p>	<b><u>Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation</u></b>	<b><u>Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required) <sup>1</sup> (%)</u></b>	Above 80%	Deload to not lower than 70% loading	Between 60% to 70%	No change in loading	<p>supply disruption.</p> <p>Energy Storage System (ESS) can potentially arrest rapid frequency decay due to its unique capability of delivering power much faster than Combined Cycle Gas Turbine (CCGT), proposals to adopt larger CCGTs capacity can also incorporate the use of ESS to ensure system resiliency.</p>
<b><u>Generating Facility Rated MW Loading on Primary Fuel (%) prior to FCO initiation</u></b>	<b><u>Generating Facility Permissible Loading Level for FCO to Alternate Fuel (if loading or de-loading is required) <sup>1</sup> (%)</u></b>									
Above 80%	Deload to not lower than 70% loading									
Between 60% to 70%	No change in loading									

Modification Ref. No.	Clause	Original Text	Modified Text	Reasons
			<u>put on Automatic Generation Control (AGC) and free governor mode immediately.</u>	

**Figure F13.1.a** –Demarcation of System Off-take Point in accordance to Gas Network Code (GNC)



**Figure F13.1.b – Design Load for Fuel Changeover over different modes of MW loading**



**Note:**

**Mode 1** - illustrates the fuel changeover profile & capability upon initialised by the generating facility to complete or achieve stable firing load (within 10-minutes) on alternative fuel (i.e. diesel) with change (deload in MW) load of the generating facility.

**Mode 2** – illustrates the fuel changeover profile & capability upon initialised by the generating facility to complete or achieve stable firing load (within 10-minutes) on alternative fuel (i.e. diesel) without any change (in MW) load of the generating facility.