ENTSO-E OPERATIONAL SECURITY NETWORK CODE (Consultation version)

PREPARED FOR JESG TECHNICAL WORKSHOP 3 & 4 OCTOBER 2012

Including Commentary and references to equivalent GB Code framework for Articles 6-31

27/9/12

Operational Security Network Code Article comparisons v GB Codes and brief article commentary – for JESG workshop 3-4th Oct

Disclaimer

By using this document you understand that the Network Code text and interpretation/commentary are DRAFT
It is a current interpretation of the Operational Security Network Code - and it is likely to change.
Therefore, this document should **not** be taken as legal advice and should be used only as a guide, to aid the reading of the Network Code.

Green = No change / Same as GB now / not applicable

Amber = Potential change to what happens in GB now

Red = New to GB Codes requirement

	Chapter2 OPERATIONAL SECURITY REQUIREMENTS		Equivalent GB Codes Framework reference		
	Article 6 SYSTEM STATES		**GB Code**		**Commentary**
1	Each TSO shall differentiate five System States: a) Normal State: i. frequency, voltage, active and reactive power flows are within the Operational Security Limits defined in accordance with Article 6(5) and (6); ii. active and reactive power reserves are sufficient to withstand Contingencies; and iii. operation is and will remain within Operational Security Limits even after Contingencies from the Contingency List and after effects of Remedial Actions. b) Alert State: i. frequency, voltage, active and reactive power flows are within their Operational Security Limits defined in accordance with Article 6(5) and (6);		GC OC7 OC7.4.8 System Warnings Inadequate System		Ensures TSO have a common definition of system states. These are perhaps more definitions.

	ii. reserve requirements are not fulfilled with no means to replace them; and iii. at least one Contingency from the Contingency List can lead to deviations from Operational Security Limits, even after effects of Remedial Actions. c) Emergency State: i. there is at least one deviation from Operational Security Limits; ii. at least one measure of the System Defence Plan is activated. When Operational Security is endangered because of a major IT problem, the TSO also has to declare Emergency State. d) Blackout State: i. almost or total absence of voltage in the transmission system and triggering restoration plans e) Restoration: i. frequency, voltage and other operational parameters are brought within the Operational Security Limits defined in accordance with Article 6(5) and (6); and ii. Demand Facilities are connected at a pace decided by the TSOs in charge of restoration, depending on the technical capability and feasibility of the transmission system resources and Power Generating Facility resources.		Margin warning Risk of System Disturbance warning Demand Control Imminent warning GC OC9 Black start/System splits		
2	Each TSO shall monitor in real-time the following parameters on its transmission system: a) active and reactive power flows; b) busbar voltages; c) frequency; d) active and reactive power reserves; e) actual generation and consumption.		N/A		Ensure TSO base their assessment of the system state on real measured values. Sufficient measurements allow robust state estimation for missing /faulty/ erroneous meters.

3	In order to determine the System State of its transmission system, each TSO shall continuously monitor the relevant parameters against a common set of criteria as defined in Article 6(1) while taking into account the effect of potential Remedial Actions.		N/A		Credible post fault actions can be used to limit pre-fault costs and are taken into account to determine if the system is in an Alert state.
4	Each TSO shall endeavour to operate its transmission system within the Operational Security Limits in order to maintain a Normal State.		GB SQSS 5.1		GB SQSS - A secured event should not result in unacceptable overloading,….
5	For each element of its transmission system, each TSO shall define the Operational Security Limits for: a) admissible voltage ranges, in terms of the strength of insulation and steady state system stability b) admissible short-circuit current ranges in terms of equipment capacity and impedance; and c) admissible power flow limits in terms of thermal rating of the given transmission system elements. For each Interconnection, each TSO shall coordinate with the interconnected TSO to define the Operational Security Limits.		GB SQSS 5.1 ESQCR & GC CC6.1.4 set voltage ranges in GB GC OC2 interconnector owners submit output useable (DC)		 Safety, asset damage, security, customers Safety Safety and asset damage avoidance More applicable to AC interconnectors, needs the 'how' to be from and / or consistent with CACM
6	Each TSO shall coordinate with the TSOs operating within its Synchronous Area and define the Operational Security Limits for admissible frequency quality in accordance with the requirements on frequency quality of the [NC LFC&R].		N/A ESQCR & GC CC6.1.2 sets the admissible freq to +/-1%, 49.5-50.5Hz		No other SOs in GB are responsible for frequency control. AC interconnected TSO must co-operate and agree freq control standard
7	If its transmission system is not in a Normal State, a TSO shall: a) adopt and implement the Remedial Actions which are rendered necessary to restore the Normal State; b) adopt and implement the Remedial Actions which are rendered necessary to prevent the propagation of this System State outside of its transmission system; and c) inform the directly interconnected TSOs, DSOs directly connected to the transmission system and Significant Grid Users involved in the system defence and restoration, if there is a risk of an Emergency State.		GB SQSS 5.1 or 5.8 N/A GC OC7.4.8 System Warnings		 Maintain or restore secure operation pre or post fault Prevent the risk of widespread disturbance across neighbouring AC connected TSOs. Situational awareness for users and external TSOs

8	If its transmission system is not in a Normal State and that System State is qualified as "wide area" in accordance with Article 6(1), a TSO shall: a) inform all TSOs about the System State of its transmission system via a common awareness system; b) provide additional information on the elements of its transmission system which area part of the Observability Area of the affected TSOs; and c) coordinate the joint Remedial Actions which are taken by the affected TSOs.		N/A as DC interconnected		Ensure neighbouring TSOs awareness of Alert states in other TSOs to reduce risk of widespread disturbances. Entso-e developing a inter TSO awareness system to be updated in real time by each TSO and displayed in control rooms. TSO co-operate to restore secure operation.
9	When preparing and implementing a Remedial Action which has an effect on other TSOs, a TSO shall cooperate with the affected TSOs to assess the impact of its Remedial Action within and outside its Responsibility Area and coordinate with affected TSOs to select the action which is in accordance with the principle of optimisation between the highest overall efficiency and lowest total cost for all involved parties. Each affected TSO shall provide all the information necessary for this cooperation.		N/A, would be in Interconnector Protocol Agreements Eg. select bipole to intertrip must inform other TSO		Relevant for AC connected TSOs. Internal TSO constraints resolved by actions may impact neighbouring TSOs
10	When preparing and implementing a Remedial Action, a TSO shall, when necessary, cooperate with the Significant Grid Users and DSOs. Each Significant Grid User or DSO shall execute the instructions given by the TSO to support maintaining Operational Security of the transmission system, without undue delay. Unless decided otherwise by the TSO, the relevant DSO shall communicate the instructions of the TSO to the Significant Grid Users if the latter is connected to the distribution network.		GC BC1.7 for special action prep. GC BC2.7 for BOAs and AS instructions. GC BC2.9 for emergency instructions to users and DNOs.		TSO must have the ability to instruct users and DNOs to defend system security.
11	While respecting the provisions of Article 3(3), each TSO shall define the threshold of significance of the Significant Grid Users, depending on the following parameters of the transmission system under the TSO's responsibility: a) size of the transmission system; b) number and size of Power Generating Facilities and Demand Facilities connected to the transmission system; and		GC GD Small/Medium/Large varies geographically. England&Wales:<50MW SPTL: <30MW SHETL: <10MW		Significant Grid User (SGU) threshold will determine the many obligations in this OS NC that the SGU has to comply with. A number of factors contribute to the need for more lower resolution data to aid forecasting and ensure secure operational planning

	c) generation mix.				
12	Each TSO shall ensure the availability, reliability and redundancy of the following critical tools and facilities, which are required for system operation: a) facilities for monitoring of the System State of the transmission system, including State Estimation applications; b) means for controlling switching; c) means of communication between control centres of TSOs; d) means of communication between the control centres of a TSO and of DSOs, Power Generating Facility Operators and Demand Facilities, on the issues of balancing, Ancillary Services, transmission system defence, Restoration and on the delivery and coordination of real-time operational data; e) tools for Operational Security analysis.		N/A Not a user facing requirement		Existing and essential infrastructure for a TSO to operate the power system. Ensure minimum requirements for all TSOs, particularly relevant in large AC connected systems with many TSOs.
13	Each TSO shall adopt an Emergency Plan which shall be reviewed at least annually and updated as required or following any significant change of critical tools and facilities or relevant system operation conditions		N/A Not a user facing requirement		Business continuity plan.
14	Each TSO shall establish a confidential Security Plan containing a risk assessment of critical TSO assets to major physical or cyber threat scenarios to be conducted by the Member State with an assessment of the potential impacts. Each TSO shall have in place organizational, logistical and other physical measures which shall cover the major findings from the risk assessment. The plan shall be kept under regular review to limit the impact of threats and maintain the secure operation of the TSO's network and IT systems and the European interconnected transmission systems. These reviews can lead to set up intruder detection, access control, procedures, training, alert processes, preventive procedures, restoration plans and other counter-measures as deemed appropriate.		N/A Not a user facing requirement. UK CPNI classification		Physical security of key TSO assets must be protected. Digital risk and security procedures.
15	Each TSO shall perform Operational Security analysis based on the forecast and real-time system operation parameters.		GB SQSS 5.1 GC OC2		Basic requirement for N-1 security standard.
16	For Operational Security analysis in operational planning, each TSO shall use		N/A		Increasing interaction in mainland Europe

	information on network, load and generation based upon a Common Grid Model.				has driven need for regional security co-ordination centres (e.g. Coreso) assessing the wider system for interactions and influences between TSO networks using a more extensive network model (a CGM) than individual TSO models with equivalents.

	Article 7 FREQUENCY CONTROL MANAGEMENT		GB Code		Commentary
1	In accordance with Article 6(4), each TSO shall endeavour to maintain the frequency quality within Operational Security Limits. Each TSO shall operate its transmission system with sufficient upward and downward active power reserve, which may include shared or exchanged reserves, to face unbalances of demand and supply within its Control Area. Each TSO shall keep the Area Control Error or an equivalent parameter at the Set-Point as defined in the [NCLFC&R] in order to reach the required frequency quality within the Synchronous Area in cooperation with the TSOs in the same Synchronous Area. Each TSO shall coordinate with the other TSOs of its Synchronous Area to establish the methodology used within this Synchronous Area to determine the sufficient upward and downward active power reserve in accordance with the provisions of the [NC LFC&R].		GC CC6.1.2 & ESQCR set freq standard. GB SQSS 5.1 N/A		Frequency control has in the last couple of years become an issue in mainland Europe.
2	Each TSO shall monitor in real-time the frequency and the Area Control Error or an equivalent parameter.		N/A		Core function for TSO
3	Each TSO shall monitor generation and exchange schedules, power flows, node injections and other parameters relevant for detecting a risk of a frequency deviation and, in co-ordination with other TSOs of its Synchronous Area, take joint measures to limit their effects on the transmission system balance.		N/A		Need for greater co-ordination and co-operation, particularly for AC connected TSOs.
4	Each TSO shall activate, or set up conditions necessary to ensure the activation of, active power reserves at different time-frames, in order to maintain: a) the balance of demand and supply of its Control Area; b) its Area Control Error, or an equivalent parameter at the Set-Point value; c) the frequency within the range defined for its Synchronous Area.		GB SQSS 5.1		
5	Each TSO shall implement the necessary Remedial Actions, including Demand		GC OC6.6 for LF triggered and OC6.5 for		

	Side Management or Load Shedding in order to maintain the frequency quality within Operational Security Limits in its Responsibility Area.		manual instructed		
6	All Power Generating Facilities shall remain connected at least within the frequency and time ranges defined in the [NCRfG].		GC CC		
7	Notwithstanding the provisions of Article 7(5), a DSO, Power Generating Facility or Demand Facility shall automatically disconnect at specified frequencies if required by the relevant TSO or DSO. The relevant TSO and DSO shall define the terms and settings for automatic disconnection while respecting the provisions of Article 3(3), Article 7(6) and the requirements specified for the whole Synchronous Area in the [NCRfG].When the DSO defines this terms and settings, it shall obtain the TSO's approval.		GC OC6.6		
8	Before proceeding to an exchange of reserve, the TSOs which would provide and receive the reserve, together with all other affected TSOs, shall carryout a common Operational Security analysis and adopt the necessary measures to ensure that the resulting cross-border flows do not endanger the Operational Security Limits during the exchange of reserve.		Implied by GB SQSS 5.1		Ensures TSOs have security assessed potential flows, particularly relevant for AC systems where flows are not directly controllable

	Article 8 VOLTAGE CONTROL AND REACTIVE POWER MANAGEMENT		GB Code		Commentary
1	In accordance with Article 6(4), each TSO shall endeavour to maintain the voltage and reactive power flows within Operational Security Limits. Each TSO shall monitor, control and maintain voltage levels and reactive power flows of its transmission system in real-time to protect equipment and maintain Voltage Stability of the transmission system. Each TSO shall be able to ensure adequate instantaneous reactive power reserve in order to secure the technical functioning of the transmission system and to restore a Normal State following a Contingency from the Contingency List.		GB SQSS 5.1		Requirement of N-1 secure operation.
2	In accordance with Article 6(5), directly connected TSOs shall define the voltage and/or reactive power flow limits on the Interconnections between their networks in order to use the reactive power resources in the most effective way and ensure adequate voltage control.		N/A		Co-ordination between AC connected TSOs.
3	Each TSO shall coordinate Operational Security analysis with all affected TSOs in order to ensure respecting of the Operational Security Limits of voltages in its Responsibility Area and within the Responsibility Areas of these other TSOs. Each TSO shall perform Operational Security analysis based on the forecast and real-time operational parameters.		N/A		Requirement for N-1 secure operation.
4	Each Significant Grid User or DSO shall maintain reactive power limits at the Connection Point to the transmission system in a range defined in accordance with Article 6(5).		GC CC6.1.4, CC6.3.2 And/or in Bilateral Connection agreement		Avoid voltage collapse or potential deviations beyond standard
5	All Power Generating Facilities shall remain connected at least within the voltage and time ranges defined in the [NCRfG].		GC CC		
6	Notwithstanding the provisions of the Article 8(4), a Power Generating Facility or Demand Facility shall automatically or manually, disconnect at specified voltages in the specified timeframe if required by the relevant TSO or DSO. The relevant TSO and DSO shall define the terms and settings for automatic disconnection while respecting the provisions of Article 3(3),		Bilateral Connection		

	Article 8(5) and the requirements specified for the whole Synchronous Area in the[NCRfG].When the DSO defines this terms and settings, it shall obtain the TSO's approval. The relevant TSO and DSO shall insert these terms and settings for automatic disconnection in a contractual agreement with the Power Generating Facility Operators and/or Demand Facilities.		Agreement		
7	Each TSO shall use all available reactive power resources to ensure effective reactive power management within its Responsibility Area and maintain the voltage and reactive power Operational Security Limits.		GB SQSS 5.1 and 6.5		
8	Each TSO shall prepare Remedial Actions to cope with the potential or identified deviation from the voltage Operational Security Limits. The effectiveness of Remedial Actions shall be evaluated by the TSO. When the Remedial Actions are found ineffective, the TSO shall either adjust its Remedial Actions to render them effective or apply pre-fault Remedial Actions.		GB SQSS5.1 and 6.5		
9	Each TSO shall monitor the respecting of operational voltage limits by Power Generating Facility Operators and Demand Facilities within its Responsibility Area, using real-time measurements of at least three of the following quantities: a) voltages; b) currents; c) active and reactive power flows; and d) node injections and withdrawals. These quantities, measured within the Observability Area of each TSO, shall refer to: e) transmission system elements; f) Power Generating Facilities connected to the transmission system; g) Demand Facilities connected to the transmission system; and h) aggregated values of Power Generating Facilities and Demand Facilities connected to a distribution system.		GC CC6.5.6 requires V,I,f,MW and Mvar as requested by NGET for Tx connected CC6.4.4 refers to embedded medium, by exception. None		Sufficient real-time measurements required for state estimation, situational awareness and forecasting.

10	Each TSO shall operate or direct the operation of reactive power resources within its Responsibility Area including blocking of automatic voltage/reactive power control of transformers, voltage reduction and load-shedding measures, in order to maintain Operational Security Limits, to prevent out-of-limit voltage variations and to prevent voltage collapse of the transmission system.		GB SQSS 5.1		
11	While respecting the provisions of Article 3(3), each TSO shall coordinate and define the Voltage Control actions with the Significant Grid Users, relevant DSOs and with neighbouring TSOs. TSOs and DSOs shall be entitled to direct their Significant Grid Users in a coordinated way to follow Voltage Control instructions if and where this is relevant for the voltage and reactive power management of the transmission system.				
12	Each TSO and each DSO shall maintain voltage and reactive power flows within the defined limits at the interconnection points between the transmission system and the distribution networks. If voltage deterioration jeopardizes Operational Security or threatens to develop into a voltage collapse, the TSO may direct DSOs and Significant Grid Users to block automatic voltage/reactive power control of transformers and/or to follow other Voltage Control instructions. As a consequence of these measures directed by the TSO, the DSO may have to disconnect Demand Facilities and/or Power Generating Facility Operators to avoid jeopardising the transmission system.		GB SQSS 6.5 GC BC2.6.3 instructing DNO in emergencies and OC6 for demand control by DNOs		Ensure system security

	Article 9 SHORT-CIRCUIT CURRENT MANAGEMENT		GB Code		Commentary
1	In accordance with Article 6(4), each TSO shall maintain the short-circuit current within Operational Security Limits. Each TSO shall endeavour to ensure within its Responsibility Area, that the short-circuit current does not exceed the limits of the short-circuit capability of circuit breakers and other equipment and that the short-circuit current is not lower than the current required for correct operation of the protection equipment at any time. This condition has to be fulfilled for all Fault types and for all protection equipment, with a deviation from this condition allowed only during switching sequences.		GB SQSS 5.1.6 shall not be unacceptable overloading. N/A		Safety. Adequate discrimination.
2	In accordance with Article 6(5), and in order to fulfil the provisions of the Article 9(1) each TSO shall define the maximum limits of admissible short-circuit current.		GB SQSS 5.1.6 requires this		Safety
3	Each TSO shall perform the short-circuit current and power calculation according to the best available data and its own practice approaches or according to IEC 60909.		ER G74		GB adopted Engineering Recommendation G74 to meet requirements of IEC 60909
4	When assessing the compliance with the limits according to Article 9(1), each TSO shall consider operational conditions that provide the highest conceivable level of short-circuit current, considering also the short-circuit contribution from other transmission systems and distribution networks.				
5	Each TSO shall perform short-circuit calculations in order to evaluate the impact of neighbouring transmission systems and connected distribution networks on the short-circuit current level. If the impact of a connected distribution network is significant, the distribution network has to be modelled in the transmission short-circuit calculations with the level of detail which is needed for successful calculations, using where applicable the equivalents with sufficient degree of detail and accuracy.				
6	Each TSO shall apply operational measures to prevent or relieve a deviation from short-circuit limits in the transmission system according to Article 9(1).		GB SQSS 5.1		

	Article 10 CONGESTION AND POWER FLOWS MANAGEMENT		GB Code		Commentary
1	Each TSO shall endeavour to maintain the active power flows within Operational Security Limits in accordance with Article 6(4).		GB SQSS		
2	Each TSO shall coordinate Operational Security analysis with all affected TSOs in order to ensure the respecting of the Operational Security Limits of power flows in its Responsibility Area. Each TSO shall perform Operational Security analysis based on the forecast and real-time operational parameters.		GB SQSS 5.1		
3	Each TSO shall adopt and implement Remedial Actions to cope with the potential or identified deviation from the power flow Operational Security Limits in N-Situation and be prepared to set-up the necessary Remedial Actions for coping with (N-1)-Situation.		GB SQSS 5.1		N-1 = single element loss, which can include a double circuit as well as single circuit.
4	If after a Contingency when the steady-state operation is re-established, the transmission system is not compliant with the (N-1)-Criterion, the TSO shall initiate Remedial Actions to recover compliance with the (N-1)-Criterion as soon as reasonably practicable. If there is a risk of a post Contingency disturbance propagation involving neighbouring TSOs or enhanced probability of further Faults, the TSO shall initiate Remedial Actions as soon as possible.		GB SQSS 5.8 – "after a secured fault then.. re-secure as soon as reasonably practical" GB SQSS 5.6 "periods of system risk NGET may…"		TSOs do not need to incur very high cost balancing actions or implement demand control against the next fault immediately after the first fault. However, if there is enhanced risk of the next fault or the consequences are very high then TSO should take immediate corrective action.
5	Non-compliance with the (N-1)-Criterion is acceptable: a) during switching sequences; b) if it only has local consequences within the TSO Responsibility Area; and c) during the time period required to activate the Remedial Actions.		N/A N/A GB SQSS 5.6		
6	In accordance with Article 10(7) and (8), each TSO shall be entitled to redispatch available Power Generating Facilities and Demand Facilities connected to the transmission system or to the distribution networks if it is necessary to prevent deviations from the power flow Operational Security limits in the transmission system.		GC BC2		Requirement to follow TSO instructions when needed for system security.
7	While respecting the provisions of Article 3(3), each TSO shall, when there is		N/A, as DC connections		Increasing need for TSO to coordinate,

	an impact on cross-border flows, define Redispatch measures in coordination with other affected TSOs in order to find the most efficient solution to maintain Operational Security Level.		only		particularly AC connected TSOs.
8	While respecting the provisions of Article 3(3), each TSO shall define Redispatch measures in coordination with DSOs before real-time to determine those Grid Users connected to distribution networks which may be re-dispatched. Each TSO shall inform the affected DSO of Redispatch measures affecting Power Generating or Demand Facilities connected to its distribution networks.		GC BC1.6.1 user system data from DNOs wrt despatch limits for embedded. GC BC2.5.2.5 for sync and desync times by TSO to DNO		Coordination between TSO and DSO on embedded despatchable generation
9	Unless market based pricing for Redispatch exists, affected Grid Users shall ex-ante provide Redispatch costs to the relevant TSOs and also to DSOs if DSOs are involved in Redispatch. This information shall be treated as confidential and be shared only between the TSOs, the DSOs involved in the Redispatch measures and relevant NRAs.		GC BC1, BSC		
10	Each TSO shall monitor power flows within its Responsibility Area and on its Interconnections based on the real-time telemetry and measurements from its own Responsibility Area and from the Responsibility Areas of the TSOs within its Observability Area.		N/A		AC connected TSOs need to monitor wider area beyond their own system.
11	Each TSO shall define Operational Security Limits for power flows on each transmission system element within its own Responsibility Area in accordance with Article 6(5). Directly connected TSOs shall define together the Operational Security Limits for power flows on common Interconnections in a coordinated and coherent way, throughout the Synchronous Area and between the Synchronous Areas where the connected TSOs are located in different Synchronous Areas.		N/A		The 'how' needs to be from / consistent with CACM.
12	Each TSO shall perform power flow Operational Security analysis in real-time, based on real-time measurements of voltages, currents, power flows, injections and withdrawals in its own Observability Area, of: a) transmission system elements; b) Power Generating Facilities and Demand Facilities connected to		GB SQSS 5.1		

	transmission system; c) relevant aggregated values of Power Generating Facilities and Demand Facilities connected to distribution systems.				
13	In the (N-1)-Situation each TSO shall keep relevant parameters within the Transitory Admissible Overloads and prepare Remedial Actions to be applied within the time allowed for Transitory Admissible Overloads.		GB SQSS 5.1 “no unacceptable overloading”		Recognises that overhead lines and cables have thermal short term loading capabilities (e.g. 10min, 20 min, 6 hrs etc)

	Article 11 CONTINGENCY ANALYSIS AND HANDLING		GB Code		Commentary
1	In order to identify the Contingencies which would endanger the Operational Security of the transmission system and to identify the appropriate Remedial Actions, each TSO shall perform a Contingency analysis to monitor impacts of Contingencies from its Contingency List on its Responsibility Area in real-time and during operational planning.		GB SQSS 5.1		The deterministic standard to ensure the system is secure used by all TSOs in planning and operational timescales.
2	Each TSO shall perform Contingency analysis on the basis of the forecast and real-time system operation parameters. Each TSO shall ensure that potential deviations from the (N-1)-Criterion which are identified by the Contingency analysis of Internal and External Contingencies in its Responsibility Area do not endanger the Operational Security of its transmission system or of the interconnected transmission systems.TSO can decide not to apply Remedial Actions considered as too expansive in accordance with its national legislation if the potential Disturbances are local and they do not impact the Operational Security of the interconnected transmission systems.		GB SQSS 5.4 recognises different security for groups >1500MW, 300 to 1500MW, 60-300MW etc		Aims to ensure TSO that are AC connected must secure all credible faults if it could result in widespread disturbance
3	Each TSO shall assess the risks associated with potential Disturbances and prepare the relevant Remedial Actions after testing each Contingency in its Contingency Lists and after assessing whether it can maintain its transmission system within the Operational Security limits in the (N-1)- Situation. The starting point for the Contingency analysis in the N-Situation shall at any time be the forecast or actual topology of the transmission system, including planned outages.		GB SQSS 5.1		
4	When establishing a Contingency List and performing Contingency analysis, each TSO shall differentiate between Ordinary, Exceptional and Out-of-Range Contingencies and between Internal and External Contingencies. Each TSO shall distinguish between these Contingencies in light of the probability of occurrence and of the following principles: a) Each TSO shall classify Contingencies for its own Responsibility Area. b) Ordinary Contingencies shall include, but not be limited to, the loss of		GB SQSS 5.1 Normal criteria, includes single, double cct and section of busbar or mesh corner + largest infeed loss.		

	any single Transmission Circuit, transformer, phase-shifting transformer, Power Generation Facility, HVDC link and reactive power compensation facilities; c) when and as long as unusual conditions, such as severe weather conditions, significantly increase the probability of an Exceptional Contingency, the TSO shall include this Exceptional Contingency in its Contingency List. The TSO shall determine the pre-fault or post-fault Remedial Actions necessary to maintain its transmission system within Operational Security Limits or to mitigate the impact of this Exceptional Contingency as far as reasonably practical; d) When and as long as very unusual conditions, such as very severe weather conditions, significantly increases the probability of an Out-of-Range Contingency, the TSO shall include this Out-of-Range Contingency in its Contingency List and prepare the pre-fault or post-fault Remedial Actions necessary to maintain its transmission system within Operational Security Limits or to mitigate the impact of this Out-of-Range Contingency as far as reasonably practical; e) Each TSO shall determine the Ordinary and Exceptional Contingencies based on the current topology. Each TSO shall take all Internal and External Ordinary Contingencies into account in Contingency analysis in a Normal State; f) in order to account for Exceptional Contingencies with high impact on neighbouring transmission systems or high probability of occurrence, each TSO shall include such Exceptional Contingencies in its Contingency List. The included Exceptional Contingencies shall be reassessed and if necessary the Contingency List readjusted in case of significantly changed operational conditions.		GB SQSS 5.5 "if adverse conditions…likelihood of double circuit is significantly higher than normal….should be no loss of supply > 300MW GB SQSS 5.6 "During periods of major risk, NGET may implement measures such as additional reserve, ..,reduce system transfers through balancing actions"		
5	Each TSO shall prepare Remedial Actions to cope with any Contingency from its Contingency List, for which potential deviation from Operational Security Limits is identified, in accordance with Article 6(7). Each TSO shall assess the		SQSS 5.1		Requirement to re-assess N-1 in real-time and for future times

	effectiveness of Remedial Actions in advance.				
6	Each TSO shall monitor the course of the planned and actual operation of its transmission system and if necessary reassess the Contingencies to be taken into account in a Normal State and adjust the prepared Remedial Actions.		SQSS 5.1		
7	Each TSO shall apply pre-fault Remedial Actions when there is a danger of not being able to cope efficiently and in a timely manner with the conditions occurring after a Contingency.		SQSS 5.1		TSO must apply re-dispatch or other measures in the N state if post fault options are not effective for the N-1
8	Each TSO shall apply post-fault Remedial Actions to cope with and to relieve the conditions occurring after a Contingency, within the time allowed for Transitory Admissible Overloads of the transmission system elements.		SQSS5.1		
9	Each TSO shall use in its Contingency analysis a Common Grid Model gathering information on its own network and at least Demand and Power Generation Facilities and network elements of the neighbouring transmission systems		N/A		Network model in AC interconnected N-1 security assessment needs to be multi TSO or regional if interactions are to be determined
10	In order to perform Contingency analysis and other Operational Security analyses, each TSO shall use and provide to the other TSOs the consumption and generation forecast for its Responsibility Area.		N/A		Real-time on-line model needs to be wider enough to ensure AC connected TSO interdependencies are discovered
11	Each TSO shall ensure that the model of its Observability Area used for Contingency analysis is based upon a sufficient amount of accurate real-time data and gathers information on its own network and at least Demand and Power Generation Facilities and network elements of the neighbouring transmission systems.		N/A		
12	Each DSO and Significant Grid User shall cooperate and deliver all information for Contingency analysis as requested by the TSO, including forecast and real-time data, with possible data aggregation in line with Article 25(1).		GC data provisions (PC, OC1, OC2, BC1, BC2, DRC,..)		User and DNO data needed for N-1 security analysis, see Articles 15-28
13	Each TSO is responsible for Operational Security within its Responsibility Area. Each TSO shall coordinate its Operational Security analysis with other affected TSOs. Each neighbouring TSO shall cooperate and deliver all necessary information for Contingency Analysis including forecast and real-time data.		N/A		Greater TSO co-ordination.

14	Each TSO shall contribute to establishing a Common Grid Model within its Synchronous Area. This contribution shall include the data for the Common Grid Model according to the defined quality and timeframes established in the [NCOPS]. Each Significant Grid User shall provide and update regularly the data required by their TSO for the CGM in accordance with Articles 15 to 28.		N/A GC data provisions		
15	Each TSO shall inform the neighbouring TSOs about its External Contingencies taken into account in the Normal State.		N/A		Supports TSO coordination and situational awareness
16	For each Interconnection, each TSO shall inform the connected TSO about the Operational Security Limits of its system. The applicable Operational Security Limits for the Interconnection shall be coordinated and agreed as the most restrictive one defined by both TSOs.		N/A		Needs to be consistent with the 'how' in CACM.
17	Each TSO shall inform the neighbouring TSOs when it operates a transmission system element which is taken into account as an External Contingency of these neighbouring TSOs, outside the Operational Security Limits.		N/A		TSO coordination and awareness, reduce probability of widespread disruption.
18	Neighbouring TSOs shall coordinate and agree any significant changes of the topology in their Observability Area if this is necessary for maintaining Operational Security of the interconnected system.		N/A		
19	Each Significant Grid User connected to the transmission system shall, after a de-synchronisation, obtain the permission from its TSO to re-synchronise.		GC BC2.5.2.4 "min notice of 5 min or 15min before resync		Safety (fault levels) and security, allows the TSO to reconfigure the system if needed.
20	After de-synchronization and when requested by a TSO, each DSO shall ensure that each relevant Significant Grid User connected to the distribution network and identified by the TSO obtains the permission to re-synchronize from its DSO and from its TSO via its DSO prior to its re-synchronization.		GC BC2.5.2.4 – but only applies to BMUs		Probably only required under very specific conditions e.g. fault conditions leading to depleted weak system, islanding , partial shutdowns, or very high frequency. The scope of this depends upon the TSO own defined threshold for Significant Grid User.

	Article 12 PROTECTION		GB Code		Commentary
1	Each TSO shall endeavour to ensure the correct functioning of protection of its equipment through updates of the settings of protection relays if the network topology or operational conditions change. Each TSO shall continuously analyse and when necessary change the functioning of its protection relays or review the protection concept.		N/A, not user facing		Ensure correct discrimination
2	Each TSO shall endeavour to operate the protection of its transmission system with Set-Points that ensure reliable, fast and selective fault clearing, including backup protection for fault clearing in case of malfunction of the main protection system or primary equipment.		N/A		
3	Each TSO shall coordinate with neighbouring TSOs the relevant protection concepts and Set-Points for the Interconnections and inform other TSOs before changing the settings.		SO TO Code for TO co-ordination		
4	If a TSO is using a System Protection Scheme, the TSO shall: a) Perform analysis in order to ensure that each SyPS acts selectively, reliably and effectively. In the analysis of SyPS, the TSO shall evaluate the consequences for the transmission system in the event of an incorrect SyPS function, taking into account the interaction with affected TSOs; b) Verify that the SyPS has a comparable reliability as the protection relays used for the protection of primary equipment; c) operate the SyPS within the Operational Security Limits determined in accordance with Article 6(5) and (6);and d) coordinate SyPS functions, activation principles and Set-Points with affected TSOs and affected Grid Users.		N/A GC BC2.10		SyPS is for example a system to generation or demand intertripping scheme.
5	While respecting the provisions of Article3(3) of this Network Code and the provisions of the [NC DCC], each TSO shall define a Low Frequency Demand Disconnection in coordination with the respective DSOs and the TSOs of its synchronous area. Each DSO or where relevant TSO shall implement the Low		GC OC6.6		System defence co-ordination

	Frequency Demand Disconnection in its area of responsibility and shall inform the affected TSOs in case of change of the conditions and settings.				
	Article 13 DYNAMIC STABILITY MANAGEMENT		**GB Code**		**Commentary**
1	Each TSO shall perform Dynamic Stability Assessment studies in order to identify potential stability problems in its transmission system. These studies can be offline.		GB SQSS 5.1 "there shall not be system instability" for N or N-1 secured events		On-line N-1 angular stability assessors are not common amongst TSO.
2	Where a TSO identifies a potential mutual influence of dynamic stability with other interconnected transmission systems, the affected TSOs shall contribute to coordination of approaches to the DSA, including provision of data needed for DSA and preparation of joint Remedial Actions.		N/A		
3	In deciding the approach for DSA, each TSO shall apply the following rules: a) if with respect to the Contingency List, steady state Operational Security Limits are reached before Stability Limits, the TSO shall base its DSA only on the offline stability studies carried out in the longer term operational planning phase; b) if under planned outage conditions, with respect to the Contingency List, steady state limits and Stability Limits are close to each other or Stability Limits are reached before steady state limits, the TSO shall perform a DSA in the short term operational planning phase whilst these outage conditions remain. The TSO shall prepare Remedial Actions to be used in real-time operation if necessary; c) if under intact network conditions, with respect to the Contingency List, Stability Limits are reached before steady state limits, the TSO shall perform a DSA in all phases of operational planning and have a capability to re-assess the Stability Limits within a day.		N/A		Off-line angular stability assessment in the control phase is not common amongst TSOs, only those with potential transient stability problems under outage conditions would do such assessment routinely. NGET carries out off-line transient stability assessment routinely in all timescales.
4	Each TSO shall coordinate with the other TSOs of its Synchronous Area to establish the methodology used within this Synchronous Area to calculate the minimum percentage of generation from Power Generating Facility with synchronous generators which is required to be procured at any times for maintaining stability and Operational Security. While respecting the		GB SQSS 5.1 "there shall not be system instability" but is not specific about the causes/drivers		Lower system inertia, lower fault level infeed from increases in RES may mean in the future this is the limiting factor to maintain stability under N -1.

	provisions of Article 3(3), each TSO shall be entitled to define this minimum percentage.				
	Chapter 3 TESTING AND INVESTIGATION				
	Article 14 **OPERATIONAL TESTING, MONITORING AND INVESTIGATION**		**GB Code**		**Commentary**
1	Each TSO, DSO and Significant Grid User shall continuously monitor their areas of responsibility, perform operational testing when required and participate in the investigation of events in order to: a) ensure correct functioning of elements of transmission system, distribution network and Significant Grid Users; b) maintain and develop operational procedures; c) ensure the fulfilment of Ancillary Services; d) train staff; e) acquire information about system and equipment performance under any conditions, including: - test involving the controlled application of frequency or voltage variations aimed at gathering information on transmission system behaviour; and - test standard procedures for Alert and Emergency States.		GC OC5 testing and monitoring		
2	Each TSO retains the right, based on operational monitoring, continuously, or periodically for subsequent periods of time, to evaluate by data recording, examination and analysis, a Significant Grid User's compliance with its connection and operating conditions in accordance with Article 14(3), declared availability and contracted provision of Ancillary Services. It does not require advance notification from a TSO to Significant Grid Users.		GC OC5.2		Ensure comply with connection conditions and ancillary service provisions.
3	Each TSO shall monitor the quality of the response of Power Generating Facilities to active and reactive power Set Points and the response of Power Generating Facilities providing Frequency Containment Reserve to frequency deviations and Faults.		As above		
4	Each TSO shall carry out investigations to acquire or verify information		GC OC7 – Operational		

	relating to events on the transmission system at the level of Responsibility Area. Involved TSOs and Significant Grid Users shall provide all information required to fully complete the investigation.		Liaison – exchange of information following events.		
5	Each TSO shall classify system incidents according to the common incidents classification scale adopted by ENTSO-E by application of the Article 8(3)(a) of the Regulation (EC) N°714/2009 in order to correctly rank the incidents based on their level of importance with regards to Operational Security.		N/A		The Entso-e Incident Classification Scale Methodology (doc. dated 23/3/12), Level 0 – 3 events, with examples / thresholds for each level and with regional variations (e.g. frequency deviation level 1 for GB is wider limit than for mainland Europe).
6	After connection to the Transmission or distribution network, each Significant Grid User shall carry out the tests specified by the relevant TSO or by the relevant TSO and DSO to which the Significant Grid User is connected, to confirm that their plant and apparatus meets the requirements for connection to the transmission system or distribution network and that the Significant Grid User is complying with its declared capability of Ancillary Services in accordance with the requirements of the [NCRfG].		CUSC OC5		Operational notification process
7	The TSO, DSO or Significant Grid User responsible for the test shall establish a test plan for each intended test.				
8	Each TSO shall use a Common Grid Model of its Synchronous Area or a part of it in its assessment of and planning for a test. The test plan shall include an appropriate margin for emergencies and look at the impact both inside and outside its Responsibility Area.		N/A		TSO to ensure they have studied the tests and their potential interactions beyond TSO own system.
9	Each TSO shall carry out the necessary analysis and planning to ensure that tests in its Responsibility Area are carried out in a manner that minimizes the impact on Operational Security and economic operation of the interconnected transmission systems.		N/A		As above
10	Each TSO shall have Operational Security of its own transmission system and Responsibility Area as its main concern during testing. Any test may be postponed or interrupted due to unplanned system conditions as assessed by the TSO.				System security is paramount
11	Each TSO can request additional tests to be performed by the DSOs or		N/A?		

	Significant Grid Users, if they are deemed necessary to maintain and develop operational procedures, to train staff, or to acquire information of transmission system or equipment behaviour under certain system conditions.				
12	In case of System State degradation, the TSO of the transmission system in which the testing is performed shall be entitled to stop the testing and deploy any measures to return to a Normal State as soon as possible. If a TSO or a Significant Grid User is conducting a test influencing another TSO and the System State of the affected transmission system changes to Alert State or Emergency State, the TSO or Significant Grid User conducting the test shall, having been informed by its TSO, immediately cease the test.		N/A		TSO co-operation and co-ordination.
13	Each Significant Grid User requesting permission for testing from the TSO, shall provide all necessary information and allow reasonable time for the TSO to plan for the test, taking into account the impact on system operation, the scope of and procedure for the test.		GC OC7.5, Operational Liaison - tests by users		
14	Each TSO shall ensure timely and effective co-ordination of tests in its Responsibility Area with other affected TSOs.		N/A		TSO coordination
15	After an incident classified as level 2 according to the common incidents classification scale adopted by ENTSO-E by application of the Article 8(3)(a) of the Regulation (EC) N°714/2009, the TSOs involved shall carry out a joint investigation to analyse the reasons for the incident and to adjust the existing operational procedures, if required.		N/A		Level 2 is for major incidents that have led to load shedding (automatically or manually).
16	Significant Grid Users shall provide to the TSO at least the following information on the test: a) intended timing and duration of the test; b) active and reactive power profiles during the proposed testing period; c) details of each test to be carried out during the testing period, including the purpose of the test, the risk of tripping during each test and the availability of the affected unit during the test; and d) contact details of the onsite personnel.		GC OC7.5.5		

17	TSO shall provide to affected TSOs at least the following information on the test: a) details and timing of the test; b) plans for accommodation of the test.		N/A		
18	If necessary to fully investigate both local and wide area system incidents, the TSO can require additional data from Significant Grid Users. Affected TSOs shall co-operate in the provision of this data.		N/A		TSO share user data in widespread incidents across multiple TSOs.

	Chapter 4 DATA EXCHANGE Article 15 GENERAL REQUIREMENTS		GB Code		Commentary
1	Each TSO shall endeavor to use accurate data and information which reflect as closely as possible the real situation in the transmission system.		N/A		TSO obligation, ensure minimum standard across TSOs
2	Each TSO shall endeavor to resolve inaccuracies and uncertainties and continuously ensure high quality of the data and information used.		N/A		As above
3	Each TSO shall be entitled to gather the information on generation, consumption, schedules, balance positions, planned outages and substation topologies and its own forecasts, required for the Operational Security analysis. This information shall be transformable into the nodal injections and withdrawals on its own transmission system model.		N/A		High level statement, TSOs need powers to gather data to assess system security.
4	Each TSO shall adhere to the organisational requirements, roles and responsibilities in relation to the data exchange, which are agreed upon and implemented at the level of ENTSO-E for all TSOs. This shall encompass the following issues: a) obligations among the TSOs to communicate without undue delay to all neighbouring TSOs, any changes in the protection settings, thermal limits and technical capacities at the interconnections between the their Control Areas; b) obligations of the Relevant DSOs to inform without undue delay their TSOs of any changes in the data and information scope and contents from Chapter 4 of this Network Code; c) obligations of the Significant Grid Users connected to the transmission system to inform their TSO about any relevant change in the scope and contents of the relevant data from Chapter 4 of this Network Code.		N/A		
5	Each TSO shall define and implement in a common and coherent way in coordination with the other TSOs, the detailed contents and reporting formats of the data and information referred to in this Chapter.		N/A		TSO cooperation and coordination

6	While remaining the sole entity responsible and liable, a TSO can entrust a regional security coordination initiative or a regional coordination centre with some of the tasks that it shall perform in accordance with this Network Code. In such a case, the TSO shall inform officially other TSOs, regional control centers or initiatives about this delegation, so that these regional control centers or initiatives can get all the data and information needed to perform the tasks entrusted to them.		N/A		Allows TSOs to ask another TSO to send data on their SGUs to a co-ordination centre established by a group of TSOs (e.g. Coreso), for which the sending TSO is not a member.

	Article 16 STRUCTURAL AND FORECAST DATA EXCHANGED BETWEEN TSOs		GB Code		Commentary
1	Neighbouring TSOs shall exchange the structural information related to the Observability Area including at least: a) substations' regular topologies and other relevant data by voltage level; b) transmission lines; c) transformers connecting the DSOs, Demand Facilities and generators' block-transformers of Power Generating Facilities; d) phase-shifting transformers; e) high voltage DC lines; and f) reactors, capacitors and Static VAR Compensators.		N/A STC gives the SO the other GB TOs network data.		Basic data such as R,X,B etc
2	Neighbouring TSOs shall exchange the protection Set-Points to allow protection coordination between the different transmission systems.		N/A		
3	In order to support coordinated Operational Security analysis and the establishment of the Common Grid Model, each TSO shall exchange with all other relevant TSOs at least the following data: a) topology of the 220 kV and higher voltage transmission system within its Responsibility Area; b) an equivalent of the transmission systems of significant impact to its own transmission system; c) the forecast sum of injection and withdrawal in every node of the transmission system for the different time frames. This data shall correspond to the best forecast available at the TSO level and the resulting situation in the transmission system shall be as realistic and accurate as possible; d) if the impact of a connected distribution network is significant, the distribution network model for transmission short-circuit calculations with		N/A		Common Grid Model used in operational timescales allows wider / regional interactions to be identified between AC connected TSOs.

	the level of detail which is needed for successful calculations, using where applicable the distribution network equivalents with sufficient degree of detail and accuracy. Each TSO shall determine the significance of the distribution networks connected to it for short-circuit calculations.				
4	In order to support coordinated Dynamic Stability Assessment, each TSO shall, when required in accordance with article 13(2), exchange with other relevant TSOs the necessary data for DSA. Concerning Power Generating Module, the TSO shall provide the necessary data on: a) electrical parameters of the alternator including direct permanent and transient impedances; b) step up transformer description; c) minimum and maximum reactive power; Concerning tap changers, description of existing on load tap changers, step up and network transformers, the TSO shall provide the necessary data on: a) type of regulation; b) voltage regulation range.		N/A		As above

	Article 17 REAL-TIME DATA EXCHANGED BETWEEN TSOs		GB Code		Commentary
1	In accordance with Article 6(8)(a), each TSO shall exchange with all other TSOs in its Synchronous Area the necessary data on the System State of its transmission system using a common awareness system, including: a) frequency; b) Area Control Error or an equivalent parameter; c) measured active power exchanges between Control Areas; d) generation infeed; e) System State in accordance with Article 6(1); f) set-value of the load-frequency controller; and g) energy exchange via the virtual tie-lines.		N/A		TSO coordination and wider situational awareness.
2	Each TSOs shall exchange with its neighbouring TSOs the following data related to the Observability Area referred: a) actual topology; b) active and reactive power in line bay; c) active and reactive power in transformer bay; d) active and reactive power in Power Generating Facility bay; e) active and reactive injections and withdrawals of generation, demand and subsequent DSOs; f) regulating positions of transformers, including phase-shifting transformers; g) measured or estimated busbar voltage; h) reactive power in reactor and capacitor bay or from a static VAR compensator; and i) restrictions on active and reactive power supply capabilities with respect to the Observability Area.		N/A		As above

	Article 18 **STRUCTURAL DATA EXCHANGED BETWEEN TSOs AND RELEVANT DSOs WITHIN THE TSO's RESPONSIBILITY AREA**				
1	Each TSO shall define the Observability Area of the distribution networks connected to its transmission system which are relevant to accurately and efficiently determine the System State of the transmission system.		GC DRC schedule 5, user system data		DNO network in sufficient detail is in TSO on-line security analysis modelling.
2	Each DSO connected to the transmission system shall provide to its TSO the structural information related to the Observability Area referred to in Article 18(1) including, but not limited to, : a) substations directly connected to the transmission system, by voltage; b) lines connected to the substations from a) above; c) transformers from the substations from a) above; d) Power Generating Facilities and Demand Facilities of relevance for the Operational Security of the transmission system; and e) reactors and capacitors of relevance for the Operational Security of the transmission system.		GC DRC schedule 5, user system data, R,X,B etc		
3	Each DSO connected to the transmission system shall provide the TSO with updated structural information of the elements of the Observability Area every time it changes.		GC DRC 5.3.1 – ensure data is kept up to date		
4	Each DSO exchanging the data with the TSO shall also provide historical data of up to three years in the past if necessary and required by the TSO.		N/A		Could be required if a TSO increases its level of modelling detail needed.

	Article 19 **RELEVANT REAL-TIME DATA EXCHANGED BETWEEN TSOs AND DSOs WITHIN THE TSO's RESPONSIBILITY AREA**		**GB Code**		**Commentary**
1	Each DSO connected to the transmission system shall provide in real-time to its TSO the information related to the Observability Area referred to in Article 18(1), which is relevant for the Operational Security of the transmission system comprising: a) actual topology; b) active and reactive power in line bay; c) active and reactive power in transformer bay; d) active and reactive power injection in Power Generating Facility bay; e) active and reactive power withdrawals and injections of any subsequent DSOs and of Demand Facilities; f) tap positions of transformers; g) busbar voltages; and h) reactive power in reactor and capacitor bay.		N/A N/A GC CC 6.4.4		This data would be provided by a DSO for its network only where the TSO requires it for system security of the Tx system, eg potential for significant flows between interface sites through LV interconnection

	Article 20 STRUCTURAL DATA EXCHANGED BETWEEN TSOs, INTERCONNECTION OWNERS AND GENERATORS DIRECTLY CONNECTED TO THE TRANSMISSION SYSTEM		GB Code		Commentary
1	Each type D Power Generating Facility Operator according to Article 3 of the [NCRfG]shall provide at least the following data to the TSO: a) general data of the power plant which are relevant for Operational Security; b) turbine and Power Generating Facility data including time for cold and warm start; c) data for short-circuit calculation; d) Power Generating Facility transformer data; e) Frequency Containment Reserve data according to the definition and needs of the[NC LFR]; f) Frequency Restoration Reserve data, according to the definition and needs of the [NC LFR]for plants that participate in this service; g) data necessary for Restoration; h) data and model necessary for performing dynamic simulation in the format specified by the TSO according to Article 13; i) protection data; and j) reactive power control capability;		GC DRC Schedule 1		Basic standing data to allow TSO to model generation in security analysis
2	Each type B and C Power Generating Facility Operator according to Article 3 of the [NCRfG]which is directly connected to the transmission system shall at least provide the following data to the TSO: a) general data of the power plant which are relevant for Operational Security; b) data for short-circuit calculation; c) Frequency Containment Reserve data;		GC DRC Schedule 1		

	d) Frequency Restoration Reserve data for plants that participate in this service; e) protection data; f) reactive power control capability; and g) data necessary for performing dynamic simulation, if required by the TSO and in the format specified by the TSO according to Article 13.				
3	While respecting the provisions of Article 3(3), a TSO may request any Power Generating Facility Operator directly connected to the transmission system to provide further data needed for Operational Security analysis.		N/A?		Reasonably requested standing data not already covered by Codes could be requested from a directly connected user.
4	Each TSO shall inform the Power Generating Facility Operators directly connected to the transmission system, about those changes in the transmission system topology, which affect such Power Generating Facility Operators.		GC OC7.4.5		Operational liaison
5	Each Interconnection owner shall provide at least the following data to the TSO: a) general data of the AC or HVDC Interconnection; b) transformers' data; c) data on filters and filter banks; d) reactive compensation data; k) data necessary for performing dynamic simulation; l) protection data; and e) reactive power control capability.		GC DRC Schedule 1 page 12-15		

	Article 21 **SCHEDULED DATA EXCHANGED BETWEEN TSOs, INTERCONNECTION OWNERS AND GENERATORS DIRECTLY CONNECTED TO THE TRANSMISSION SYSTEM**		**GB Code**		**Commentary**
1	Each type D Power Generating Facility Operator according to Article 3 of the [NCRfG]shall inform the TSO without delay about its scheduled unavailability or active power restriction, forecast scheduled active power output, active power reserves amount and availability.		GC OC2, BC1, BC2		Required data for N-1 security analysis
2	Each type D Power Generating Facility Operator according to Article 3 of the [NCRfG] shall provide to the TSO, as a minimum, its scheduled active and reactive consumption on the Day-Ahead and Intraday basis, including any changes of these schedules.		As above		
3	Each type B and C Power Generating Facility Operator according to Article 3 of the [NCRfG]which is directly connected to the transmission system shall provide the TSO its scheduled unavailability or active power restriction, forecast scheduled active power output, active power reserves amount and availability.		As above		
4	Each type D Power Generating Facility Operator according to Article 3 of the [NCRfG] shall provide to the TSO any forecast restriction in the reactive power control capability, reactive power reserves amount and availability.		As above		
5	Each type B and C Power Generating Facility Operator according to Article 3 of the [NCRfG] which is directly connected to the transmission system shall provide the TSO any forecast restriction in the reactive power control capability, reactive power reserves amount and availability.		As above		
6	In regions where market structures, in terms of number and size of market participants and in terms of geographical position, prevent data provision referred to in Article 21(1) and (3), the Power Generating Facility Operator shall submit the data required by the TSO to allow the TSO to construct an active power output schedule.		N/A		
7	Each Interconnection owner shall provide the following data to the TSOs:		GC OC2		Required for margin analysis and security

	a) scheduled unavailability or active power restriction; b) scheduled unavailability or forecast restrictions of filter banks or reactive compensation that form part of the Interconnection; and c) scheduled active power transfers and reactive output levels.				analysis.

	Article 22 REAL-TIME DATA EXCHANGED BETWEEN TSOs, INTERCONNECTION OWNERS AND GENERATORS DIRECTLY CONNECTED TO THE TRANSMISSION SYSTEM		GB Code		Commentary
1	Each type D Power Generating Facility Operator according to Article 3 of the [NCRfG], including Power Generating Facilities own consumption, shall provide the TSO in real-time the following information: a) position of the circuit breakers; b) active and reactive power at the high voltage side of the transformer; and shall provide in real-time or periodically with time stamping the information on active power reserve.		GC CC6.5.6 "volts, current, frequency, active, reactive and switchgear status"		Required for safe and secure operation.
2	Each type B and C Power Generating Facility Operator according to Article 3 of the [NC RfG], including Power Generating Facilities own consumption, which is directly connected to the transmission system, shall provide the TSO in real-time or periodically with time stamping at least the following information: a) position of the circuit breakers; b) active and reactive power at the high voltage side of the transformer; and c) active power reserve;		As above		
3	Each Interconnection owner shall provide the following data to the TSOs in real-time: a) position of the circuit breakers; and b) active and reactive power.		GC CC6.5.6 (b)(ii) covers interconnectors		

	Article 23 **STRUCTURAL DATA EXCHANGED BETWEEN DSOs AND GENERATING FACILITIESCONNECTED TO THE DISTRIBUTION SYSTEM**		**GB Code**		**Commentary**
1	Each type B, C and D Power Generating Facility Operator according to Article 3 of the [NCRfG]shall provide the following data to the DSO: a) general data of the power plant which are relevant for Operational Security: installed capacity and primary energy source or fuel type; b) turbine and Power Generating Facility data including necessary time for cold and warm start; c) transformer data; d) Frequency Containment Reserve data; e) Frequency Restoration Reserve data for plants that participate in this service; f) data necessary for Restoration; g) protection data; h) reactive power control capability; i) remote access to the circuit breaker; and j) data and model of Power Generating Facility in the format specified by the TSO according to Article 13.		N/A		This is largely static modelling data, and along with Article 24 (embedded forecast output) and Article 25 (embedded real-time output measurements) is intended to be given to the DSO, so that is the TSO requires it the DSO would provide it to the TSO (see Article 26)

	Article 24 **SCHEDULED DATA EXCHANGED BETWEEN DSOs AND GENERATORS CONNECTED TO THE DISTRIBUTION SYSTEM**		**GB Code**		**Commentary**
1	Each Significant Grid User which is a type B, C or D Power Generating Facility according to Article 3 of the [NCRfG]shall provide the DSO with its scheduled unavailability, active power restriction and its forecast scheduled active power output.		GC OC2, BC1 for BMUs GC OC1.5.2 for Medium power stations, the MW schedules, if reasonably request by NGET		Grid Code deals with provision of this data to NGET if they are large enough. Threshold for defining Significant Grid User is key. Distribution Code?
2	Each Significant Grid User which is a type B, C or D Power Generating Facility according to Article 3 of the [NCRfG] shall provide to the DSO any forecasted restriction in the reactive power control capability.		GC OC2, BC2 for BMUs to NGET		Distribution Code?
	Article 25 **REAL-TIME DATA EXCHANGED BETWEEN DSOs AND GENERATORS CONNECTED TO THE DISTRIBUTION SYSTEM**				
1	Each Significant Grid User which is a type B, C or D Power Generating Facility according to Article 3 of the [NCRfG]shall provide to the DSO in real-time the following information: a) status of the switching devices and circuit breakers at the Connection Point; b) active and reactive power flows, including the direction, and voltage at the Connection Point; and c) remote disconnection capability of the circuit breaker.		Licence Embedded BMUs provide this data to NGET		Threshold for defining Significant Grid User is key. Distribution code?
2	In cases where the real-time availability of the information according to Article 25(1) is prohibitive, especially because of large numbers of small generating units, each TSO shall decide together with the responsible DSOs, whether and which Significant Grid Users might be exempted from providing the real-time information and if the data of such Significant Grid Users need to be delivered by responsible DSOs in an aggregated form, with the approval		N/A		Seeking the minimum real time data flows in situations where there might be 10s or 100s of 'small' embedded units. DNO scada would provide the aggregated values to TSO Scada

	of its national regulatory authority.				

	Article 26 **DATA EXCHANGED BETWEEN TSOs AND GENERATORS CONNECTED TO THE DISTRIBUTION SYSTEM**		**GB Code**		**Commentary**
1	Power Generating Facility Operators and DSOs shall provide to the TSO all the information described in Articles 23 to 25 if requested by the TSO.		N/A		Increased interactions TSO-DSO and future volumes of embedded generation drives need for lower resolution of data.
2	A TSO may request further data from any Power Generating Facility Operator connected to the distribution network, if this is necessary for Operational Security analysis, or if, after aggregation of data, the significance of a particular Power Generating Facility is raised in terms of Operational Security.		N/A		If TSO under Article 25(2) has opted for small units data to be aggregated then TSO can ask for some more detailed breakdown of the aggregated data.
	Article 27 **DATA EXCHANGED BETWEEN TSOs AND DEMAND FACILITIES DIRECTLY CONNECTED TO THE TRANSMISSION SYSTEM**		**GB Code**		**Commentary**
1	1. Demand Facilities which are directly connected to the transmission system shall provide the following structural data to the TSO: a) electrical data of the transformers connected to the transmission system; b) characteristics of the load of the Demand Facility; and c) characteristics of the reactive power control.		GC CC, DRC		
2	Each Demand Facility directly connected to the transmission system shall communicate to the TSO, as a minimum, its scheduled active and reactive consumption on a day-ahead and intraday basis, including any changes of these schedules.		GC OC1, BC1 , will be BMUs as Tx connected		
3	Each Demand Facility directly connected to the transmission system shall communicate to the TSO any forecast restriction in the reactive power control capability.		GC BC1, BC2		
4	Each Demand Facility directly connected to the transmission system which participates in demand side response shall inform the TSO about the minimum and maximum power to be curtailed.		GC OC1, BC1, BC2		

5	Each Demand Facility directly connected to the transmission system shall communicate to the TSO in real-time the following information: a) active and reactive power at the high voltage side of the transformer; and b) minimum and maximum power to be curtailed.		GC CC		
	Article 28 DATA EXCHANGED BETWEEN TSOs AND DEMAND FACILITIES CONNECTED TO THE DISTRIBUTION SYSTEM		**GB Code**		**Commentary**
1	Each Demand Facility connected to the distribution network which participates in demand side response shall communicate to its DSO and TSO in real-time the minimum and maximum active power which can be curtailed and active and reactive power at the high voltage side of the transformer.		GC OC1.5.5.2 Supplier provided forecasts of proposed demand management/control		Data needed for secure and economic balancing
2	Relevant DSOs shall communicate to the TSO the minimum and maximum active power that can be curtailed at the Connection Point between transmission and distribution system.		GC OC1.5.2, DNO provides forecasts of their potential use as a network operator		As above
3	Each Demand Facility connected to the distribution network which participates in DSM shall communicate to its DSO and TSO in real-time the active and reactive power at the high voltage side of the transformer.		N/A,		Scope will depend upon SGU thresholds, real-time metering of embedded demand sites, would be SCADA to SCADA
4	In cases where the real-time information according to Article28(1) includes large numbers of small Demand Facilities, each TSO shall decide while respecting the provisions of Article 3(3) and together with the responsible DSOs, whether and which Significant Grid Users might be exempted from providing the real-time information and if the data of such Demand Facilities needs to be delivered by responsible DSOs in an aggregated form.		N/A		Recognition of the costs / burden of providing above data at a discrete site level maybe reduced by DNO aggregating?

	Chapter 5 TRAINING				
	Article 29 OPERATIONAL TRAINING AND CERTIFICATION		**GB Code**		**Commentary**
1	Each TSO shall adopt and develop a training program for its System Operator Employees in charge of real-time operation of the transmission system.		N/A, not user facing		TSO control staff need to be skilled, trained, assessed and authorised.
2	Each TSO shall include in its training programs the knowledge of the transmission equipment, the operation of the transmission system, use of the on-the-job systems and processes, inter-TSO operations and market arrangements. Each TSO shall also include in its training programmes training on recognizing of and responding to exceptional situations as defined by TSO.		N/A		
3	To maintain and extend the System Operator Employees' skills, each TSO shall carry out continuous training. The detailed contents and frequency of the training for all relevant roles shall be defined in the training programme of each TSO. The training shall include but not be limited to: a) relevant areas of electrical power engineering; b) relevant aspects of the European Internal Electricity Market; c) safety and security for humans and equipment in transmission system operation; d) transmission system operation in a Normal and an Alert State; e) emergency control and restoration; and f) inter-TSO cooperation and coordination in real-time and in operational planning at the level of main control centres; this part of the training shall, if not otherwise specified and agreed, be in English.		N/A		TSO staff training must increasingly cover inter-actions between systems.
4	Each TSO shall prepare and carry out training plans for all new System Operator Employees in training - trainees. The training plans shall be tailored to suit each individual. They shall be structured and detailed and take account of the trainees background and experience relative to the position they are being trained for. Adequate records of System Operators Employees' training plans shall be retained by the TSO for a period not less		N/A		

	than 3 years.				
5	The training plans shall comprise: a) an initial program, to be followed by a trainee System Operator Employee before certification; b) a program for the prolongation of a System Operators Employees' certification, at least every three years; and c) a continuous development program, to be followed between prolongations of the certification for each System Operator Employee.		N/A		Maintain standards and increase skills, ensure operators are up to date with latest changes.
6	Each TSO shall appoint an experienced training coordinator, who is responsible for designing, monitoring and updating the complete training process. The training coordinator shall be responsible for defining: a) qualifications for System Operator Employees; b) training required for certification; c) processes with documentation for initial and continuous training; d) process for certification of System Operator Employees; e) process for prolongation of a certification; and f) competences for on-the-job trainers and training of trainers in teaching and mentoring skills.		N/A		Ensure a degree of independence in the certification process, documented minimum standards. Specific re-certification process. Recognise the value of teach the teacher training and skills.
7	Each TSO shall define the skills and the level of competence of the on-the-job trainers. This shall include the necessary practical experience. System Operator Employees acting as trainers shall be registered by each TSO and their on-the-job trainer status reviewed at the same time as their certification prolongation is assessed.		N/A		Ensure TSO staff with sufficient experience can only train a new member of staff.
8	Each TSO shall review training programmes at least annually or following any significant system changes and update them to reflect changing operational circumstances, market rules, network configuration and system characteristics, with particular focus on new transmission and generation technologies, changing generation patterns and market evolution.		N/A		Ensure training material is kept up to date, invest in training.
9	Each TSO shall ensure the training includes on-the-job training and training		N/A		Un-certified operator (trainee) must not

	offline. On-the-job training shall be carried out under the supervision of an experienced System Operator Employee. Offline training shall, as far as practicable, resemble the actual control room equipment with network modelling details appropriate to the role being trained for.				fly solo, always under supervision.
10	Each TSO shall ensure that the training is based on a comprehensive database model with respective data from neighbouring networks at a sufficient level to replicate inter-TSO operational issues. Where relevant, the role of neighbouring TSOs, connected DSOs and Power Generating Facility Operators and directly connected Demand Facilities shall also be simulated in the offline training.		N/A		TSO investment in training systems
11	TSO shall co-ordinate with DSOs, Power Generating Facility Operators and directly connected Demand Facilities to ensure TSO offline training regarding the impact of users' systems is as comprehensive as reasonably practical and reflects the latest developments in systems and equipment. TSOs and Significant Grid Users may run joint offline training simulations or training workshops for their System Operator Employees to enhance co-operation and understanding.		N/A		Ensure TSO staff training is wide ranging and involves users.
12	Each TSO shall ensure that System Operator Employees have a certification, issued by a nominated representative from their TSO, for the role they are to perform before they can work unsupervised in the control room.		N/A		Formal certification process for all TSO control room staff.
13	Each TSO shall actively participate in the inter-TSO training at a defined frequency, taking into account the level of mutual influence with neighbouring systems.		N/A		Training on inter-dependencies between neighbouring systems
14	Each TSO shall define the level of competence and process to gain a certification for each relevant role for System Operator Employee within the control room. The certification shall only be awarded to the System Operator Employees following the passing of a formal assessment.		N/A		Underpin minimum standards, documentation.
15	Each TSO shall record the period of validity of the certification issued to any System Operator. The maximum period of any certification shall be defined by each TSO and shall not exceed three years. The prolongation of the certification before expiry shall be based on criteria defined by each TSO,		N/A		Ensure regular re-assessment of TSO control staff.

	including the System Operator Employees' participation in a continuous training programme with sufficient practical experience.				
16	Each TSO shall collaborate with each neighbouring TSO to determine a common language for contacts between their System Operators. If not otherwise agreed, the language shall be English. Each TSO shall train the relevant System Operator Employees to achieve a sufficient skill in this language to carry out their tasks.		N/A		
17	Each TSO shall exchange operational experiences with their neighbouring TSOs, including facilitating visits and exchange of experiences between System Operator Employees. There shall be regular training between neighbouring TSOs to improve the knowledge of the characteristics of neighbouring transmission systems and communication and coordination between System Operator Employees of neighbouring TSOs. The inter-TSO training shall include awareness of co-ordinated actions required under Normal, Alert, Emergency States and other exceptional conditions.		N/A		Ensure TSO co-operate and share knowledge.
18	Each TSO shall collaborate with each neighbouring TSO to determine the need and frequency for holding joint training sessions and the minimum content and scope of those sessions, taking into account the level of mutual influence and operational cooperation needed. This inter-TSO training may include, but should not be limited to, joint training workshops and joint training simulator sessions.		N/A		As above
19	Each TSO shall ensure that each System Operator Employee as a part of their initial training undergoes training in interoperability issues between neighbouring systems based upon operational experiences and feedback from the joint training carried out with their neighbouring TSOs. This part of the initial training regarding interoperability issues shall include awareness of co-ordinated actions required under Normal, Alert, Emergency States and other exceptional conditions.		N/A		As above

	Chapter 6 COMPLIANCE				
	Article 30 RESPONSIBILITY OF THE SIGNIFICANT GRID USERS		**GB Code**		**Commentary**
1	Each Significant Grid User or DSO shall ensure that its facilities are compliant with the requirements from this Network Code, which are relevant for their connection and interaction with the transmission system. This compliance shall be maintained throughout the lifetime of the facility.				
2	Before initiating any modification, each Significant Grid User shall notify to the relevant TSO or DSO any planned modification of its technical capabilities which could have an impact on its compliance with the requirements of this Network Code.				
3	Each Significant Grid User shall notify to the relevant TSO or DSO any operational disturbance on its facility which could have an impact on its compliance with the requirements of this Network Code as soon as possible and without any delay after its occurrence.				
4	In order to allow the relevant TSO or DSO to evaluate and mitigate where necessary the risks to the transmission system or distribution networks, each Significant Grid User shall notify to the relevant TSO or DSO any foreseen test schedules and procedures to verify compliance of a Significant Grid User's facility with the requirements of this Network Code. The relevant TSO or DSO shall approve these foreseen test schedules and procedures prior to their launch.				
5	The Significant Grid User shall enable the participation of the relevant TSO or DSO in such tests. The relevant TSO or DSO shall have the right to record the performance of the facilities of the Significant Grid Users.				

	Article 31 RESPONSIBILITIES OF THE TRANSMISSION AND DISTRIBUTION SYSTEM OPERATORS		GB Code		Commentary
1	Each TSO has the sole responsibility for the Operational Security of its transmission system.				
2	The relevant TSO or DSO shall assess and where necessary request to witness the testing of the compliance of a Significant Grid User's facility with the requirements of this Network Code at any time throughout the lifetime of the Significant Grid Users' facility.				
3	Upon request from the relevant TSO or DSO, the Significant Grid User shall carryout compliance tests and simulations at any time throughout the lifetime of the Significant Grid User's facility and in particular after any Fault, modification or replacement of any equipment which could have an impact on the Significant Grid User's facility compliance with the requirements of this Network Code.				
4	The relevant TSO or DSO shall make publicly available the list of information and documents to be provided as well as the requirements to be fulfilled by the Significant Grid User in the framework of the compliance testing. Such list shall at least cover the following information, documents and requirements: a) all documentation and certificates to be provided by the Significant Grid User; b) details of the technical data of the Significant Grid User facility with relevance for the system operation; c) requirements for models for steady-state and Dynamic Stability Assessment; studies by the Significant Grid Users demonstrating expected steady-state performance and Dynamic Stability Assessment outcome.				
5	The relevant TSO or DSO shall make publicly available the allocation of responsibilities of the Significant Grid User and of the TSO or DSO for				

	compliance testing and monitoring.				
6	The relevant TSO or DSO may partially or totally delegate the performance of its compliance monitoring to third parties.				

End of document

CHAPTER 7

FINAL PROVISIONS

Chapter 7

FINAL PROVISIONS

Article 32

AMENDMENT OF CONTRACTS AND GENERAL TERMS AND CONDITIONS

Within three years after the entry into force of this Network Code, each relevant TSO, DSO and each relevant Significant Grid User shall amend all relevant clauses in contracts and/or relevant clauses in general terms and conditions relating to the grid connection of New Power Generating Modules, regardless of whether the relevant contracts or general terms and conditions contain an amendment process, in order to achieve compliance with the requirements of this Network Code.

Article 33

ENTRY INTO FORCE

This Network Code shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

All provisions of this Network Code shall apply as from the day of expiration of a two years period following its publication.

This Network Code shall be binding in its entirety and directly applicable in all Member States.

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PURPOSE AND OBJECTIVES

ARTICLES 1 - 5

PURPOSE AND OBJECTIVES

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC,

Having regard to Regulation (EC) 714/2009 of the European parliament and of the Council of 13 July 2009 and in particular Article 6,

Having regard to the priority list issued by the European Commission on 22 December 2010,

Having regard to the Framework Guidelines on Electricity System Operation issued by ACER on 2 December 2011,

Whereas:

(1) Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC and Regulation (EC) N° 714/2009 of the European parliament and of the Council of 13 July 2009 underline the need for an increased cooperation and coordination among Transmission System Operators within a European Network of Transmission System Operators for Electricity (ENTSO-E) to create Network Codes for providing and managing effective and transparent access to the transmission systems across borders, and to ensure coordinated and sufficiently forward-looking planning and sound technical evolution of the transmission system in the European Union, including the creation of Interconnection capacities, with due regard to the environment.

(2) Directive 2009/72/EC stresses that a secure supply of electricity is of vital importance for the development of European society, the implementation of a sustainable climate change policy, and the fostering of competitiveness within the internal market.

(3) Transmission System Operators (TSOs) are according to Article 2 of Directive 2009/72/EC responsible for operating, ensuring the maintenance of and, if necessary developing the extra-high and high voltage interconnected system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity. TSOs are also responsible for the Operational Security of their Control Areas and together in the whole Synchronous Areas and the European Union, with a high level of reliability and quality.

(4) Secure transmission system operation can be made possible only if there is an obligation for the TSOs, Distribution System Operators (DSOs), Power Generating Facility Operators

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and Demand Facilities to cooperate and to meet the relevant minimum technical requirements for the operation of the interconnected transmission systems as one entity.

(5) ENTSO-E has drafted this Network Code for Operational Security aiming at setting out clear and objective requirements for TSOs, DSOs, Power Generating Facility and Demand Facilities in order to contribute to non-discrimination, effective competition and the efficient functioning of the internal electricity market and to ensure system security.

(6) This Network Code has been drafted in accordance with the Article 8(7) of Regulation (EC) No 714/2009 according to which the network codes shall be developed for cross-border network issues and market integration issues and shall be without prejudice to the Member States' right to establish national network codes which do not affect cross-border trade.

(7) To ensure the Operational Security of the interconnected transmission systems and to provide a common Security Level it is essential that a common set of minimum requirements for European Union-wide Operational Security principles is defined as a basis for both the cross-border cooperation between the TSOs and for utilising where relevant characteristics of the connected generation, consumption and distribution systems.

(8) The distinction between the different types of Power Generating Facility Operators as defined in the Article 3 of the Network Code on Requirements for Grid Connection Applicable to All Generators should be used in this Network Code to address Power Generating Facility Operators in a systematic and consistent manner.

(9) Transmission System Operators should respect the common principles when operating the interconnected transmission systems in order to maintain the Operational Security, quality and stability of the interconnected transmission system and to support the efficient functioning of the European Internal Electricity Market. These principles are the basis for the key elements, structure and provisions of this Network Code.

(10) Measuring and monitoring operational parameters in order to estimate the System State is the first step required for activities and applications to maintain Operational Security. State Estimation throughout the EU in a common and coherent way supports communication between Transmission System Operators and where necessary with Distribution System Operators and Grid Users.

(11) Each Transmission System Operator should operate the frequency control management in its transmission system, in order to actively contribute to maintaining the global balance between generation and demand of all transmission systems interconnected within a Synchronous Area.

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(12) At a local level, Transmission System Operators should apply voltage control and reactive power management, in order to keep voltages within the Operational Security Limits and to minimize reactive power flows.

(13) Transmission System Operators should deploy short-circuit management in order to calculate the short-circuit currents within and beyond the borders of Control Areas and thus to ensure adequate treatment of short-circuit Faults.

(14) The goal of the congestion and power flow management is twofold: the effective and efficient functioning of the Internal Electricity Market and the maintaining of the Operational Security. These objectives should be attained by an adequate coordination between TSOs in order to get an overview of the power-flows all over the transmission system, to detect the potential constraints, and to set up the Remedial Actions when necessary.

(15) To identify contingencies which would endanger the Operational Security and lead to unplanned outages, the Transmission System Operators should rely on Contingency analysis and handling. The Contingency analysis should be performed during the operational planning and in real-time operation. The results of the Contingency analysis will allow identifying and deploying necessary pre-fault or post-fault Remedial Actions.

(16) Transmission system protection, coordinated with Dynamic Stability Management and short-circuit management, should establish the protection concepts and devices required to manage Faults and disturbances in the operation of the transmission system.

(17) The correct functioning of the transmission system elements, processes and facilities of the Grid Users which are connected to the transmission system should be continuously monitored, tested if required and investigated following disturbances in a coordinated and coherent way throughout Europe. These monitoring, investigating and testing activities should take place before, during and after any changes affecting the Operational Security of the transmission system.

(18) The Operational Security of the transmission system and all the activities which contribute to it require an accurate, timely and adequate exchange of data and information. Data exchange should therefore not encounter any barrier between the different actors involved in ensuring the Operational Security.

(19) Finally, the relevant education, on-the-job training and certification should be obligatory for the employees of the Transmission System Operators who are in charge of the operation of the transmission system and of its Operational Security. All European Transmission System Operators should adopt a coordinated and coherent approach towards training and certification.

HAS ADOPTED THIS NETWORK CODE:

Chapter 1

GENERAL PROVISIONS

Article 1

SUBJECT MATTER AND SCOPE

1. This Network Code defines the minimum Operational Security requirements and principles for transmission systems applicable to all TSOs, relevant DSOs and Significant Grid Users.

2. This Network Code aims at:
   a) determining common Operational Security requirements and principles;
   b) ensuring conditions for maintaining Operational Security throughout the EU;
   c) providing for coordination of system operation;
   d) determining common requirements for DSOs which are relevant for Operational Security of the transmission system and Significant Grid Users.

3. In the small isolated systems for which a derogation has been granted in application of Article 44 of Directive 2009/72/EC and in the isolated systems which do not present any cross-border network issues or market integration issues, in the absence of transmission system, the provisions of this Network Code shall not apply. DSOs shall nevertheless take fully into account the provisions of this Network Code when adopting their own network codes on Operational Security.

4. In the Spanish isolated systems (SEIE), the references to this Network Code shall not apply and shall be replaced by references to SEIE rules.

Article 2

DEFINITIONS

1. For the purpose of this Network Code, the definitions contained in Article 2 of Directive 2009/72/EC and in Article 2 of Regulation (EC) N°714/2009 apply. The definitions contained in the Article [2] of the [NC RfG], [NC DCC], [NC CACM], [NC LFC&R] and [NC OPS] shall also apply.

2. The following definitions shall apply:

(N-1)-Criterion means the rule according to which elements remaining in operation after a Fault of one element within TSO's Control Area must be capable of accommodating the new operational situation without exceeding Operational Security Limits;

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(N-1)-Situation means the situation in the transmission system in which a Fault on an element of transmission system or a Power Generating Facility has happened;

Active Power Reserve means the operational reserves available for maintaining the planned power exchange and for guaranteeing secure operation of the transmission system;

Alert State means the operational state where transmission system is within Operational Security Limits, but a Contingency has been detected, for which in case of occurrence, the available Remedial Actions are not sufficient to cope with;

Area Control Error (ACE) means the instantaneous difference between the actual and the reference value, of the power interchange of a Control Area, taking into account the effect of the frequency bias for that Control Area according to the network power frequency characteristics of that Control Area and the overall frequency deviation;

Automatic Voltage Control means the automatic control system at the generation node, at the end nodes of the AC lines, High-Voltage DC lines or including actions on automatic voltage and reactive power control of transformers, or other means that contribute to Voltage Control, designed to maintain the set or reference voltage level and the set value of reactive power;

Blackout State means the state where the operation of part or all of the transmission system is terminated;

Common Grid Model (CGM) means the European-wide or multiple-TSOs-wide data set, created by the TSOs and coordinated within the ENTSO-E, created through merging of relevant data;

Connection Point means the interface at which the Demand Facility or Power Generating Facility is connected to a transmission or distribution network, or at which the distribution network is connected to a transmission network;

Contingency means the identified and possible or already occurred Fault of an element within the TSO's Control Area, including not only the transmission but also the distribution networks of DSOs on lower voltage levels. Internal Contingency is a Contingency within the TSO's Control Area. External Contingency is a Contingency within the Control Area of neighbouring TSO having effects in the Control Area of the TSO;

Contingency List means the list of Contingencies to be simulated in the Contingency analysis in order to test the compliance with the Operational Security Limits a priori or a posteriori after a Contingency took place;

Control Area means a part of the interconnected transmission system controlled by a single TSO;

Demand Facility means a facility which consumes electrical energy and is connected at one or more Connection Points, to the exclusion of distribution networks and auxiliary supplies of a Power Generating Facility which do not qualify as Demand Facilities;

Demand Side Management (DSM) means all activities undertaken to encourage Demand Facilities to modify patterns of electricity usage, including the timing and level of electricity demand. DSM covers the complete range of load shape objectives, including strategic conservation and load management, as well as strategic load growth. It does not include

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energy and load-shaped changes arising from the normal operation of the marketplace or from government-mandated energy-efficiency standards;

Disturbance means an unplanned event that causes the transmission system to divert from Normal State;

Dynamic Stability Assessment (DSA) means the security assessment in terms of Rotor Angle Stability, Frequency Stability and Voltage Stability;

Emergency Plan means the plan detailing TSO's responses to a loss of critical tools and facilities;

Emergency State means the situation where Operational Security Limits are not kept with at least one of the operational parameters outside of the respective limits;

ENTSO-E means the European Network of Transmission System Operators for Electricity as established in the Regulation (EC) 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) 1228/2003[1];

Exceptional Contingency means the unusual – as opposed to Ordinary Contingency – loss of an element such as, but not limited to, a double line - two circuits on the same tower over a long distance, where the consideration of distance is left to the determination of the TSO, a single busbar, a circuit breaker failure, a common mode Fault with the loss of more than one Power Generating Facility, a common mode Fault with the loss of more than one DC line;

Fault means the event occurring on the primary equipment in a transmission system such as all kinds of short-circuits: single-, double- and triple-phase, with and without earth contact. It means further a broken conductor, interrupted circuit, or an intermittent connection, resulting in a permanent non-availability of the affected transmission system element;

Frequency Stability means the ability of the electric power system to maintain steady frequency in N-Situation and after being subjected to a disturbance in (N-1)-Situation.

Grid User means the natural or legal person supplying to, or being supplied with active and/or reactive power by a TSO or DSO;

Interconnection means the transmission link – AC or DC line, circuit or transformer – which connects two Control Areas;

Load Shedding means the disconnection of load from the synchronous electric power system, performed automatically or manually, to control the system frequency, to avoid voltage deterioration, or prevent another disturbance and deterioration of Operational Security;

Local means the qualification of an Alert, Emergency or Blackout State when there is no risk of extension of the consequences outside of the transmission system of a single TSO;

[1] *OJ L 211, 14.8.2009, p. 15–35*

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Market Balance Area means the smallest area on which scheduling is performed, which corresponds to the largest area on which each balance responsible party is authorized to pool the imbalance between generation and consumption related to its perimeter;

Normal State means the operational state in which there is a low risk for deterioration of Operational Security of the transmission system;

N-Situation means the situation where no element of the transmission system is unavailable due to a Fault;

Observability Area means the area of the relevant parts of the transmission systems, relevant DSOs and neighbouring TSOs, on which TSO shall implement a real-time monitoring and modelling to ensure reliability of the respective Responsibility Area;

Operational Security means the transmission system capability to retain a Normal State or to return to a Normal State as soon and as close as possible, and is characterized by thermal limits, voltage constraints, short-circuit current, frequency reference value and stability limits;

Operational Security Limits means the acceptable operating boundaries: thermal, voltage, Fault levels, frequency and stability limits;

Ordinary Contingency means the non-unusual loss of a transmission system element such as, but not limited to, a single line, a single Power Generating Facility, a single transformer, a single phase-shifting transformer, a voltage compensation installation of 50 MVAr or more or a DC link;

Out-of-Range Contingency means the very unusual simultaneous loss of several transmission system elements such as, but not limited to two independent lines, a substation of more than one busbar, a tower with more than two circuits or a power swinging or oscillation event leading to the loss of more than one large Power Generating Facility;

Power Generating Facility Operator means the natural or legal person who is the operator of a Power Generating Facility;

Redispatch means the measures taken by System Operator Employee to alter the generation or demand pattern in order to change physical flows in the grid and relieve congestion;

Remedial Action means the measure activated by the TSO manually or automatically to relieve consequences of disturbances and maintain a Normal State or move towards a Normal State, which can be applied pre-fault or post-fault and may involve costs;

Responsibility Area means a coherent part of the interconnected system operated by a single TSO with physical loads and generation units connected within the area;

Restoration means the transition between different System States in which the Operational Security is improved, in the sense of transition from Alert to Normal, Emergency to Normal or Emergency to Alert, or re-established in the sense of transition from Blackout to restored system operation;

Rotor Angle Stability means the ability of synchronous machines to remain in synchronism under N-Situation and after being subjected to a disturbance in (N-1)-Situation.

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Schedule means the reference set of values of energy or power within a future time period and for a resolution time interval. Schedules refer to:

a) Commercial exchange between different market participants;

b) Generation program of a particular Power Generating Facility or the aggregation of generation programs of a group of Power Generating Facilities, termed also generation schedule;

c) Demand program of a particular Demand Facility or the aggregation of consumption programs of a group of Consumption Units, termed also consumption schedule;

d) Planned exchange of energy between Market Balance Areas on a given time interval and at a given time resolution. These Market Balance Areas might belong to different Synchronous Areas and might be none neighbouring;

e) Aggregated cross-border exchange programme aggregated programme of the exchange across the Control Area borders;

Security Plan means the plan containing a risk assessment of critical TSO's assets to major physical- and cyber-threat scenarios with an assessment of the potential impacts;

Set-Point means the target value for any parameter typically used in control schemes;

Significant Grid User means the pre-existing Grid Users and new Grid Users which are deemed significant on the basis of their impact on the cross border system performances via influence on the Control Area's security of supply including provision of ancillary services;

Stability Limits means the permitted operating boundaries of the transmission system in terms of respecting the constraints of Voltage Stability, Rotor Angle Stability and Frequency Stability;

State Estimation means the methodology and algorithms used to calculate a reliable set of measurements defining the state of the transmission system out of the redundant set of measurements which might contain faulty and inaccurate values or where some measurement values are missing;

Synchronous Area means an area covered by interconnected TSOs with a common system frequency in a steady operational state;

System Defence Plan means the summary of all technical and organisational measures undertaken to prevent the propagation or deterioration of an incident in the transmission system, in order to avoid a widespread disturbance and Blackout State;

System Operator Employee means the person in charge of the operation of the transmission system in real-time;

System Protection Schemes (SyPS) means the set of coordinated and automatic measures designed to ensure fast reaction to disturbances and to avoid their propagation through transmission system. SyPS can be event or measure based and may use telecommunication infrastructure to transmit the tripping functions;

System State means the operational state of the transmission system in relation to the Operational Security Limits;

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Transitory Admissible Overloads means the temporary overloads of transmission system elements or secondary equipment which are allowed for a limited period in case of switching or Fault and which do not cause physical damage to the elements or secondary equipment as long as the defined duration and thresholds are respected;

Transmission Circuit means the system of three-phase alternating current conductors with, where relevant, accompanying earth wire and other AC transmission hardware, or a direct-current conductor(s) with accompanying DC transmission hardware;

Transmission Line means the system of structures, wires, insulators and associated hardware that carry electric energy from one point to another in an electric power system. Transmission Lines are operated at voltages varying from 50 kV up to 765 kV. One Transmission Line can have one or more Transmission Circuits;

Voltage Control means the balancing of the reactive power needs of the network and the Grid Users in order to maintain permitted voltage profile;

Voltage Stability means the ability of a transmission system to maintain acceptable voltages at all buses in the system under N-Situation and after being subjected to a disturbance in (N-1)-Situation;

Wide Area means the qualification of an Alert, Emergency or Blackout State when there is a risk of propagation to the interconnected transmission systems.

Article 3

REGULATORY ASPECTS

1. The requirements established in this Network Code and their applications are based on the principle of non-discrimination and transparency as well as the principle of optimisation between the highest overall efficiency and lowest total cost for all involved parties.

2. Notwithstanding the above, the application of non-discrimination principle and the principle of optimization between the highest overall efficiency and lowest total costs while maintaining Operational Security as the highest priority for all involved parties, shall be balanced with the aim of achieving the maximum transparency in issues of interest for the market and the assignment to the real originator of the costs.

3. Where reference is made to this paragraph, the TSO and/or DSO shall, in cooperation with their national regulatory authority, establish the terms and conditions or actions necessary to ensure Operational Security in accordance with the principles of transparency, proportionality and non-discrimination. The establishment of these terms and conditions or actions necessary to ensure Operational Security shall be performed in compliance with and respecting the TSO's responsibility to ensure system security according to national legislation.

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Article 4

RECOVERY OF COSTS

1. The costs related to the obligations referred to in this Network Code which have to be borne by regulated transmission system Operators shall be assessed by National Regulatory Authorities.

2. Costs assessed as reasonable and proportionate shall be recovered in a timely manner via network tariffs or appropriate mechanisms as determined by National Regulatory Authorities.

3. If requested by National Regulatory Authorities, regulated Transmission System Operators shall, within three months of such a request, use best endeavours to provide such additional information as reasonably requested by National Regulatory Authorities to facilitate the assessment of the costs incurred.

Article 5

CONFIDENTIALITY OBLIGATIONS

1. Each TSO, DSO, Power Generating Facility Operator or Demand Facility Operator shall preserve the confidentiality of the information and data submitted to them in connection with this Network Code and shall use them exclusively for the purpose they have been submitted in compliance with this Network Code.

2. Without prejudice to the obligation to preserve the confidentiality of commercially sensitive information obtained in the course of carrying out its activities, each TSO shall provide to the operator of any other transmission system with which its system is interconnected, sufficient information to ensure the secure and efficient operation, coordinated development and interoperability of the interconnected system.

3. Regional coordination initiatives or centres shall preserve the confidentiality of the information and data submitted to them in connection with this Network Code and shall use them exclusively for the purpose they have been submitted, in compliance with this Network Code.

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