Danish Energy Agency

ERAV
Electricity Regulatory Authority of Vietnam

Grid Codes: Comparison of Vietnamese and European Grid Codes

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Document history

Rev.	Date	Author	Reviewer	Description
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0.1	2020.06.12	Knud Johansen	ERAV, DEA	Revised after comments from ERAV, DEA and LC
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1.0	2020.10.08	Knud Johansen	ERAV	Document release for final comments

1. Acronyms

AS	Ancillary Services
C21	Circular 21 - On regulating the pricing method for electric power system's ancillary services and the procedure for scrutinizing a contract for provision of electric power system's ancillary services.
C25	Circular 25 – The regulations on electricity transmission system
C39	Circular 39 – The regulations on electricity distribution system
C40	Circular 40 – The procedure for dispatching of national power system
C55	Circular 55 – Technical requirements and management and operation of the SCADA system
CACM	Capacity Allocation and Congestion Management
CDSO	Closed Distribution System Operator – Military campus, University Campus, etc.
CGM	ENTSO-E Common Grid Model
DSO	Distribution System Operator
EB GL	Electricity Balancing Guideline
FCA GL	Forward Capacity Allocation Guideline
GC	Grid Code
GL	European Guideline
IGM	ENTSO-E Individual Grid Model
ISO	Independent System Operator – system balancing responsible
NC	European Network Code
NC DCC	Network code for connection of demand facilities to the transmission grid
NC ER	Network Code for emergency and system restoration
NC HVDC	Network Code for HVDC systems
NC RfG	Network Code for connecting all types of generators
NEMO	Nominated Electricity Market Operators – e.g. Nord Pool
QD106	Decision 106 - The procedure of identifying and operating ancillary services
RG CE	Region Central Europe – Central European synchronous area with 26 countries
RG NORDIC	Region Nordic – Nordic synchronous area with 4 countries
RSO	Relevant System Operator – could be a TSO, DSO or CDSO, depending on the specific grid
RTO	Regional Transmission System Operator
SA	Synchronous Area – an electricity system with the same frequency
SO GL	ENTSO-E System Operation Guideline
TSO	Transmission System Operator
VN	Vietnam

2. Introduction

This document provides a comparison of current grid code regulation in Vietnam to international regulation, especially European/Danish rules, looking primarily at the structure of these grid codes. An overview of relevant grid code documents for selected countries is provided in this document.

The purpose is to compare existing Vietnamese grid code with the referenced documents and point out differences related to the structure of each one at article level. Based on the resulting list of structural differences, this document includes recommendations for revisions of specific points in future releases of the VN GC documents.

3. Scope of document

Compare regulation in Vietnamese grid codes to international regulation, especially European/Danish rules, focusing on the regulation structure in each area/country.

Compare existing Vietnamese grid codes to those of selected countries and point out structural differences in each grid code at article level.

Based on a list of structural differences, present recommendations on how differences found could enrich future revisions of the VN grid code documents.

This document is provided as deliverable 3.1 according to the VN DEPP DE2 ToR agreement.

4. Grid codes in Vietnam

The VN regulations for the power sector consist of the following documents.

- Regulation for licensing of power producers, transmission system operators, regional transmission system operators, distribution system operators, wholesale and retailors.
- Regulation on grid connection - minimum Technical requirements, responsibilities of relevant parties involving in connection
- Regulation on system operation - transmission system, distribution system
- Regulation on operational procedures for system security, system balancing (generation and demand) in real time, dimensioning of ancillary services and reserve dimensioning, incident classification.
- Market Regulation for generation: market rule; market procedure; capacity calculation, capacity pricing; metering code; settlement of disputes
- Regulation on tariffs for generation, transmission, distribution and end-user.
- Regulation on PPA contracts

The grid code documents of relevance for this report on grid connection and system operation are the following documents.

4.1 Grid connection codes

C25 Circular 25 – "The regulations on electricity transmission system"
The document states a mix of requirements among others some of the requirements to be met in order to be granted a grid connection, some other requirements to the transmission grid system operator as well as requirements for grid system operation and providers of ancillary services. The document also includes a description of some of the responsibilities of the various parties involved.

C30 Circular 30 – "Amendments to some articles of C25"
The document states corrective amendments to C25 and C39.

C39 Circular 39 – "The regulations on electricity distribution system"
The document states a mix of requirements among others some of the requirements to be met to be granted a grid connection, some requirements to the distribution grid system operator as well as requirements for distribution system operation and demand facility obligations.

4.2 System operation codes

C40 Circular 40 – "The procedure for dispatching of national power system"
The document states operational procedures for dispatching power generating facilities.

C31 Circular 31 – "Amending and supplementing a number of articles of C28, C40 and C44"
The document states corrective amendments to C40.

QD106 Decision 106 – "The procedure of identifying and operating ancillary services"
The document states operational procedures for identifying, verifying compliance of and activating power generating facilities.

4.3 Market codes

Not of relevance for this report.

4.4 The structure of the Vietnam grid codes

4.4.1 The structure of the C25/2016/TT-BCT document

The structure of the grid connection code for transmission-connected facilities are presented in the table below.

Chapter I, GENERAL PROVISIONS		C25/2016/TT-BCT
		Article 1. Governing scope
		Article 2. Regulated entities
		Article 3. Interpretation of terms
Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICITY TRANSMISSION SYSTEM		
		Article 4. Frequency
		Article 5. Stabilization of electricity system
		Article 6. Voltage
		Article 7. Phase balance
		Article 8. Harmonics
		Article 9. Flicker perceptibility
		Article 10. Voltage fluctuation
		Article 11. Neutral grounding
		Article 12. Short-circuit current and fault clearing time
		Article 13. Earth fault factor
		Article 14. Reliability of transmission grid
		Article 15. Loss of power on transmission grid
Chapter III, LOAD FORECASTING FOR NATIONAL ELECTRICITY SYSTEM		
		Article 16. General provisions on residual load forecasting for national electricity system
		Article 17. Annual load forecasting
		Article 18. Monthly load forecasting
		Article 19. Weekly load forecasting
		Article 20. Daily load forecasting
		Article 21. Load forecasting in a electricity market transaction cycle
~~Chapter IV, TRANSMISSION GRID DEVELOPMENT PLAN~~		***Note:*** *this chapter is removed according to the C30 statements.* *Question: where will these requirements be placed in the future? In the proposed grid planning code?*
		~~Article 22. General principle~~

		~~Article 23. Content of transmission grid development plan~~
		~~Article 24. Responsibility for supplying information serving formulation of transmission grid development plan~~
		~~Article 25. Procedures for formulation, approval and public announcement of transmission grid development plans~~
Chapter V, CONNECTION TO TRANSMISSION GRID	Section 1. GENERAL PRINCIPLE	
		Article 26. Connection point
		Article 27. Borders of assets and operation management
		Article 28. General requirements
	Section 2. GENERAL TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTING TO TRANSMISSION GRID	
		Article 29. Requirements for connecting equipment
		Article 30. Requirements for protective relay system
		Article 31. Requirements for information system
		Article 32. Requirements for connection of SCADA system
		Article 33. Neutral grounding in transformers
		Article 34. Power factor
		Article 35. Load fluctuation
		Article 36. Automatic frequency load shedding system
		Article 37. Requirements of Control Center
	Section 3. TECHNICAL REQUIREMENTS FOR CONNECTION TO HYDRO POWER PLANTS AND THERMO POWER PLANTS	
		Article 38. Requirements for generating sets' power control
		Article 39. Excitation system of a generating set
		Article 40. Governor

		Article 41. Black start
	Section 4. TECHNICAL REQUIREMENTS OF WIND AND SOLAR POWER PLANTS	
		Article 42. Technical requirements of wind and solar power plants
	Section 5. PROCEDURES FOR CONNECTION AGREEMENT	
		Article 43. Procedures
		Article 44. Time limit for execution of connection agreement
	Section 6. IMPLEMENTATION OF CONNECTION AGREEMENT	
		Article 45. Rights to get access to equipment at connection points
		Article 46. Dossier for inspection of energizing conditions
		Article 47. Inspection of conditions for energizing connection points
		Article 48. Energizing connection points
		Article 49. Trial operation, acceptance and official operation of equipment behind connection points
		Article 50. Inspection and monitoring of equipment after being put into official operation
		Article 51. Replacement of equipment at connection points
	Section 7. PREPARATION FOR ENERGIZING ELECTRICAL EQUIPMENT OF TRANSMISSION NETWORK OPERATOR	
		Article 52. Dossier for inspection of connection point energizing conditions
		Article 53. Energizing
		Article 54. Replacement of equipment on transmission grid
		Article 55. General provisions on disconnection and reconnection
		Article 56. Voluntary disconnection
		Article 57. Compulsory disconnection
		Article 58. Reconnection

Chapter VI, OPERATION OF ELECTRICITY TRANSMISSION SYSTEM	Section 1. OPERATING PRINCIPLES	
		Article 59. Operation modes of electricity transmission system
		Article 60. Operating principles of electricity transmission system
		Article 61. Inspection and monitoring of protective relay system
		Article 62. Stable operation of electricity system
		Article 63. Trial operation and monitoring
		Article 64. Handling of incident
		Article 65. Notice of decline in electricity system security
		Article 66. Load shedding for electricity system security
	Section 2. RESPONSIBILITY OF UNITS IN OPERATION OF ELECTRICITY TRANSMISSION SYSTEM	
		Article 67. Responsibility of electricity system and market operator
		Article 68. Responsibility of transmission network operator
		Article 69. Responsibility of generating units
		Article 70. Responsibility of electricity distribution units, electricity retailers
		Article 71. Responsibility of electricity customers
	Section 3. ANCILLARY SERVICES	
		Article 72. Types of ancillary services
		Article 73. Technical requirements of ancillary services
		Article 74. Principles of determining demand for ancillary services
		Article 75. Registration of ancillary services
	Section 4. MAINTENANCE AND REPAIR OF ELECTRICITY TRANSMISSION SYSTEM	
		Article 76. General provisions on maintenance and repair of electricity transmission system

		Article 77. Establishment of plan for maintenance and repair of electricity transmission system
		Article 78. Order of priority on separation of equipment for maintenance and repair
		Article 79. Registration for separation of equipment for maintenance and repair
		Article 80. Separation of equipment in operation for urgent repair
		Article 81. Reports on urgent separation of equipment for repair
	Section 5. ELECTRICITY SYSTEM SCHEDULING AND DISPATCHING	
		Article 82. Day-ahead mobilization schedules
		Article 83. Obligations for system security
		Article 84. Real-time dispatching
		Article 85. Methods of real-time operation of electricity system
	Section 6. COORDINATION IN OPERATION, EXCHANGE OF INFORMATION AND OPERATION REPORTING MODES	
		Article 86. General responsibility for operation coordination
		Article 87. Exchange of information
		Article 88. Confidentiality
		Article 89. Reporting of incidents in national electricity system
		Article 90. Reporting of performance of transmission grid
		Article 91. Reporting of operation plan and result of operation of national electricity system
Chapter VII, ASSESSMENT OF ELECTRICITY SYSTEM SECURITY		
		Article 92. General provisions on assessment of electricity system security
		Article 93. Reserve capacity and electrical energy of electricity system
		Article 94. Assessment of medium-term assessment of electricity system security
		Article 95. Assessment of short-term assessment of electricity system security

Chapter VIII, ASSESSMENT OF QUALITY OF OPERATION OF ELECTRICITY TRANSMISSION SYSTEM		
		Article 96. General requirements
		Article 97. Performance indicators of electricity system and market operator
		Article 98. Performance indicators of transmission network operator
Chapter IX, SETTLEMENT OF DISPUTES AND HANDLING OF VIOLATION		
		Article 99. Settlement of disputes
		Article 100. Handling of violation
Chapter X, IMPLEMENTATION		
		Article 101. Implementation
		Article 102. Effect

4.4.2 The structure of the C39/2015/TT-BCT document

The structure of the grid connection code for distribution-connected facilities are presented in the table below.

Chapter I, GENERAL RULES		C39/2015/TT-BCT
		Article 1. Scope
		Article 2. Subject of applications
		Article 3. Definitions
Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICAL DISTRIBUTION SYSTEM	Section 1. TECHNICAL REQUIREMENTS	
		Article 4. Frequency
		Article 5. Voltage
		Article 6. Balance Phase
		Article 7. Harmonics voltage
		Article 8. Blinking voltages
		Article 9. Short-circuit and eliminate the problem of time
		Article 10. Grounding mode

		Article 11. Coefficient of trouble touching the ground
	Section 2. ELECTRICITY SUPPLY RELIABILITY AND POWER LOSS	
		Article 12. Indication of power supply reliability of distribution grids
		Article 13. Index of power supply reliability
		Article 14. Loss of power distribution grid
		Article 15. The order of approval of the norm of power supply reliability, annual electricity loss of the distribution grid
	Section 3. QUALITY REQUIREMENT OF CUSTOMER SERVICE	
		Article 16. The target quality of service customers
		Article 17. Require quality of service customers
Chapter III, DEMAND FORECASTING ELECTRIC LOADING DISTRIBUTION ELECTRIC SYSTEM		
		Article 18. General provisions on forecasting the demand for electricity load of the electricity distribution system
		Article 19. Forecast of electricity load demand year
		Article 20. Forecast of monthly load demand
		Article 21. Forecast of electricity demand for weekly load
~~Chapter IV, INVESTMENT PLAN FOR DEVELOPMENT OF DISTRIBUTION ELECTRIC NETWORK~~		***Note:*** *this chapter is removed according to the C30 statements.* *Question: where will these requirements be placed in the future? In the proposed grid planning code?*
		~~Article 22. General provisions on investment plans to develop distribution grids~~
		~~Article 23. Requirements for investment plans to develop electricity distribution network every year~~
		~~Article 24. Content of investment plan to develop distribution grid~~
		~~Article 25. Order of approving investment plans to develop distribution grid~~

Chapter V, CONNECTION TO DISTRIBUTION GRID	Section 1. GENERAL PRINCIPLE	
		Article 26. Connection points
		Article 27. Boundary of asset allocation and operation management
		Article 28. Complying with electricity development planning
		Article 29. Responsibility to comply with the connection requirements and coordinate the connection
	Section 2. TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTION	
		Article 30. Requirements for electrical equipment connected
		Article 31. Requirements phase balance
		Article 32. Requirements for harmonics
		Article 33. Requirements on voltage flicker
		Article 34. Requirement for groundwater regime
		Article 35. Power factor requirements
		Article 36. Protection system requirements
		Article 37. Information system requirements
		Article 38. Requirements for connecting SCADA system
		Article 39. Requirements for generating sets of hydroelectric plants and thermal power plants connected to distribution networks
		Article 40. Requirements for the wind power, solar power plant connected to the electricity distribution networks from the medium voltage level upwards
		Article 41. Requirements for solar power system connected to the distribution grid with low voltage supply
		Article 42. Technical requirements of the Control Center
	Section 3. ORDER AND PROCEDURES FOR CONNECTION AGREEMENT	
		Article 43. Application for connection
		Article 44. Order of agreement on connection of medium voltage and 110 Kv

		Article 45. Time limit for reviewing and signing the Connection Agreement
	Section 4. IMPLEMENTATION OF WIRING TO CUSTOMER USE DISTRIBUTED ELECTRIC NETWORK	
		Article 46. Access to equipment at the connection point
		Article 47. Provide documents to check the condition of electrical connection points for K customers using distribution grid at 110 kV voltage level and customers have generator sets connected at medium voltage level
		Article 48. Provide documents to check the condition of electrical connection points for customers using electricity with separate power stations connected to medium voltage grid
		Article 49. Check condition energized connection points
		Article 50. Close electrical connection points
		Article 51. Test and acceptance order to put into operation of equipment after connection point
		Article 52. Check and monitor the operation of connection devices
		Article 53. Replace and install additional equipment at the connection point
		Article 54. Implementation of antihypertensive connected to the grid for electricity customers
	Section 5. PREPARARING ENERGIZING FOR CONNECTION POINT TO ELECTRICAL EQUIPMENT DISTRIBUTION OPERATOR	
		Article 55. Provide records to check the condition of electrical connection points for electrical equipment of the electricity distribution unit
		Article 56. Power connection points for electrical equipment of the electricity distribution unit
		Article 57. Replace and install additional equipment on the distribution grid
	Section 6. DISCONNECTION AND RESTORING CONNECTION	

		Article 58. General provisions for connection separation and connection recovery
		Article 59. Separating voluntary connection
		Article 60. Required splice
		Article 61. Restore connection
Chapter VI, OPERATION OF DISTRIBUTION ELECTRIC SYSTEM	Section 1. RESPONSIBILITIES IN OPERATION	
		Article 62. Responsibilities of the electricity distribution unit
		Article 63. Responsibilities of the national electricity system moderation unit, the moderation level have control
		Article 64. Responsibilities of the Customer uses electricity distribution networks
	Section 2. MAINTENANCE PLAN AND REPAIR DISTRIBUTION ELECTRIC SYSTEM	
		Article 65. General provisions on the protection and line repair system in distribution
		Article 66. Plan for maintenance and repair of the year
		Article 67. Plan for maintenance and repair of the month
		Article 68. Planning maintenance, repair weeks
	Section 3. PLAN OF OPERATION	
		Article 69. operating plan year
		Article 70. Operational planning months
		Article 71. Operational planning week
		Article 72. Mode of operating the day
		Article 73. Operating distribution electricity system
	Section 4. OPERATION IN EMERGENCY	
		Article 74. Emergency situation
		Article 75. Operating distribution power system in case of breakdown or disintegration of whole or part of transmission power system

		Article 76. Operating distribution electricity system in case of island separation
		Article 77. Operating power distribution system when a serious incident occurs on the power distribution grid voltage of 110 kV
		Article 78. Restore power distribution system
	Section 5. LOAD AND VOLTAGE CONTROLS	
		Article 79. Load control
		Article 80. Stop reducing the power supply
		Article 81. Develop a plan to sack load
		Article 82. Measures to lay off load
		Article 83. Performing load dismissal
		Article 84. Perform voltage regulators
		Article 85. Monitoring and Remote Control
	Section 6. EXCHANGE INFORMATION IN OPERATION AND REPORTING REGIME	
		Article 86. Information exchange form
		Article 87. Information exchange in operation
		Article 88. Notice of unusual situations
		Article 89. Notice of serious incidents
	Section 7. COORDINATION OF OPERATION	
		Article 90. General responsibility in coordinating operation
		Article 91. Coordinate the operation
	Section 8. TEST ON THE DISTRIBUTION ELECTRIC SYSTEM	
		Article 92. General requirements for experiments on distribution power systems
		Article 93. Cases of experimenting on equipment on distribution grid
		Article 94. Cases of experiment of generating sets
		Article 95. Responsibility in experimental equipment on distribution grid
		Article 96. Experimental order at the request of the Power Distribution Unit

		Article 97. Experimental order at the request of customers using distribution grid
		Article 98. Responsibility after the experiment
	Section 9. REPORT ON OPERATION OF DISTRIBUTION ELECTRICITY SYSTEM	
		Article 99. The reporting regime
Chapter VII, IMPLEMENTATION		
		Article 100. Organization of implementation
		Article 101. Amending a number of Articles of Circular No. 12/2010 / TT-BCT dated April 15, 2010 of the Minister of Industry and Trade regulating transmission power system and Circular No. 40/2014 / TT-BCT dated November 5 in 2014, the Minister of Industry and Trade stipulated the regulation of national electricity system regulation
		Article 102. Effect

4.4.3 The structure of the C40/2014/TT-BCT document

The structure of the operational procedures for dispatching, as well as roles and responsibilities and training of system dispatchers for grid-connected facilities are presented in the table below.

Chapter I, GENERAL PROVISIONS		C40/2014/TT-BCT
		Article 1. Scope of regulation
		Article 2. Subject of application
		Article 3. Interpretation of terms
		Article 4. General provisions on power system dispatching
Chapter II, DISPATCHING HIERARCHY AND RIGHTS OF DISPATCHING LEVELS	Section 1. DISPATCHING HIERARCHY OF NATIONAL POWER SYSTEM AND HIERARCHY OF RIGHT OF CONTROL AND INSPECTION AND GRASP OF INFORMATION	
		Article 5. Dispatching hierarchy of national power system
		Article 6. Principles of hierarchy of control and inspection authority

	Section 2. CONTROL AUTHORITY, INSPECTION AUTHORITY AND INFORMATION GRASPING RIGHT	
		Article 7. Control authority
		Article 8. Inspection authority of superior dispatching level
		Article 9. Information grasping right
		Article 10. The control and inspection and information grasping right in case of breakdown or breakdown threatening case
	Section 3. RIGHT OF NATIONAL DISPATCHING LEVEL	
		Article 11. Control authority of national dispatching Level
		Article 12. Inspection authority of the national dispatching Level
		Article 13. Information grasping right of national dispatching Level
	Section 4. RIGHT OF REGIONAL DISPATCHING LEVEL	
		Article 14. Control authority of regional dispatching level
		Article 15. Inspection authority of regional dispatching level
		Article 16. Information grasping right of regional dispatching level
	Section 5. RIGHT OF PROVINCIAL DISPATCHING LEVEL	
		Article 17. Control authority of provincial dispatching level
		Article 18. Inspection authority of provincial dispatching level
		Article 19. Information grasping right of provincial distribution dispatching level
	Section 6. RIGHT OF DISTRICT DISTRIBUTION DISPATCHING LEVEL	
		Article 20. Control authority of district distribution dispatching level

		Article 21. Inspection authority of district distribution dispatching level
		Article 22. Information grasping right of district distribution dispatching level
	Section 7. RIGHT OF UNIT MANAGING AND OPERATING POWER PLANT, POWER STATION AND CONTROL CENTER	
		Article 23. Control authority of power plant, power station and control center
		Article 24. Information grasping right of power plant, power station and control center
Chapter III, RESPONSIBILITY OF DISPATCHING LEVELS AND UNITS INVOLVED IN DISPATCHING AND OPERATION OF NATIONAL POWER SYSTEM		
		Article 25. Basic objectives of dispatching of nation power system
	Section 1. RESPONSIBILITY OF DISPATCHING LEVELS	
		Article 26. Responsibility of national dispatching Level
		Article 27. Responsibility of regional dispatching level
		Article 28. Responsibility of provincial distribution dispatching level
		Article 29. Responsibility of district distribution dispatching level
	Section 2. RESPONSIBILITY OF UNITS INVOLVED IN OPERATION OF NATIONAL POWER SYSTEM	
		Article 30. Responsibility of power generating units
		Article 31. Responsibility of power transmission units
		Article 32. Responsibility of power distributing units
		Article 33. Responsibility of the power retailing and distributing units

		Article 34. Responsibility of telecommunications services providers
		Article 35. Responsibility of gas suppliers for power generation
Chapter IV, OPERATION MODE OF POWER SYSTEM	Section 1. REGISTRATION AND APPROVAL OF OPERATION MODE OF POWER SYSTEM	
		Article 36. Main contents of operation mode of power system
		Article 37. Approval of operation mode of power system
		Article 38. Content of mode registration
		Article 39. Order of registration of year-ahead operation mode
		Article 40. Notification order of operation mode
	Section 2. DEVELOPMENT OF OPERATION MODE OF POWER SYSTEM	
		Article 41. Basic one-line diagram of power system
		Article 42. Forecasting of power load demand
		Article 43. Evaluation of power system security
		Article 44. Plan of power source and power network maintenance and repair
		Article 45. Plan to put new works into operation
		Article 46. Switching Form
		Article 47. Trial and testing plan during equipment operation
		Article 48. Power source mobilization plan
Chapter V, DISPATCHING AND OPERATION OF NATIONAL POWER SYSTEM IN REAL TIME	Section 1. GENERAL PROVISIONS	
		Article 49. Contents of dispatching instructions
		Article 50. Form of dispatching instructions
		Article 51. Requirements for compliance with dispatching instructions
		Article 52. National dispatching Level
		Article 53. Regional dispatching level
		Article 54. Provincial distribution dispatching level
		Article 55. District distribution dispatching level
		Article 56. Working relationship in dispatching and operation of power system

		Article 57. Report on daily operation and breakdown
	Section 2. OPERATION SHIFT REGULATION	
		Article 58. Regulation on shift handover and acceptance
		Article 59. Regulations for operator during shift duty
	Section 3. POWER PLANT AND POWER STATION WITHOUT OPERATOR	
		Article 60. Conditions to allow power plant or power station without operator
		Article 61. Operation of power plant or power station without operator on shift duty
	Section 4. FREQUENCY CONTROL	
		Article 62. Frequency meter
		Article 63. Requirements for speed control system of power generator
		Article 64. Regulation on primary frequency controlling levels
		Article 65. Regulation on frequency control
		Article 66. Measures of frequency control
		Article 67. Limit of voltage
		Article 68. Principles of voltage adjustment
		Article 69. Requirements for excitation of power generator with installed capacity over 30MW
		Article 70. Regulation on voltage adjustment
		Article 71. Hierarchy of voltage calculation and balance of reactive capacity
		Article 72. Regulations on voltage diagram
		Article 73. Measures of voltage adjustment
	Section 6. POWER NETWORK CONTROL	
		Article 74. Switching activities of power network control
		Article 75. Automatic power network control
		Article 76. Outage of lines and electrical equipment
	Section 7. POWER SOURCE CONTROL	
		Article 77. Diagram of generating capacity of power source

		Article 78. Implementation of diagram of active capacity generation
		Article 79. Self-control of active capacity generation
	Section 8. LOAD CONTROL	
		Article 80. Notification of control of non-emergency usable capacity
		Article 81. Dispatching instructions on control of emergency usable capacity
		Article 82. Breakdown load switching due to shortage of power source as per dispatching instruction
		Article 83. Automatic load shedding under low frequency
		Article 84. Load switching due to overloading or low voltage
	Section 9. BREAKDOWN TROUBLESHOOTING, BLACK START AND RESTORATION OF POWER SYSTEM	
		Article 85. Breakdown troubleshooting of power system
		Article 86. Black start and restoration of power system
Chapter VI, DUTIES OF DIVISIONS DIRECTLY INVOLVED IN DISPATCHING AND OPERATION ACTIVITIESOF NATIONAL POWER SYSTEM	Section 1. NATIONAL DISPATCHING LEVEL	
		Article 87. Divisions directly involved in dispatching activities of national power system
		Article 88. Regulations on employee of national dispatching division on duty
		Article 89. Duties, powers and responsibilities of national dispatcher
		Article 90. Duties of short-term Operational planning Division
		Article 91. Duties of long-term operational planning Division
		Article 92. Duties of automatic and protective relay setting and calculating Division
		Article 93. Duties of computers & communication Division

	Section 2. REGIONAL DISPATCHING LEVEL	
		Article 94. Divisions directly involved in dispatching activities of regional power system
		Article 95. Regulations on employees of regional dispatching division on duty
		Article 96. Duties, powers and responsibilities of regional dispatchers
		Article 97. Duties of short-term Operational planning Division
		Article 98. Duties of long-term Operational planning Division
		Article 99. Duties of automatic and protective relay setting and calculating Division
		Article 100. Duties of Computers & Communication Division
	Section 3. PROVINCIAL DISTRIBUTION LEVEL	
		Article 101. Divisions directly involved in dispatching activities of distribution power system
		Article 102. Regulations on provincial distribution dispatching division on duty
		Article 103. Responsibilities, powers and responsibilities of provincial distributing dispatchers
		Article 104. Duties of short-term operational planning Division
		Article 105. Duties of long-term operational planning Division
		Article 106. Duties of automatic and protective relay division
		Article 107. Duties of computers & communication division
	Section 4. DISTRICT DISTRIBUTION DISPATCHING LEVEL	
		Article 108. Regulation on operation shift of district distribution dispatching level
	Section 5. OPERATORS AT POWER PLANTS, POWER STATIONS AND CONTROL CENTERS	
		Article 109. Divisions directly involved in operation
		Article 110. Regulation on operation shift

		Article 111. Duties of chief operators of power plant or control center of power plant
		Article 112. Duties of team leaders of power station or control center
Chapter VII, TRAINING OF TITLES DIRECTLY INVOLVED IN DISPATCHING AND OPERATION OF NATIONAL POWER SYSTEM	Section 1. GENERAL PROVISIONS	
		Article 113. Titles directly involved in **dispatching and operation of national power system**
		Article 114. Regulation on examination and issue of operation Certificate
		Article 115. Training of operator at dispatching levels
		Article 116. Training of operators at power plants, power stations or control centers.
		Article 117. General responsibilities
	Section 2. TRAINING AT NATIONAL POWER SYSTEM	
		Article 118. Regulation on new training for national dispatchers
		Article 119. Regulation on re-training for national dispatcher
		Article 120. Regulation on training of power system planning and analysis engineer for national power system
		Article 121. Regulation on training for SCADA/EMS engineer of national power system
	Section 3. TRAINING AT THE REGIONAL DISPATCHING LEVEL	
		Article 122. Regulations on new training for regional dispatcher
		Article 123. Regulation on re-training for regional dispatcher
		Article 124. Regulation on training for power system planning and analysis engineer of regional power system
		Article 125. Regulation on training for SCADA/EMS engineer of regional power system
	Section 4. TRAINING AT PROVINCIAL DISTRIBUTION DISPATCHING LEVEL	

		Article 126. Regulation on new training for provincial distributing dispatcher
		Article 127. Regulation on re-training for provincial distributing dispatcher
		Article 128. Regulation on training for engineer of distribution power system
		Article 129. Regulation on training for SCADA/DMS engineer of distribution power system
	Section 5. TRAINING AT DISTRICT DISTRIBUTION DISPATCHING LEVEL	
		Article 130. Regulation on new training of district distributing dispatcher
		Article 131. Regulation on re-training for district distributing dispatcher
	Section 6. TRAINING AT POWER PLANT, POWER STATION AND CONTROL CENTER	
		Article 132. Regulation on new training for Chief operator of power plant or control center of power plant
		Article 133. Regulation on new training for Team leader of power station or control center of power station
		Article 134. Regulation on re-training for Chief operator of power plant and Team leader of power station or control center
Chapter VIII, IMPLEMENTATION ORGANIZATION		
		Article 135. Implementation organization
		Article 136. Effect

5. Grid codes in Europe

European grid code regulation consists of network codes (NCs) and guidelines (GLs) and comprises the documents listed below.

5.1 Grid connection network codes

a. COMMISSION REGULATION (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (NC RfG)
b. COMMISSION REGULATION (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection NC DCC)
c. COMMISSION REGULATION (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules (NC HVDC)

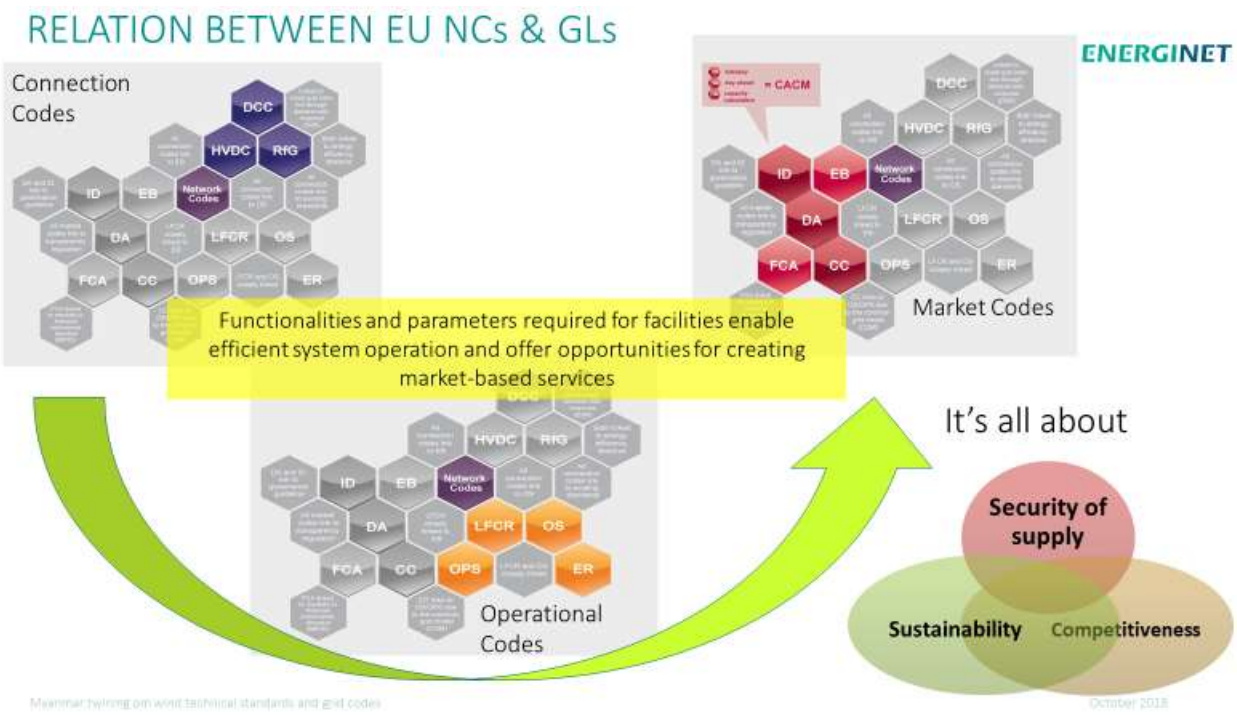
5.2 System operation guideline and network code

a. COMMISSION REGULATION (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SO GL)
b. COMMISSION REGULATION (EU) 2017/2196 of 24 November 2017 establishing a network code on electricity emergency and restoration (NC ER)

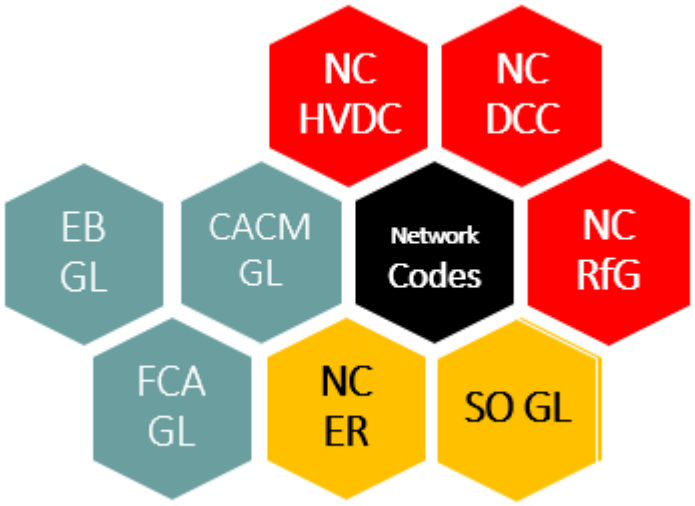
5.3 Market guidelines

a. COMMISSION REGULATION (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (CACM GL)
b. COMMISSION REGULATION (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation (FCA GL)
c. COMMISSION REGULATION (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (EB GL)

The relation between the codes is illustrated in the following figure.



The outcome of the process of creating a harmonised set of network codes and guidelines was the following network codes and guidelines.



The connection codes (red) specify the minimum technical requirements that any kind of power-generating facility must comply with to be connected to the grid system.

The operation network code and guidelines (yellow) specify the minimum technical and organisational requirements as well as roles and responsibilities for parties involved in the operation of facilities connected to the grid system. In addition, the system operation guideline (SO GL) and the related methodologies specify the roles and responsibilities of grid

system operators. NC ER specifies the minimum technical and organisational requirements for all grid users and system operators to safeguard a high level in security of supply.

The market guidelines (grey-blue) specify fundamental capacity algorithms which the system operator notifies the market participants of via the market platform operator.

a. The guideline for Capacity Allocation and Congestion Management (CACM GL) specifies the requirements for capacity calculation for intraday and day-ahead time frames as well as how to handle congestion. In addition, the CACM GL includes requirement for grid description models which are used for capacity and security calculations as well as requirements for market platform operators (NEMOs).
b. The Forward Capacity Allocation guideline (FCA GL) specifies algorithms for calculation and allocation of capacity for transmission of electricity.
c. The Electricity Balancing guideline (EB GL) specifies requirements for balancing and the system operator.

5.4 The structure of the European **connection** network codes

Only main topics are listed in the structural overview of the various network codes.

5.4.1 The structure of the NC RfG document

The overall structure of the NC RfG document is as follows.

NC RfG CONTENT- OVERVIEW

Title I General Provisions

Title II Requirements

- Chapter 1 General Requirements
- Chapter 2 Requirements for Synchronous Power Generating Modules
- Chapter 3 Requirements for Power Park Modules
- Chapter 4 Requirements for Offshore Power Park Modules

Title III Operational Notification Procedure for Connection

- Chapter 1 Connection of New Power Generating Modules
- Chapter 2 Cost Benefit Analysis

Title IV Compliance

- Chapter 1 Compliance Monitoring
- Chapter 2 Compliance Testing for Synchronous Power Generating Modules
- Chapter 3 Compliance Testing for Power Park Modules
- Chapter 4 Compliance Testing for Offshore Power Park Modules
- Chapter 5 Compliance Simulations for Synchronous Power Generating Modules
- Chapter 6 Compliance Simulations for Power Park Modules
- Chapter 7 Compliance Simulations for Offshore Power Park Modules
- Chapter 8 Non-Binding Guidance and Monitoring of Implementation

Title V Derogations

Title VI Transitional Arrangements for Emerging Technologies

Title VII Final Provisions

> 72 articles

5.4.2 The structure of the NC DCC document

The overall structure of the NC DCC document is as follows.

NC DCC CONTENT- OVERVIEW

Title I - General provisions

Title II - Connection of transmission-connected demand facilities, transmission-connected distribution facilities and distribution systems

- Chapter 1 - general requirements
- Chapter 2 - operational notification procedure

Title III - Connection of demand units used by a demand facility or a closed distribution system to provide demand response services to system operators

- Chapter 1 - general requirements
- Chapter 2 - operational notification procedure

Title IV - Compliance

- Chapter 1 - general provisions
- Chapter 2 - compliance testing
- Chapter 3 - compliance simulation
- Chapter 4 - compliance monitoring

Title V - Applications and derogations

- Chapter 1 - cost-benefit analysis
- Chapter 2 - derogations

Title VI - Non-binding guidance and monitoring of implementation

Title VI - Final provisions

> 59 articles

5.4.3 The structure of the NC HVDC document

The overall structure of the NC HVDC document is as follows.

NC HVDC CONTENT- OVERVIEW

TITLE I - General provisions

TITLE II - General requirements for HVDC connections

- CHAPTER 1 - Requirements for active power control and frequency support
- CHAPTER 2 - Requirements for reactive power control and voltage support
- CHAPTER 3 - Requirements for fault ride through capability
- CHAPTER 4 - Requirements for control
- CHAPTER 5 - Requirements for protection devices and settings
- CHAPTER 6 - Requirements for power system restoration

TITLE III - Requirements for DC-connected power park modules and remote-end HVDC converter stations

- CHAPTER 1 - Requirements for DC-connected power park modules (PPM)
- CHAPTER 2 - Requirements for remote-end HVDC converter stations

TITLE IV - Information exchange and coordination

TITLE V - Operational notification procedure for connection

- CHAPTER 1 - Connection of new HVDC systems
- CHAPTER 2 - Connection of new DC-connected power park modules
- CHAPTER 3 - Cost benefit analysis

TITLE VI – Compliance

- CHAPTER 1 - Compliance monitoring
- CHAPTER 2 - Compliance testing
- CHAPTER 3 - Compliance simulations
- CHAPTER 4 - Non-binding guidance and monitoring of implementation

TITLE VII – Derogations

TITLE VIII - Final provisions

>84 articles

5.5 The structure of the EU **operation** guideline and network code

5.5.1 The structure of the SO GL document

The overall structure of the SO GL document is as follows.

SO GL CONTENT- OVERVIEW

PART I - General provisions; article 1- 17

PART II Operational security; article 18 - 63

- Title 1 Operational security requirements; article 18 - 39
- Title 2 Data exchange; article 40 - 53
- Title 3 Compliance; article 54 - 57
- Title 4 Training; article 58 - 63

PART III Operational planning; article 64 - 117

- Title 1 Data for operational security analysis in operational planning; article 64 - 71
- Title 2 Operational security analysis; article 72 - 81
- Title 3 Outage coordination; article 82 - 103
- Title 4 Adequacy; article 104 - 107
- Title 5 Ancillary services; article 108 - 109
- Title 6 Scheduling; article 110 - 113
- Title 7 ENTSO-E operational planning data environment; article 114-117

PART IV Load-frequency control and reserves; article 118 - 190

- Title 1 Operational agreements; article 118 – 126
- Title 2 Frequency quality; article 127 - 138
- Title 3 Load-frequency control structure; article 139 - 151
- Title 4 Operation of load-frequency control; article 152
- Title 5 Frequency containment reserves; article 153 - 156
- Title 6 Frequency restoration reserves; article 157 - 159
- Title 7 Replacement reserves; article 160 - 162
- Title 8 Exchange and sharing of reserves; article 163 - 180
- Title 9 Time control process; article 181
- Title 10 Co-operation with DSOs; article 182
- Title 11 Transparency of information; article 183 - 190

PART V Final provisions; article 191 - 192

> 192 articles

5.5.2 The structure of the NC ER document

The overall structure of the NC ER document is as follows.

NC ER CONTENT- OVERVIEW

CHAPTER I General provisions; article 1- 10

CHAPTER II System Defence Plan; article 11 - 22

- Section 1 General provisions; article 11 - 14
- Section 2 Measures of the system defence plan; article 15 – 22

CHAPTER III Restoration plan; article 23 - 34

- Section 1 General provisions; article 23 - 25
- Section 2 Re-energisation; article 26 – 27
- Section 3 Frequency management; article 28 – 31
- Section 4 Resynchronisation; article 32 - 34

CHAPTER IV Market interactions; article 35 - 39

CHAPTER V Information exchange and communication; article 40 - 42

CHAPTER VI Compliance and review; article 43 - 51

- Section 1 Compliance testing of TSO, DSO, and SGU; article 43 - 49
- Section 2 Compliance testing and review of System Defence Plan and Restoration Plan; article 50 – 51

CHAPTER VII Implementation; article 52 - 53

CHAPTER VIII Final provisions; article 54 - 55

> 55 articles

5.6 The structure of the European **market** guidelines

5.6.1 The structure of the CACM GL document

The overall structure of the CACM GL document is as follows.

CACM GL CONTENT- OVERVIEW

TITLE I - GENERAL PROVISIONS

TITLE II - REQUIREMENTS FOR TERMS, CONDITIONS AND METHODOLOGIES CONCERNING CAPACITY ALLOCATION AND CONGESTION MANAGEMENT

- CHAPTER 1 - Capacity calculation
  - Section 1 – General requirements
  - Section 2 – Common grid model
  - Section 3 – Capacity calculation methodologies
  - Section 4 – The capacity calculation process
  - Section 5 – Biennial report on capacity calculation and allocation
- CHAPTER 2 – Bidding zone configuration
- CHAPTER 3 – Redispatching and countertrading
  - Section 1 – General provisions
  - Section 2 – Options for cross-zonal transmission risk hedging
  - Section 3 – Nomination procedures for physical transmission rights
  - Section 4 – Processes and operation
- CHAPTER 4 – Algorithm development

- CHAPTER 5 – Single day-ahead coupling
  - Section 1 – The price coupling algorithm
  - Section 2 – The single day-ahead coupling process
- CHAPTER 6 – Single intraday coupling
  - Section 1 – Objectives, conditions and results of single intraday coupling
  - Section 2 – The single intraday coupling process
  - Section 3 – Transitional intraday arrangements
-
- CHAPTER 7 – Clearing and settlement for single day-ahead and intraday coupling
- CHAPTER 8 – Firmness of allocated cross-zonal capacity

TITLE III – COSTS

- CHAPTER 1 - Congestion income distribution methodology for single day-ahead and intraday coupling
- CHAPTER 2 – Re-dispatching and countertrading cost sharing methodology for single day-ahead and intraday coupling
- CHAPTER 3 - Capacity allocation and congestion management cost recovery

TITLE IV - DELEGATION OF TASKS AND MONITORING

TITLE V – TRANSITIONAL AND FINAL PROVISIONS

>84 articles

5.6.2 The structure of the FCA GL document

The overall structure of the FCA GL document is as follows.

FCA GL CONTENT- OVERVIEW

TITLE I - GENERAL PROVISIONS

TITLE II - REQUIREMENTS FOR TERMS, CONDITIONS AND METHODOLOGIES

- CHAPTER 1 - Forward capacity calculation
  - Section 1 – General requirements
  - Section 2 – Capacity calculation methodology
  - Section 3 – Common grid model
  - Section 4 – Capacity calculation process
  - Section 5 – Biennial report on capacity calculation
- CHAPTER 2 – Bidding zones
- CHAPTER 3 – Forward capacity allocation
  - Section 1 – General provisions
  - Section 2 – Options for cross-zonal transmission risk hedging
  - Section 3 – Nomination procedures for physical transmission rights
  - Section 4 – Processes and operation
- CHAPTER 4 – Single allocation platform
- CHAPTER 5 – Harmonised allocation rules
- CHAPTER 6 – Firmness of allocated cross-zonal capacity
- CHAPTER 7 – Congestion income distribution
- CHAPTER 8 – Cost recovery

TITLE III - DELEGATION OF TASKS AND MONITORING

TITLE IV - FINAL PROVISIONS

>64 articles

5.6.3 The structure of the EB GL document

The overall structure of the EB GL document is as follows.

EB GL CONTENT- OVERVIEW

TITLE I - GENERAL PROVISIONS

TITLE II - ELECTRICITY BALANCING MARKET

- CHAPTER 1 - Functions and responsibilities
- CHAPTER 2 - European platforms for the exchange of balancing energy

TITLE III - PROCUREMENT OF BALANCING

- CHAPTER 1 – Balancing Energy
- CHAPTER 2 – Balancing Capacity
- CHAPTER 3 – TSO-BSP model

TITLE IV - CROSS-ZONAL CAPACITY FOR BALANCING SERVICES

- CHAPTER 1 – Exchange of balancing energy or imbalance netting process
- CHAPTER 2 – Exchange of balancing capacity or sharing of reserves

TITLE V - SETTLEMENT

- CHAPTER 1 - Settlement principles
- CHAPTER 2 - Settlement of balancing energy
- CHAPTER 3 - Settlement of the exchanges of energy between TSOs
- CHAPTER 4 - Imbalance settlement
- CHAPTER 5 - Settlement of balancing capacity

TITLE VI – ALGORITM

TITLE VII – REPORTING

TITLE VIII – COST BENEFIT ANALYSIS

TITLE IX – DEROGATIONS AND MONTORING

TITLE VIII – TRANSITIONAL AND FINAL PROVISIONS

>65 articles

6. Grid codes in Denmark

The Danish grid codes are based on the implementation of the European network codes and guidelines combined with additional national requirements. The Danish grid codes consist of grid connection codes, system operation codes and market codes, and these are described in the following sections.

6.1 Grid connection codes

As mentioned, the Danish grid connection codes are based on the implementation of the European network codes NC RfG, NC DCC and NC HVDC.

In addition to the implementation of EU network code requirements, the following supplementary documents have been prepared:

1. A set of national connection requirements for energy storage systems (batteries) as storage facilities are not yet covered by the EU network codes.
2. A set of national requirements for power quality parameters for power-generating facilities as this topic is not yet covered by the NC RfG network code.
3. A set of national requirements for electrical simulation models for power-generating facilities and HVDC systems as this topic is not yet fully covered by the NC RfG network code.

The standard structure for grid connection codes in Denmark is shown below.

The standard structure for system operation codes in Denmark follows the EU guideline and network code for emergency and system restoration. Prior to the implementation of the EU guidelines and network codes, the ENTSO-E Operational Handbook was the guiding document on system operation aspects.

The standard structure for market codes in Denmark follows the EU guideline and network code for electricity balancing and capacity calculation. Prior to the implementation of the EU guidelines and network codes, the Nordic market regulations were the guiding documents on market aspects.

6.2 System operation codes

In addition to the European system operation guideline requirements and responsibilities, the following supplementary documents have been prepared:

1. Creation of a Synchronous Area Operational Agreement (SAOA) with the neighbouring SAs: RG Nordic and RG CE.
2. Creation of an LFC block agreement in the SA.
3. Implementation of SO GL requirements and related methodologies.
    a. Methodology 1 – key organizational requirements, roles and responsibilities in relation to data exchange related to operational security in accordance with Article 40(6);
    b. Methodology 2 – methodology for building the common grid models in accordance with Article 67(1) and Article 70;
    c. Methodology 3 – methodology for coordinating operational security analyses in accordance with Article 75;
    d. Methodology 4 – methodology for each synchronous area for the definition of minimum inertia in accordance with Article 39(3)(b);
    e. Methodology 5 – common provisions for each capacity calculation region for regional operational security coordination in accordance with Article 76;
    f. Methodology 6 – methodology, at least per synchronous area, for assessing the relevance of assets to outage coordination in accordance with Article 84;
    g. Methodology 7 – methodologies, conditions and values included in the synchronous area operational agreements in Article 118 concerning: (i) frequency quality defining parameters and frequency quality target parameter in accordance with Article 127; (ii) dimensioning rules for FCR in accordance with Article 153; (iii) additional properties of FCR in accordance with Article 154(2);
    h. Methodology 8 – methodology to determine the minimum provision of FCR reserve capacity between synchronous areas, defined in accordance with Article 174(2)(b); limits on the amount of exchange of FRR between synchronous areas defined in accordance with Article 176(1) and limits on the amount of sharing of FRR between synchronous areas defined in accordance with Article 177(1); methodology to determine the minimum provision of FCR reserve capacity between synchronous areas, defined in accordance with Article 174(2)(b); (ix) (x) limits on the amount of exchange of RR between synchronous areas defined in accordance with Article 178(1) and limits on the amount of sharing of RR between synchronous areas defined in accordance with Article 179(1);
    i. Methodology 9 – methodologies and conditions included in the LFC block operational agreements in Article 119, concerning: (i) ramping restrictions for active power output in accordance with Article 137(3) and (4); (ii) coordination actions aiming to reduce FRCE as defined in Article 152(14); (iii) measures to reduce FRCE by requiring changes in active power generation or consumption of power-generating modules and demand units in accordance with Article 152(16); (iv) FRR dimensioning rules in accordance with Article 157(1); (f) mitigation measures per synchronous area or LFC block in accordance with Article 138; (g) common proposal per synchronous area for the determination of LFC blocks in accordance with Article 141(2).
4. Implementation of NC ER requirements – implementation guidance documents on selected topics.

6.3 Market codes

In addition to European market requirements and responsibilities:

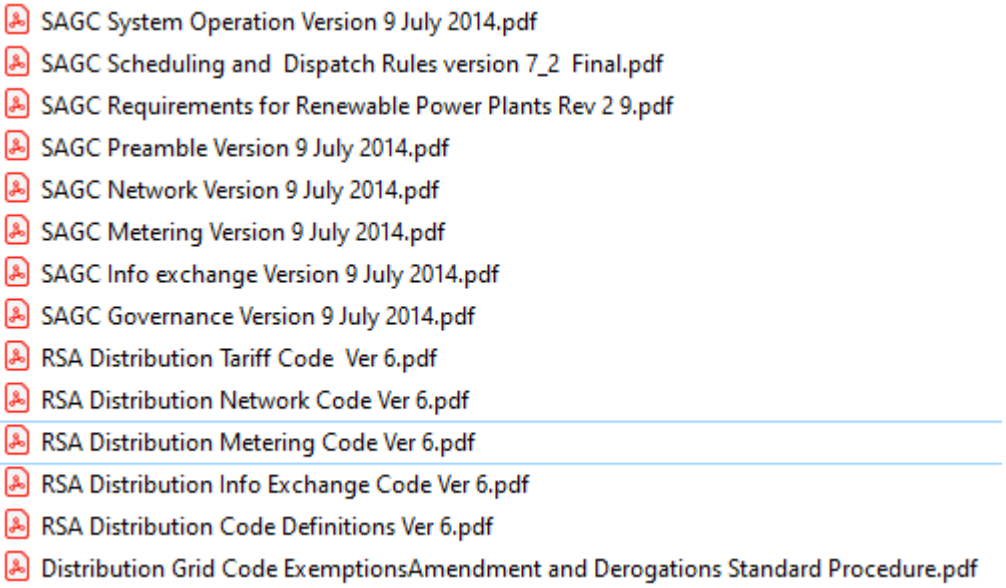
1. Implementation of CACM requirements and related methodologies.
    a. Common Grid Model (CGM)
    b. Individual Grid Model (IGM)
2. Implementation of FCA requirements and related methodologies.

   a. Methodology for capacity calculation
   b. Methodology for capacity allocation
3. Implementation of EB requirements and related methodologies.
   a. Methodology for balancing
   b. Methodology for settlement

7. Grid codes in other countries

7.1 Grid codes in South Africa

7.1.1 The South African grid code consists of the following documents



7.1.2 Structure of the South African network code

The below screenshot exemplifies the contents of the South African network code.

Paragraph No./Title **Page Number**

7.2 Grid codes in Australia

7.2.1 The Australian grid code consists of one document

A lengthy document of 1563 pages comprises all electricity regulation in Australia.

The document “National Electricity Rules, Version 139” comprises connection, operation and market regulations in one document. The document history clearly shows that such a huge document requires a massive maintenance effort and very quickly becomes outdated.

Based on our more than 20 years of experience with global grid codes, it is not recommendable to follow the document strategy applied in Australia as maintenance will become a very time consuming and complex process to manage. One major obstacle for the reader will be to understand the requirements to be fulfil for being granted a grid connection. The reader needs to keep track of all corrections in consecutive order and dig out the final requirement. Such a complexity in reading a document will increase the risk seen from an IPP perspective and as such the VN electricity sector will be less attractive for investors.

7.2.2 Structure of the Australian grid code

The very limited screenshot below exemplifies the contents of the Australian network code.

8. Focal points for a future VN GC structure

Based on the structure and content of the VN grid code documents and several years of experience with the European / Danish / South African / Australian grid code documents, the recommended approach to a revision of the VN grid code documents is to create targeted sections in a complete document with a focused scope for each section for flooring the way for the reader to get hold of the requirements they must fulfil. The justification for creating sections with a focused scope are the following:

a. Readers / stakeholder groups are different for each section of the complete document
b. Technology changes rapidly and needs frequently update of some of the requirements

c. Portfolio of generators evolves very quickly by integrating distributed renewables which might require adjustment of minimum design requirements and adjustment of operational parameters. Requirements could be isolated in annexes with a less complex revision process.
d. Market conditions might require a large degree of flexibility and frequently adjustments. Market conditions could be isolated in annexes with a less complex revision process.

The following chapter uses global best practice to illustrate recommendations for a reorganisation of the content of the current grid code documents into a new set of specific section in a complete document and in further evolutional steps in separate grid code documents as the most frequently observed global practice.

Another aspect of the complete grid code document discussion is to determine if any relevant technical topics or aspects are missing in the current VN circulars / VN grid codes. In report for delivery 3.3 it will be described which topics and aspects is recommended to be included a revised VN complete grid code document. Further details will be given in the D3.3 report.

The present report is focusing the overall structure of the various sections in a revised complete VN grid code. The report on delivery D3.2 will focus on merging of the content of C25 and C39 into one section addressing minimum design requirements for grid connection of generator facilities.

9. Recommendations on revision of VN grid codes

The following three tables list recommendations on how to reorganize the existing VN grid code documents and group them into new a complete grid code document with sections addressing the proposed topics as a first approach.
In a later development stage, the specific sections could be transformed into separate documents if it's feasible and more efficient for maintain an updated legislation for the electricity sector.

The recommend sections in a new VN grid code document are the following:

1. Connection Code – Generators
2. Connection Code – Demand
3. Connection Procedures
4. Operational Code
5. Operational Procedures
6. Market Code - Ancillary Services
7. Grid Planning Code
8. TSO Licensee
9. DSO Licensee
10. Performance assessment (KPI)

The proposed distribution of the current content of C25, C30 and C40 into new sections of a complete VN grid code document is described in more detail in the following subchapters.

9.1 Recommended distribution of the C25 document content

	Current VN grid code document – C25/2016/TT-BCT	Recommendation for a sectional structure of a complete VN grid code document. Proposed sections in a new document.									
		Connection Code - Generators	Connection Code - Demand	Connection Procedures	Operational Code	Operational Procedures	Market Code - Ancillary Services	Grid Planning Code	TSO Licensee	DSO Licensee	Performance assessment (KPI)
	Chapter I, GENERAL PROVISIONS										
	Article 1. Governing scope	X	X	X							
	Article 2. Regulated entities	X	X	X							
	Article 3. Interpretation of terms	X	X	X							
	Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICITY TRANSMISSION SYSTEM										
	Article 4. Frequency								X		
	Article 5. Stabilization of electricity system								X		
	Article 6. Voltage								X		

	Article 7. Phase balance								X		
	Article 8. Harmonics								X		
	Article 9. Flicker perceptibility								X		
	Article 10. Voltage fluctuation								X		
	Article 11. Neutral grounding								X		
	Article 12. Short-circuit current and fault clearing time								X		
	Article 13. Earth fault factor								X		
	Article 14. Reliability of transmission grid								X		
	Article 15. Loss of power on transmission grid								X		
	Chapter III, LOAD FORECASTING FOR NATIONAL ELECTRICITY SYSTEM										
	Article 16. General provisions on residual load forecasting for national electricity system										X
	Article 17. Annual load forecasting										X
	Article 18. Monthly load forecasting										X
	Article 19. Weekly load forecasting										X
	Article 20. Daily load forecasting										X
	Article 21. Load forecasting in a electricity market transaction cycle										X
	Chapter IV, TRANSMISSION GRID DEVELOPMENT PLAN										
	Article 22. General principle							X			
	Article 23. Content of transmission grid development plan							X			
	Article 24. Responsibility for supplying information serving formulation of transmission grid development plan							X			
	Article 25. Procedures for formulation, approval and public announcement of transmission grid development plans							X			
	Chapter V, CONNECTION TO TRANSMISSION GRID										
	Section 1. GENERAL PRINCIPLE										
	Article 26. Connection point	X									
	Article 27. Borders of assets and operation management	X									
	Article 28. General requirements	X									
	Section 2. GENERAL TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTING TO TRANSMISSION GRID										
	Article 29. Requirements for connecting equipment	X									

	Article 30. Requirements for protective relay system	X									
	Article 31. Requirements for information system	X									
	Article 32. Requirements for connection of SCADA system	X									
	Article 33. Neutral grounding in transformers	X									
	Article 34. Power factor		X	X							
	Article 35. Load fluctuation		X	X							
	Article 36. Automatic frequency load shedding system		X	X					X	X	
	Article 37. Requirements of Control Centre	X									
	Section 3. TECHNICAL REQUIREMENTS FOR CONNECTION TO HYDRO POWER PLANTS AND THERMO POWER PLANTS										
	Article 38. Requirements for generating sets' power control	X									
	Article 39. Excitation system of a generating set	X									
	Article 40. Governor	X									
	Article 41. Black start						X				
	Section 4. TECHNICAL REQUIREMENTS OF WIND AND SOLAR POWER PLANTS										
	Article 42. Technical requirements of wind and solar power plants	X									
	Section 5. PROCEDURES FOR CONNECTION AGREEMENT										
	Article 43. Procedures			X							
	Article 44. Time limit for execution of connection agreement			X							
	Section 6. IMPLEMENTATION OF CONNECTION AGREEMENT										
	Article 45. Rights to get access to equipment at connection points	X									
	Article 46. Dossier for inspection of energizing conditions	X	X	X							
	Article 47. Inspection of conditions for energizing connection points	X	X	X							
	Article 48. Energizing connection points	X	X	X							
	Article 49. Trial operation, acceptance and official operation of equipment behind connection points	X	X	X							
	Article 50. Inspection and monitoring of equipment after being put into official operation	X	X	X							

	Article 51. Replacement of equipment at connection points	X	X	X							
	Section 7. PREPARATION FOR ENERGIZING ELECTRICAL EQUIPMENT OF TRANSMISSION NETWORK OPERATOR										
	Article 52. Dossier for inspection of connection point energizing conditions	X	X								
	Article 53. Energizing	X	X								
	Article 54. Replacement of equipment on transmission grid	X	X								
	Article 55. General provisions on disconnection and reconnection	X	X								
	Article 56. Voluntary disconnection	X	X								
	Article 57. Compulsory disconnection	X	X								
	Article 58. Reconnection	X	X								
	Chapter VI, OPERATION OF ELECTRICITY TRANSMISSION SYSTEM										
	Section 1. OPERATING PRINCIPLES										
	Article 59. Operation modes of electricity transmission system				X						
	Article 60. Operating principles of electricity transmission system				X						
	Article 61. Inspection and monitoring of protective relay system				X						
	Article 62. Stable operation of electricity system				X						
	Article 63. Trial operation and monitoring				X						
	Article 64. Handling of incident				X						
	Article 65. Notice of decline in electricity system security				X						
	Article 66. Load shedding for electricity system security				X				X	X	
	Section 2. RESPONSIBILITY OF UNITS IN OPERATION OF ELECTRICITY TRANSMISSION SYSTEM										
	Article 67. Responsibility of electricity system and market operator				X						
	Article 68. Responsibility of transmission network operator				X						
	Article 69. Responsibility of generating units				X						
	Article 70. Responsibility of electricity distribution units, electricity retailers				X						
	Article 71. Responsibility of electricity customers				X						

	Section 3. ANCILLARY SERVICES										
	Article 72. Types of ancillary services						X				
	Article 73. Technical requirements of ancillary services						X				
	Article 74. Principles of determining demand for ancillary services						X				
	Article 75. Registration of ancillary services						X				
	Section 4. MAINTENANCE AND REPAIR OF ELECTRICITY TRANSMISSION SYSTEM										
	Article 76. General provisions on maintenance and repair of electricity transmission system				X				X		
	Article 77. Establishment of plan for maintenance and repair of electricity transmission system				X				X		
	Article 78. Order of priority on separation of equipment for maintenance and repair				X				X		
	Article 79. Registration for separation of equipment for maintenance and repair				X				X		
	Article 80. Separation of equipment in operation for urgent repair				X				X		
	Article 81. Reports on urgent separation of equipment for repair				X				X		
	Section 5. ELECTRICITY SYSTEM SCHEDULING AND DISPATCHING										
	Article 82. Day-ahead mobilization schedules				X						
	Article 83. Obligations for system security				X						
	Article 84. Real-time dispatching				X						
	Article 85. Methods of real-time operation of electricity system				X						
	Section 6. COORDINATION IN OPERATION, EXCHANGE OF INFORMATION AND OPERATIONAL REPORTING MODES										
	Article 86. General responsibility for operation coordination				X						
	Article 87. Exchange of information				X						
	Article 88. Confidentiality				X						
	Article 89. Reporting of incidents in national electricity system				X						
	Article 90. Reporting of performance of transmission grid				X						
	Article 91. Reporting of operation plan and result of operation of national electricity system				X						
	Chapter VII, ASSESSMENT OF ELECTRICITY SYSTEM SECURITY										

	Article 92. General provisions on assessment of electricity system security				X						
	Article 93. Reserve capacity and electrical energy of electricity system				X						
	Article 94. Assessment of medium-term assessment of electricity system security				X						
	Article 95. Assessment of short-term assessment of electricity system security				X						
	Chapter VIII, ASSESSMENT OF QUALITY OF OPERATION OF ELECTRICITY TRANSMISSION SYSTEM										
	Article 96. General requirements										X
	Article 97. Performance indicators of electricity system and market operator										X
	Article 98. Performance indicators of transmission network operator										X
	Chapter IX, SETTLEMENT OF DISPUTES AND HANDLING OF VIOLATION										
	Article 99. Settlement of disputes	X									
	Article 100. Handling of violation	X									
	Chapter X, IMPLEMENTATION										
	Article 101. Implementation	X	X	X	X		X	X	X	X	X
	Article 102. Effect	X	X	X	X		X	X	X	X	X

9.2 Recommended distribution of the C39 content

	Current VN grid code document – C39/2015/TT-BCT	Recommendation for a sectional structure of a complete VN grid code document. Proposed sections in a new document.									
		Connection Code - Generators	Connection Code - Demand	Connection Procedures	Operational Code	Operational Procedures	Market Code - Ancillary Services	Grid Planning Code	TSO Licensee	DSO Licensee	Performance assessment (KPI)
	Chapter I, GENERAL RULES										
	Article 1. Scope	X									
	Article 2. Subject of applications	X									
	Article 3. Definitions	X									
	Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICAL DISTRIBUTION SYSTEM										
	Section 1. TECHNICAL REQUIREMENTS										
	Article 4. Frequency									X	
	Article 5. Voltage									X	
	Article 6. Balance Phase									X	
	Article 7. Harmonics voltage									X	
	Article 8. Blinking voltages									X	
	Article 9. Short-circuit and eliminate the problem of time									X	
	Article 10. Grounding mode									X	
	Article 11. Coefficient of trouble touching the ground									X	
	Section 2. ELECTRICITY SUPPLY RELIABILITY AND POWER LOSS										
	Article 12. Indication of power supply reliability of distribution grids									X	
	Article 13. Index of power supply reliability									X	
	Article 14. Loss of power distribution grid									X	
	Article 15. The order of approval of the norm of power supply reliability, annual electricity loss of the distribution grid									X	
	Section 3. QUALITY REQUIREMENT OF CUSTOMER SERVICE										
	Article 16. The target quality of service customers									X	
	Article 17. Require quality of service customers									X	

	Chapter III, DEMAND FORECASTING ELECTRIC LOADING DISTRIBUTION ELECTRIC SYSTEM										
	Article 18. General provisions on forecasting the demand for electricity load of the electricity distribution system				X	X					
	Article 19. Forecast of electricity load demand year				X	X					
	Article 20. Forecast of monthly load demand				X	X					
	Article 21. Forecast of electricity demand for weekly load				X	X					
	Chapter IV, INVESTMENT PLAN FOR DEVELOPMENT OF DISTRIBUTION ELECTRIC NETWORK										
	Article 22. General provisions on investment plans to develop distribution grids							X			
	Article 23. Requirements for investment plans to develop electricity distribution network every year							X			
	Article 24. Content of investment plan to develop distribution grid							X			
	Article 25. Order of approving investment plans to develop distribution grid							X			
	Chapter V, CONNECTION TO DISTRIBUTION GRID										
	Section 1. GENERAL PRINCIPLE										
	Article 26. Connection points	X									
	Article 27. Boundary of asset allocation and operational management				X						
	Article 28. Complying with electricity development planning							X			
	Article 29. Responsibility to comply with the connection requirements and coordinate the connection			X							
	Section 2. TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTION										
	Article 30. Requirements for electrical equipment connected	X									
	Article 31. Requirements phase balance	X									
	Article 32. Requirements for harmonics	X									
	Article 33. Requirements on voltage flicker	X									
	Article 34. Requirement for groundwater regime	X									

	Article 35. Power factor requirements	X									
	Article 36. Protection system requirements	X									
	Article 37. Information system requirements	X									
	Article 38. Requirements for connecting SCADA system	X									
	Article 39. Requirements for generating sets of hydroelectric plants and thermal power plants connected to distribution networks	X									
	Article 40. Requirements for the wind power, solar power plant connected to the electricity distribution networks from the medium voltage level upwards	X									
	Article 41. Requirements for solar power system connected to the distribution grid with low voltage supply	X									
	Article 42. Technical requirements of the Control Centre	X			X						
	Section 3. ORDER AND PROCEDURES FOR CONNECTION AGREEMENT										
	Article 43. Application for connection			X		X					
	Article 44. Order of agreement on connection of medium voltage and 110 kV			X		X					
	Article 45. Time limit for reviewing and signing the Connection Agreement			X		X					
	Section 4. IMPLEMENTATION OF WIRING TO CUSTOMER USE DISTRIBUTED ELECTRIC NETWORK										
	Article 46. Access to equipment at the connection point	X									
	Article 47. Provide documents to check the condition of electrical connection points for K customers using distribution grid at 110 kV voltage level and customers have generator sets connected at medium voltage level			X							
	Article 48. Provide documents to check the condition of electrical connection points for customers using electricity with separate power stations connected to medium voltage grid			X							
	Article 49. Check condition energized connection points			X	X						
	Article 50. Close electrical connection points			X	X						

	Article 51. Test and acceptance order to put into operation of equipment after connection point			X	X						
	Article 52. Check and monitor the operation of connection devices			X	X						
	Article 53. Replace, install additional equipment at the connection point			X							
	Article 54. Implementation of antihypertensive connected to the grid for electricity customers			X							
	Section 5. PREPARARING ENERGIZING FOR CONNECTION POINT TO ELECTRICAL EQUIPMENT DISTRIBUTION OPERATOR										
	Article 55. Provide records to check the condition of electrical connection points for electrical equipment of the electricity distribution unit			X	X	X					
	Article 56. Power connection points for electrical equipment of the electricity distribution unit			X	X	X					
	Article 57. Replace and install additional equipment on the distribution grid				X						
	Section 6. DISCONNECTION AND RESTORING CONNECTION										
	Article 58. General provisions for connection separation and connection recovery				X						
	Article 59. Separating voluntary connection				X						
	Article 60. Required splice				X						
	Article 61. Restore connection				X						
	Chapter VI, OPERATION OF DISTRIBUTION ELECTRIC SYSTEM										
	Section 1. RESPONSIBILITIES IN OPERATION										
	Article 62. Responsibilities of the electricity distribution unit				X						
	Article 63. Responsibilities of the national electricity system moderation unit, the moderation level have control				X						
	Article 64. Responsibilities of the Customer uses electricity distribution networks				X						
	Section 2. MAINTENANCE PLAN AND REPAIR DISTRIBUTION ELECTRIC SYSTEM										
	Article 65. General provisions on the protection and line repair system in distribution				X						
	Article 66. Plan for maintenance and repair of the year				X						

	Article 67. Plan for maintenance and repair of the month				X						
	Article 68. Planning maintenance, repair weeks				X						
	Section 3. PLAN OF OPERATION										
	Article 69. operating plan year				X						
	Article 70. Operational planning months				X						
	Article 71. Operational planning week				X						
	Article 72. Mode of operating the day				X						
	Article 73. Operating distribution electricity system				X						
	Section 4. OPERATION IN EMERGENCY										
	Article 74. Emergency situation				X						
	Article 75. Operating distribution power system in case of breakdown or disintegration of whole or part of transmission power system				X						
	Article 76. Operating distribution electricity system in case of island separation				X						
	Article 77. Operating power distribution system when a serious incident occurs on the power distribution grid voltage of 110 kV				X						
	Article 78. Restore power distribution system				X						
	Section 5. LOAD AND VOLTAGE CONTROLS										
	Article 79. Load control				X						
	Article 80. Stop, reducing the power supply				X						
	Article 81. Develop a plan to sack load				X						
	Article 82. Measures to lay off load				X						
	Article 83. Performing load dismissal				X						
	Article 84. Perform voltage regulators				X						
	Article 85. Monitoring and Remote Control				X						
	Section 6. EXCHANGE INFORMATION IN OPERATION AND REPORTING REGIME										
	Article 86. Information exchange form	X	X		X						
	Article 87. Information exchange in operation				X						
	Article 88. Notice of unusual situations				X	X					
	Article 89. Notice of serious incidents				X	X					
	Section 7. COORDINATION OF OPERATION										
	Article 90. General responsibility in coordinating operation				X						
	Article 91. Coordinate the operation				X						

	Section 8. TEST ON THE DISTRIBUTION ELECTRIC SYSTEM										
	Article 92. General requirements for experiments on distribution power systems				X						
	Article 93. Cases of experimenting on equipment on distribution grid				X						
	Article 94. Cases of experiment of generating sets	X			X						
	Article 95. Responsibility in experimental equipment on distribution grid				X					X	
	Article 96. Experimental order at the request of the Power Distribution Unit				X					X	
	Article 97. Experimental order at the request of customers using distribution grid	X			X					X	
	Article 98. Responsibility after the experiment	X			X					X	
	Section 9. REPORT ON OPERATION OF DISTRIBUTION ELECTRICITY SYSTEM										
	Article 99. The reporting regime	X			X					X	
	Chapter VII, IMPLEMENTATION										
	Article 100. Organization of implementation	X	X	X	X	X		X		X	
	Article 101. Amending a number of Articles of Circular No. 12/2010 / TT-BCT dated April 15, 2010 of the Minister of Industry and Trade regulating transmission power system and Circular No. 40/2014 / TT-BCT dated November 5 in 2014, the Minister of Industry and Trade stipulated the regulation of national electricity system regulation	?	?	?	?	?		?		?	
	Article 102. Effect	X									

9.3 Recommended distribution of the C40 content

Current VN grid code document – C40/2015/TT-BCT	Recommendation for a sectional structure of a complete VN grid code document. Proposed sections in a new document.									
	Connection Code - Generators	Connection Code - Demand	Connection Procedures	Operational Code	Operational Procedures	Market Code - Ancillary Services	Grid Planning Code	TSO Licensee	DSO Licensee	Performance assessment (KPI)
Chapter I, GENERAL PROVISIONS										
Article 1. Scope of regulation				x						
Article 2. Subject of application				x						
Article 3. Interpretation of terms				x						
Article 4. General provisions on power system dispatching				x						
Chapter II, DISPATCHING HIERARCHY AND RIGHTS OF DISPATCHING LEVELS										
Section 1. DISPATCHING HIERARCHY OF NATIONAL POWER SYSTEM AND HIERARCHY OF RIGHT OF CONTROL AND INSPECTION AND GRASP OF INFORMATION										
Article 5. Dispatching hierarchy of national power system				X						
Article 6. Principles of hierarchy of control and inspection authority				X						
Section 2. CONTROL AUTHORITY, INSPECTION AUTHORITY AND INFORMATION GRASPING RIGHT										
Article 7. Control authority				X						
Article 8. Inspection authority of superior dispatching level				X						
Article 9. Information grasping right				X						
Article 10. The control and inspection and information grasping right in case of breakdown or breakdown threatening case				X						
Section 3. RIGHT OF NATIONAL DISPATCHING LEVEL										
Article 11. Control authority of national dispatching Level				X						

Article 12. Inspection authority of the national dispatching Level				X						
Article 13. Information grasping right of national dispatching Level				X						
Section 4. RIGHT OF REGIONAL DISPATCHING LEVEL										
Article 14. Control authority of regional dispatching level				X						
Article 15. Inspection authority of regional dispatching level				X						
Article 16. Information grasping right of regional dispatching level				X						
Section 5. RIGHT OF PROVINCIAL DISPATCHING LEVEL										
Article 17. Control authority of provincial dispatching level				X						
Article 18. Inspection authority of provincial dispatching level				X						
Article 19. Information grasping right of provincial distribution dispatching level				X						
Section 6. RIGHT OF DISTRICT DISTRIBUTION DISPATCHING LEVEL										
Article 20. Control authority of district distribution dispatching level				X						
Article 21. Inspection authority of district distribution dispatching level				X						
Article 22. Information grasping right of district distribution dispatching level				X						
Section 7. RIGHT OF UNIT MANAGING AND OPERATING POWER PLANT, POWER STATION AND CONTROL CENTER										
Article 23. Control authority of power plant, power station and control centre				X						
Article 24. Information grasping right of power plant, power station and control centre				X						
Chapter III, RESPONSIBILITY OF DISPATCHING LEVELS AND UNITS INVOLVED IN DISPATCHING AND OPERATION OF NATIONAL POWER SYSTEM										
Article 25. Basic objectives of dispatching of nation power system				X						
Section 1. RESPONSIBILITY OF DISPATCHING LEVELS										
Article 26. Responsibility of national dispatching Level				X						

Article 27. Responsibility of regional dispatching level				X						
Article 28. Responsibility of provincial distribution dispatching level				X						
Article 29. Responsibility of district distribution dispatching level				X						
Section 2. RESPONSIBILITY OF UNITS INVOLVED IN OPERATION OF NATIONAL POWER SYSTEM										
Article 30. Responsibility of power generating units				X						
Article 31. Responsibility of power transmission units				X						
Article 32. Responsibility of power distributing units				X						
Article 33. Responsibility of the power retailing and distributing units				X						
Article 34. Responsibility of telecommunications services providers				X						
Article 35. Responsibility of gas suppliers for power generation				X						
Chapter IV, OPERATION MODE OF POWER SYSTEM										
Section 1. REGISTRATION AND APPROVAL OF OPERATION MODE OF POWER SYSTEM										
Article 36. Main contents of operation mode of power system				X						
Article 37. Approval of operation mode of power system				X						
Article 38. Content of mode registration				X						
Article 39. Order of registration of year-ahead operation mode				X						
Article 40. Notification order of operation mode				X						
Section 2. DEVELOPMENT OF OPERATION MODE OF POWER SYSTEM										
Article 41. Basic one-line diagram of power system				X						
Article 42. Forecasting of power load demand				X			X			
Article 43. Evaluation of power system security				X						X
Article 44. Plan of power source and power network maintenance and repair				X			X			
Article 45. Plan to put new works into operation				X			X			
Article 46. Switching Form				X	X					
Article 47. Trial and testing plan during equipment operation				X	X					
Article 48. Power source mobilization plan				X	X					
Chapter V, DISPATCHING AND OPERATION OF NATIONAL POWER SYSTEM IN REAL TIME										
Section 1. GENERAL PROVISIONS										

Article 49. Contents of dispatching instructions				X						
Article 50. Form of dispatching instructions				X						
Article 51. Requirements for compliance with dispatching instructions				X						
Article 52. National dispatching Level				X						
Article 53. Regional dispatching level				X						
Article 54. Provincial distribution dispatching level				X						
Article 55. District distribution dispatching level				X						
Article 56. Working relationship in dispatching and operation of power system				X	X					
Article 57. Report on daily operation and breakdown				X	X					
Section 2. OPERATION SHIFT REGULATION										
Article 58. Regulation on shift handover and acceptance				X						
Article 59. Regulations for operator during shift duty				X						
Section 3. POWER PLANT AND POWER STATION WITHOUT OPERATOR										
Article 60. Conditions to allow power plant or power station without operator				X						
Article 61. Operation of power plant or power station without operator on shift duty				X						
Section 4. FREQUENCY CONTROL										
Article 62. Frequency meter				X						
Article 63. Requirements for speed control system of power generator				X						
Article 64. Regulation on primary frequency controlling levels				X						
Article 65. Regulation on frequency control				X						
Article 66. Measures of frequency control				X	X					
Article 67. Limit of voltage				X						
Article 68. Principles of voltage adjustment				X	X					
Article 69. Requirements for excitation of power generator with installed capacity over 30MW				X						
Article 70. Regulation on voltage adjustment				X						
Article 71. Hierarchy of voltage calculation and balance of reactive capacity				X	X					
Article 72. Regulations on voltage diagram				X	X					
Article 73. Measures of voltage adjustment				X	X					
Section 6. POWER NETWORK CONTROL										
Article 74. Switching activities of power network control				X						
Article 75. Automatic power network control				X						

Article 76. Outage of lines and electrical equipment				X						
Section 7. POWER SOURCE CONTROL										
Article 77. Diagram of generating capacity of power source				X			X			
Article 78. Implementation of diagram of active capacity generation				X			X			
Article 79. Self-control of active capacity generation				X			X			
Section 8. LOAD CONTROL										
Article 80. Notification of control of non-emergency usable capacity				X						
Article 81. Dispatching instructions on control of emergency usable capacity				X	X					
Article 82. Breakdown load switching due to shortage of power source as per dispatching instruction		X		X						
Article 83. Automatic load shedding under low frequency		X		X						
Article 84. Load switching due to overloading or low voltage				X						
Section 9. BREAKDOWN TROUBLESHOOTING, BLACK START AND RESTORATION OF POWER SYSTEM										
Article 85. Breakdown troubleshooting of power system				X						
Article 86. Black start and restoration of power system				X						
Chapter VI, DUTIES OF DIVISIONS DIRECTLY INVOLVED IN DISPATCHING AND OPERATION ACTIVITIES OF NATIONAL POWER SYSTEM										
Section 1. NATIONAL DISPATCHING LEVEL										
Article 87. Divisions directly involved in dispatching activities of national power system				X						
Article 88. Regulations on employee of national dispatching division on duty				X						
Article 89. Duties, powers and responsibilities of national dispatcher				X						
Article 90. Duties of short-term Operational planning Division				X						
Article 91. Duties of long-term operational planning Division				X						
Article 92. Duties of automatic and protective relay setting and calculating Division				X						
Article 93. Duties of computers & communication Division				X						
Section 2. REGIONAL DISPATCHING LEVEL										

Article 94. Divisions directly involved in dispatching activities of regional power system				X						
Article 95. Regulations on employees of regional dispatching division on duty				X						
Article 96. Duties, powers and responsibilities of regional dispatchers				X						
Article 97. Duties of short-term Operational planning Division				X						
Article 98. Duties of long-term Operational planning Division				X						
Article 99. Duties of automatic and protective relay setting and calculating Division				X						
Article 100. Duties of Computers & Communication Division				X						
Section 3. PROVINCIAL DISTRIBUTION LEVEL										
Article 101. Divisions directly involved in dispatching activities of distribution power system				X						
Article 102. Regulations on provincial distribution dispatching division on duty				X						
Article 103. Responsibilities, powers and responsibilities of provincial distributing dispatchers				X						
Article 104. Duties of short-term operational planning Division				X						
Article 105. Duties of long-term operational planning Division				X						
Article 106. Duties of automatic and protective relay division				X						
Article 107. Duties of computers & communication division				X						
Section 4. DISTRICT DISTRIBUTION DISPATCHING LEVEL										
Article 108. Regulation on operation shift of district distribution dispatching level				X						
Section 5. OPERATORS AT POWER PLANTS, POWER STATIONS AND CONTROL CENTERS										
Article 109. Divisions directly involved in operation				X						
Article 110. Regulation on operation shift				X						
Article 111. Duties of chief operators of power plant or control centre of power plant				X						
Article 112. Duties of team leaders of power station or control centre				X						
Chapter VII, TRAINING OF TITLES DIRECTLY INVOLVED IN DISPATCHING AND OPERATION OF NATIONAL POWER SYSTEM										

Section 1. GENERAL PROVISIONS										
Article 113. Titles directly involved in dispatching and operation of national power system				X						
Article 114. Regulation on examination and issue of operation Certificate				X						
Article 115. Training of operator at dispatching levels				X						
Article 116. Training of operators at power plants, power stations or control centres.				X						
Article 117. General responsibilities				X						
Section 2. TRAINING AT NATIONAL POWER SYSTEM										
Article 118. Regulation on new training for national dispatchers				X						
Article 119. Regulation on re-training for national dispatcher				X						
Article 120. Regulation on training of power system planning and analysis engineer for national power system				X						
Article 121. Regulation on training for SCADA/EMS engineer of national power system				X						
Section 3. TRAINING AT THE REGIONAL DISPATCHING LEVEL										
Article 122. Regulations on new training for regional dispatcher				X						
Article 123. Regulation on re-training for regional dispatcher				X						
Article 124. Regulation on training for power system planning and analysis engineer of regional power system				X						
Article 125. Regulation on training for SCADA/EMS engineer of regional power system				X						
Section 4. TRAINING AT PROVINCIAL DISTRIBUTION DISPATCHING LEVEL										
Article 126. Regulation on new training for provincial distributing dispatcher				X						
Article 127. Regulation on re-training for provincial distributing dispatcher				X						
Article 128. Regulation on training for engineer of distribution power system				X						
Article 129. Regulation on training for SCADA/DMS engineer of distribution power system				X						
Section 5. TRAINING AT DISTRICT DISTRIBUTION DISPATCHING LEVEL										
Article 130. Regulation on new training of district distributing dispatcher				X						

Article 131. Regulation on re-training for district distributing dispatcher				X						
Section 6. TRAINING AT POWER PLANT, POWER STATION AND CONTROL CENTER										
Article 132. Regulation on new training for Chief operator of power plant or control centre of power plant				X						
Article 133. Regulation on new training for Team leader of power station or control centre of power station				X						
Article 134. Regulation on re-training for Chief operator of power plant and Team leader of power station or control centre				X						
Chapter VIII, IMPLEMENTATION ORGANIZATION										
Article 135. Implementation organization				X						
Article 136. Effect				X						

9.4 Proposed sections in a new VN grid code document

The purpose and content of the proposed sections in a new VN grid code document is described in more detail in the following subchapters.

9.4.1 Connection Code – generator facilities

Proposal for new VN grid connection code for all types of generators

1. Why establish a grid connection code?
    a. Generator manufacturers need a clear set of minimum technical requirements to develop their products.
    b. Plant developers needs a clear set of minimum technical requirements to design and select components/subsystems for power plant development. They are looking to minimize the risk of mistakes on technical aspects.
    c. Investors are looking to minimize financial risks. Do not revise the code too often (revision cycle should not be more often than every 4-5 years). It typically takes 2-3 years to fully establish a renewable power plant. If technical requirements change during the establishment process, investors may move their investments to less regulated places on the globe. Creating a sound investment climate is one of the success criteria.

2. Who is the typical reader / user of a grid connection code?
    a. Product design engineers
    b. Power system design engineers
    c. Power plant developers
    d. Power system investors

3. What is the recommendation on what to include as a minimum?
    a. Specification of the legal foundation for the technical regulation – e.g. VN Electricity Act

b. Scope of document
c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
d. Definitions and acronyms
    1. Plant categories used, e.g. A, B, C, D, for setting varying requirements
    2. Grid Connection point, compliance evaluation point, etc.
e. All relevant **minimum** technical requirements to be fulfilled to achieve grid connection
    1. Operational ranges – frequency / voltage
    2. Power quality aspects
        1. headroom for emission of harmonics, flicker, rapid voltage changes, etc.
        2. immunity against disturbances from the grid
    3. Active power control capability
    4. Reactive power capability
    5. Protection requirements
    6. Communication and information exchange and protection capability
    7. Documentation requirements
        1. compliance testing
        2. electrical simulation model
        3. product type certificates
        4. safety certificates
        5. compliance certificates
f. All relevant technical information about the grid connection point
    1. Short-circuit impedance – minimum / maximum
    2. Frequency plot for grid connection point impedance
    3. Availability of grid connection point
    4. Normal operating conditions – frequency, voltage,
        1. normal operating state
        2. alert operating state
    5. Abnormal operating conditions
        1. emergency operating state
        2. system restoration state
        3. black-out state

4. Recommended structure of technical requirements of a connection code – an example.

Generator technology / Requirement categories (plant size)	Synchronous generation systems	Non-synchronous generation systems
Requirements for category A	Minimum requirements for A	Minimum requirements for A
Requirements for category B	Minimum requirements for B	Minimum requirements for B
Requirements for category C	Minimum requirements for C	Minimum requirements for C
Requirements for category D	Minimum requirements for D	Minimum requirements for D

Note:
The recommendation is for requirements to be specified as cumulative, meaning that minimum requirements for category B are based on minimum requirements for category A plus additional requirements for category B; minimum requirements for category C are based on minimum requirements for category B plus additional requirements for category C; minimum requirements for category D are based on minimum requirements for category C plus additional requirements for category D.

9.4.2 Connection Code – demand facilities

The proposal for a new VN grid connection code for all types of demand facilities is similar to the generator specifications, and it would be reasonable to have the same content and structure.

Modern demand facilities use power electronics comparable to those of generators and thus impact the stability of the grid system in a similar manner.

9.4.3 Connection Procedures - generator and demand facilities

As procedures typically have different revision cycles than grid codes, operational procedures should be described in separate documents.

Procedures relevant in a grid connection process could consist of the following:

1. Procedure for granting a grid connection
    a. step-by-step guidance on obtaining a grid connection
    b. grid connection agreement template
    c. how to terminate a grid connection agreement
2. Procedure for compliance testing / simulation
    a. what is tested and what can be demonstrated in a simulation model
3. Procedure for operational notification
    1. includes energization notification, interim notification, final notification
4. Procedure for exemption requests.

9.4.4 System Operation Code

Proposal for new VN system operation code.

1. A system operation code must be observed by all grid-connected users and operators – existing as well as new grid-connected facilities (generators, demand facilities and grid components)

2. Why establish a system operation code?
    a. System balancing operators need a clear specification of the minimum operational actions they must perform and their responsibilities.
    b. Facility (generator and demand) operators need a clear specification of the minimum operational actions they must perform and their responsibilities.
    c. Grid system operators need a clear specification of the minimum operational actions they must perform and their responsibilities.

d. Investors are looking to minimize financial risks. Grid infrastructure investors are looking for efficiency in grid system operation and maintenance.

3. Who is the typical reader / user of an operation code?
    a. Power plant operators, managers and investors
    b. Grid operators – at transmission and distribution grid level – ISO, TSO, RTO, DSO, CDSO
    c. Power system design engineers
    d. Grid infrastructure investors

4. What is the recommendation on what to include as a minimum?
    a. Specification of the legal foundation of the code – e.g. VN Electricity Act
    b. Scope of document
    c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
    d. Transparency of information
    e. Definitions and acronyms
        1. All definitions of relevance to system operation, control rooms, compliance evaluation points, system states (normal, alert, emergency, restoration, black-out) etc.
    f. All relevant **minimum** technical requirements to be met to grant an operational notification- e.g.
        1. Operational security
            1. Operational security requirements
            2. Roles and responsibility of parties involved
            3. Information exchange, tools and facilities (could also be in a separate document)
            4. Compliance documentation
            5. Training of system operators
        2. Operational planning
            1. Data for operational security analysis in operational planning
            2. Operational security analysis
            3. Outage coordination
            4. System adequacy
            5. Balancing and scheduling
        3. Load-frequency control and reserves
            1. Operation agreements on interconnectors
            2. Frequency quality
            3. Load-frequency control structure
            4. Operation of load-frequency control
            5. Frequency containment reserves (could be placed in AS code)
            6. Frequency restoration reserves (could be placed in AS code)
            7. Replacement reserves (could be placed in AS code)
            8. Exchange and sharing of reserves
            9. Time control process
            10. Co-operation between RTOs, DSOs, CDSOs

    g. Emergency operation
        1. System defence plan
            1. General principles

    2. Measures of the system defence plan
2. Restoration plan
    1. General principles
    2. Re-energization
3. Frequency management
4. Resynchronization
5. Market interactions (could be placed in AS code)
6. Information exchange and communication, tools and facilities (could also be in a separate document)
7. Compliance and review
    1. Compliance testing of TSO, DSO and significant grid user capabilities
    2. Compliance testing and review of system defence and restoration plans
    3. Compliance assessment – self assessments

9.4.5 Operational procedures

As procedures typically have different revision cycles than grid codes, operational procedures should be described in separate annexes

Procedures relevant to the operational process could include the following recommended content.

1. Procedure for granting an operational notification
    1. step-by-step guidance on obtaining an operational notification
    2. operation notification templates, e.g.
        a. energization notification
        b. interim notification
        c. final notification
2. Procedure for compliance testing / simulation and monitoring
    1. what is tested and what can be demonstrated in a simulation model before granting the respective operation notifications
    2. What must be checked on a regular basis?
3. Procedure for operational notification
    1. Includes energization notification, interim notification, final notification
4. Procedure for a derogation request

9.4.6 Market Code - Ancillary Services

Ancillary services could be specified as an integral part of the operation code as described in the proposed operation code under “Load-frequency control and reserves” section or as a separate section for AS providers.

As ancillary services requirements and portfolios could change more frequently than other operational specifications, the recommendation is to create a separate section for providing AS, including the following.

1. The Ancillary Services Code must be observed by all service providers – existing as well as new grid-connected facilities (generators, demand facilities and grid components).

2. Why establish an Ancillary Services Code?

a. Ancillary Service providers need a clear specification of the minimum technical requirements that they must comply with to provide the various services.
b. Grid system operators need a clear specification of the minimum operational actions they must perform and their responsibility as grid system operators to purchase ancillary services.

3. Who is the typical reader / user of the AS code?
    a. Power plant operators and managers

4. What is the recommendation on what to include as a minimum?
    a. Specification of the legal foundation of the technical code – e.g. VN Electricity Act
    b. Scope of document
    c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
    d. Transparency of information
    e. Definitions and acronyms
        1. All definitions of relevance to service providers, control rooms, compliance evaluation point, system states (normal, alert, emergency, restoration, black-out) etc.
    f. All relevant **minimum** technical requirements to be met to provide ancillary services, e.g.
        1. **Minimum design requirements**
            1. Additional roles and responsibilities of parties involved in providing AS
            2. Additional information exchange, tools and facilities for providing AS
            3. Additional compliance demonstration and review
        2. **Dimensioning and activation of AS**
            1. Frequency containment reserves
            2. Frequency restoration reserves
            3. Replacement reserves
            4. Balancing and scheduling of AS

9.4.7 Information exchange code

A separate code should be prepared for information exchange as communication aspects span the connection, operational and market codes. Such a cross-code function should be regulated in a separate code, an information exchange code. The VN circular C55 specifications could be applied for some of the proposed requirements in a new code, but the completeness of an information exchange code is not secured by using C55 unaccompanied.

1. The aim of an information exchange code is to establish a harmonized way of communicating based on a set of requirements for information exchange activities

2. Why establish an information exchange code?
   To have common set of requirements for all level of communication in the electricity sector of Vietnam
    a. To share the most updated information to secure adequate grid stability

3. Who is the typical reader / user of the information exchange code?
    a. Grid investors, system operators (Tx, Dx)
    b. Power plant managers and investors
    c. Grid planners – at transmission and distribution grid level – ISO, TSO, RTO, DSO, CDSO

d. System adequacy assessment analysers
e. Grid infrastructure investors

4. What should be included as a minimum?
    a. Specification of the legal basis of the code – e.g. VN Electricity Act
    b. Scope of document
    c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
    d. Transparency of information
    e. Definitions and acronyms
        1. All definitions of relevance to grid system planners, decision makers and politicians
    f. Roles and responsibilities of parties involved – ERAV, TSO, RTO, DSO, Grid users
    g. Information type 1: Structural information – information on rated capacity, electrical characteristics, possible limitations etc.
    h. Information type 2: Scheduled information (control center communication) – dispatching, forecasting, outage coordination, availability monitoring, etc.
    i. Information type 3: Real-time information – SCADA system values, Access to data base systems, measured values, status of substations, grid element status, alarms, warnings, monitoring of power quality parameters, PMU information processing, Early warning systems, Dynamic Line Monitoring systems, data network monitoring, time management systems, etc
    j. Protocols applied – the recommended exchange protocols are the following:
        1. Devices – e.g. IEC 61850 with Secure MMS stack
        2. Control centre – IEC 69870-6 ICCP, TASE2 – with secure communication
    k. Information security – recommended standards are the following:
        1. Standards to apply as a minimum? – e.g. ISO/IEC 27002, 27019, IEC 62351
        2. Specific security monitoring requirements are under development in IEC TC57
    l. Redundancy strategy – e.g. double or triple redundant data network system?
    m. Requirements for data storage and information back-up – e.g. how long must data be stored by the involved parties? To which security level?

Information exchange is very essential to implement a reliable operation and thereby keep security of supply and a maintain a stable grid. If you cannot trust the information provided, the quality of decisions in system operation will be affected.

9.4.8 Grid Planning Code

Proposal for new VN grid planning code.

5. The aim for a grid planning code is to establish a common understanding of the methodology and procedures applied grid planning activities

6. Why establish a grid planning code?
    a. To have common methodology and procedures
    b. To share the most updated information to secure an adequate grid stability

7. Who is the typical reader / user of a planning code?

a. Politicians, Grid Investors, System operators (Tx, Dx)
b. Power plant managers and investors
c. Grid planners – at transmission and distribution grid level – ISO, TSO, RTO, DSO, CDSO
d. System adequacy assessment analysers
e. Grid infrastructure investors
f. Screen of possible connection points for new grid users

8. What is the recommendation on what to include as a minimum?
    a. Specification of the legal foundation of the code – e.g. VN Electricity Act
    b. Scope of document
    c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
    d. Transparency of information
    e. Definitions and acronyms
        1. All definitions of relevance to grid system planner and decision makers as well as politicians
    f. General principle
    g. Minimum required information to be exchanged in grid development – from Tx and Dx grid operators.
    h. Public consultations procedures - procedures for preparation, approval and public announcement of transmission and distribution grid development plans
        1. Grid Planning Responsibilities and Procedures
            1. Grid Planning Responsibilities
            2. Submission of Planning Data
            3. Consolidation and Maintenance of Planning Data
            4. Evaluation of Grid Expansion Project
            5. Evaluation of Proposed User Development
            6. Preparation of the Tx and Dx Development Plans
        2. Grid Planning Studies
            1. Grid Planning Studies to be conducted
            2. Load Flow Studies
            3. Short Circuit Studies
            4. Transient Stability Studies
            5. Steady-State Stability Analysis
            6. Voltage Stability Analysis
            7. Electromagnetic Transient Analysis
            8. Reliability Analysis
            9. System adequacy monitoring/study – short, mid, long term
        3. Standard Planning Data
            1. Historical energy and demand
            2. Energy and demand forecast
            3. Generating unit data
            4. Demand system data
        4. Detailed Planning Data
            1. Generating unit and generating plant data
            2. Demand unit and demand facility data
            3. Minimum required information to be exchanged with TSO / RTO / DSO on grid development – Tx and Dx

i.

9.4.9 TSO Licensee

Proposal for **TSO licensee**.

1. The purpose of a TSO license is to secure the responsibility of the entity granted a TSO license. To secure a well functional and efficient transmission of electricity from producers to distributors and end users connected to the Tx grid.

2. Why establish a TSO license?
    a. To have responsible entity for securing grid access to the grid users connected.

3. Who is the typical reader / user of a TSO license?
    a. Transmission System Operators
    b. Grid operators – at transmission grid level –TSO, RTO

4. What is the recommendation on what to include as a minimum?
    a. Specification of the legal foundation of the code – e.g. VN Electricity Act
    b. Scope of document
    c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
    d. Transparency of information
    e. Definitions and acronyms
        1. All definitions of relevance to grid system operators
    f. Technical requirements for the Tx grid elements
    g. Minimum technical quality of supply from Tx grid
    h. Minimum technical availability for the Tx grid
    i. KPIs for the licensee
    j. Handling of disputes

9.4.10 DSO Licensee

Proposal for **DSO licensee**.

1. The purpose of a DSO license is to secure the responsibility of the entity granted a DSO license. To secure a well functional and efficient transmission of electricity from transmission to end users connected to the Dx grid.

2. Why establish a DSO license?
    a. To have responsible entity for securing grid access to the grid users connected.

3. Who is the typical reader / user of a DSO license?
    a. Distribution System Operators
    b. Grid operators – at distribution grid level –DSO, CDSO

4. What is the recommendation on what to include as a minimum?
    a. Specification of the legal foundation of the license – e.g. VN Electricity Act
    b. Scope of document
    c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
    d. Transparency of information
    e. Definitions and acronyms
        1. All definitions of relevance to grid system operators
    f. Technical requirements for the Dx grid elements
    g. Minimum technical quality of supply from Dx grid
    h. Minimum technical availability for the Dx grid
    i. KPIs for the licensee
    j. Handling of disputes

9.4.11 Performance assessment (KPI)

Proposal for new Performance assessment section

1. The purpose for a set of Key Performance Indicators (KPI) for evaluation of the performance of the various parties involved in securing the supply and a stable grid system.

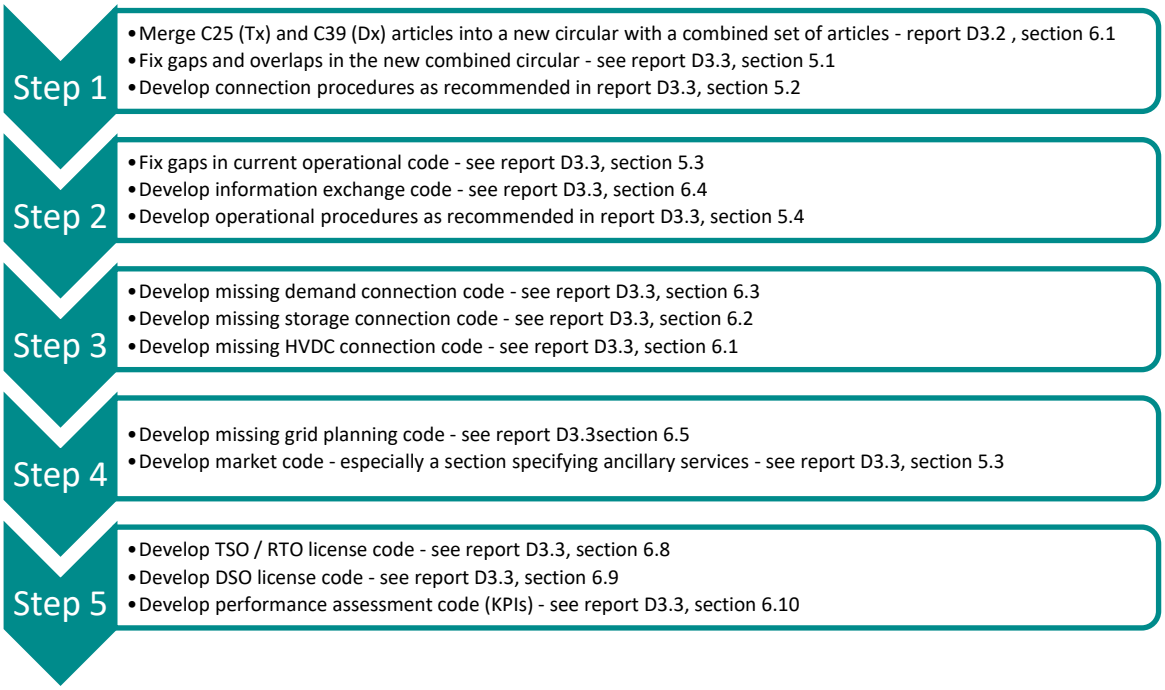
2. Why establish a set KPIs?
    a. For being able to quantify the degree of fulfilment of the expected performance of the parties involved in security of supply.
    b. Monitoring of the performance of the parties involved

3. Who is the typical reader / user of KPIs?
    a. Power plant operators, managers, and investors
    b. Grid operators – at transmission and distribution grid level – ISO, TSO, RTO, DSO, CDSO
    c. Politicians
    d. Grid infrastructure investors

4. What is the recommendation on what to include as a minimum?
    a. Specification of the legal foundation of the code – e.g. VN Electricity Act
    b. Scope of document
    c. Legal aspects / document validity / confidentiality / entry into force / reference to other regulations of relevance
    d. Transparency of information
    e. Definitions and acronyms
        1. All definitions of relevance to grid system planner and decision makers as well as politicians
    f. Methodology for calculation of defined KPIs
    g. Acceptable level of KPIs for contractual agreements
    h. Benchmark procedures for KPIs
    i. Exemptions from the minimum KPI acceptance level
    j. Handling disputes and contract terminations

10. Recommendations for further GC development

The recommended sequence of actions for further development of the grid codes as detailed in this document is listed below in priority order and referenced to the other DEPP DE2 documents.
The recommended sequence of activities is based on the fundamental priority of securing the stability of the grid first and foremost, or, in other words, securing a sufficient supply of electricity in an efficient manner.



The first step is to ensure that **new** facilities connected to the grid are compliant with an upgraded grid connection code for safe and reliable system integration of renewables. This might need some organisational adjustments on top of the enhanced grid connection requirements because of a recommended focus on compliance verification, e.g. establishment of a compliance verification team under the scope of TSO / RTO / DSO to ensure compliance with the legislation. The step 1 – action 1 – have to be seen as an interim action with merging the current C25 and C39 articles into a combined circular for smoothing the legal process but are not handling the technical issues raised in section 5.1.1 - 5.1.8 of this report and the overlapping issues raised in section 5.3 of report D3.3.

The second step is to ensure that operational aspects are in place, and that information exchanged is valid and present at the requested time and of the required quality.

The third step is intended to include the missing connection codes for Demand, Storage and HVDC facilities. The connection codes could be developed in parallel as the experts to be involved in the specific codes are typically from different teams with different skills. The benefit of developing these in parallel could be to create a harmonized structure with the purpose of ease the reading and public acceptance of the new connection codes.

The fourth step is to address the market code and especially the ancillary services. These codes are not critical for the security of supply in the short and mid-term aspect, but it will be critical in the long term.

The fifth step is to ensure development of the quality of supply. This makes step 5 critical in the long term only as current regulation seems to be appropriate, focusing on the quality and efficiency of operation and long-term development of the Vietnamese electricity infrastructure.

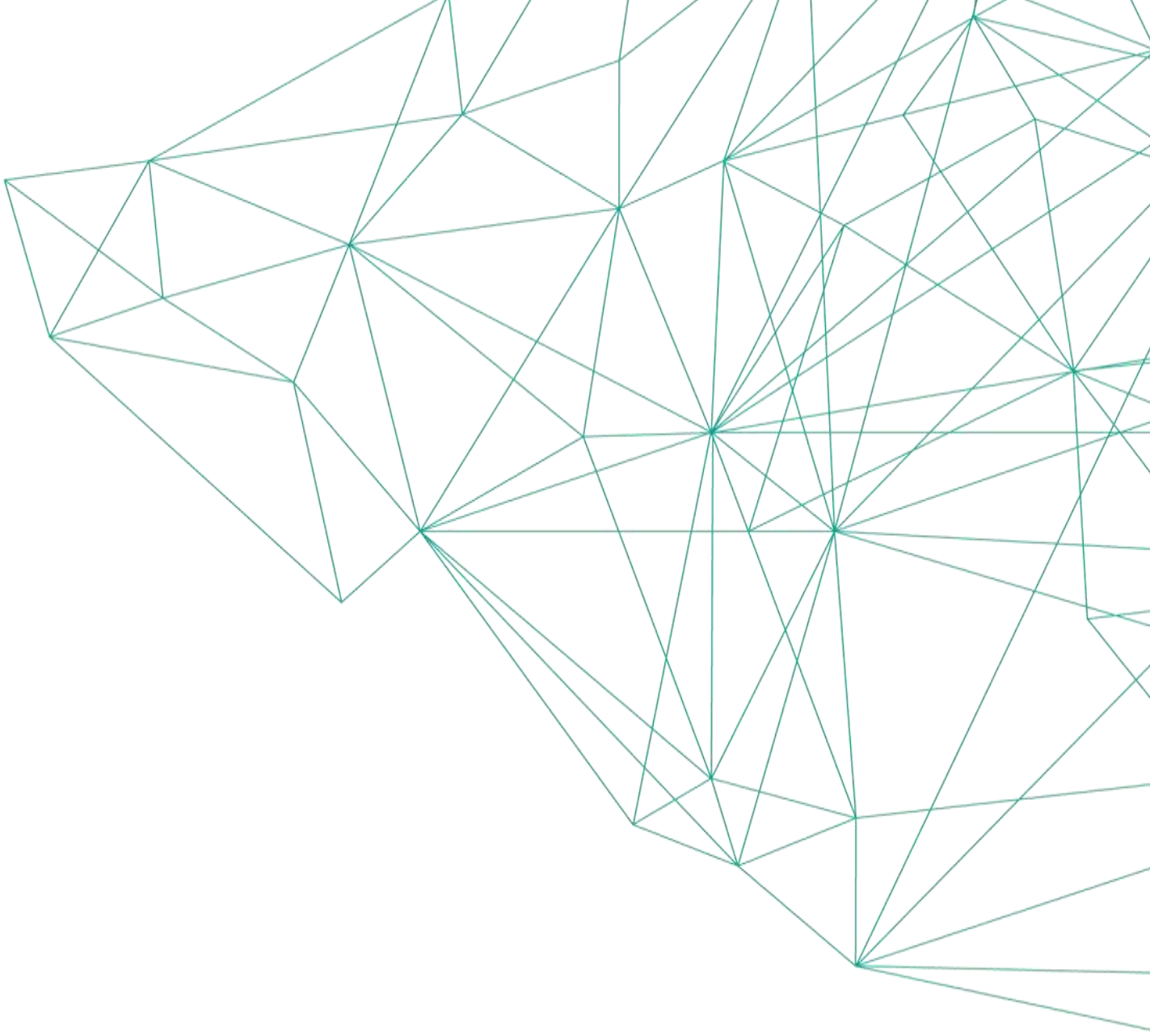
11. References

The following documents are used as references in the report.

#	Description
1.	COMMISSION REGULATION (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (NC RfG)
2.	COMMISSION REGULATION (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection NC DCC)
3.	COMMISSION REGULATION (EU) 2016/1447 of 26 August 2016 establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules (NC HVDC)
4.	COMMISSION REGULATION (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation (SO GL)
5.	COMMISSION REGULATION (EU) 2017/2196 of 24 November 2017 establishing a network code on electricity emergency and restoration (NC ER)
6.	COMMISSION REGULATION (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management (CACM GL)
7.	COMMISSION REGULATION (EU) 2016/1719 of 26 September 2016 establishing a guideline on forward capacity allocation (FCA GL)
8.	COMMISSION REGULATION (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing (EB GL)
9.	South African grid code – latest versions to be found on NERSA website - https://nersa.org.za/transmission-grid-code/
10.	Australian grid code – National Electricity Rules Version 139, May 2020; https://www.aemc.gov.au/sites/default/files/2020-05/NER%20v139%20full_1.pdf
11.	Circular 55 – "Technical requirements and management and operation of the SCADA system"

12. Further reading on grid codes and guiding documents

#	Description & link
1.	Florence school of regulators - Network Codes - self-study programs: https://fsr.eui.eu/tag/network-codes/
2.	ENTSO-E implementation Guidance Documents (IGD) https://www.entsoe.eu/network_codes/cnc/cnc-igds/
3.	Evolution of Electricity Markets in Europe - 9 weeks online course https://fsr.eui.eu/course/eu-electricity-network-codes/



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