Danish Energy Agency

ERAV
Electricity Regulatory Authority of Vietnam

Grid Codes: Recommendations for Merging Transmission and Distribution Codes

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ENERGINET
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Document history

Rev.	Date	Author	Reviewer	Description
0.0	2020.06.28	Knud Johansen	ERAV, DEA	Draft document released for comments
0.1	2020.07.03	Knud Johansen	ERAV, DEA	Section 6 - tables finalized, section 7 added
0.2	2020.09.29	Knud Johansen	ERAV, DEA	Language corrections all over in the document. Section 6 spilt up into two subsections: Section 6.1 – an interim step in the merging is included as proposed by ERAV. Section 6.2 - the recommended final merging is kept as the current version of C25 and C39 is lacking several essential requirements and the requirements is not sorted into categories (A, B, C, D) so it's difficult for the reader to find the relevant requirements. Section 7 is corrected accordingly with introduction of section 6.1 and related activities.
0.3	2020.10.05	Knud Johansen	ERAV, DEA	Section 6.2 – content with final generator connection code moved to the report D3.3. The content changed to the final content of the interim version with a combination of the articles from circular C25 and C39.
1.0	2020.10.08	Knud Johansen	ERAV	Document released for final comments.

1. Acronyms

The table includes acronyms used in this document.

AS	Ancillary Services
C25	Circular 25 – The regulations on electricity transmission system
C39	Circular 39 – The regulations on electricity distribution system
DSO	Distribution System Operator
Dx	Distribution grid system
FSM	Frequency Sensitivity Mode – frequency control mode in normal frequency range
GC	Grid Code
GL	European Guideline
ISO	Independent System Operator – system balancing responsible
LFSM-O	Limited Frequency Sensitivity Mode – Overfrequency – required frequency response in case of high system frequency – above normal range
LFSM-U	Limited Frequency Sensitivity Mode – Underfrequency – required frequency response in case of low system frequency – below normal range
NC	European Network Code
NC RfG	Network Code for connecting all types of generators
RSO	Relevant System Operator – could be a TSO or DSO 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
Tx	Transmission grid system
VN	Vietnamese
VN GC	Vietnamese Grid Code – one collective document

2. Introduction

The main purpose of this document is to recommend a possible merging of the grid connection requirements for connections in the transmission grid system C25 (Tx) and the distribution grid system C39 (Dx).

Based on the review of the current VN grid connection code documents, a recommendation is provided for further in-depth discussions in the VN electricity sector and brought up at the next maintenance cycle of the VN GC for Tx and Dx connections.

This document provides a proposal on how to merge the current grid connection code based on our experience from the global arena of grid codes, especially European/Danish regulations, looking at the structure and content of the Tx and DX grid codes. A detailed analysis of the requirement structure can be found in the report for Deliverable 3.1 according to the VN DEPP DE2 ToR agreement.

As the resulting proposal for a new structure and content of the VN connection code, this document includes recommendations for a merging of the Tx and Dx connection codes in future releases of the VN GC documents.

The primary motivation and reflections for a merged grid connection code are the following.

1. Why establish one single 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.
    d. Generation units connected to Tx and Dx grid systems are the same and the grid systems need the same stabilizing services as specified in the grid connection code. The amount of services could be different in various parts of the grid system which is handled by parameter ranges and allocation of the specific parameters for the specific part of the grid system.

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 content? 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 sorting the 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. resistance to disturbances in 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.

In section 6 below, a detailed proposal for the final, merged grid connection code is stated.

3. Scope of document

Compare the VN grid connection codes to international regulations, especially European/Danish regulations, focusing on the generic connection code structure and content with the aim of harmonizing and combining existing distribution and transmission connection codes into one grid code. This document only concerns grid connection of generation facilities.

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

The recommendations for a merging of the Tx and Dx connection code can be adopted in future releases of the VN GC documents, depending on the needs in VN's industry.

This document is provided as deliverable 3.2 according to the VN DEPP DE2 ToR agreement.

4. Structure and content of Tx connection code

The structure and articles in the current Tx connection code are as listed in the table below. Articles not included in the merged connection code structure are marked with ~~strikethrough~~ in the table.

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 equip-ment 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

5. Structure and content of Dx connection code

The structure and articles in the current Dx connection code are as listed in the table below. The articles not included in the merged connection code structure are marked with ~~strikethrough~~ in the table.

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

6. First step of a future generator connection code

6.1 Interim step of merging C25 and C39

To advance from the two separate codes (C25 and C39) as of today the following combination of the articles of circular C25 and C39 into articles in a combined interim version is proposed as given in table overview on next pages.

For improved reading the Excel sheet “Report 3.2 - Table with C25-C39 combined” might be applicable.

In subsection 6.2 the structure and articles of the combined version is illustrated.

C25/2016/TT-BCT			C39/2015/TT-BCT			Combined Circular - Interim version		
Chapter #, description	Section, description	Circular xx, article yyy	Chapter #, description	Section, description	Circular xx, article yyy	Chapter #, description	Section, description	Circular xx, article yyy
Chapter I, GENERAL PROVISIONS			Chapter I, GENERAL RULES			Chapter I, GENERAL RULES		
-		Article 1. Governing scope	-		Article 1. Scope			Article 1. Governing scope
-		Article 2. Regulated entities	-		Article 2. Subject of applications			Article 2. Regulated entities
-		Article 3. Definitions	-		Article 3. Definitions			Article 3. Definitions
Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICITY TRANSMISSION SYSTEM			Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICAL DISTRIBUTION SYSTEM	Section 1. TECHNICAL REQUIREMENTS		Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICAL SYSTEM	Section 1. TECHNICAL REQUIREMENTS	Article 4. Frequency
-		Article 4. Frequency	-		Article 4. Frequency			Article 5. Stabilization of electricity system
-		Article 5. Stabilization of electricity system	-		Article 5. Voltage			Article 6. Voltage
-		Article 6. Voltage	-		Article 6. Phase Balance			Article 7. Phase balance

-		Article 7. Phase balance	-		Article 7. Harmonics voltage			Article 8. Harmonics
-		Article 8. Harmonics	-		Article 8. Blinking voltages			Article 9. Flicker perceptibility
-		Article 9. Flicker perceptibility	-		Article 9. Short-circuit and eliminate the problem of time			Article 10. Voltage fluctuation
-		Article 10. Voltage fluctuation	-		Article 10. Grounding mode			Article 11. Neutral grounding
-		Article 11. Neutral grounding	-		Article 11. Coefficinet of trouble touching the ground			Article 12. Short-circuit current and fault clearing time
-		Article 12. Short-circuit current and fault clearing time	-	Section 2. ELECTRICITY SUPPLY RELIABILITY AND POWER LOSS				Article 13. Earth fault factor
-		Article 13. Earth fault factor	-		Article 12. Inidcation of power supply reliability of distribution grids		Section 2. ELECTRICITY SUPPLY RELIABILITY AND POWER LOSS	Article 14. Reliability of grid

-		Article 14. Reliability of transmission grid	-		Article 13. Index of power supply reliablity			Article 15. Index of power supply reliablity
-		Article 15. Loss of power on transmission grid	-		Article 14. Loss of power distribution grid			Article 16. Loss of power on grid
-			-		Article 15. The order of approval of the norm of power supply reliability , annual electricity loss of the distribution grid			Article 17. The process of approval of the index of power supply reliability , annual electricity loss of the distribution grid
-			-	Section 3. QUALITY REQUIREMENT OF CUSTOMER SERVICE			Section 3. QUALITY REQUIREMENT OF CUSTOMER SERVICE	Article 16. The target quality of service customers
-			-		Article 16. The target quality of service customers			Article 17. Require quality of service customers
-			-		Article 17. Require quality of			

					service customers			
Chapter III, LOAD FORECASTING FOR NATIONAL ELECTRICITY SYSTEM			-			Chapter III, LOAD FORECASTING FOR NATIONAL ELECTRICITY SYSTEM		
		Article 16. General provisions on residual load forecasting for national electricity system	-					Article 18. General provisions on residual load forecasting for electricity system
		Article 17. Annual load forecasting						Article 19. Annual load forecasting
		Article 18. Monthly load forecasting						Article 20. Monthly load forecasting
		Article 19. Weekly load forecasting	Chapter III, DEMAND FORECASTING ELECTRIC LOADING DISTRIBUTION ELECTRIC SYSTEM					Article 21. Weekly load forecasting
		Article 20. Daily load forecasting			Article 18. General provisions on forecasting the demand			Article 22. Daily load forecasting

					for electricity load of the electricity distribution system			
		Article 21. Load forecasting in a electricity market transaction cycle			Article 19. Forecast of electricity load demand year			Article 23. Load forecasting in a electricity market transaction cycle
Chapter IV, TRANSMISSION GRID DEVELOPMENT PLAN					Article 20. Forecast of monthly load demand			
		Article 22. General principle			Article 21. Forecast of electricity demand for weekly load			
		Article 23. Content of transmission grid development plan	Chapter IV, INVESTMENT PLAN FOR DEVELOPMENT OF DISTRIBUTION ELECTRIC NETWORK		Article 19. Weekly load forecasting			

		Article 24. Responsibility for supplying information serving formulation of transmission grid development plan			Article 20. Daily load forecasting			
		Article 25. Procedures for formulation, approval and public announcement of transmission grid development plans			Article 21. Load forecasting in a electricity market transaction cycle			
Chapter V, CONNECTION TO TRANSMISSION GRID	Section 1. GENERAL PRINCIPLE				Article 24. Content of investment plan to develop distribution grid	Chapter IV, CONNECTION TO TRANSMISSION GRID	Section 1. GENERAL PRINCIPLE	Article 24. Connection point
		Article 26. Connection point			Article 25. Order of approving investment			Article 25. Borders of assets and operation management

					plans to develop distribution grid			
		Article 27. Borders of assets and operation management	Chapter V, CONNECTION TO DISTRIBUTION GRID	Section 1. GENERAL PRINCIPLE				Article 26. General requirements
		Article 28. General requirements			Article 26. Connection pointS		Section 2. GENERAL TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTING TO GRID	Article 27. Requirements for electrical equipment connected
	Section 2. GENERAL TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTING TO TRANSMISSION GRID				Article 27.Boundary of asset allocation and operational management			Article 28. Requirements phase balance
		Article 29. Requirements for connecting equipment			Article 28. Complying with electricity development planning			Article 29. Requirements for harmonics
		Article 30. Requirements for protective relay system			Article 29. Responsibility to comply with the			Article 30. Requirements on voltage flicker

					connection require-ments and coordinate the connec-tion			
		Article 31. Re-quirements for information system		Section 2. TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTION				Article 31. Require-ment for groundwater regime
		Article 32. Re-quirements for connection of SCADA system			Article 30. Require-ments for electrical equipment connected			Article 32. Power fac-tor requirements
		Article 33. Neutral grounding in transformers			Article 31. Require-ments phase balance			Article 35. Load fluctu-ation
		Article 34. Power factor			Article 32. Require-ments for harmonics			Article 36. Automatic frequency load shed-ding system
		Article 35. Load fluctua-tion			Article 33. Require-ments on voltage flicker			Article 33. Protection system requirements

		Article 36. Automatic frequency load shedding system			Article 34. Requirement for groundwater regime			Article 34. Information system requirements
		Article 37. Requirements of Control Center			Article 35. Power factor requirements			Article 35. Requirements for connecting SCADA system
	Section 3. TECHNICAL REQUIREMENTS FOR CONNECTION TO HYDRO POWER PLANTS AND THERMO POWER PLANTS				Article 36. Protection system requirements			Article 36. Technical requirements of the Control Center
		Article 38. Requirements for generating sets' power control			Article 37. Information system requirements		Section 3. TECHNICAL REQUIREMENTS FOR CONNECTION TO HYDRO POWER PLANTS AND THERMO POWER PLANTS CONNECT TO ELECTRICITY NETWORK	
		Article 39. Excitation system of a generating set			Article 38. Requirements for connecting			Article 37. Requirements for generating sets' power control

					SCADA system			
		Article 40. Governor			Article 39. Requirements for generating sets of hydroelectric plants and thermal power plants connected to distribution networks			Article 38. Excitation system of a generating set
		Article 41. Black start			Article 40. Requirements for the wind power , solar power plant connected to the electricity distribution networks from the medium voltage level upwards			Article 39. Governor

	Section 4. TECHNICAL REQUIREMENTS OF WIND AND SOLAR POWER PLANTS				Article 41. Require-ments for solar power system con-nected to the distribu-tion grid with low voltage sup-ply			Article 40. Black start
		Article 42. Technical re-quirements of wind and solar power plants			Article 42. Technical re-quirements of the Con-trol Center		Section 4. TECHNICAL REQUIREMENTS OF WIND AND SOLAR POWER PLANTS CONNECT TO ELECTRICITY NETWORK	
-	Section 5. PROCEDURES FOR CONNECTION AGREEMENT		-	Section 3. ORDER AND PROCEDURES FOR CONNECTION AGREEMENT				Article 41. Technical requirements of wind and solar power plants
-		Article 43. Pro-cedures	-		Article 43. Application for connec-tion		Section 5. PROCEDURES FOR CONNECTION AGREEMENT	Article 42. Application for connection
-		Article 44. Time limit for execution of	-		Article 44. Order of agreement			Article 43. Procedures

		connection agreement			on connection of medium voltage and 110 Kv			
-	**Section 6. IMPLEMENTATION OF CONNECTION AGREEMENT**		-		Article 45. Time limit for reviewing and signing the Connection Agreement			Article 44. Time limit for execution of connection agreement
-		Article 45. Rights to get access to equipment at connection points	-	**Section 4. IMPLEMENTATION OF WIRING TO CUSTOMER USE DISTRIBUTED ELECTRIC NETWORK**			**Section 6. IMPLEMENTATION OF CONNECTION AGREEMENT**	
-		Article 46. Dossier for inspection of energizing conditions	-		Article 46. Access to equipment at the connection point			Article 45. Rights to get access to equipment at connection points
		Article 47. Inspection of conditions for energizing connection points			Article 47. Provide documents to check the condition of electrical connection			Article 46. Dossier for inspection of energizing conditions

					points for K customers using distribution grid at 110 kV voltage level and customers have generator sets connected at medium voltage level			
		Article 48. Energizing connection points			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 47. Inspection of conditions for energizing connection points

		Article 49. Trial operation, acceptance and official operation of equipment behind connection points			Article 49. Check condition energized connection points			Article 48. Energizing connection points
		Article 50. Inspection and monitoring of equipment after put into official operation			Article 50. Close electrical connection points			Article 49. Trial operation, acceptance and official operation of equipment behind connection points
		Article 51. Replacement of equipment at connection points			Article 51. Test and acceptance order to put into operation of equipment after connection point			Article 50. Inspection and monitoring of equipment after put into official operation
	Section 7. PREPARATION FOR ENERGIZING ELECTRICAL EQUIPMENT OF TRANSMISSION NETWORK OPERATOR				Article 52. Check and monitor the operation of connection devices			Article 51. Replacement of equipment at connection points

		Article 52. Dossier for inspection of connection point energizing conditions			Article 53. Replace , install additional equipment at the connection point			Article 52. Implementation of antihypertensive connected to the grid for electricity customers
		Article 53. Energizing			Article 54. Implementation of antihypertensive connected to the grid for electricity customers		Section 7. PREPARATION FOR ENERGIZING ELECTRICAL EQUIPMENT OF NETWORK OPERATOR	
		Article 54. Replacement of equipment on transmission grid		Section 5. PREPARARING ENERGIZING FOR CONNECTION POINT TO ELECTRICAL EQUIPMENT DISTRIBUTION OPERATOR				Article 52. Dossier for inspection of connection point energizing conditions
		Article 55. General provisions on disconnection and reconnection			Article 55. Provide records to check the condition of electrical connection			Article 53. Energizing

					points for electrical equipment of the electricity distribution unit			
		Article 56. Voluntary disconnection			Article 56. Power connection points for electrical equipment of the electricity distribution unit			Article 54. Replacement of equipment on transmission grid
		Article 57. Compulsory disconnection			Article 57.Replace and install additional equipment on the distribution grid		Section 8. DISCONNECTION AND RESTORING CONNECTION	Article 55. General provisions on disconnection and reconnection
		Article 58. Reconnection		Section 6. DISCONNECTION AND RESTORING CONNECTION				Article 56. Voluntary disconnection
Chapter VI, OPERATION OF ELECTRICITY TRANSMISSION SYSTEM	Section 1. OPERATING PRINCIPLES				Article 58. General provisions for connection separation			Article 57. Compulsory disconnection

					and connection recovery			
		Article 59. Operation modes of electricity transmission system			Article 59. Separating voluntary connection			Article 58. Reconnection
		Article 60. Operating principles of electricity transmission system			Article 60. Required splice	Chapter V, OPERATION OF ELECTRICITY SYSTEM	Section 1. OPERATING PRINCIPLES	
		Article 61. Inspection and monitoring of protective relay system			Article 61. Restore connection			Article 59. Operation modes of electricity system
		Article 62. Stable operation of electricity system	Chapter VI, OPERATION OF DISTRIBUTION ELECTRIC SYSTEM	Section 1. RESPONSIBILITIES IN OPERATION				Article 60. Operating principles of electricity system
		Article 63. Trial operation and monitoring			Article 62. Responsibilities of the electricity distribution unit			Article 61. Inspection and monitoring of protective relay system
		Article 64. Handling of incident			Article 63. Responsibilities of the national			Article 62. Stable operation of electricity system

					electricity system moderation unit, the moderation level have control			
		Article 65. Notice of decline in electricity system security			Article 64. Responsibilities of the Customer uses electricity distribution networks			Article 63. Trial operation and monitoring
		Article 66. Load shedding for electricity system security		Section 2. MAINTENANCE PLAN AND REPAIR DISTRIBUTION ELECTRIC SYSTEM				Article 64. Handling of incident
	Section 2. RESPONSIBILITY OF UNITS IN OPERATION OF ELECTRICITY TRANSMISSION SYSTEM				Article 65. General provisions on the protection and line repair system in distribution			Article 65. Notice of decline in electricity system security
					Article 66. Plan for maintenance and			Article 66. Load shedding for electricity system security

					repair of the year			
					Article 67. Plan for maintenance and repair of the month		Section 2. RESPONSIBILITY OF UNITS IN OPERATION OF ELECTRICITY TRANSMISSION SYSTEM	
					Article 68. Planning maintenance, repair weeks			Article 67. Responsibility of electricity system and market operator
				Section 3. PLAN OF OPERATION				Article 68. Responsibility of transmission network operator
		Article 67. Responsibility of electricity system and market operator			Article 69. operating plan year			Article 69. Responsibility of generating units
		Article 68. Responsibility of transmission network operator			Article 70. Operational planning months			Article 70. Responsibility of electricity distribution units, electricity retailers
		Article 69. Responsibility of generating units			Article 71. Operational planning week			Article 71. Responsibility of electricity customers

		Article 70. Responsibility of electricity distribution units, electricity retailers			Article 72. Mode of operating the day		Section 3. ANCILLARY SERVICES	
		Article 71. Responsibility of electricity customers			Article 73. Operating distribution electricity system			Article 72. Types of ancillary services
	Section 3. ANCILLARY SERVICES			Section 4. OPERATION IN EMERGENCY				Article 73. Technical requirements of ancillary services
		Article 72. Types of ancillary services			Article 74. Emergency situation			Article 74. Principles of determining demand for ancillary services
		Article 73. Technical requirements of ancillary services			Article 75. Operating distribution power system in case of breakdown or disintegration of whole or part of transmission power system			Article 75. Registration of ancillary services

		Article 74. Principles of determining demand for ancillary services			Article 76. Operating distribution electricity system in case of island separation		Section 4. MAINTENANCE AND REPAIR OF ELECTRICITY SYSTEM	
		Article 75. Registration of ancillary services			Article 77. Operating power distribution system when a serious incident occurs on the power distribution grid voltage of 110 kV			Article 76. General provisions on maintenance and repair of electricity system
	Section 4. MAINTENANCE AND REPAIR OF ELECTRICITY TRANSMISSION SYSTEM				Article 78. Restore power distribution system			Article 77. Establishment of plan for maintenance and repair of electricity transmission system
		Article 76. General provisions on maintenance and repair of electricity		Section 5. LOAD AND VOLTAGE CONTROLS				Article 78. Plan for maintenance and repair of the year

		transmission system						
		Article 77. Establishment of plan for maintenance and repair of electricity transmission system			Article 79. Load control			Article 79. Plan for maintenance and repair of the month
		Article 78. Order of priority on separation of equipment for maintenance and repair			Article 80. Stop , reducing the power supply			Article 80. Planning maintenance, repair weeks
		Article 79. Registration for separation of equipment for maintenance and repair			Article 81. Develop a plan to sack load			Article 78. Order of priority on separation of equipment for maintenance and repair
		Article 80. Separation of equipment in operation for urgent repair			Article 82. Measures to lay off load			Article 79. Registration for separation of equipment for maintenance and repair
		Article 81. Reports on ur-			Article 102. Scope and Objectives			Article 80. Separation of equipment in operation for urgent repair

		gent separation of equipment for repair						
		Article 86. Objective			Article 103. General Provisions			Article 81. Reports on urgent separation of equipment for repair
		Article 87. Main planning principles and criteria			Article 104. Technical Requirements for Metering Equipment		Section 5. ELECTRICITY SYSTEM SCHEDULING AND DISPATCHING	Article 82
		Article 88. Strategic Plans			Article 105. Metering Register			Article 83
		Article 89. Five-Year Distribution Network Plan			Article 106. Multifunctional Metering Systems			Article 84
		Article 90. The Procedure for Developing the Five-year Distribution Network Plan			Article 83. Performing load dismissal			Article 85
		Article 91. The Provision of Planning Data			Article 84. Perform voltage regulators		Section 6. PLAN OF OPERATION	

		Article 92. Electronic Maps			Article 85. Monitoring and Remote Control			Article 86. operating plan year
		Article 93. Planning Facilities of the Distribution Licensee		Section 6. EXCHANGE INFORMATION IN OPERATION AND REPORTING REGIME				Article 87. Operational planning months
		Article 94. Measures for Reducing Losses			Article 86. Information exchange form			Article 88. Operational planning week
		Article 95. Consumption (Load) Forecasting			Article 87. Information exchange in operation			Article 89. Mode of operating the day
		Article 96. Distribution Network Studies			Article 88. Notice of unusual situations			Article 90. Operating distribution electricity system
	Section 5. ELECTRICITY SYSTEM SCHEDULING AND DISPATCHING				Article 89. Notice of serious incidents		Section 7. OPERATION IN EMERGENCY	
		Article 97. General Provisions		Section 7. COORDINATION OF OPERATION				Article 91. Emergency situation

		Article 98. Scope and Objectives			Article 90.General responsibility in coordinating operation			Article 92. Operating power system in case of breakdown or disintegration of whole or part of transmission power system
		Article 99. Short-term Load Forecast of the Customers Connected to the Distribution Network			Article 91. Coordinate the operation			Article 93. Operating electricity system in case of island separation
		Article 100. Outage Planning		Section 8. TEST ON THE DISTRIBUTION ELECTRIC SYSTEM				Article 94. Operating power system when a serious incident occurs on the power distribution grid voltage of 110 kV
		Article 101. Operational Management of the Distribution Network			Article 92. General requirements for experiments on distribution power systems			Article 95. Restore power system
		Article 82. Day-ahead mobilization schedules			Article 93. Cases of experimenting on equip-		Section 8. LOAD AND VOLTAGE CONTROLS	

					ment on distribution grid			
		Article 102. Scope and Objectives			Article 94. Cases of experiment of generating sets			Article 96. Load control
		Article 103. General Provisions			Article 95. Responsibility in experimental equipment on distribution grid			Article 97. Stop , reducing the power supply
		Article 104. Technical Requirements for Metering Equipment			Article 96. Experimental order at the request of the Power Distribution Unit			Article 98. Develop a plan to sack load
		Article 105. Metering Register			Article 97. Experimental order at the request of customers using distribution grid			Article 99. Measures to lay off load

		Article 106. Multifunctional Metering Systems			Article 98. Responsibility after the experiment			Article 100. Scope and Objectives
		Article 83. Obligations for system security		Section 9. REPORT ON OPERATION OF DISTRIBUTION ELECTRICITY SYSTEM				Article 101. General Provisions
		Article 84. Real-time dispatching			Article 99. The reporting regime			Article 102. Technical Requirements for Metering Equipment
		Article 85. Methods of real-time operation of electricity system	Chapter VII, IMPLEMENTATION					Article 103. Metering Register
	Section 6. COORDINATION IN OPERATION, EXCHANGE OF INFORMATION AND OPERATIONAL REPORTING MODES				Article 100. Organization of implementation			Article 104. Multifunctional Metering Systems

		Article 86. General responsibility for operation coordination			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 105. Performing load dismissal

		Article 87. Exchange of information			Article 102. Effect			Article 106. Perform voltage regulators
		Article 88. Confidentiality						Article 107. Monitoring and Remote Control
		Article 89. Reporting of incidents in national electricity system					Section 9. EXCHANGE INFORMATION IN OPERATION AND REPORTING REGIME	
		Article 90. Reporting of performance of transmission grid						Article 108. Information exchange form
		Article 91. Reporting of operation plan and result of operation of national electricity system						Article 109. Information exchange in operation
Chapter VII, ASSESSMENT OF ELECTRICITY SYSTEM SECURITY								Article 110. Notice of unusual situations
		Article 92. General provisions on assessment of						Article 111. Notice of serious incidents

		electricity system security						
		Article 93. Reserve capacity and electrical energy of electricity system					Section 10. COORDINATION OF OPERATION	
		Article 94. Assessment of medium-term assessment of electricity system security						Article 112.General responsibility in coordinating operation
		Article 95. Assessment of short-term assessment of electricity system security						Article 113. Coordinate the operation
Chapter VIII, ASSESSMENT OF QUALITY OF OPERATION OF ELECTRICITY TRANSMISSION SYSTEM							Section 11. TEST ON THE ELECTRIC SYSTEM	
		Article 96. General requirements						Article 114. General requirements for experiments on distribution power systems

		Article 97. Performance indicators of electricity system and market operator						Article 115. Cases of experimenting on equipment on distribution grid
		Article 98. Performance indicators of transmission network operator						Article 116. Cases of experiment of generating sets
Chapter IX, SETTLEMENT OF DISPUTES AND HANDLING OF VIOLATION								Article 117. Responsibility in experimental equipment on distribution grid
		Article 99. Settlement of disputes						Article 118. Experimental order at the request of the Power Distribution Unit
		Article 100. Handling of violation						Article 119. Experimental order at the request of customers using distribution grid
Chapter X, IMPLEMENTATION								Article 120. Responsibility after the experiment
		Article 101. Implementation					Section 12. REPORT ON OPERATION OF ELECTRICITY SYSTEM	

		Article 102. Effect				Chapter VI, ASSESSMENT OF ELECTRICITY SYSTEM SECURITY		
								Article 121. General provisions on assessment of electricity system security
								Article 122. Reserve capacity and electrical energy of electricity system
								Article 123. Assessment of medium-term assessment of electricity system security
								Article 124. Assessment of short-term assessment of electricity system security
						Chapter VII, ASSESSMENT OF QUALITY OF OPERATION OF ELECTRICITY SYSTEM		
								Article 125. General requirements
								Article 126. Performance indicators of electricity system and market operator

								Article 127. Performance indicators of network operator
						Chapter VIII, SETTLEMENT OF DISPUTES AND HANDLING OF VIOLATION		
								Article 128. Settlement of disputes
								Article 129. Handling of violation
						Chapter IX, IMPLEMENTATION		
								Article 130. Implementation
								Article 131. Effect

6.2 Recommended interim combined circular – article level

The combined articles from circular C25 and C39 is recommended to be as illustrated in the table below.

The interim version will still be impaired from the sorting of the requirements into generator categories based on size. Additionally, the combined interim version will include several articles with requirements which is not relevant to generator grid connection. The recommend step must be observed as a step on the road to a final generator connection code as recommend in report D3.3.

Combined Circular - Interim version		
Chapter #, description	Section, description	Circular xx, article yyy
Chapter I, GENERAL RULES		
		Article 1. Governing scope
		Article 2. Regulated entities
		Article 3. Definitions
Chapter II, REQUIREMENTS FOR OPERATION OF ELECTRICAL SYSTEM	Section 1. TECHNICAL REQUIREMENTS	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
	Section 2. ELECTRICITY SUPPLY RELIABILITY AND POWER LOSS	Article 14. Reliability of grid
		Article 15. Index of power supply reliability
		Article 16. Loss of power on grid
		Article 17. The process of approval of the index 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, LOAD FORECASTING FOR NATIONAL ELECTRICITY SYSTEM		

		Article 18. General provisions on residual load forecasting for electricity system
		Article 19. Annual load forecasting
		Article 20. Monthly load forecasting
		Article 21. Weekly load forecasting
		Article 22. Daily load forecasting
		Article 23. Load forecasting in a electricity market transaction cycle
Chapter IV, CONNECTION TO TRANSMISSION GRID	Section 1. GENERAL PRINCIPLE	Article 24. Connection point
		Article 25. Borders of assets and operation management
		Article 26. General requirements
	Section 2. GENERAL TECHNICAL REQUIREMENTS FOR EQUIPMENT CONNECTING TO GRID	Article 27. Requirements for electrical equipment connected
		Article 28. Requirements phase balance
		Article 29. Requirements for harmonics
		Article 30. Requirements on voltage flicker
		Article 31. Requirement for groundwater regime
		Article 32. Power factor requirements
		Article 35. Load fluctuation
		Article 36. Automatic frequency load shedding system
		Article 33. Protection system requirements
		Article 34. Information system requirements
		Article 35. Requirements for connecting SCADA system
		Article 36. Technical requirements of the Control Canter
	Section 3. TECHNICAL REQUIREMENTS FOR CONNECTION TO HYDRO POWER PLANTS AND THERMO POWER PLANTS CONNECT TO ELECTRICITY NETWORK	
		Article 37. Requirements for generating sets' power control
		Article 38. Excitation system of a generating set
		Article 39. Governor

		Article 40. Black start
	Section 4. TECHNICAL REQUIREMENTS OF WIND AND SOLAR POWER PLANTS CONNECT TO ELECTRICITY NETWORK	
		Article 41. Technical requirements of wind and solar power plants
	Section 5. PROCEDURES FOR CONNECTION AGREEMENT	Article 42. Application for connection
		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 putting into official operation
		Article 51. Replacement of equipment at connection points
		Article 52. Implementation of antihypertensive connected to the grid for electricity customers
	Section 7. PREPARATION FOR ENERGIZING ELECTRICAL EQUIPMENT OF NETWORK OPERATOR	
		Article 52. Dossier for inspection of connection point energizing conditions
		Article 53. Energizing

		Article 54. Replacement of equipment on transmission grid
	Section 8. DISCONNECTION AND RESTORING CONNECTION	Article 55. General provisions on disconnection and reconnection
		Article 56. Voluntary disconnection
		Article 57. Compulsory disconnection
		Article 58. Reconnection
Chapter V, OPERATION OF ELECTRICITY SYSTEM	Section 1. OPERATING PRINCIPLES	
		Article 59. Operation modes of electricity system
		Article 60. Operating principles of electricity 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 SYSTEM	
		Article 76. General provisions on maintenance and repair of electricity system
		Article 77. Establishment of plan for maintenance and repair of electricity transmission system
		Article 78. Plan for maintenance and repair of the year
		Article 79. Plan for maintenance and repair of the month
		Article 80. Planning maintenance, repair weeks
		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. PLAN OF OPERATION	
		Article 86. operating plan year
		Article 87. Operational planning months
		Article 88. Operational planning week
		Article 89. Mode of operating the day
		Article 90. Operating distribution electricity system
	Section 7. OPERATION IN EMERGENCY	

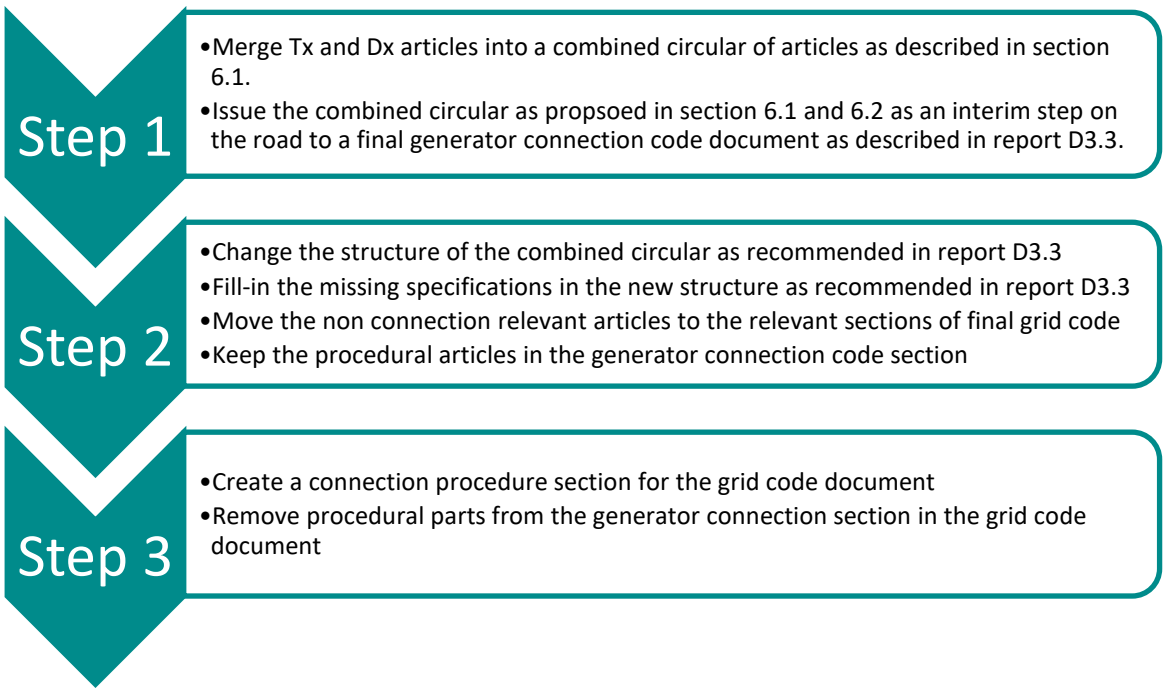
		Article 91. Emergency situation
		Article 92. Operating power system in case of breakdown or disintegration of whole or part of transmission power system
		Article 93. Operating electricity system in case of island separation
		Article 94. Operating power system when a serious incident occurs on the power distribution grid voltage of 110 kV
		Article 95. Restore power system
	Section 8. LOAD AND VOLTAGE CONTROLS	
		Article 96. Load control
		Article 97. Stop, reducing the power supply
		Article 98. Develop a plan to sack load
		Article 99. Measures to lay off load
		Article 100. Scope and Objectives
		Article 101. General Provisions
		Article 102. Technical Requirements for Metering Equipment
		Article 103. Metering Register
		Article 104. Multifunctional Metering Systems
		Article 105. Performing load dismissal
		Article 106. Perform voltage regulators
		Article 107. Monitoring and Remote Control
	Section 9. EXCHANGE INFORMATION IN OPERATION AND REPORTING REGIME	
		Article 108. Information exchange form
		Article 109. Information exchange in operation
		Article 110. Notice of unusual situations
		Article 111. Notice of serious incidents
	Section 10. COORDINATION OF OPERATION	
		Article 112.General responsibility in coordinating operation
		Article 113. Coordinate the operation
	Section 11. TEST ON THE ELECTRIC SYSTEM	
		Article 114. General requirements for experiments on distribution power systems

		Article 115. Cases of experimenting on equipment on distribution grid
		Article 116. Cases of experiment of generating sets
		Article 117. Responsibility in experimental equipment on distribution grid
		Article 118. Experimental order at the request of the Power Distribution Unit
		Article 119. Experimental order at the request of customers using distribution grid
		Article 120. Responsibility after the experiment
	Section 12. REPORT ON OPERATION OF ELECTRICITY SYSTEM	
Chapter VI, ASSESSMENT OF ELECTRICITY SYSTEM SECURITY		
		Article 121. General provisions on assessment of electricity system security
		Article 122. Reserve capacity and electrical energy of electricity system
		Article 123. Assessment of medium-term assessment of electricity system security
		Article 124. Assessment of short-term assessment of electricity system security
Chapter VII, ASSESSMENT OF QUALITY OF OPERATION OF ELECTRICITY SYSTEM		
		Article 125. General requirements
		Article 126. Performance indicators of electricity system and market operator
		Article 127. Performance indicators of network operator
Chapter VIII, SETTLEMENT OF DISPUTES AND HANDLING OF VIOLATION		
		Article 128. Settlement of disputes
		Article 129. Handling of violation
Chapter IX, IMPLEMENTATION		
		Article 130. Implementation
		Article 131. Effect

7. Recommendations for roadmap

Merging the current Tx and Dx circulars could take place in several steps towards a final generator connection code.

The following figure illustrates the three steps recommended to obtaining a combined grid connection code.



The recommended first step is to combine the C25 and C39 circulars into one combined circular, using the recommended structure in section 6.2.

The second step is recommended to restructure the combined circular, including introducing the categories (A, B, C and D) might involve a lot of meetings with various internal as well as external stakeholders in the VN electricity sector. In addition, any missing specifications must be added to the connection requirements so the task of keeping a stable grid does not get out of control. It must be pointed out that the updated / new requirements for grid connection are recommended to be valid only for new connections. The connection agreement must state which document version compliance testing / verification has been approved for. The specifications for step 2 are given in report D3.3.

The actions recommended in step 3 could be included in step 2, but it will depend on the actual situation in the VN electricity sector and the resource availability situation in ERAV. The recommendation to remove the procedural part of the connection code is based om the fact that procedural aspects have different readers than technical aspects, and the procedural part could also be applicable to other sections of the grid code than the grid connection section.

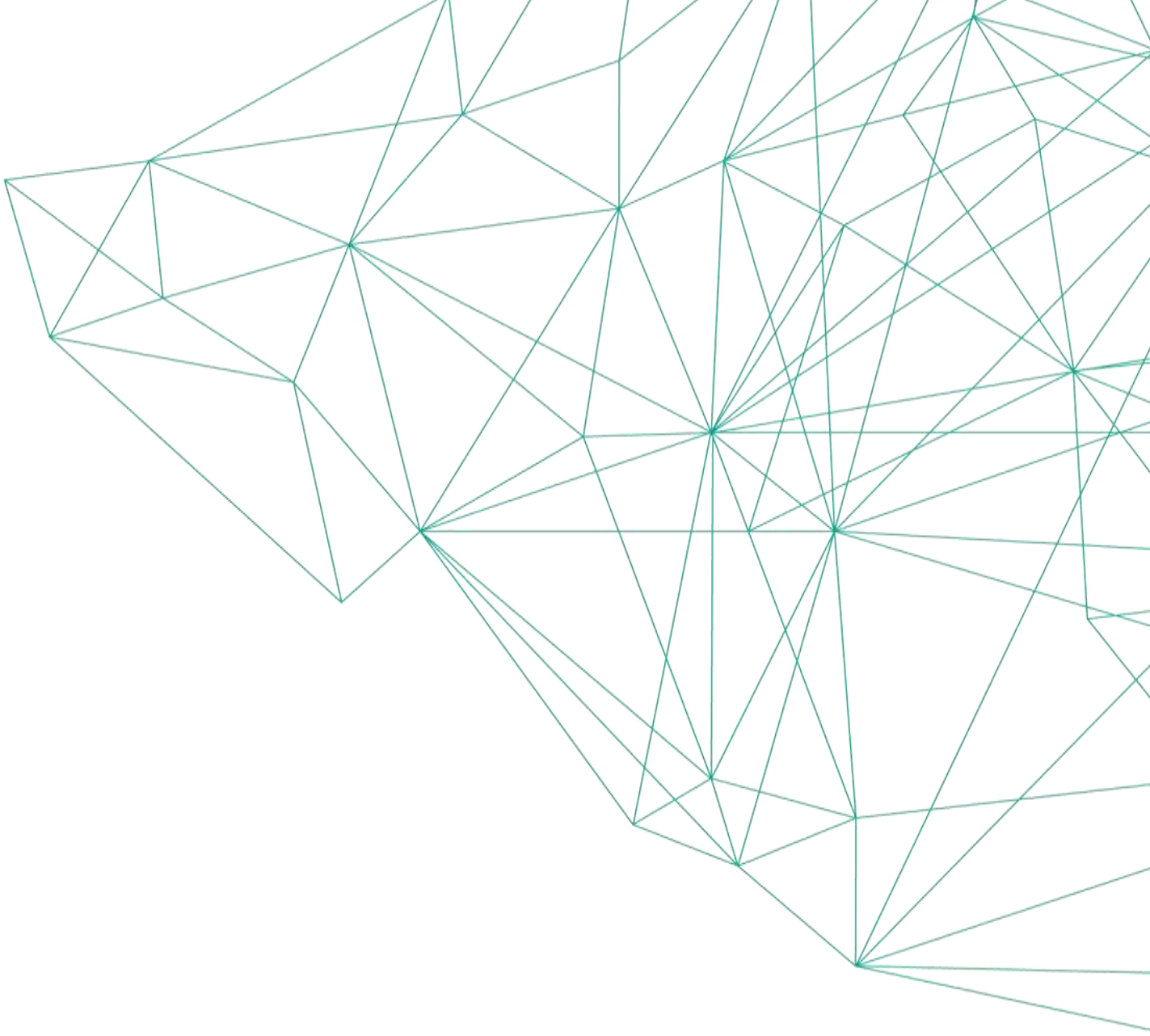
8. References

The following documents are used as references in the report.

#	Description
1.	Circular 25 – "The regulations on electricity transmission system"
2.	Circular 30 – "Amendments to some articles of C25 and C39"
3.	Circular 39 – "The regulations on electricity distribution system"
4.	COMMISSION REGULATION (EU) 2016/631 of 14 April 2016 establishing a network code on requirements for grid connection of generators (NC RfG)
5.	Technical regulation 3.3.1 for battery plants, Danish grid connection code for BESS; published 28.09.2017.
6.	Technical regulation 3.2.3 for Thermal Power Plants, Danish grid connection code for Thermal power plants; published 10.01.2017.
7.	Technical regulation 3.2.5 for Wind Power Plants, Danish grid connection code for Wind Power Plants; published 22.07.2016.

9. 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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