



Transposition of ENTSO-E grid connection codes into the Network Code of BiH

Vojislav Pantić, ISO BiH

ENTSO-E network codes / EU Regulations

- Connection of generators (RfG) - Regulation of Commission (EU) 2016/631 of 28 August 2016 establishing a network code on requirements for grid connection of generators
- Demand connection code (DCC) - Commission Regulation (EU) 2016/1388 of 17 August 2016 establishing a Network Code on Demand Connection
- Connection of High Voltage Direct Current systems (HVDC) - Commission Regulation (EU) 2016/1447 of 26 August 2016 on establishing a network code on requirements for grid connection of high voltage direct current systems and direct current-connected power park modules



Grid connection of generators

Applies to:

- Connection of synchronous generation modules
- Connection of power park modules

Does not apply to:

- Generation modules for ensuring back-up supply
- Storing devices, excluding pump-storage generation modules

The requirements apply to connection to grid (transmission or distribution) in accordance with categorization of generation modules

Grid connection of generators

Categorization of generation modules

TYPE	Max capacity (MW)	Connection
A	0.5	<110 kV
B	10	<110 kV
C	20	<110 kV
D	≥20	≥110 kV <110 kV if $P \geq 20\text{MW}$

Connection of types A and B to transmission network

- Only if there is no possibility of connection to distribution system
- Requirements for these types to be applied

Grid connection of generators

Requirements by types

Requirements	A	B	C	D
<i>Frequency stability</i>	+	+	+	+
<i>Regulation P</i>			+	+
<i>LFSM-O</i>	+	+	+	+
<i>Automatic disconnection</i>	+			
<i>Automatic connection</i>	+			
<i>LFSM-U</i>			+	+
<i>Reduction of P at falling frequency</i>	+	+	+	+
<i>Interface for reducing P</i>		+	+	+
<i>Stability - FRT curve</i>		+	+	+
<i>Control and protection schemes</i>		+	+	+
<i>Information exchange</i>		+	+	+
<i>Reactive power capability</i>		+	+	+
<i>Regulation of Q</i>			+	+
<i>Voltage stability</i>		+	+	+
<i>Active power frequency response</i>			+	+
<i>Monitoring active power frequency response</i>			+	+
<i>Black start</i>			+	+

Grid connection of generators

Frequency and voltage ranges

Frequency range	Operation time period (min)
47,5 – 48,5	30
48,5 – 49,0	30
49,0 – 51,0	unlimited
51,0 – 51,5	30

Nominal voltage (kV)	Voltage range (kV)	Operation time period (min)
400	340 – 380	60
	380 – 420	unlimited
	420 – 440	60
220	187 – 198	60
	198 – 245	unlimited
	245 – 253	60
110	93.5 – 99	60
	99 – 123	unlimited
	123 – 126,5	60

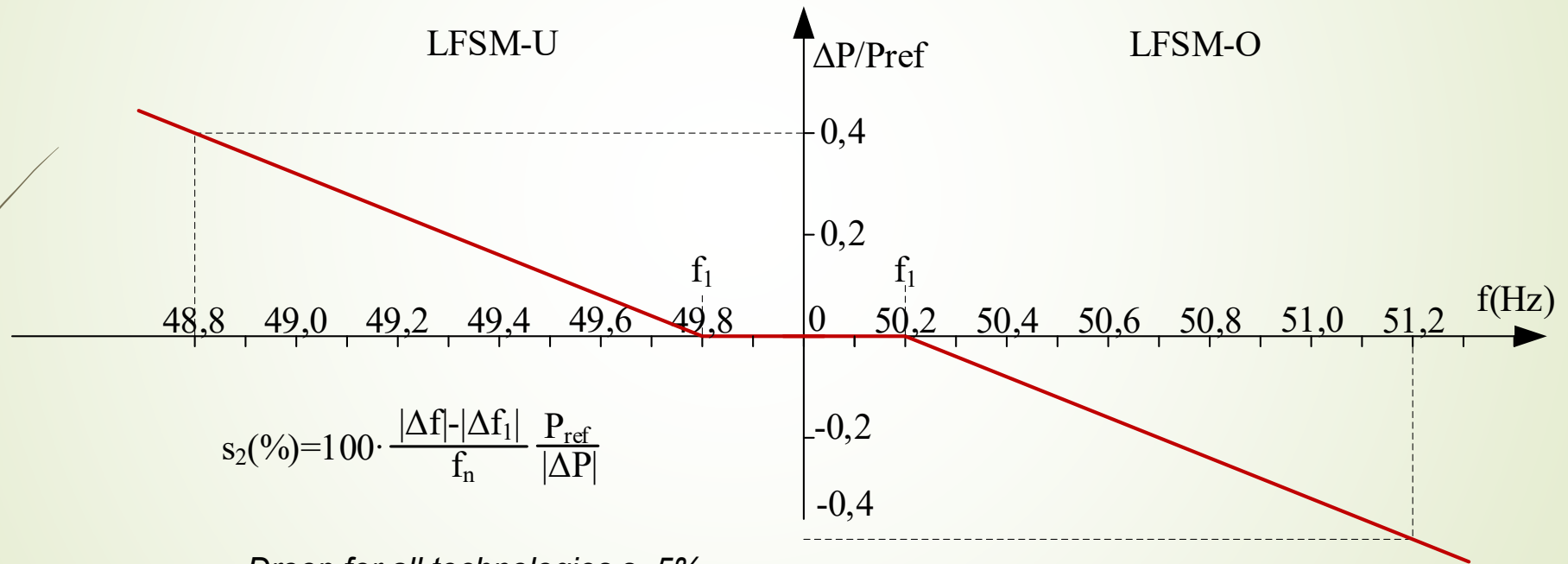
Grid connection of generators

Voltage values in BiH power system (2020) - example

Substation	Voltage level (kV)	Number of hours U>Um	%
Tuzla 4	400	8393	96%
	220	3094	35%
	110	14	0%
Mostar 4	400	8602	98%
	220	8114	93%
	110	94	1%
Sarajevo 10	400	8204	94%
	110	474	5%
Trebinje	400	8178	93%
	220	5987	68%
	110	20	0%

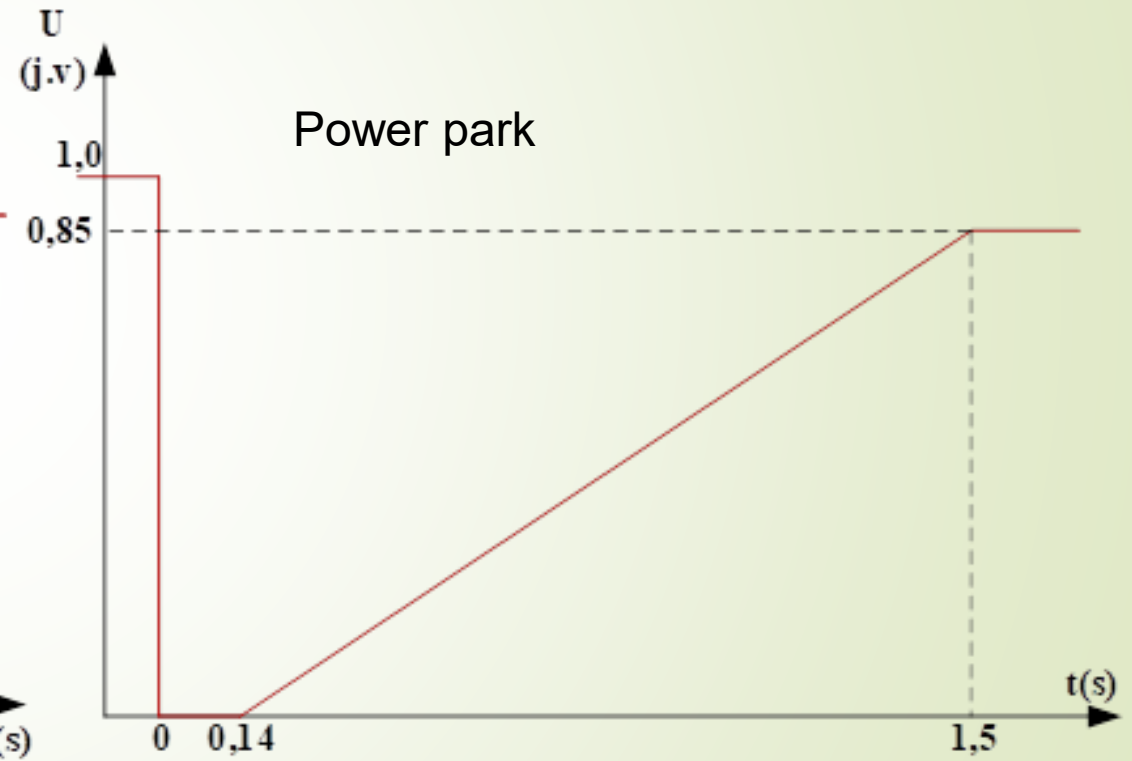
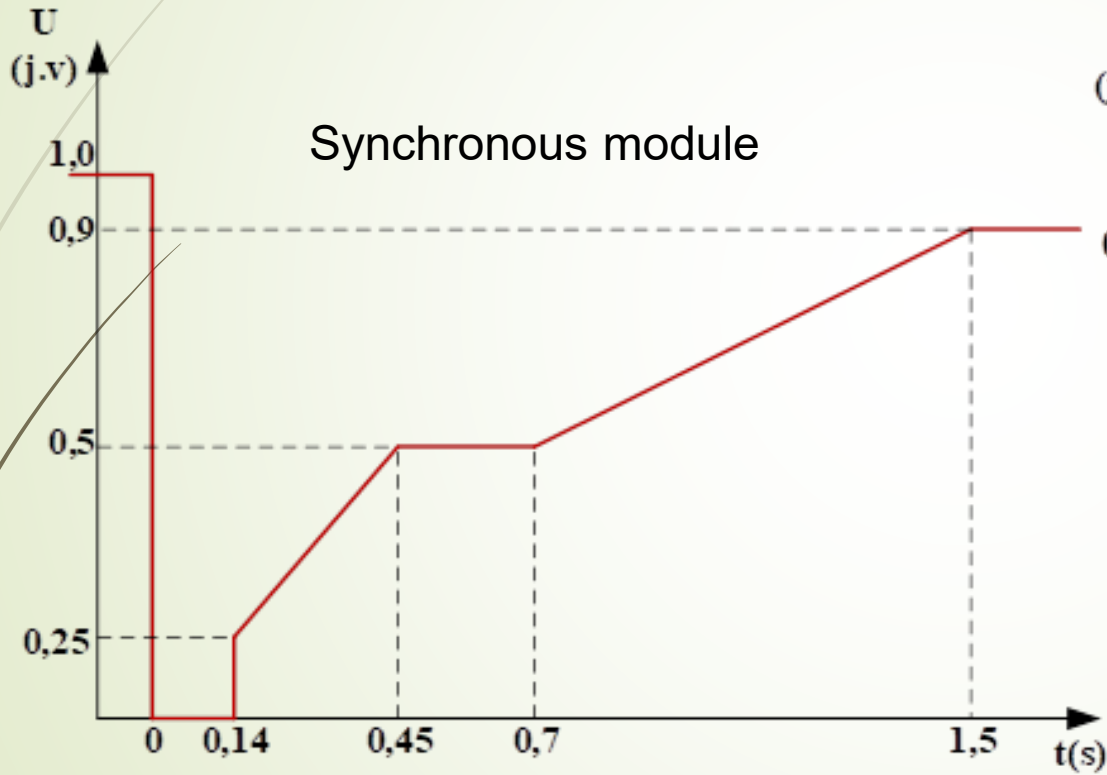
Grid connection of generators

Limited frequency sensitive mode LFSM-U and LFSM-O



Grid connection of generators

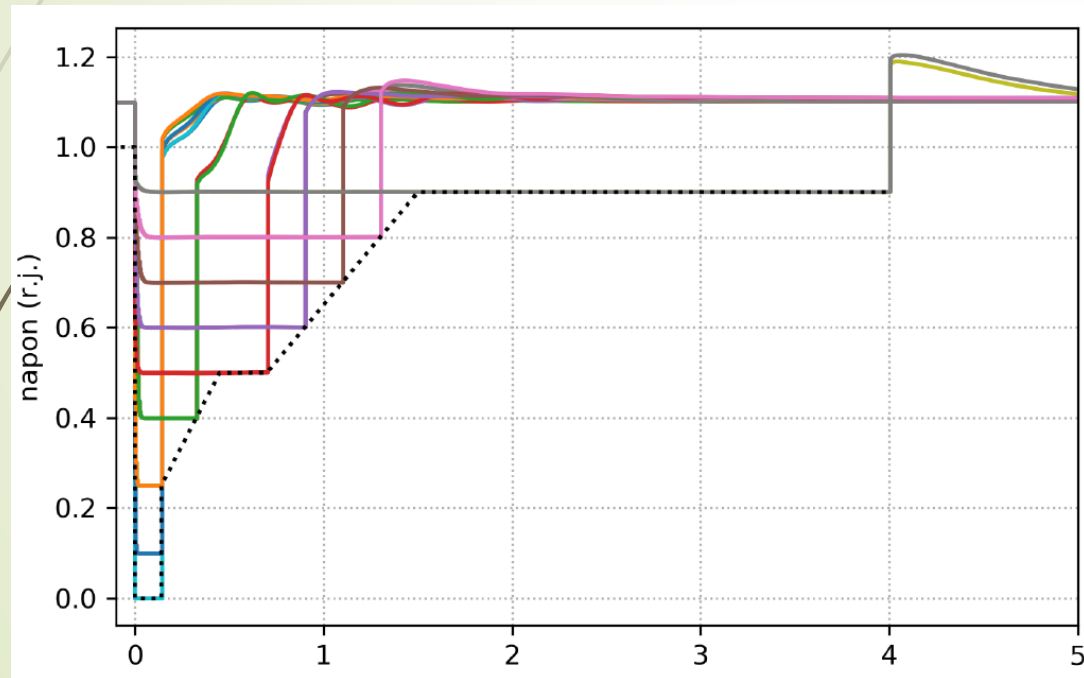
Stability - FRT curve (Type D)



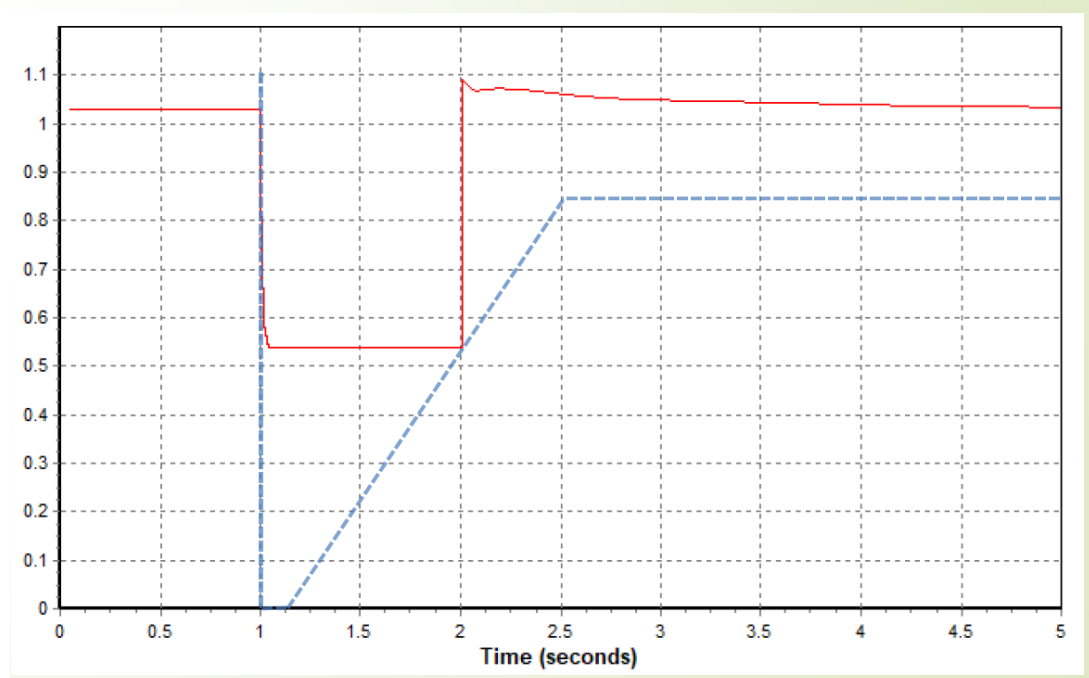
Grid connection of generators

Stability FRT curve (Type D)- example

Synchronous module



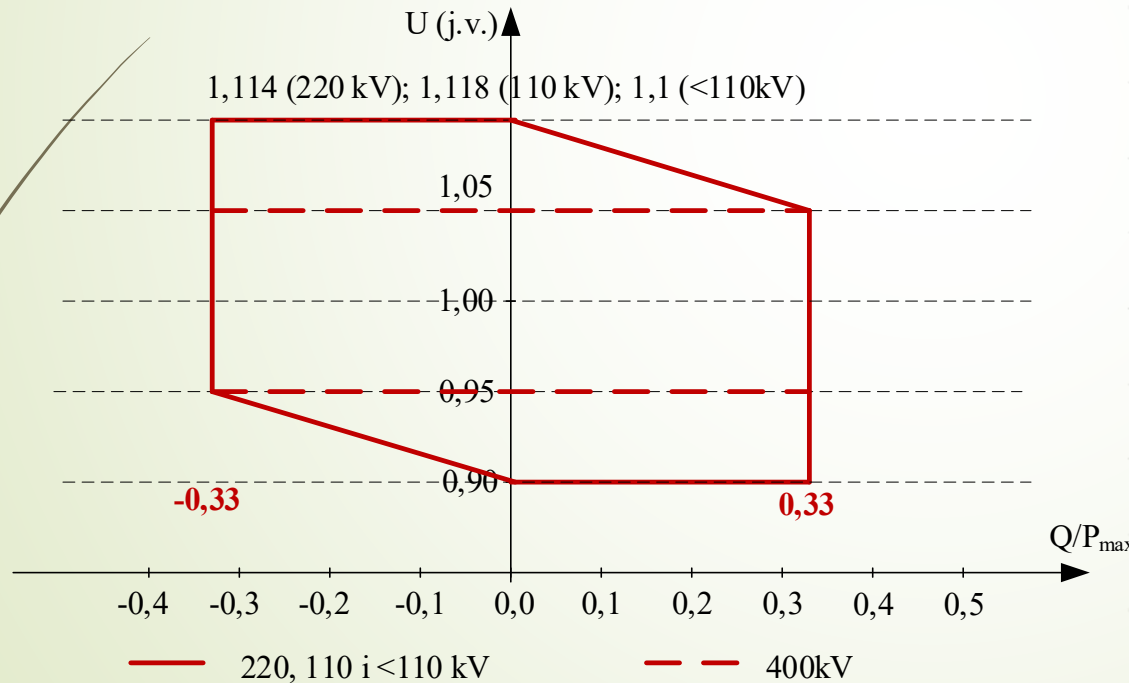
Power park



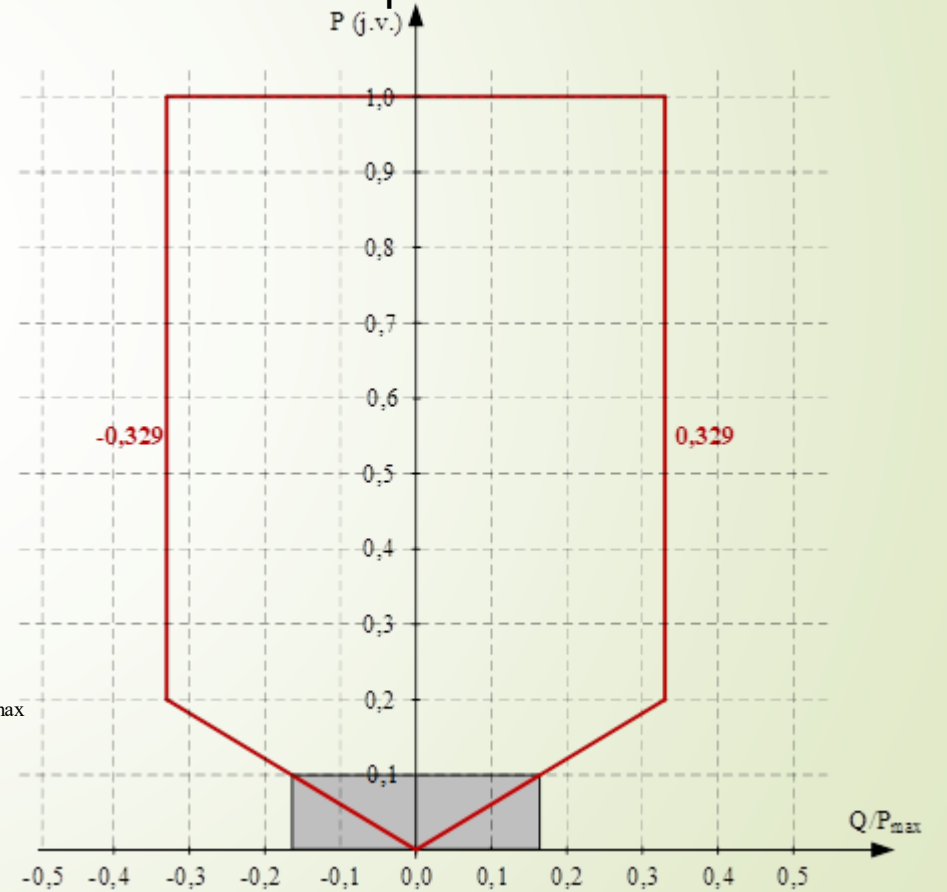
Grid connection of generators

Reactive power capability

Synchronous module and power park
For $P=P_{max}$

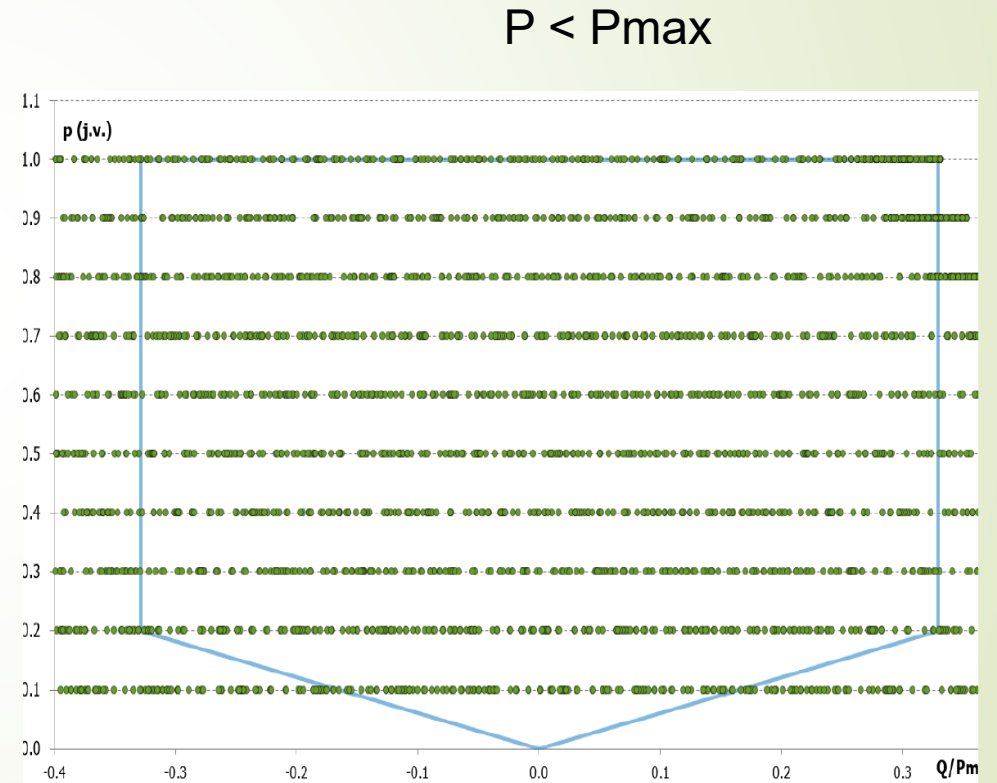
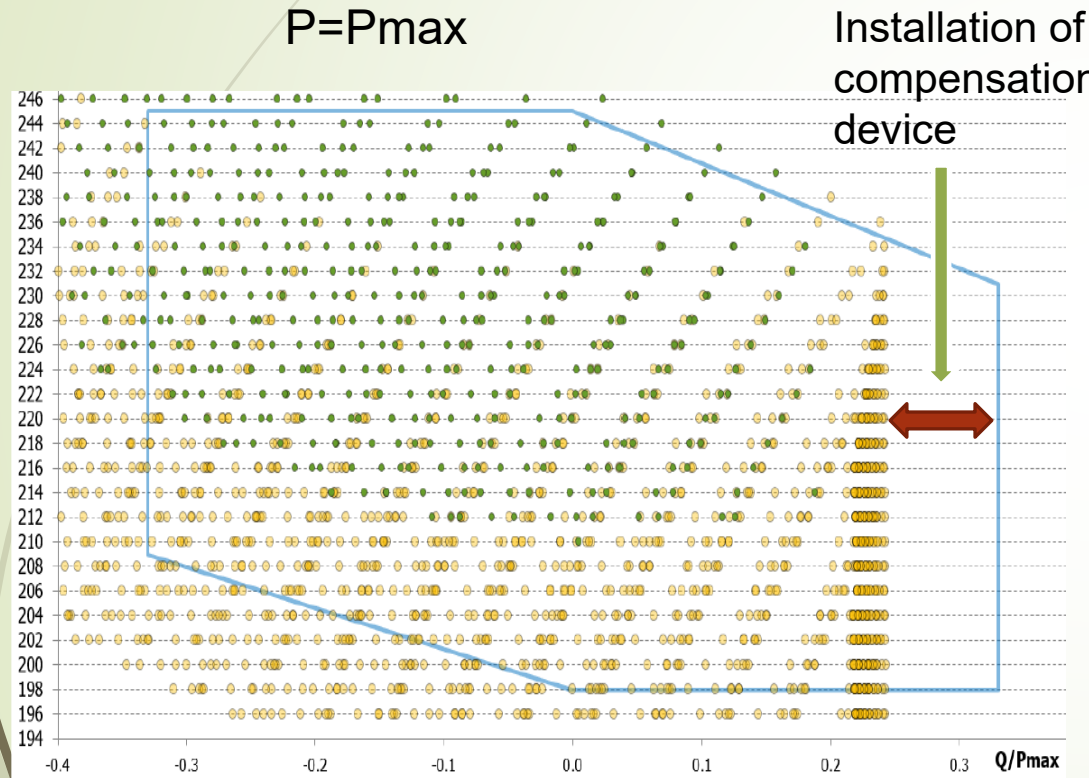


Power park for $P < P_{max}$



Grid connection of generators

Reactive power capability - example





Demand connection to transmission grid

Applies to:

- Demand facilities that are connected to transmission grid
- Distribution systems, including the closed distribution systems
- Demand units used by a demand facility or a closed distribution system to provide demand response services

Closed distribution system - definition

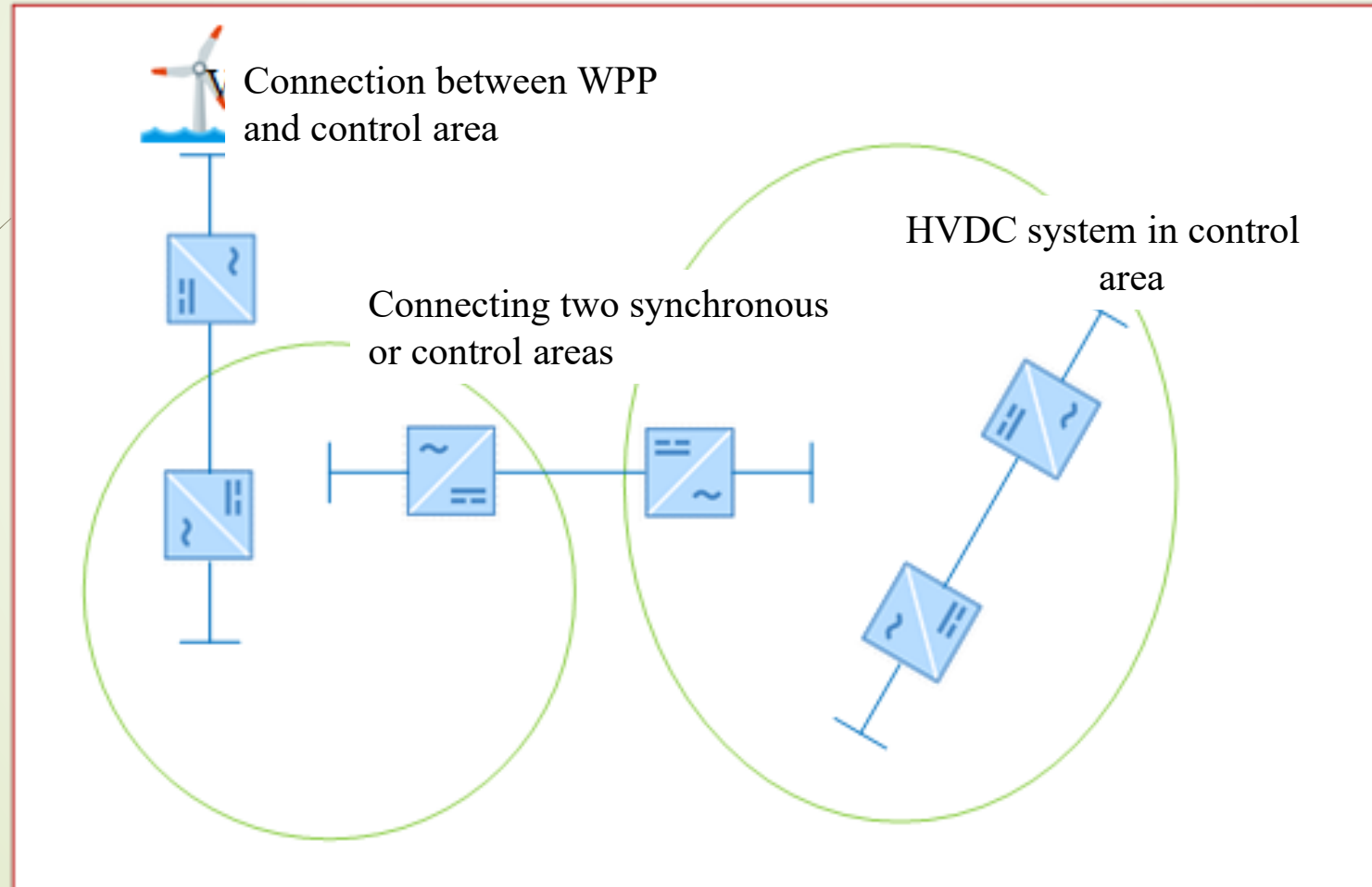
Distribution system that distributes electricity within a geographically confined industrial or commercial location, or a location with shared services, which does not supply customers from the category of households, except for a small number of households that are located within the area served by the systems and that are by employment or in a similar way associated to the owner of the system

Demand connection to transmission grid

Basic requirements	Values
Frequency	Requirements are the same as for connection of generators
Voltage	
Short Circuit Currents	Maximum and minimum values to be publically disclosed
Reactive power	<p>Customers:</p> <ul style="list-style-type: none">▪ Importing reactive power $\leq 48\% P_{\max \text{ importing}}$ - ($\cos \varphi = 0,9$)▪ Exporting reactive power $\leq 15\% P_{\max \text{ exporting}}$ - ($\cos \varphi = 0,99$) <p>Distribution systems:</p> <ul style="list-style-type: none">▪ Importing reactive power $\leq 48\% P_{\max \text{ importing}}$ - ($\cos \varphi = 0,9$)▪ Exporting reactive power $\leq 33\% P_{\max \text{ exporting}}$ - ($\cos \varphi = 0,95$) <p>Possible requirements of ISO BiH</p> <ul style="list-style-type: none">• For $P \leq 25\% P_{\max \text{ exporting}}$ DSO does not supply reactive power to the grid• DSO actively controls the reactive power at the point of connection <p>Possible requirements for DSO:</p> <ul style="list-style-type: none">• ISO BiH considers the possibility of participation of DSO facilities in managing the reactive power

Connection of HVDC systems

Application





Connection of HVDC systems

Why the requirements for DC systems in Network Code

- ▶ Requirements of the Energy Community

Need for such a system

- ▶ Such systems do not exist in BiH Power system, and there are no plans to install them
- ▶ Many European TSOs do not have such systems, but they have defined the requirements

Basic requirements

- ▶ Regulation of active power and frequency regulation
- ▶ Regulation of active power and voltage regulation

TSO-DSO coordination regarding the grid codes requirements

Generators

Why types A, B, C in Network Code?

- Network code applies to network ≥ 110 kV (legal provision)
- The Regulation defines system requirements for all generator types, irrespective of connection location, and provides for obligation of the system operators to define the system requirements
- TSO-DSO obligations are defined and assigned

DSO obligations:

- Rules that take into consideration these requirements to make reference to ISO BiH Network Code
- Provide the needed level of information for control and protection devices, if necessary
- Provide functional testing in accordance with Compliance Tests



TSO-DSO coordination regarding the grid codes requirements

Connection to grid (competences)

- DSO - Rules for connection to distribution network
- Transmission company BiH - Rulebook for connection to transmission grid ≥ 110 kV and for voltage < 110 kV for facilities owned by TransCo

System requirements

- Maintaining frequency stability in whole power system
- Maintaining stability of generation modules (fault ride through capability)



TSO-DSO coordination regarding the grid codes requirements

Demand connection

- Q-U regulation - defining conditions for reactive power exchange (auxiliary service)
- Defining conditions for demand side management (auxiliary service)
- Information exchange in relation to the control and protection devices at the connection point between distribution and transmission network

HVDC systems

- N/A



Thank you for your
attention!