Implementation of European Network Codes

Asset protection and system robustness

→ Robustness and Fault ride through

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2. Fault-ride-through capabilities: requirements
3. Expert group: expected joint work

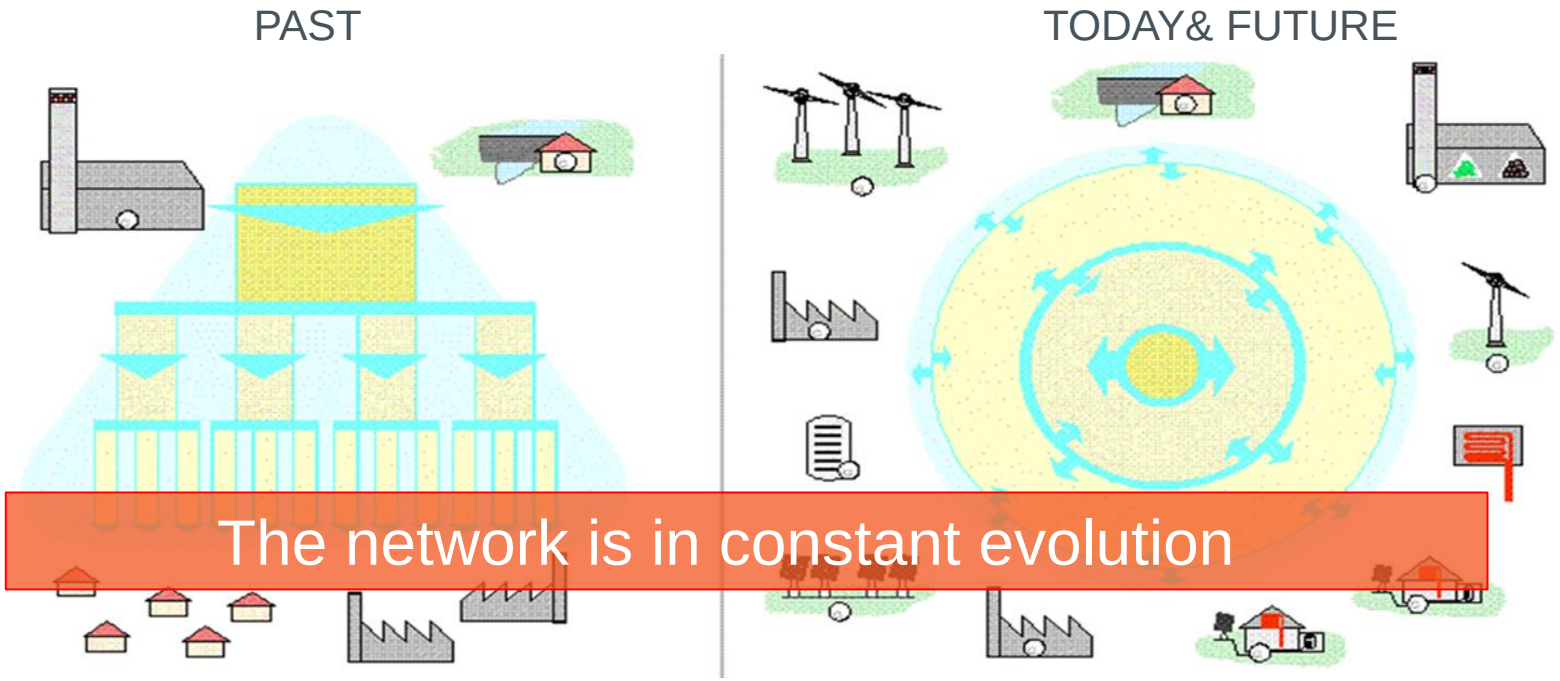
Introduction:
Asset protection and system robustness

Grid Users Inter-dependability

Robustness of the system = capability of the system to face disturbances, to prevent and limit the large disturbances

Robustness of the system is relaying on the technical capabilities and on the adequate performance of the elements connected to the transmission and distribution networks: the generation facilities and the demand users.

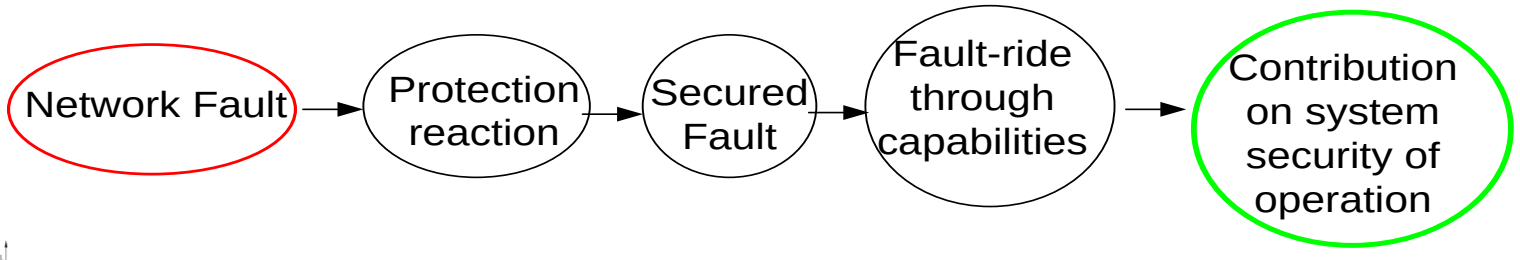
Robustness of the system: a key factor for the security of the system operation

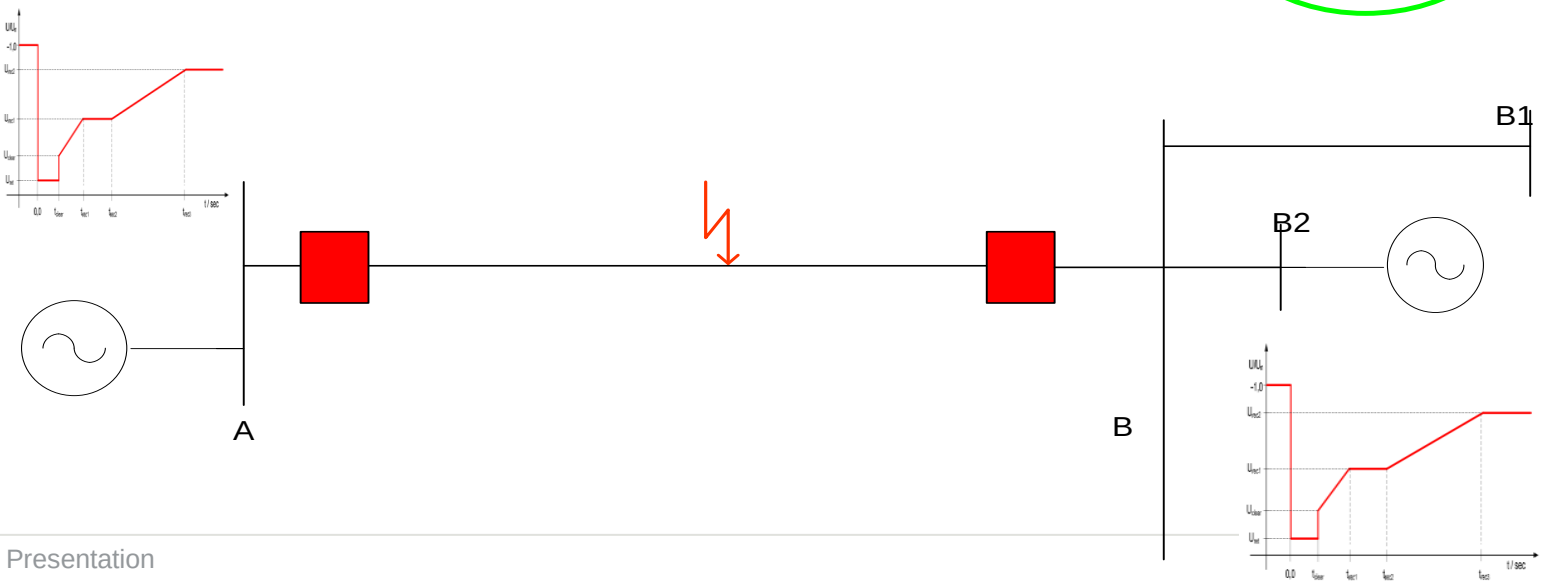


Fault-ride-through role

'fault-ride-through' means the capability of electrical devices to be able to remain connected to the network and operate through periods of low voltage at the connection point caused by secured faults; the f**ault-ride-through** capability represents the parameter of a network element robustness.

‘secured fault’ means a fault which is successfully cleared according to the system operator’s planning criteria;

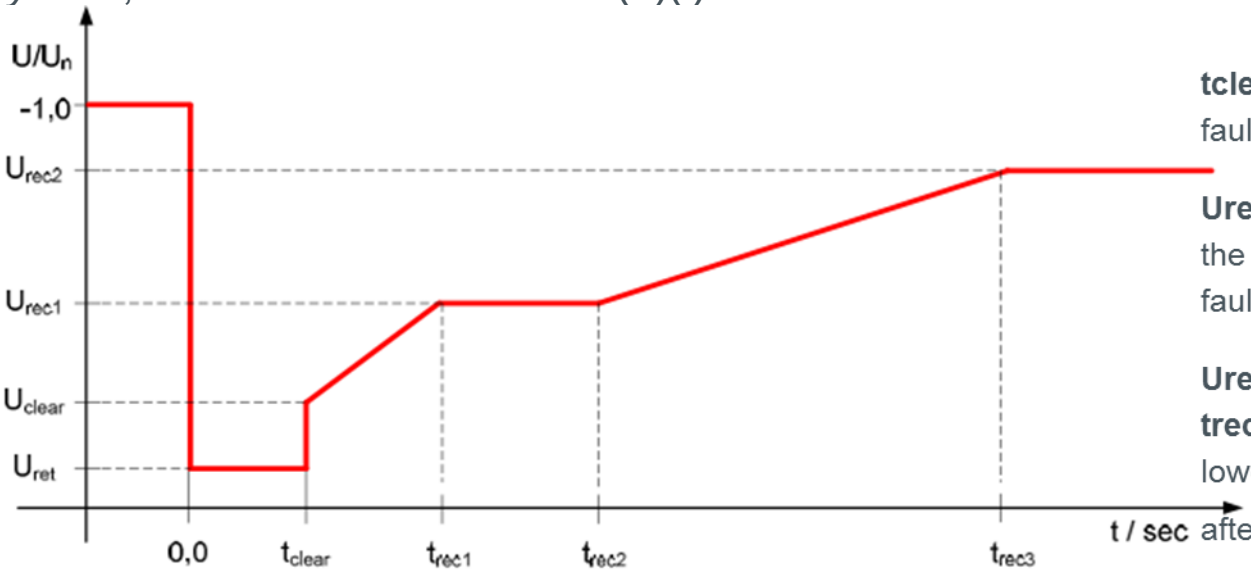




NC RfG: Fault-ride-through a robustness related requirement for type B, C, D generating units

Type B (C,D) power generating module & power park module robustness requirement concerning the fault-ride-through capability:

"*each TSO shall specify a voltage-against-time-profile in line with Figure at the connection point for fault conditions, which describes the conditions in which the power generating module is capable of staying connected to the network and continuing to operate stably after the power system has been disturbed by secured faults on the transmission system*;" NC RfG – PGM ii.1.14.3(a)(i)

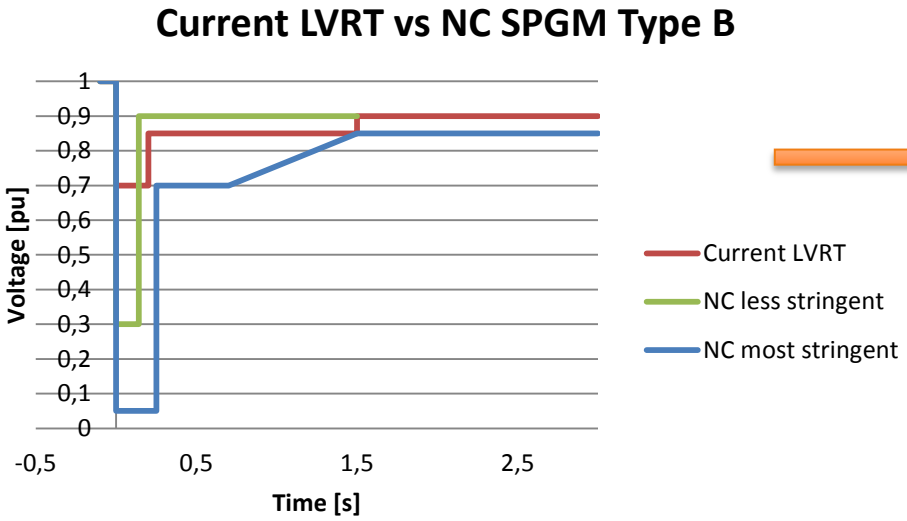


tclear is the instant when the fault has been cleared

Uret is the retained voltage at the connection point during a fault,

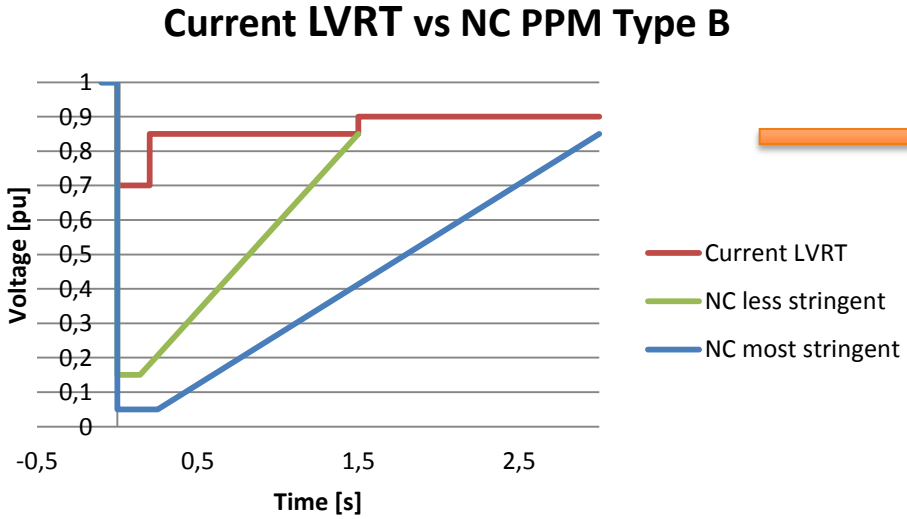
Urec1, Urec2, trec1, trec2 and trec3 specify certain points of lower limits of voltage recovery after fault clearance.

Current requirements and NC RfG for Type B and C



tclear (the instant when the fault has been cleared):
Actual = 200ms. New value

Uret (the retained voltage at the connection point during a fault):
Actual =70%, New value



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Fault-ride-through capabilities

Strong interdependence: system secure operation & protection and control systems

Main categories of requirements in the RfG, DCC, HVDC codes:

Robustness & Fault Ride Through

Short-Circuit Power management

Protection & Control/Connection

Simulation models exchange

Dynamic stability assessment

Agreement documents in the protection and control domain

Network Code Requirements for Generators: requirements related to APSR topic (1)

Type B, C, D Power Generating Modules and Power Park modules

- Control for system stability or for emergency actions
- Electrical Protections Schemes and settings
- **Fault-ride-through capabilities in case of symmetrical and asymmetrical faults**
- Agreement documents on protection and control settings requested for connection

Network Codes	
What?	Which doc?
Type B power generating modules shall fulfil the following requirements in relation to robustness: (a) with regard to fault-ride-through capability of power generating modules: (i) each TSO shall specify a voltage-against-time-profile	NC RfG – PGM ii.1.14.3(a)(i)
Each TSO shall define and make publicly available the pre-fault and post-fault conditions for the fault-ride-through capability in terms of: the calculation of the pre-fault minimum short circuit capacity at the connection point; pre-fault active and reactive power operating point of the power generating module at the connection point and voltage at the connection point; and calculation of the post-fault minimum short circuit capacity at the connection point.	NC RfG – PGM ii.1.14.3(a)(iv) &(v)
The protection schemes and settings for internal electrical faults must not jeopardise fault-ride-through performance;	NC RfG – PGM ii.1.14.3(a)(vi)
Low Voltage Ride Through – Post fault active power recovery – Simulation or Equipment Certificate	NC RfG – SPGM – Art. 47.1, 47.3, 47.4

NC HVDC systems and DC connected power park modules requirements related to APSR topic

- Short-circuit contribution during symmetric and asymmetric faults
- **Fault ride through capabilities and performances of the protections dedicated to internal faults**
- Coordination and agreement of schemes and settings necessary to protect the network
- Coordination of protection schemes relevant for the HVDC system and the network
- Agreement documents on protection schemes and settings and control schemes and settings relevant to the connection point to be included in the Operational notification procedures

Network Codes	
What?	Which doc?
If specified by the relevant system operator, in coordination with the relevant TSO, an HVDC system shall have the capability to provide fast fault current at a connection point in case of symmetrical (3-phase) faults.	HVDC II.2.19.1
Where an HVDC system is required to have the capability referred to in paragraph 1, the relevant system operator, in coordination with the relevant TSO, shall specify the following:(a) how and when a voltage deviation is to be determined as well as the end of the voltage deviation; (b) the characteristics of the fast fault current; (c) the timing and accuracy of the fast fault current, which may include several stages.	HVDC II.2.19.2

NC Demand for Connection Code requirements related to APSR topic

For the transmission connected demand facilities, transmission connected distribution systems and distribution system connections

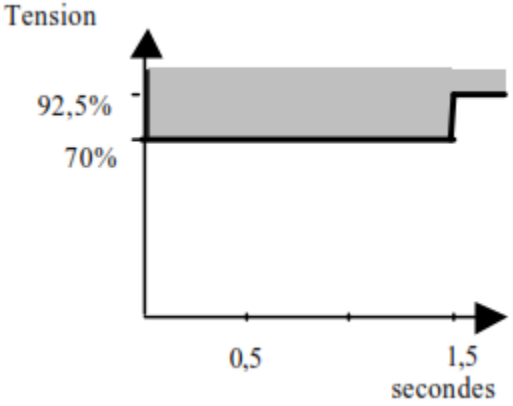
- Short-circuit relevant results exchange
- Control for system stability or for emergency actions schemes and settings;
- **Disconnection demand for system defence and reconnection demand schemes → settings coordination of the anti-islanding detection and fault-ride-through characteristic**
- Electrical Protections schemes and settings
- Agreement documents on protection and control schemes and settings
- Simulation models
- Synchronization performances

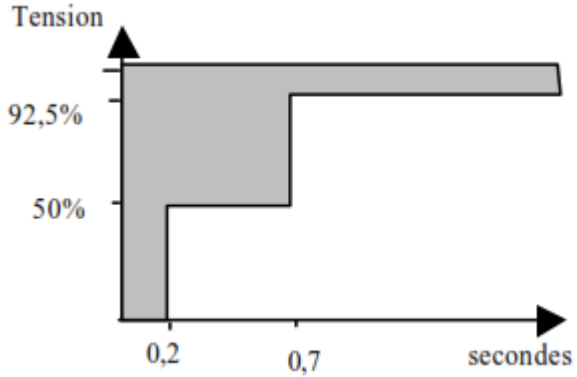
Network Codes	
What?	Which doc?
The relevant TSO and the transmission connected demand facility owner or the transmission connected distribution system operator shall agree on any changes to the protection schemes relevant for the transmission connected demand facility or the transmission connected distribution system, as well as relevant to the setting for the transmission connected demand facility or the transmission connected distribution system.	NC DCC ii1.15.4

Existing Requests for all types of generating units

RT fédéral version définitive publiée le 28.12.2001
Sous-section ii Conditions de fonctionnement; art 64 § 1,2

« pouvoir fonctionner dans l'entièreté de son domaine de fonctionnement en mode synchrone avec le réseau, lorsque la tension au point de raccordement, exprimée en pourcentage de la tension nominale en ce point, reste, durant un creux de tension d'amplitude importante, dans la plage hachurée du diagramme ci- après. »





Synergrid C10/11 for units above 1MVA

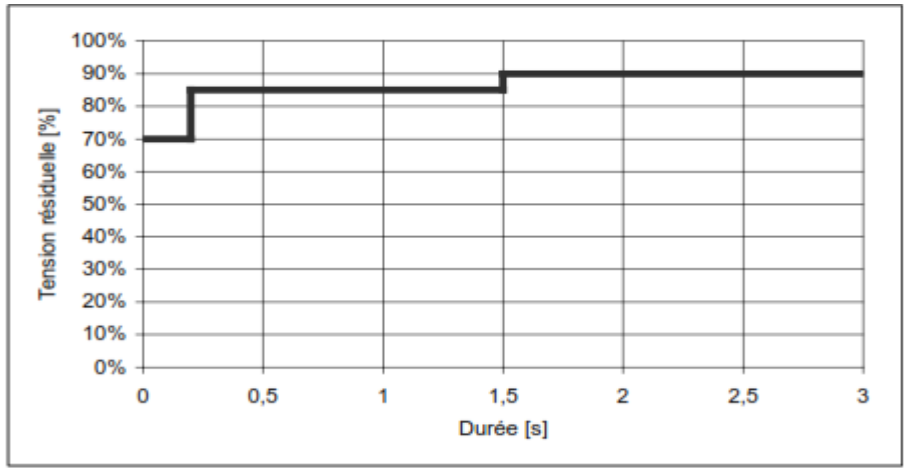
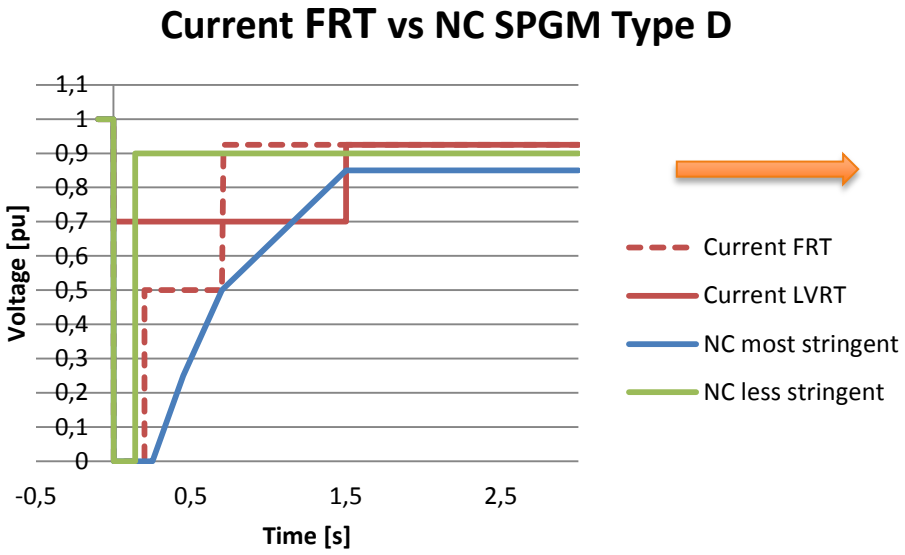


Figure 2-1 : Exigence relative à la tolérance envers les creux de tension – présentation graphique

Current requirements and NC RfG for Type D



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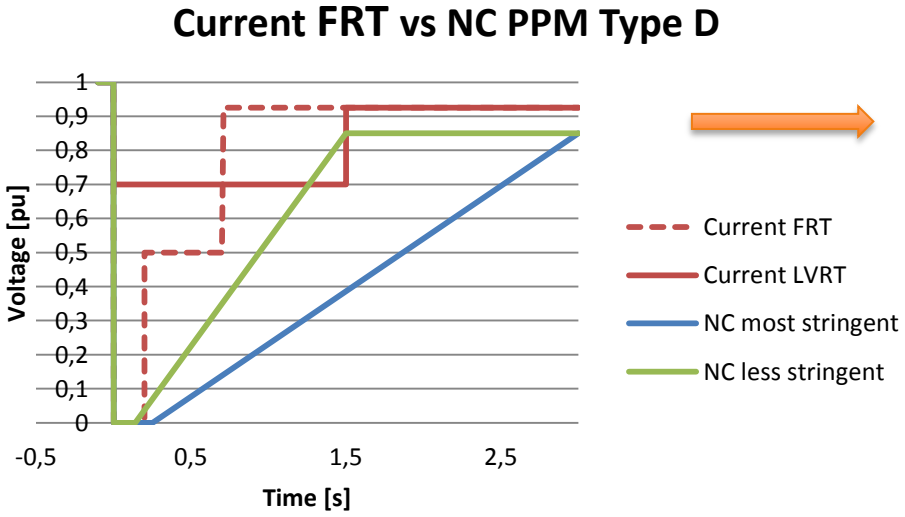

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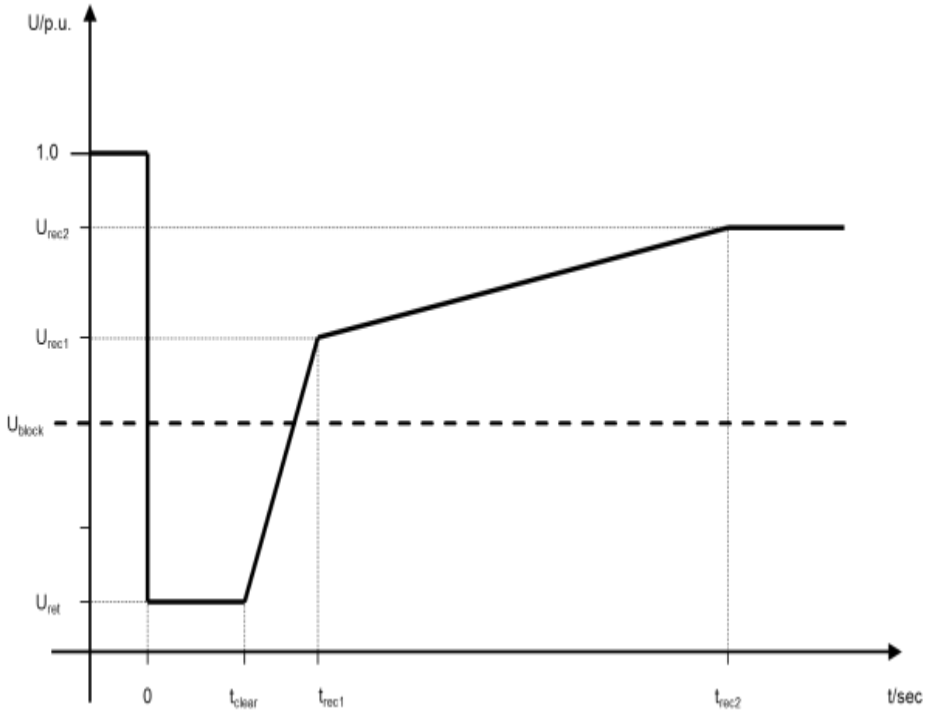
NC HVDC systems and DC connected power park modules

Fault-ride-through capability of a HVDC System (HVDC 2.3.23)

"The Relevant TSO shall define, while respecting the provisions of Article 4(3) and Article 16, a Voltage-against-time-profile according to, having regard to the voltage-against-time-profile defined for Power Park Modules according to [NC RfG]."



tclear is the instant when the fault has been cleared
Uret is the retained voltage at the connection point during a fault,
Urec1, Urec2, trec1, trec2 and trec3 specify certain points of lower limits of voltage recovery after fault clearance.
Ublock is the blocking Voltage at the Connection Point

Expert group: joint work

Expert group subjects for discussions and agreement

- Fault-ride-through characteristic:
  - Decide the reference points of the characteristics (**tclear, Uret, Urec1, Urec2, trec1, trec2 , trec3,. Ublock**):
    - For Type B,C,D
      - Synchronous Power Generating Module
        - For symmetric type of faults
        - For asymmetric type of faults
      - Power Park Module
        - For symmetric type of faults
        - For asymmetric type of faults
- The settings of protection/control systems correlated with the fault-ride-through requirements (ex: anti-islanding protection)

Working Proposal

1. 1st Expert working group meeting(3 hours):
   - ELIA (multi-disciplinary team) will prepare a proposal for discussion to present:
     - the proposed reference points for each fault-ride-through characteristic
     - the correlation between these points and system protection settings and requests deriving from system stability constrains
   - Expert discussion concerning the impact of the Network codes RfG, DCC, HVDC requirements in the fault ride through capability
     - starting point : the articles identified
2. 2nd Expert working group meeting (3 hours)
   - Feed-back from experts
   - Harmonization of the positions
   - Correlation with the discussions concerning closely related subjects: short-circuit contribution and control and protection requirements
3. 3rd and 4th Expert working group meeting (3 hours) dedicated to discussions, agreement and decision regarding the content of new requirements in the fault-ride-through capability and the place to be presented.