GC0111
RfG Clarifications to Fast Fault Current Injection

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Summary

- Current Status
- Key Features of the Revised requirements
- Resume of the fast fault current capability when subject to a balanced or unbalanced fault
- Example of a short circuit fault in excess of 140ms and the expected requirement
- Summary of the requirements
- Next Steps

Current Status

- At the last GC0111 meeting held on 4th July the following key concerns were raised amongst stakeholders
  - Clarification regarding the proportionality criteria
    - (ie We would not want full reactive current to be injected for small drops in connection point voltage below 0.9pu – eg full reactive injection at say 0.85pu voltage)
  - Modifications required for longer duration faults (ie greater than 140ms), to ensure consistency with Fast Fault Current Injection proposals
  - Clarification required in relation to unbalanced faults
  - Stakeholders generally seemed comfortable with the rating and adoption of a locus plot indicating the maximum rating that would be expected from the plant under both steady state and faulted conditions
  - Reactive current against time curves to be retained
  - Appendix 4EC to be removed

Key Features of the Revised requirements

- A new voltage / Reactive Current requirement has now been introduced similar to that adopted in a number of other European countries
  - Defines the Fast Fault capability required for a specified voltage drop.
  - For voltage drops below 50% of nominal full reactive current injection is required
  - Amendments to ECC.6.3.15.9 (ie fault ride through - voltage dips in excess of 140 ms) to ensure consistency with fast fault current injection requirements.
- The requirements for fast fault current applies to both balanced and unbalanced faults. Reference is now made to RMS positive phase sequence RMS values.
- A new clause (ECC.6.3.16.1.4) has been added with regard to the transition from pre-fault operation to post operation. This is to address the pre-fault operating conditions of the Power Park Module or HVDC Equipment

Reactive Current / Voltage Curve

FFCI Figure ECC.16.3.16(a)

Notes

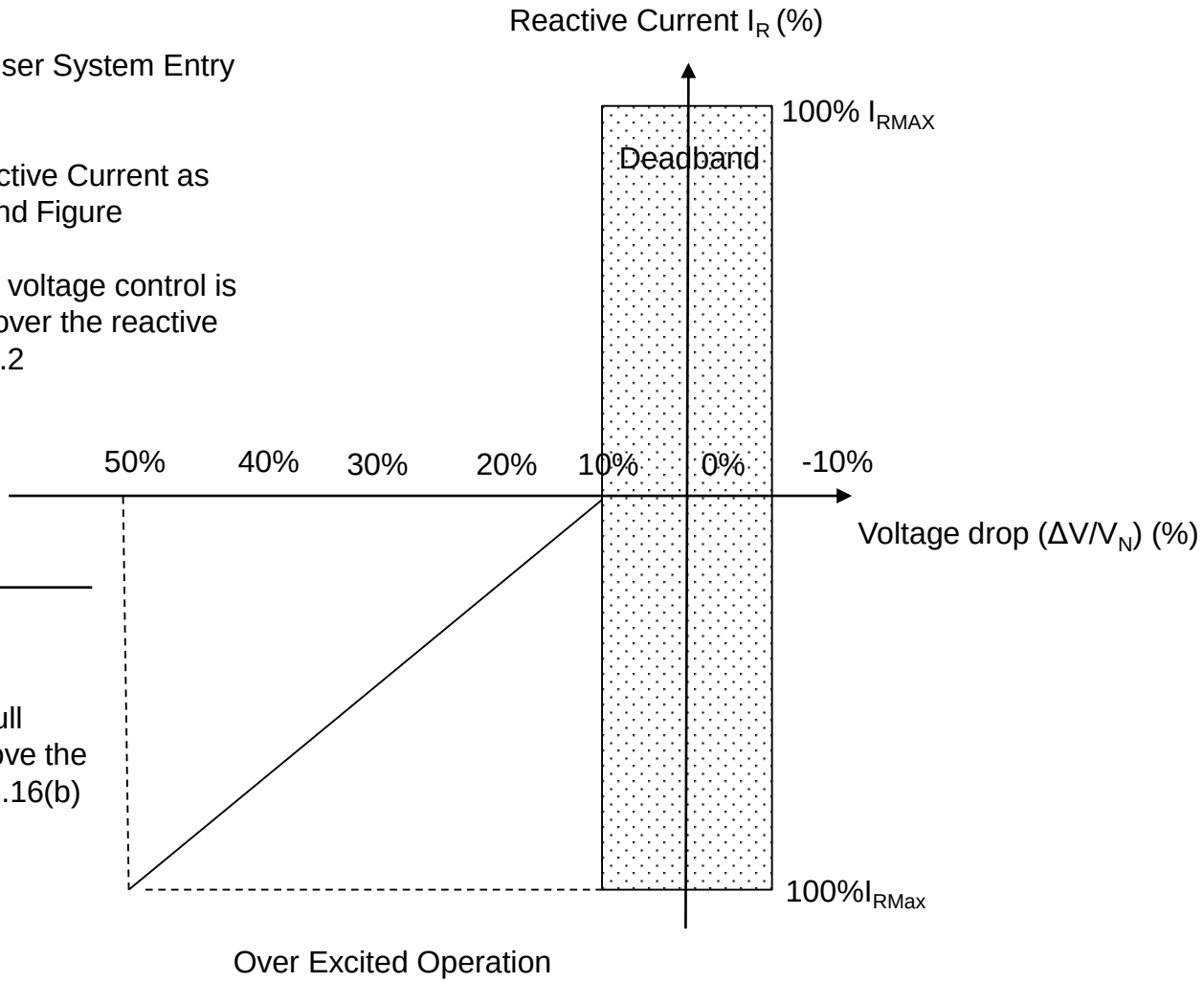
V_N – Nominal Voltage

V – Voltage at Grid Entry Point or User System Entry Point

$\Delta V = V_N - V$

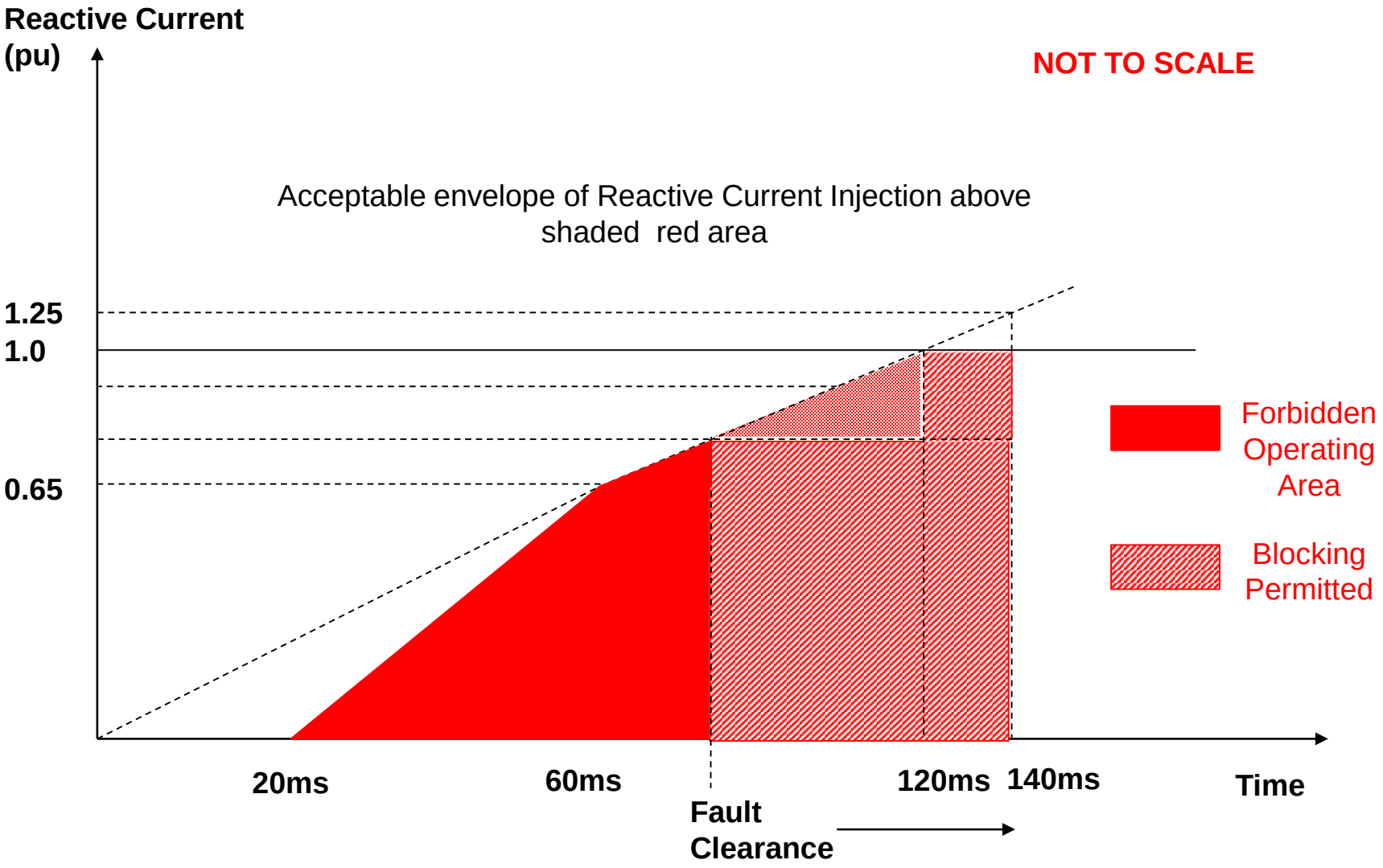
I_{RMAX} - The maximum injected Reactive Current as defined in Figure ECC.16.3.16(b) and Figure ECC.16.3.16(c)

Within the deadband (±10% of V_N) voltage control is required as specified in ECC.6.3.8 over the reactive capability range defined in ECC.6.3.2

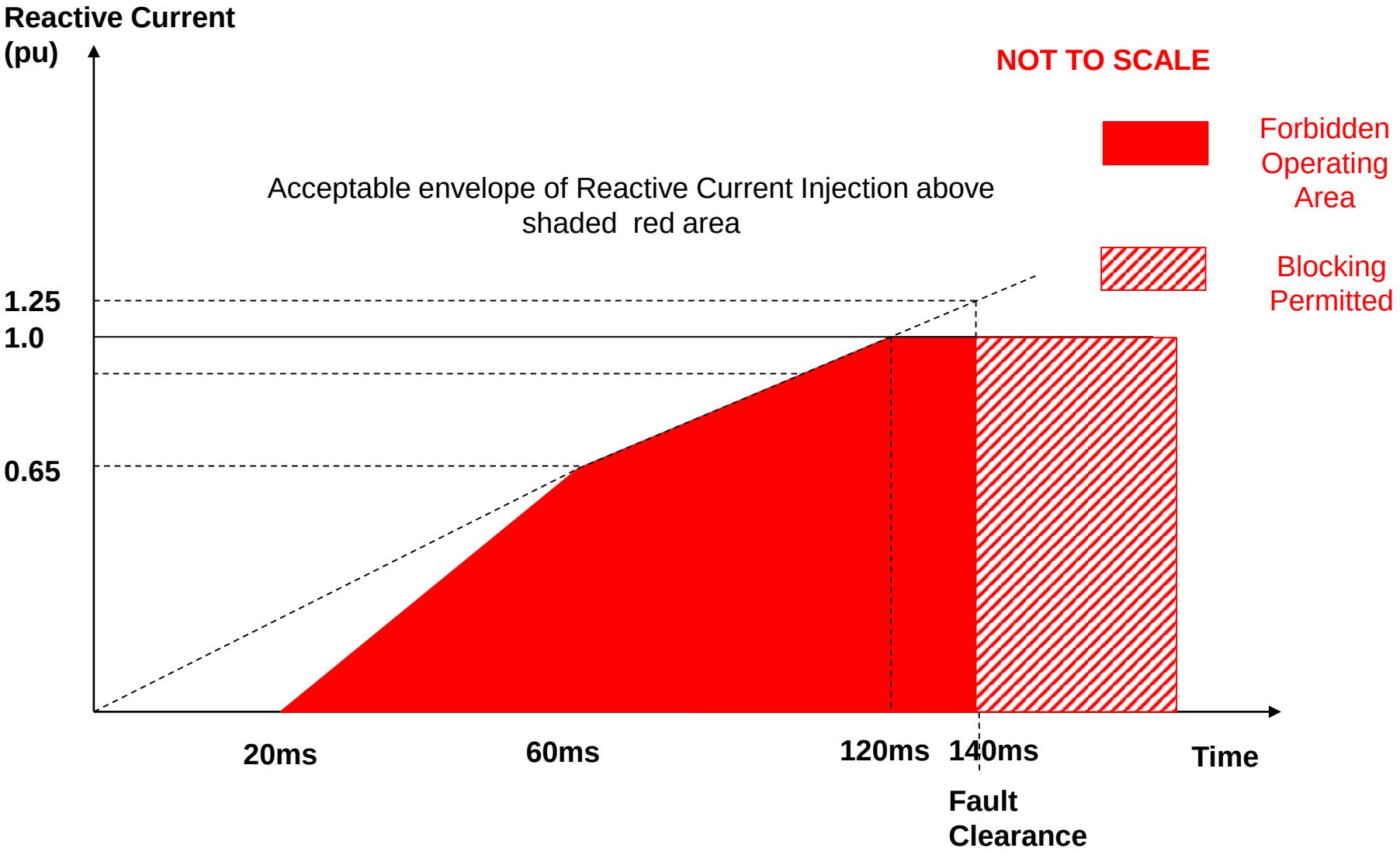


Where the retained voltage at the Grid Entry Point or User System Entry Point is below 50%, the full injection of reactive current shall be above the shaded area shown in Figure ECC.16.3.16(b) and Figure ECC.16.3.16(c).

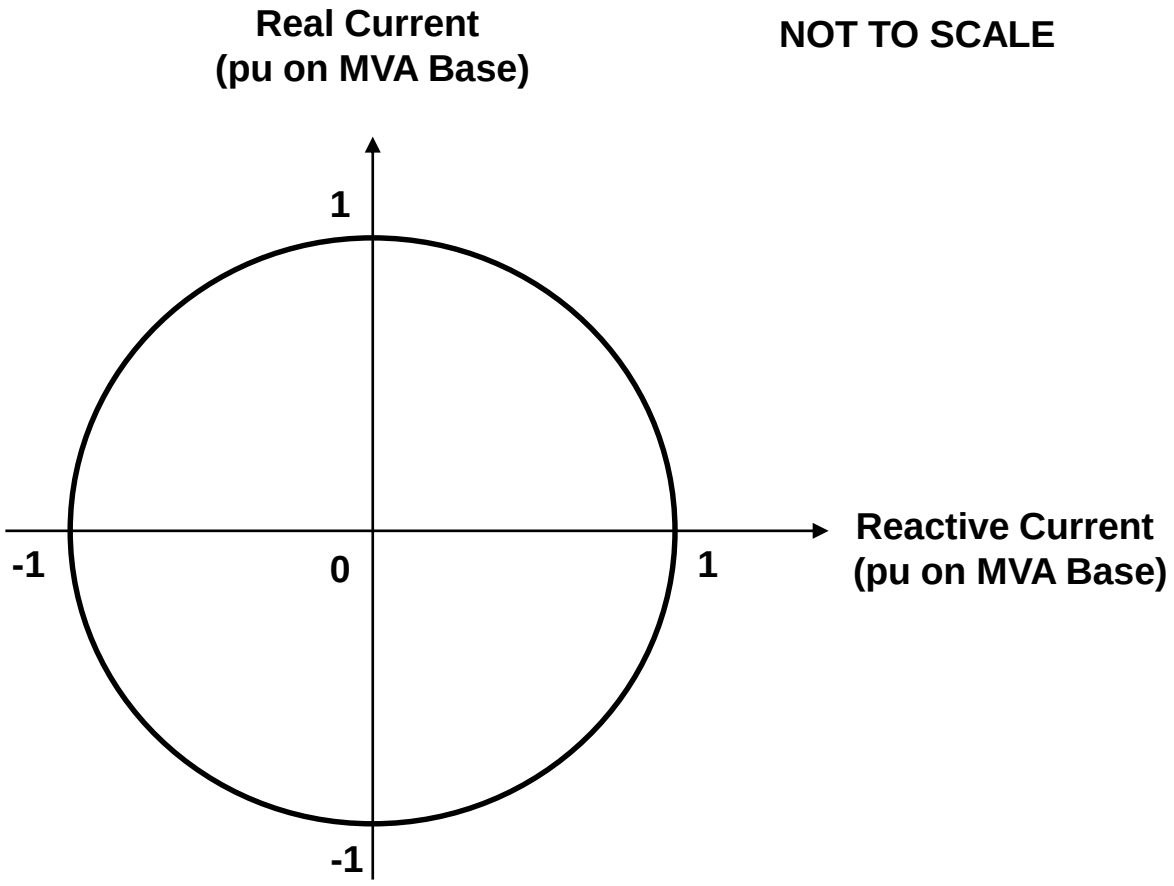
FFCI Figure ECC.16.3.16(b)



FFCI Figure ECC.16.3.16(c)

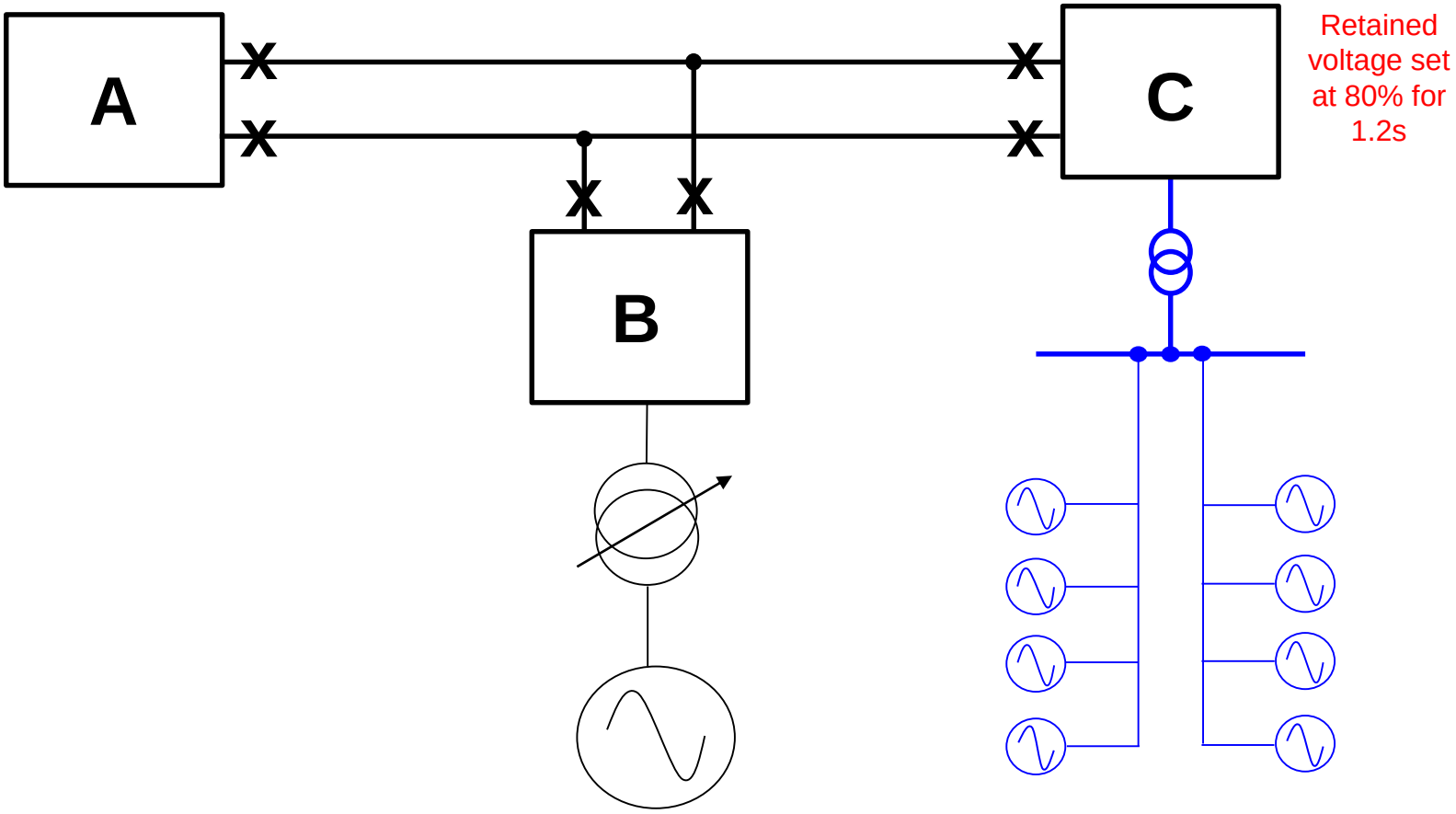


Active / Reactive Current Circle Diagram *(FFCI Figure ECC.16.3.16(d)*

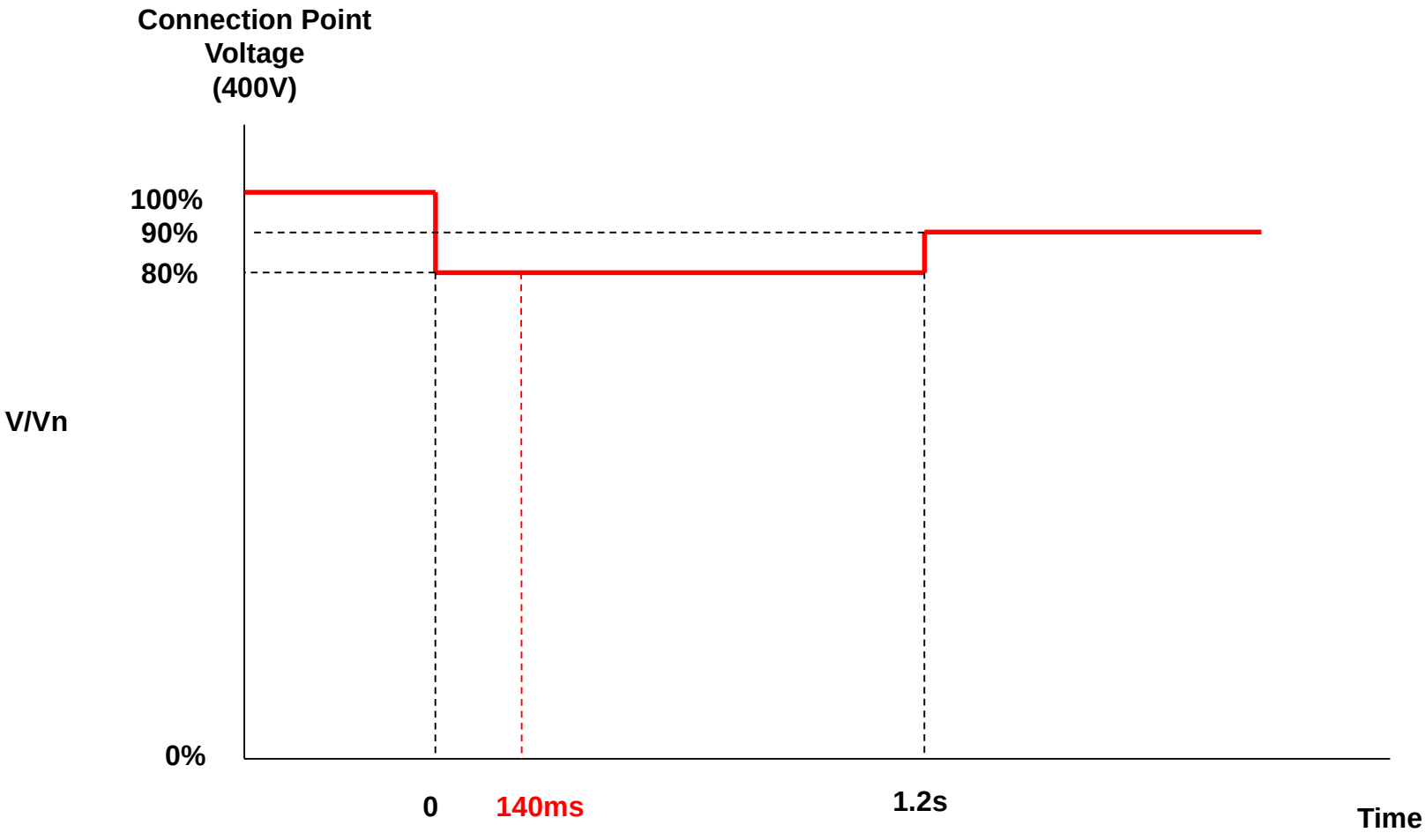


NOTE:- 1 pu current is the rated current of the Power Park Module or HVDC Equipment when operating at full MW output and full leading or Lagging MVAr capability (eg for a 100MW Power Park Module Rated Current would be obtained when the Power Park Module is supplying 100MW and 0.95 Power Factor lead or 0.95 Power Factor lag at the Connection Point)

Example – Retained Voltage set at 80% for 1.2s

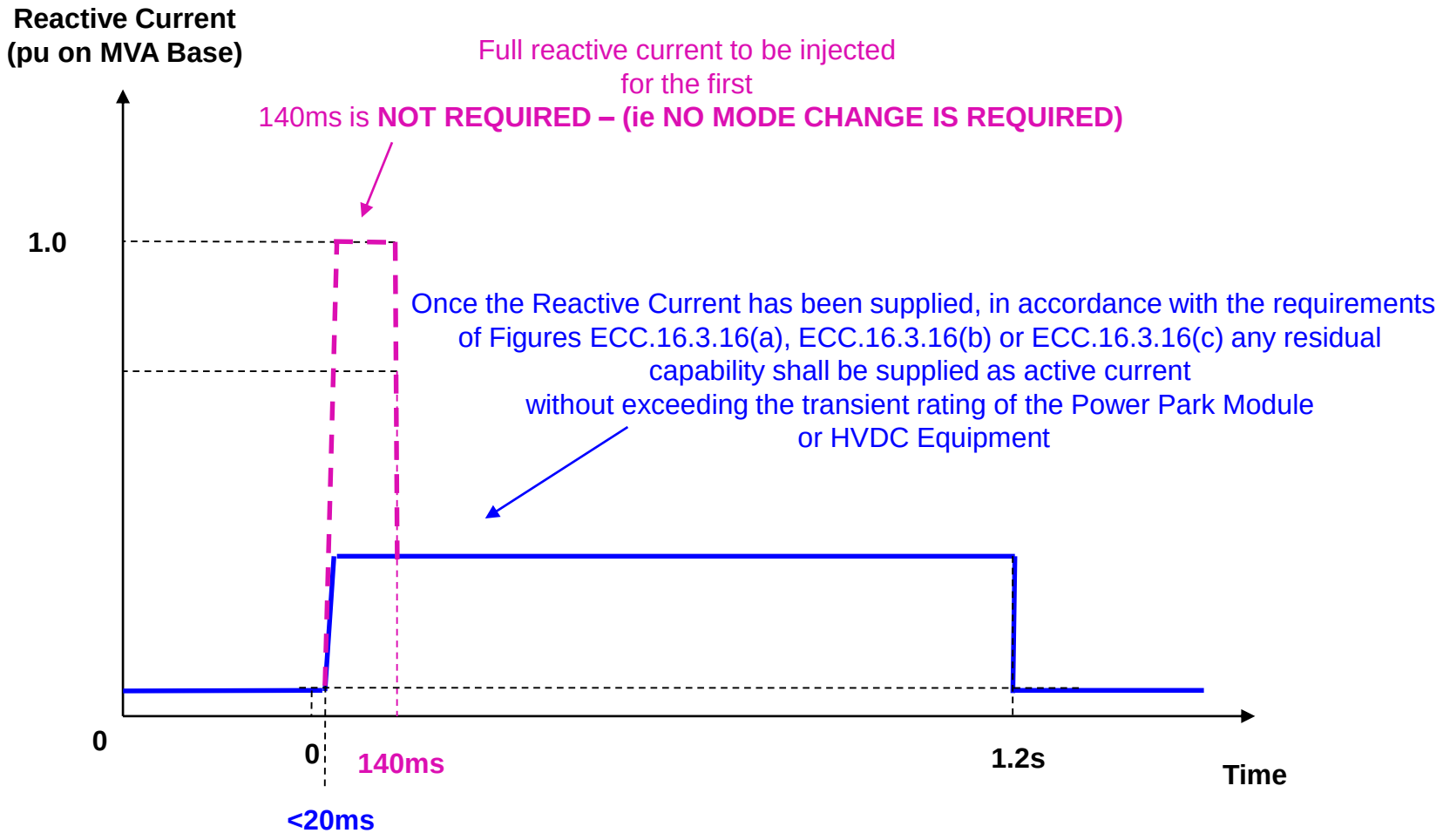


Example - Voltage dip in excess of 140ms - 80% Retained Voltage



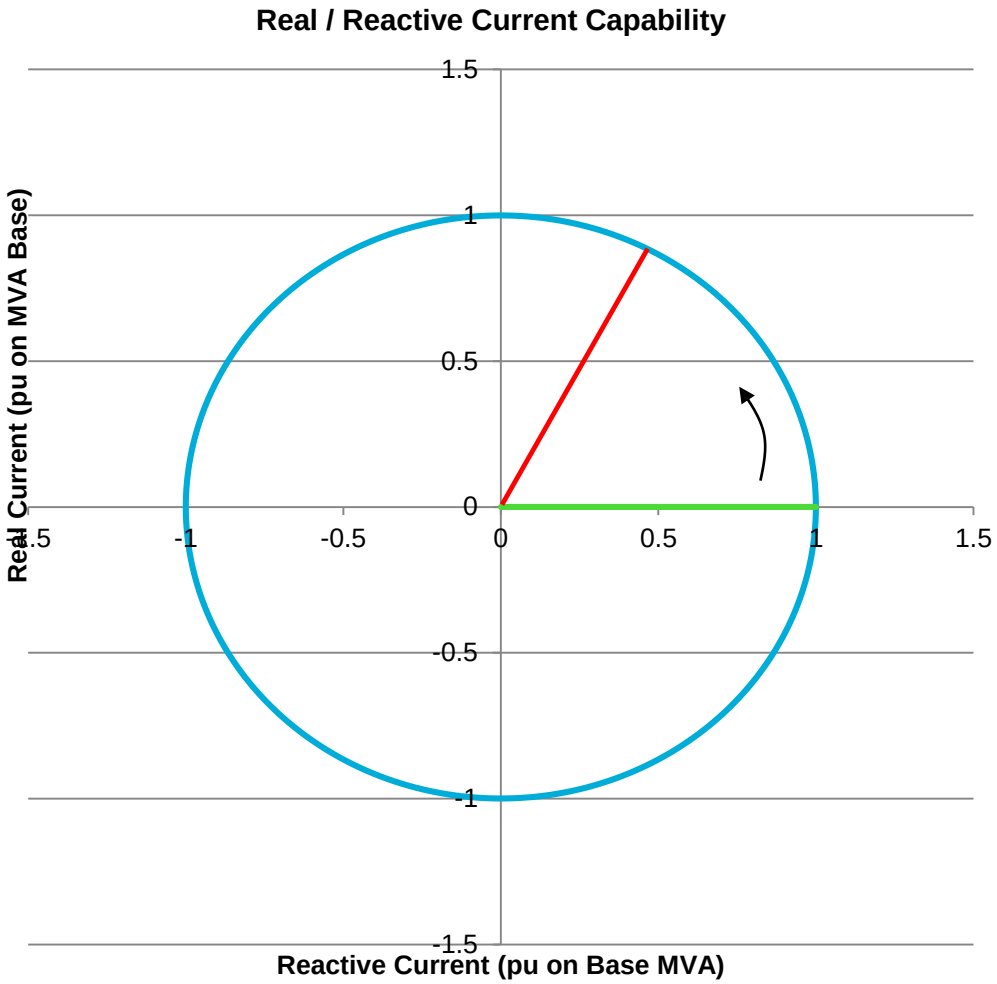
80% retained voltage, 1.2s duration

Example – Reactive Current injection for a 80% retained voltage for 1.2s



80% retained voltage, 1.2s duration

Example – Circle Diagram - 80% Retained Voltage



Summary of Requirements

- The criteria for fast fault current injection is closely linked to the requirements for fault ride through
- Criteria defined with respect to a voltage / reactive current characteristic (Figure ECC.16.3.16(a) – Slide 5)
- Full reactive current injection is required as per Figures ECC.16.3.16(b) and ECC.16.3.16(c) (Slides 6 and 7)
- Under fault conditions the Power Park Module or HVDC Equipment would not be expected to exceed the locus shown in Figure ECC.16.3.16(d) (Slide 8)
- A new clause has been added (ECC.6.3.16.1.4) to cater for the pre-fault operating condition and the subsequent performance required under faulted conditions.
- Modifications have been made to ECC.6.3.15.9.2.1 (faults / voltage dips in excess of 140ms) to ensure consistency with the revised fault current injection requirements under ECC.6.3.16.
- The wording has been clarified with respect to both balanced and unbalanced faults and all quantities are assumed to be positive phase sequence RMS values.
- For the avoidance of doubt, the requirements of ECC.6.3.15 still apply including ECC.6.3.15.10(ii) – Power Park Modules and Non-Synchronous Generating Units will be required to withstand without tripping the negative phase sequence loading incurred by clearance of a close up phase to phase fault by System Backup Protection on the Onshore Transmission System operating at Supergrid Voltage

Next Steps

- National Grid welcome comments on the revised text
- ECC.6.3.16 and EC.6.3.15.9.2.1(b) updated in draft form to provide clarification and address the defect raised
- Stakeholders requested to review draft text and establish if it provides the clarity sought
- Further issues / areas for improved text?
- Process for proceeding to the next phase