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EDF ENERGY

A generation project perspective

03-12-2013 – Fault Ride Through Workgroup kick-off meeting
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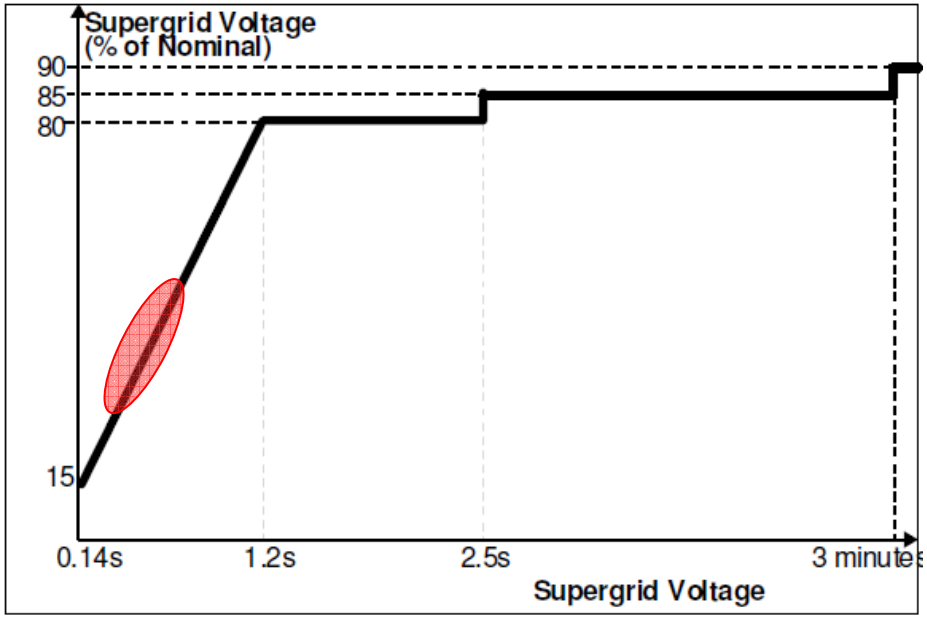
Issues with current requirement

- Requirement not thoroughly defined (pre & post-fault conditions), leading to most onerous interpretation:
  - Full lead operation;
  - Depleted grid with low load and little generation in the surroundings => maximum grid impedance.

- Additional difficulty brought by:
  - Slow voltage recovery profile compared to other standards (cf. NC RfG Requirements in the context of present practices);
  - Active power recovery requirement – makes full fast-valving implementation impossible.

Issues with current requirement

- Resulting set of requirements seems too onerous to be achievable by a regular synchronous machine:
  - Would require non-standard arrangements (eg. fly wheel or braking resistors – feasibility to be demonstrated)
  - Requirement especially hard to meet for dips around 0.3 – 0.5 pu:



Issues with current requirement

- As a result, synchronous generator project development is difficult because turbine-generator sets manufacturers cannot offer fully compliant designs in ITT;

- Risk of non-compliance borne by project is:
  - Large – What if ION/FON is not granted ?
  - Difficult to mitigate once procurement is well-advanced.

- Lack of clarity in compliance assessment does not help managing risk:
  - No clear compliance assessment methodology (simulation methodology);
  - Unclear how NGET checks compliance to grant ION/FON.

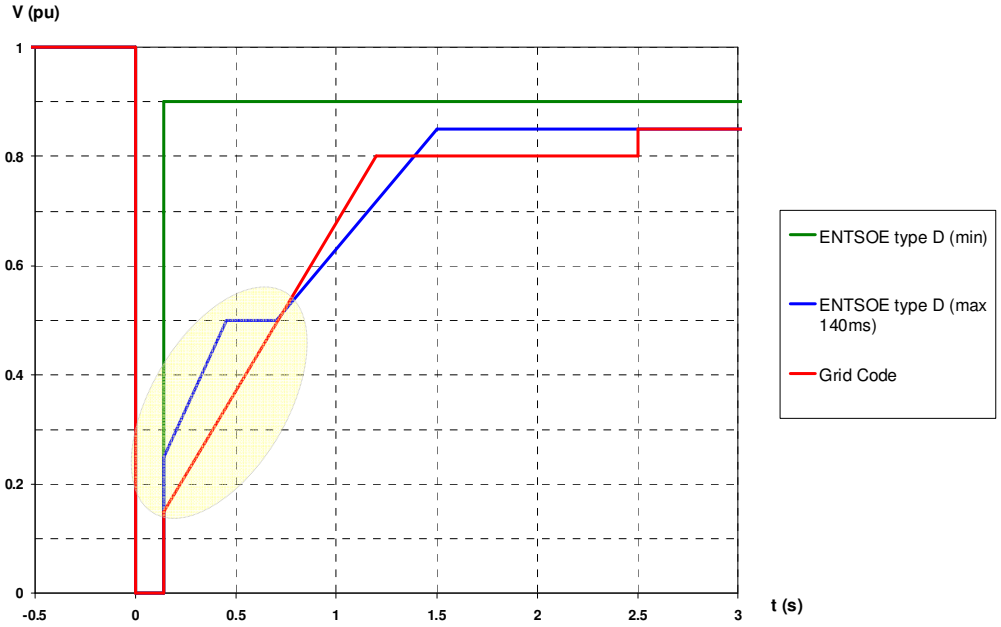
Is the current requirement ALARP ?

- Current requirement is very onerous because of the combination of:
    1. Worst operating point : (Pmax – Qmax leading);
    2. Worst grid conditions : Xmax;
    3. Deep and long dips to be considered;
    4. Power recovery requirement.

- Different questions arise…

Is the current requirement ALARP ?

- **Isn't voltage recovery profile too onerous, especially in the deep dips area ?**
  - NC RfG Requirements in the context of present practices shows higher immediate voltage recovery in most countries (often 0.6 – 0.7pu instead of 0.15pu)
  - NC RfG most onerous requirement is less stringent in that domain:



Is the current requirement ALARP ?

- **Is the combination (Worst operating point + Worst grid conditions) reasonable ?**
  - While most countries require FRT at Xmax, when clearly defined, Q is 0 at connexion point (e.g. : Finland, Sweden, Belgium, France)
  - Xmax represents a depleted grid, which usually requires generators to provide Q rather than to absorb => Full lead is unlikely.

- In the unlikely event these conditions occur, transient stability on voltage dip can be guarantied by reducing power output through balancing mechanism:
  - Higher investment cost to meet requirement has to be compared to cost of using balancing mechanism

Is the current requirement reasonable ?

Are there currently fully compliant synchronous generators connected to grid* ?

*compliance assessed by simulations which use the most onerous conditions discussed earlier.

Conclusions – Way forward

- Early implementation of NC RfG will:
  - Clarify compliance conditions : Pre & post-fault conditions to be defined;
  - Normally relax the requirement for deeper dips (current GB requirement too onerous to fit in NC RfG if 140ms is kept for Type A faults).

- Considering that:
  - GB power system has run with good OPEX for decades with standard synchronous generators (without exotic arrangements);
  - Synchronous generators are essential for frequency stability.

Synchronous generator development projects should not be jeopardized by FRT requirement

=> FRT requirement "cost" should be adjusted


thank you