Future proofing of GC0079.

The following notes indicate the sort of commentary that the WG report should include in relation the implications of the growth of DG in the future, and now it affects the assumptions of this report and the conclusions etc that are drawn from it.

1 Expected growth of DG

Most scenarios show an increased growth of DG, some very significant. However the bulk of this growth in all scenarios is asynchronous. That is not to say that there is no growth in synchronous machines, but just that is expected to be more modest.

The growth of DG means that there will be more possible situations for islanding and hence out of phase recloses. This is because the numbers of DNO circuits is largely fixed, or will certainly change a lot less than the connected generation, as is the fault rate that DNOs' circuits have. Although there will be incremental changes to DNOs' circuits and their reliability, these changes are expected to small in comparison with the growth in DG, so to a first approximation the growth in the number of potential out-of-phase recloses from that predicted in the Strathclyde report will be proportional to the growth in DG compared to that currently installed.

2 Asynchronous Machines

It is the current understanding that out-of-phase recloses do not present significant safety problems for the owners/operators of asynchronous generation.

3 Synchronous Machines

Out-of-phase recloses present problems for synchronous machines and in general the bigger the machine the more damage and risk is posed.

The risks to synchronous machines can be reduced by:

a. Retaining sensitive RoCoF or other LoM based protection
b. Changing RoCoF protection for other LoM based protection
c. Avoiding running in a fast-acting voltage control mode
d. Installing check synch or check dead on DNOs networks
e. Installing intertripping of some kind
f. Ensuring that new synchronous machines are more tolerant of OOP
g. Extending DNO autoreclose times
h. Providing NVD protection for 11kV and LV connected generation.

Taking each of these in turn

3.1 Retaining sensitive RoCoF or other LoM based protection

This is clearly easily achieved, but negates the improvements to the overall system risk that is driving the desentizing of RoCoF. However since the population of smaller synchronous machines with RoCoF protection is known, NG will be able to make allowances in their management of the system to cover for this population of smaller machines being more susceptible to RoCoF trips than generation in general. Of course this approach would be helped by the numbers and MW of machines in this class not increasing over time, ie maintaining a sufficiently low volume of generation at risk of tripping..

3.2 Changing RoCoF for other LoM base protection

In many installations it will be relatively straightforward to change the protection type to a LoM technology that is not explicitly sensitive to RoCoF, such as vector shift. The downside of this approach is that it is not clear how sensitive or otherwise such technologies are to high RoCoF events (although this uncertainty is not confined to smaller synchronous sets). Another issue for some generation owners could be the cost of achieving this if there are physical changes to be made on site. The engineering costs of this activity, although modest by most lights, could be challenging for the smallest installations.

3.3 Avoiding running voltage control mode

The risk of a synchronous machine contributing to stabilizing and island is much higher if the machine is running in voltage control mode which acts within the time limits of Loss of Mains protection. There will be a small number of cases where running in voltage control mode is important to help manage the local voltage profile, but genuine cases are rare. In other cases there should be no impediment to running in power factor control mode and although this does not prevent an island forming in the most propitious circumstances (for island formation), the likelihood is much reduced, by [two orders of magnitude].

3.4 Check Sync or Check Dead on DNO auto-reclose

Out-of-phase reclosures can be avoided if auto-reclose schemes either check for sysnchronism before closing the relevant circuit breaker or hold off closing if the circuit is detected to be live. Whilst control schemes have become progressively more economic, including within DNO networks, the lack of an existing appropriate transducer is likely to add cost to this option.

3.5 Installing Intertripping.

It is worth noting that all new RfG compliant generation will have an interface for the DNO to shut down the DG. This can be used to shut the machine down, if an island has been detected. However given that DNO auto switching times might be as short as 3s, unless the communication is achieved through an appropriate engineered communication link, the communication will be too slow, particularly if the reclose is performed on an autonomous auto-reclosing circuit breaker, itself with only “slow” communications back to the DNO control system. Whilst a possible effective mechanism for larger machines that would be islanded by overlapping primary system (33kV and above) outages, it is likely to be much less cost effective for smaller machines, and certainly anything connected at LV.

3.6 Ensuring that new synchronous machines are more tolerant of OOP

As the growth of DG will continue and it is unlikely that DNO requirements to use autoreclose and system automation will fundamentally change, the risk of out-of-phase reclose for small synchronous machines will continue to grow. Manufacturers can respond to this by designing more robust machines, although the extent to which this can be done and how it will mitigate safety risk can only be determined over time in collaboration with manufacturers. It remains to be seen if this will be an issue that affects all EU networks and generation, or if the issue is more likely confined to the smaller synchronous systems in Ireland and GB.

3.7 Extending DNO autoreclose times

Another risk mitigation that can be deployed, although its effectiveness will be uncertain, is the extension of dead times for autoreclose and system automation. The NDZ assumptions in the current report are based on dead times of 3s. It might be possible to extend many (although probably not all) dead times employed by DNOs to something more like 20s. This would give much more chance for fortuitous islands to collapse, although its efficacy will need to be modelled before pursuing this route.

3.8 NVD Protection

Although not a comprehensive defence, NVD protection installed at an appropriate point on the network will assist in reducing the likelihood of islands sustaining. All that NVD protection will do is break up an islanded network into smaller parts; it will not necessarily trip the generation. However it should prevent an HV reclose onto an LV connected generator.