Webinar: Performance of Future IBRs for Provision of Bulk Power System Services	
Question	**Answer**
How does the AC cabling for the AC output of an IBR effect the plant level capability relative to inverter capability for voltage and frequency response? (edited)	Yes it will. When moving to inverter level capability, the impact of the cabling should be considered when coordinating the response between the inverters in the plant.
On slide 17, the comparison of Plant control-retune: what and how exactly did you retune for the control here? Thanks	The controller gains in the plant controller were tuned to increase speed of response. However due to communication delay between the controller and inverter, there is only a limited amount of increase in speed of response can be achieved
What is the gap in capabilities between a standard new IBR and those capabilities required in IEEE-2800/leading grid codes? Is it a matter of just turning on?	Most of the time, yes. It is a matter of turning on capability. However, leading grid codes usually require further capability to be included as minimum capability.
Can conventional IBRs solve the issues of oscillatory instability of the bulk power system or do we need enhanced or future IBRs for the same?	It would depend on the type of oscillation being observed and the capability within conventional IBR. Some oscillations can be mitigated using power oscillation damper (POD) controls which can play the IBR between conventional IBR and enhanced IBR
On slide 27, what happens if the solar pv is not there and or if the restoration needs to happen at night?	We studied that scenario for the case. Here, BESS would be the main driver for restoration and there can be only limited levels of restoration or cranking paths that can be energized
For the blackstart study, was there a minimum voltage that the motor load at the power station plant had to be energized from during soft start? (e.g. 0.5 pu)	All motor load was energized only after voltage was brought to 1.0 pu. This was a requirement of the blackstart process
What your view of the role of utility scale IBR and residential retail scale IBR in these bulk power system services? Which one will play a more important role?	It would be a mix of both as distribution connected resources can help provide services within the distribution system and hence reduce the burden on transmission connected resources
Does the type of resource affect IBR capabilities/services, i.e. Solar, Wind, BESS	Yes absolutely. Characteristics and limitations of the source behind inverter will absolutely impact the delivery of the required service.
For black start, what is the inverter short time current rating? Also how do you tackle the high in-rush and motor start current?	In the case discussed, we used a short term over current rating of 1.6pu. To help mitigate in-rush currents, we used a softstart mechanism for the motor loads. We also compared the response with a scenario when motor was started direct on-line as cold start

Would you include the requirement of IBR operating in weak networks in the list in slide 4? (edited)	It depends on the definitions of weak networks. That being said, our understanding is the operation in weak grids can be covered through the performance categories mentioned on the slide. The objective is to have similar performance capability for both weak and strong networks
Can you share your thoughts about IBR impact on short capability and need to evaluate the protection systems.	This is absolutely necessary and a critical aspect. Performance and any subsequent capability requirement should be aligned with protection system behavior
How does time of day impact the analysis? At night and without IBR PV how will that impact short circuit capability and stability you mentioned?	It depends on which service is being utilized. If stability improvement requires injection of active power, then it can have an impact if the associated event occurs at night. If the improvement is through injection of reactive current, then as long as dc voltage is maintained, the capability should be available, unless the OEM has an additional restriction.
If you move the voltage and power control from plant-level to inverter-level control, how would you include current limiters?	my understanding is that current limiters would always reside within the inverter control, irrespective of at which hierarchy the voltage and power control exist.
When you say "capable of surviving the loss of the last SG", how does loss of inertia play into that concept?	The impact of loss of inertia needs to be evaluated against the need to have this metric and its impact. If the aim is to have to fast injection of active power, then it appears well before the loss of last SG. The capability of surviving loss of last SG is to evaluate the ability if the device can help maintain stability in a network with 100% IBRs
Could you please elaborate on the expected performance of future IBRs in terms of the dynamic voltage profile proposed in EU-SysFlex?	I am not fully aware of the details of the voltage profile proposed in EU-SysFlex. Please feel free to reach out to me via email for us to discuss this topic.
What is the advantage of providing fault ride-through support from IBRs in distribution networks? Given the low penetration of IBRs.	With fault ride through support in the distribution network, help can be provided to motor load which can subsequently be able to ride through faults and not stall. Further, legacy DER in the distribution network which may go into momentary cessation or be unable to ride through the event could get support from new DER that can provide ride through support
Why would one use reactive power control mode in an IBR when the SCR is lower than 2? as AC voltage control is better for stability of weaker AC grids?	I agree that ac voltage control is better and can improve the stability of the network. However, practical experience has shown that ac voltage control is not often implemented with IBRs, or if implemented, it is on a slower time scale with fast reactive power control on the faster time scale. This ends up defeating the purpose of improving stability.

What are main challenges in transfering from GFI to GFI?	I assume you mean main challenges in bringing in new capability and performance features in an IBR. One of the main challenges is being able to provide appropriate specifications and testing criteria. Further, a challenge is being able to define the critieria in a manner that can provide support in a variety of networks/systems
During curtailment for local reliability the frequency response exceeds the curtailment point. Should this be reversed? previous question addition.	This depends on whether a study has been carried out to evaluate the impact of delivery of frequency response over and above the curtailment point. An informational webinar from NERC was conducted on this topic in April 2022. The slides and associated white paper can be accessed from: https://www.nerc.com/comm/RSTC/IRPS/Webinar_Utilizing_Excess_IBR_Capability_FR.pdf