Rough comparison of New Draft Requirements of Generator against current GB Codes for Comment & Discussion only
by Alastair Frew, ScottishPower, 25 November 2011

Key	
Current GB code requirement	Current
Current GB code requirement can be selected	Selectable
Current GB code requirement cannot be selected	unselectable
New requirement not in current GB code	New

Code Requirement	**Reference**	**Applicable Synchronous Generator Type**					**Applicable Non-Synchronous Generator Type**			
		A	**B**	**C**	**D**		**A**	**B**	**C**	**D**
		>400W	**>1MW**	**>10MW**	**>110kV**		**>400W**	**>1MW**	**>10MW**	**>110kV**
Frequency operating Ranges	Article 7 - 1.a)1)									
47 to 47.5Hz operate for 20 seconds		Current	Current	Current	Current		Current	Current	Current	Current
47.5 to 48.5Hz operate for 90 minutes		Selectable	Selectable	Selectable	Current		Selectable	Selectable	Selectable	Current
48.5 to 49Hz operate for >90 minutes		Selectable	Selectable	Selectable	Selectable		Selectable	Selectable	Selectable	Selectable
49 to 51Hz unlimited operation		Current	Current	Current	Current		Current	Current	Current	Current
51 to 51.5Hz operate for 90 minutes		Selectable	Selectable	Selectable	Current		Selectable	Selectable	Selectable	Current
51.5 to 52Hz operate for 15 minutes		unselectable	unselectable	unselectable	Current		unselectable	unselectable	unselectable	Current
Synchronization range 47 to 52 Hz	Article 8 - 4.a)	N/A	New	New	Current		N/A	New	New	Current
Automatic Frequency Disconnection	Article 7 - 1.a)3)	Current	Current	Current	New		Current	Current	Current	New
There shall be a logical interface to switch generation ON & OFF	Article 7 - 1.d)	New	New	N/A	N/A		New	New	N/A	N/A
Under frequency disconnection for pump storage	Article 9 - 2.f)	N/A	N/A	Current	Current		N/A	N/A	Current	Current
Rate of Change of Frequency	Article 7 - 1.b)									
withstand up to 2 Hz/s rate change		New	New	New	New		New	New	New	New
remain on for 1.25 s if rate >2 Hz/s		New	New	New	New		New	New	New	New
Limited Frequency Sensitive Mode - Overfrequency	Article 7 - 1.c)	New	New	New	Selectable		New	New	New	Selectable
Maintain constant load until frequency trigger (between 50 & 50.5Hz)	Article 7 - 1.c)1)	New	New	New	Selectable		New	New	New	Selectable
Above trigger frequency reduce load at droop (between 2 & 12%)	Article 7 - 1.c)2)	New	New	New	Selectable		New	New	New	Selectable
Response time to be within 2 seconds of trigger	Article 7 - 1.c)2)	New	New	New	Current		New	New	New	Current
No conflict between speed & load control	Article 7 - 1.c)3)	New	New	New	Current		New	New	New	Current
Frequency Sensitive Mode	Article 9 - 2.c)									
Responsive Power range 10% of capacity	Article 9 - 2.c)1)	N/A	N/A	New	Selectable		N/A	N/A	New	Selectable
Droop between 2 & 20%	Article 9 - 2.c)1)	N/A	N/A	New	Selectable		N/A	N/A	New	Selectable
Frequency measurement accuracy better than 10mHz	Article 9 - 2.c)5)	N/A	N/A	New	Selectable		N/A	N/A	New	Selectable
Maximum time delay before start of power response 2 seconds	Article 9 - 2.c)7)	N/A	N/A	New	Selectable		N/A	N/A	New	Selectable
Maximum time to achieve full response (between 4 & 30 seconds)	Article 9 - 2.c)7)	N/A	N/A	New	Selectable		N/A	N/A	New	Selectable
Be capable of maintaining full power for between 15 & 30 minutes	Article 9 - 2.c)8)	N/A	N/A	New	Selectable		N/A	N/A	New	Selectable
Settable target frequency between 49.9 & 50.1 Hz	Article 9 - 2.c)9)	N/A	N/A	New	Current		N/A	N/A	New	Current
Provision for real time data transfer to Network Operator of the following:- Frequency sensitive mode status Scheduled power output Actual power output Target frequency setpoint Droop & deadband Available power	Article 9 - 2.g)1)	N/A	N/A	New	New		N/A	N/A	New	New

Limited Frequency Sensitive Mode - Under frequency	Article 9 - 2.d)									
Maintain constant load until frequency trigger (between 49.5 & 50.Hz)	Article 9 - 2.d)1)	N/A	N/A	New	New		N/A	N/A	New	New
Above trigger frequency reduce load at droop (between 2 & 12%)	Article 9 - 2.d)2)	N/A	N/A	New	New		N/A	N/A	New	New
Response time to be within 2 seconds of trigger	Article 9 - 2.d)2)	N/A	N/A	New	New		N/A	N/A	New	New
No conflict between speed & load control	Article 9 - 2.d)3)	N/A	N/A	New	New		N/A	N/A	New	New
Control Power reduction in steps < 20% capacity	Article 8 - 4.f)	N/A	New	N/A	N/A		N/A	New	N/A	N/A
Power output shall be settable	Article 9 - 2.2a)1)	N/A	N/A	New	Current		N/A	N/A	New	Current
Power accuracy as specified by Network Operator	Article 9 - 2.2a)2)	N/A	N/A	New	Current		N/A	N/A	New	Current
Stability										
No tripping or power reductions due to power oscillations	Article 9 - 3.a)	N/A	N/A	New	New		N/A	N/A	New	New
Shafts shall withstand oscillating torsional stress of 50% power	Article 9 - 3.b)	N/A	N/A	New	New		N/A	N/A	New	New
A single generator which loses stability shall automatically disconnect	Article 9 - 5.a)	N/A	N/A	New	New		N/A	N/A	New	New
Synthetic Inertia	Article 16 - 2.a)	N/A	N/A	N/A	N/A		N/A	N/A	New	New
Voltage Range										
Connection below 300kV. Voltage between 0.9 & 1.1pu Generator shall operate continuously	Article 10 - 2.a)1)	N/A	N/A	N/A	Current		N/A	N/A	N/A	Current
Connection above 300kV. Voltage between 0.9 & 1.05 pu Generator shall operate continuously	Article 10 - 2.a)1)	N/A	N/A	N/A	Current		N/A	N/A	N/A	Current
Connection above 300kV. Voltage between 1.05 & 1.10 pu Generator shall operate for more than 20 minutes	Article 10 - 2.a)1)	N/A	N/A	N/A	unselectable		N/A	N/A	N/A	unselectable
Automatic Voltage Disconnection	Article 7 - 2.a)	Current	Current	Current	N/A		Current	Current	Current	N/A
Automatic Voltage Disconnection if required by Network operator	Article 10 - 2.a)2)	N/A	N/A	N/A	New		N/A	N/A	N/A	New
Transformer earthing to Network operator requirements	Article 7 - 3.a)	Current	Current	Current	Current		Current	Current	Current	Current
Power & voltage quality to existing national requirements	Article 7 - 3.b)	Current	Current	Current	Current		Current	Current	Current	Current
Voltage Control										
Automatic excitation control to provide constant alternator terminal voltage	Article 11 - 2.b)	N/A	Current	Current	Current		N/A	N/A	N/A	N/A
In steady state conditions Limit generator terminal voltage changes to less than 1% of rated voltage	Article 12 - 3.b)	N/A	N/A	New	Current		N/A	N/A	N/A	N/A
Transient conditions step change 90 to 100% volts time to be with in 5% of change	Article 12 - 3.c)1)	N/A	N/A	New	Current		N/A	N/A	N/A	N/A
For synchronising the AVR & Exciter shall be capabile of maintaining the ceiling current for 10 seconds after a sudden 10% voltage dip	Article 12 - 3.c)2)	N/A	N/A	New	unselectable		N/A	N/A	N/A	N/A
Static excitation system should be capable of attaining negative ceiling after sudden 10% voltage drop	Article 12 - 3.c)3)	N/A	N/A	New	Current		N/A	N/A	N/A	N/A
Network operators have the right to request:- excitation system to operate with 25% volts drop Excitation system attaining 80% of positive ceiling with 80% terminal volts	Article 12 - 3.c)4)	N/A	N/A	New	Current		N/A	N/A	N/A	N/A
The excitation system bandwidth limit shall 3Hz	Article 12 - 3.d)1)	N/A	N/A	New	unselectable		N/A	N/A	N/A	N/A
Maximum overshoot of Under excitation Limiter shall not exceed 4%	Article 12 - 3.d)1)	N/A	N/A	New	Current		N/A	N/A	N/A	N/A
The final settling time of the under excitation limiter shall be less than 5 seconds	Article 12 - 3.d)1)	N/A	N/A	New	Current		N/A	N/A	N/A	N/A
Voltage range 0.95 to 1.05 pu settable in 0.01 pu steps	Article 16 - 3.e)2)	N/A	N/A	N/A	N/A		N/A	N/A	New	Current
Shall have a selectable deadband 0 to +-10% in steps no greater than 0.5%	Article 16 - 3.e)2)	N/A	N/A	N/A	N/A		N/A	N/A	New	New
Shall have selectable target power factor	Article 16 - 3.e)4)	N/A	N/A	N/A	N/A		N/A	N/A	New	New
Reactive fault infeed										
For up to 10% voltage dip supply reactive current of greater than 2% per 1% volts dip	Article 15 - 2.a)1)	N/A	N/A	N/A	N/A		N/A	New	New	New
Reactive current infeed shall be within 40ms of fault inception	Article 15 - 2.a)1)	N/A	N/A	N/A	N/A		N/A	New	New	New
During fault reactive current shall be 1 pu or greater whilst voltage above 40%	Article 15 - 2.a)2)	N/A	N/A	N/A	N/A		N/A	New	New	New
Disconnect after 0.5 second if the volts are below 85% & connection point is under excited	Article 15 - 2.c)	N/A	N/A	N/A	N/A		N/A	New	New	New
Reactive Power Range										
Required Q/Pmax 0.95 and steady state voltage range 0.1pu	Article 12 - 3.e)	N/A	N/A	New	New		N/A	N/A	N/A	N/A
Required Q/Pmax 0.66 and steady state voltage range 0.1pu	Article 16 - 3.b)	N/A	N/A	N/A	N/A		N/A	N/A	New	New
Power System Stabiliser (PSS)										

A PSS system stabiliser shall be fitted	Article 13 - 2.a)	N/A	N/A	N/A	Current		N/A	N/A	N/A	N/A
Fault Ride Through										
See voltage profile for connections less than 110kV synchronous generators	Article 11 - 3.a)	N/A	New	New	N/A		N/A	N/A	N/A	N/A
See voltage profile for 110kV & above synchronous generators	Article 13 - 3.a)	N/A	N/A	N/A	unselectable		N/A	N/A	N/A	N/A
See voltage profile for connections less than 110kV non-synchronous generators	Article 15 - 3.a)	N/A	N/A	N/A	N/A		N/A	New	New	N/A
See voltage profile for 110kV & above non-synchronous generators	Article 17 - 1.a)	N/A	N/A	N/A	N/A		N/A	N/A	N/A	unselectable
Auto-reclose										
Withstand single phase reclose on radial circuit without trip	Article 8 - 2.a)	N/A	New	New	New		N/A	New	New	New
Withstand single & 3 phase reclose on meshed circuit without trip	Article 8 - 2.a)	N/A	New	New	New		N/A	New	New	New
Automatic Reconnection of generation after network fault	Article 8 - 3.a)	N/A	New	New	New		N/A	New	New	New
Protection	Article 8 - 4.b)									
As per Network operators requirements	Article 8 - 4.b)1)	N/A	Current	Current	Current		N/A	Current	Current	Current
Over ride operational controls	Article 8 - 4.b)2)	N/A	Current	Current	Current		N/A	Current	Current	Current
Protection & Control systems shall prioritise as follows:- Generator/Network protection Synthetic Inertia Frequency control (power adjustment) Power restriction Power gradient limits	Article 8 - 4.d)	N/A	New	New	New		N/A	New	New	New
Information Transfer										
As per Network operators requirements	Article 8 - 4.e)	N/A	Current	Current	Current		N/A	Current	Current	Current
Black Start Capability (not mandatory but if agreed)	Article 9 - 4.a)1)	N/A	N/A	Current	Current		N/A	N/A	Current	Current
Island Operation	Article 9 - 4.b)									
Operate in frequency range 47 to 52 Hz	Article 9 - 4.b)1)	N/A	N/A	unselectable	Current		N/A	N/A	unselectable	Current
Operate in voltage range 47 to 52 Hz	Article 9 - 4.b)1)	N/A	N/A	N/A	Current		N/A	N/A	N/A	Current
Shall maintain frequency within operating limit after a 45% load reduction	Article 9 - 4.b)2)	N/A	N/A	New	New		N/A	N/A	New	New
Shall not use switchgear position to identify island	Article 9 - 4.b)3)	N/A	N/A	New	New		N/A	N/A	New	New
Quick start Capability	Article 9 - 4.c)									
If generator re-sync time greater than 15 minutes then trip to house load	Article 9 - 4.c)2)	N/A	N/A	New	New		N/A	N/A	New	New
When tripping to house load all operations to be automatic for first 3 minutes	Article 9 - 4.c)4)	N/A	N/A	New	New		N/A	N/A	New	New
Fault Recorders										
Fault Recorders shall provided by generators	Article 9 - 5.b)1)	N/A	N/A	New	New		N/A	N/A	New	New
Fault recorders as a minimum shall record:- Voltage Power MVArs Frequency Harmonics	Article 9 - 5.b)1)	N/A	N/A	New	New		N/A	N/A	New	New
Provide Facilities for Network Operators to access fault recorders	Article 9 - 5.b)4)	N/A	N/A	New	New		N/A	N/A	New	New
Simulation Models	Article 9 - 5.c)									
Model can be required by Network Operator on:- speed & power control Voltage control (including PSS & excitation) Converter	Article 9 - 5.c)2)	N/A	N/A	Current	Current		N/A	N/A	Current	Current
Actual Generator responses can be required by Network operators	Article 9 - 5.c)3)	N/A	N/A	Current	Current		N/A	N/A	Current	Current
Use of spares										
Use of non compliant spares need Network operator approval (even like for like)	Article 9 - 5.f)	N/A	N/A	New	New		N/A	N/A	New	New