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APPLICATION AND SETTING OF SYSTEMS THAT PERFORM SYNCHRONISING, DAR, AUTOMATIC PLANT ISOLATION AND FERRORESONANCE QUENCHING

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PURPOSE AND SCOPE

The purpose of this Technical Guidance Note (TGN) is to provide the background and necessary guidance on the application of policy PS(T) 055. This policy states the application and setting of systems that provide specific auto switching and delayed auto reclose functionality.

The information provided in the tables in this TGN support and should be read in conjunction with the policy PS(T) 055.

This information states the functional and setting requirements for equipment that is designed to perform the following tasks:-

- a) (Re)closure of Circuit Breakers under dead or live power system conditions.
- b) Delayed Automatic Reclosure (DAR) of Circuit Breakers.
- c) Automatic Switching of Disconnectors to perform plant isolation operations.
- d) Automatic Switching of Disconnectors or Earth Switches to perform ferroresonance quenching.

The purpose of these functions and settings shall be to enable: -

- e) Automated operation of plant following the tripping of a circuit due to the detection of a fault that will :-
 - (i) automatically isolate faulted plant or circuits from the system
 - (ii) restore healthy plant or circuits to service

- f) Automated Closure of a circuit breaker initiated by a manual command from the SCS
- g) Automated removal of abnormal system conditions - ferroresonance

For a given plant configuration the required DAR, Plant Isolation, Ferroresonance Suppression and Synchronising operating characteristics shall be achieved by applying appropriate settings.

The location of each section within this document and the associated section title has been designed to correlate with the layout of sections and section titles in the Policy.

The information stated in the following tables will contain sections that will indicate:-

- h) A section title for a function that will directly correlate to a section in the policy
- i) The purpose of the function that the setting is applicable to i.e. DAR, SAS or both.

The information stated in the following tables will optionally contain sections that will indicate :-

- j) A setting Name
- k) A Setting Range
- l) A preferred Normal Value for the setting
- m) An application note to indicate
 - (i) How the normal value is calculated
 - (ii) if the Normal Setting can be recalculated
 - (iii) the circumstances under which recalculation is permitted.

When the functions or settings specified in this document cannot be achieved or are considered inappropriate, reference should be made to National Grid Asset Policy.

PART 1 – PROCEDURAL

1 SYSTEM SETTINGS AND SETTING GUIDANCE

1.1 System Settings – Synchronising Function for DAR and Manual CB Closure

Sync Slip Speed – Check Sync and System Sync	
Applicable System	Synchronising (DAR & SAS)
Setting Name	Check Sync Slip Speed
Normal Setting	0.05Hz
Setting Name	System Sync Slip Speed
Normal Setting	0.125Hz or nearest available setting

Sync Phase Angle – Check Sync and System Sync	
Applicable System	Synchronising (DAR & SAS)
Setting Name	Check Sync Phase Angle
Normal Setting - 400kV & 275kV	35 deg – (Note National Grid will advise where a different setting is required)
Normal Setting – 132kV	20 deg
Setting Name	System Sync Phase Angle
Normal Setting	10 deg
Dead Voltage Threshold (NGTS 3.24.16 = Busbar Dead, Line Dead))	
Applicable System	DAR
Normal Setting	20% = 12.7V referred to 63.5V Vnominal
Live Voltage Threshold (NGTS 3.24.16 = Busbar Live, Line Live))	
Applicable System	DAR
Normal Setting	50% % = 31.75 V referred to 63.5V Vnominal
Energising Check Dead Volts	
Applicable System	Synchronising (DAR & SAS)
Normal Setting	20% = 12.7 V referred to 63.5V Vnominal
Energising Check Live Volts	
Applicable System	Synchronising (DAR & SAS)
Normal Setting	50% = 31.75 referred to 63.5V Vnominal
Energising Check Undervoltage	
Applicable System	Synchronising (DAR & SAS)
Normal Setting	85% = 54V referred to 63.5V Vnominal
Energising Check Overvoltage (was Check Sync Overvoltage) – Refer to appendix C	
Applicable System	Synchronising (DAR & SAS)
Normal Setting	200% = 127V referred to 63.5V Vnominal
Also see information in appendix C	
Energising Check Voltage Difference	
Applicable System	Synchronising (DAR & SAS)
Normal Setting	35%
Manual Sync Sequence Time - Initiation to Reset	
Applicable System	SAS
Normal Setting	60 sec
Auto Sync Sequence Time - Initiation to Reset	
Applicable System	DAR
Normal Setting	Infinity or as high as possible

Sync Close Co-ordination Delay time	
Applicable System	DAR
Setting Name	Sync Voltage Detection Time or Sync Close Delay
Normal Setting range	5 Sec
<u>Application Note</u> The Sync Close Co-ordination Delay time shall be a user configurable timer that shall be set greater than the reclaim time setting of any remote dead circuit charging DAR system. This shall allow sufficient time for any remote protection systems to re-trip the dead circuit charging circuit breaker at the remote end as a result of a persistent fault.	
System Split Time	
Applicable System	Synchronising (DAR & SAS)
Normal Setting	4 Sec
(Re)closure Mode - Dead Line Charge	
Applicable System	DAR & SAS
Setting Name	Dead Line Charge
Range	Enabled / Disabled
DAR Setting – 400 & 275kV	Enabled – Depending on conditions listed
DAR Setting - LV	Disabled
SAS Setting	Enabled
(Re)closure Mode - Dead Bar Charge	
Applicable System	DAR & SAS
Setting Name	Dead Bar Charge
Range	Enabled / Disabled
DAR Setting – 400 & 275kV	Disabled
DAR Setting – LV	Enabled depending upon conditions – refer to National Grid
SAS Setting	Enabled
(Re)closure Mode - Dead Line Dead Bar Close	
Applicable System	DAR & SAS
Setting Name	Dead Line Dead Bar Close
Range	Enabled / Disabled
DAR Setting – 400 & 275kV	Disabled
DAR Setting - LV	Disabled
SAS Setting	Enabled

(Re)closure Mode - Check Sync and Close & Power System Sync Close	
Applicable System & Range	DAR, SAS for HV & LV CB's
Setting Names	Check Sync and Close Power System Sync Close
Range	Enabled / Disabled
DAR Setting HV & LV	Enabled
SAS Setting	Enabled
<u>Application Note</u> Where a circuit breaker is fitted with synchronising facilities and this (re)closure mode is required, Check Sync Close shall be enabled. Power System Sync Close shall also be enabled if the (re)closing circuit breaker has no technical limitation that restrict this reclosure duty.	
Circuit Breaker Close Pulse	
Applicable System	DAR & SAS
Normal Setting	2 Sec

1.2 System Settings – Delayed Auto Reclosing (DAR)

Dead Time NGTS 3.24.63 Sec 8.19*	
* Also known as DAR Delay Timer NGTS 3.24.63 Table 15 Dead Line Charge Delay or Dead Bar Charge Delay TPS 2.15.1 DAR Delay Timer NGTS 3.24.16 Table 1 Dead Line Timer NGTS 3.24.16 Sec 6.2 SWITCHING DELAY TIMER NGTS 3.24.16 SEC 4.25 & 4.27	
Applicable System	DAR
Setting Name	Dead Time
Normal Setting	Minimum Dead Time + Reclosure Priority Time
<u>Application Note</u> The overall Dead Time shall calculated from the following parameter values as follows Dead Time = Minimum Dead Time + Reclosure Priority Time Preferred Dead Line Charging Circuit Breaker, Revertive Dead Line Charge and Preferred Dead Bar Charging Circuit Breaker Dead Time is only applicable to Transformer LV CB's that have been selected to Dead Bar Charge Also see Check reclose conditions in 3.24.16	

Circuit Breaker Minimum Dead Time	
Applicable System	DAR
Parameter Value Name	Minimum Dead Time
Normal Setting	5 Sec
<u>Application Note</u> The Minimum Dead Time shall be sufficient for the synchronising equipment to determine if dead or synchronising conditions exist where priority is given to synchronising.	
Priority Order of CB Reclosure - Reclosure Priority Time	
Applicable System	DAR
Parameter Value Name	Reclosure Priority Time
Value Range	0 - 55 s in 5 Sec steps – dependent on system topology
<u>Application Note</u> The Reclosure Priority Time shall form part of the overall Dead Time and can be calculated using the methods in the following sections and the appendix. The Closure Priority Time is normally set to the shortest time possible but will also depend on any additional constraints imposed by the conditions given in the policy and setting guidance for Priority Order of CB Reclosure and Revertive Dead Circuit Charging The Circuit Breaker reclosure sequence is achieved by selectively incrementing the corresponding Reclosure Priority Time for each circuit breaker associated with a particular feeder to stagger any closure sequence. The first circuit breaker to close is known as the preferred charging circuit breaker.	
Priority Order of CB Reclosure – Preferred dead line / busbar charging circuit breaker	
Applicable System	DAR
Parameter Value Name	Reclosure Priority Time
Normal Value	0 or 5 Seconds – dependent on single or parallel circuits
<u>Application Note</u> In all cases, the information given in the policy states the method used to select the preferred dead line / busbar charging circuit breaker for single or parallel circuits. National Grid will advise which of the two parallel circuits should have the overall priority A preferred dead line / busbar charging circuit breaker shall have the shortest overall Dead Time. This is accomplished by setting the Reclosure Priority Time to the lowest possible value i.e. 0 secs For parallel circuits, the preferred dead line / busbar charging circuit breakers shall have the shortest overall Dead Times. However, a reclosure sequence shall be applied to prevent the possibility of simultaneous reclosure of two circuit breakers. This is accomplished by setting the Reclosure Priority Time for each of the preferred dead line / busbar charging circuit breaker to a different value i.e. 0, 5, 10 secs etc	