UNIDAD OPERACIÓN INTEGRADA

Solicitud de inclusión del modelo de los dispositivos DFACTS

Noviembre de 2024

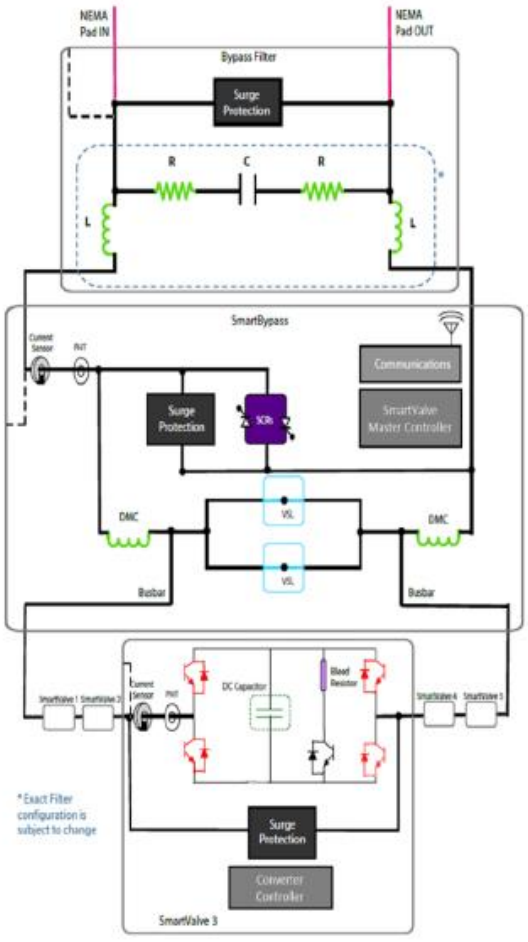
Contenido

1. OBJETO

Presentar los diagramas de bloques, parámetros y Anexo 4 del Acuerdo CNO 1816, para la inclusión de los dispositivos DFACTS en las bahías BL1 ENVIGADO A GUAYABAL 110 kV, BL1 ENVIGADO A ANCON SUR (EPM) 110 kV y BL1 GUAYABAL A EL RODEO 110 kV, en la base de datos del SIN utilizada para realizar los estudios de análisis eléctrico en el CND

2. DIAGRAMA UNIFILAR DE LA CONEXIÓN DE LOS DFACTS

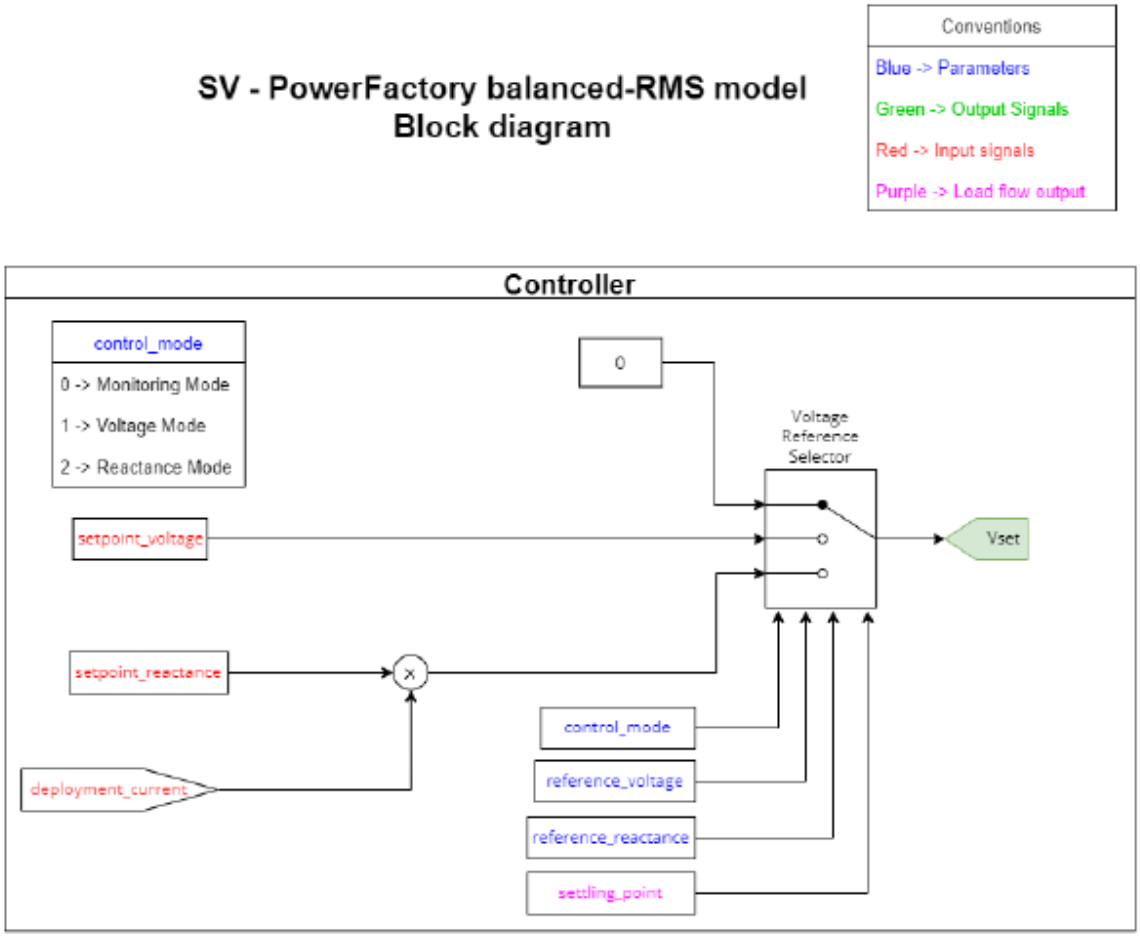
A continuación, se presenta el diagrama unifilar de la conexión del FACTS donde se detallan los equipos de seccionamiento y de corte, así como la configuración completa de TCRs, TSCs y filtros:



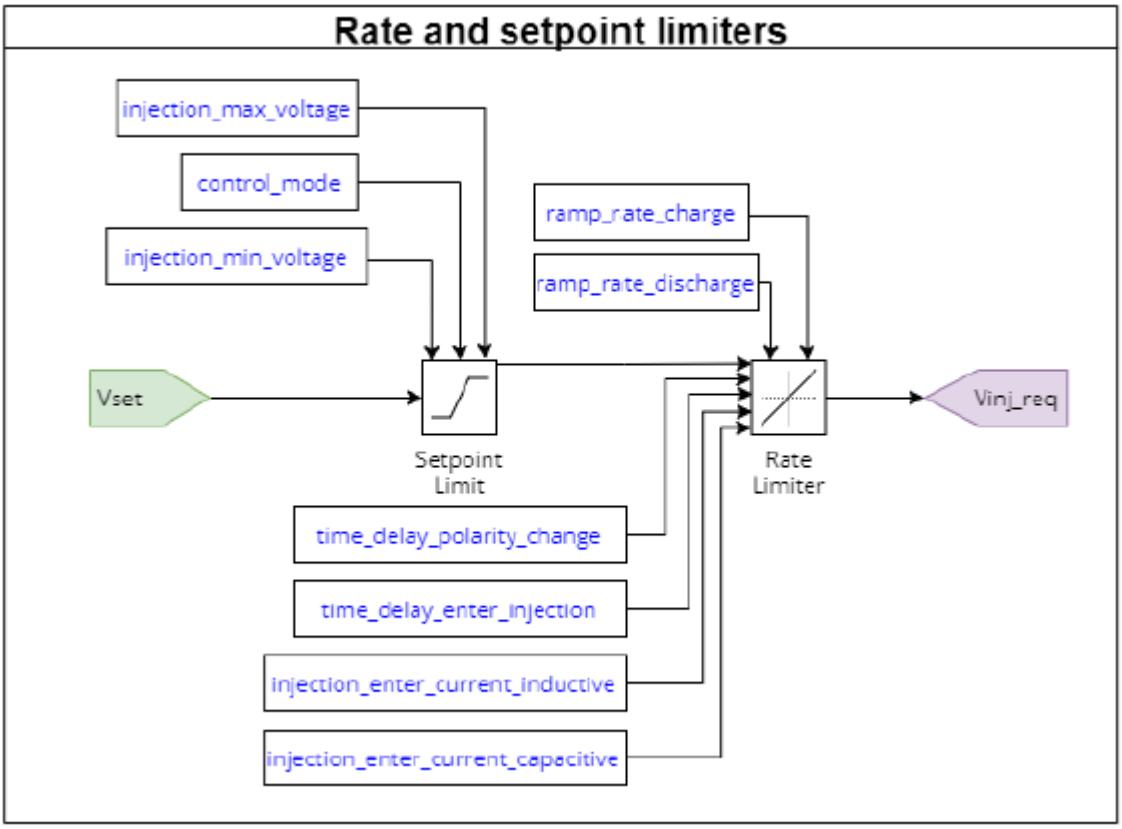
3. DIAGRAMA DE BLOQUES

A continuación, se presenta el diagrama de bloques de los dispositivos DFACTS BL1 ENVIGADO A GUAYABAL 110 kV, BL1 ENVIGADO A ANCON SUR (EPM) 110 kV y BL1 GUAYABAL A EL RODEO 110 kV:

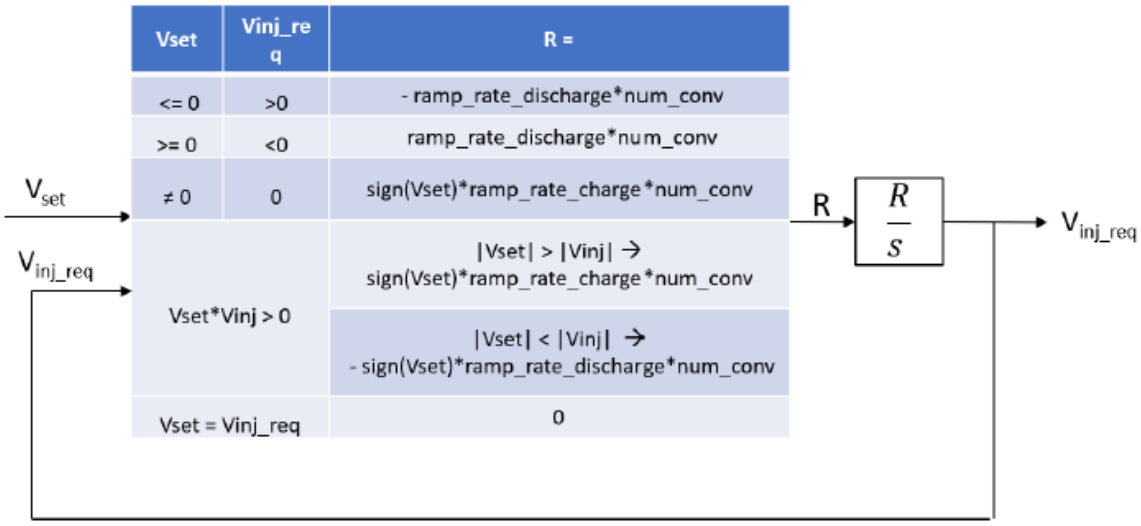
Modos de Operación:



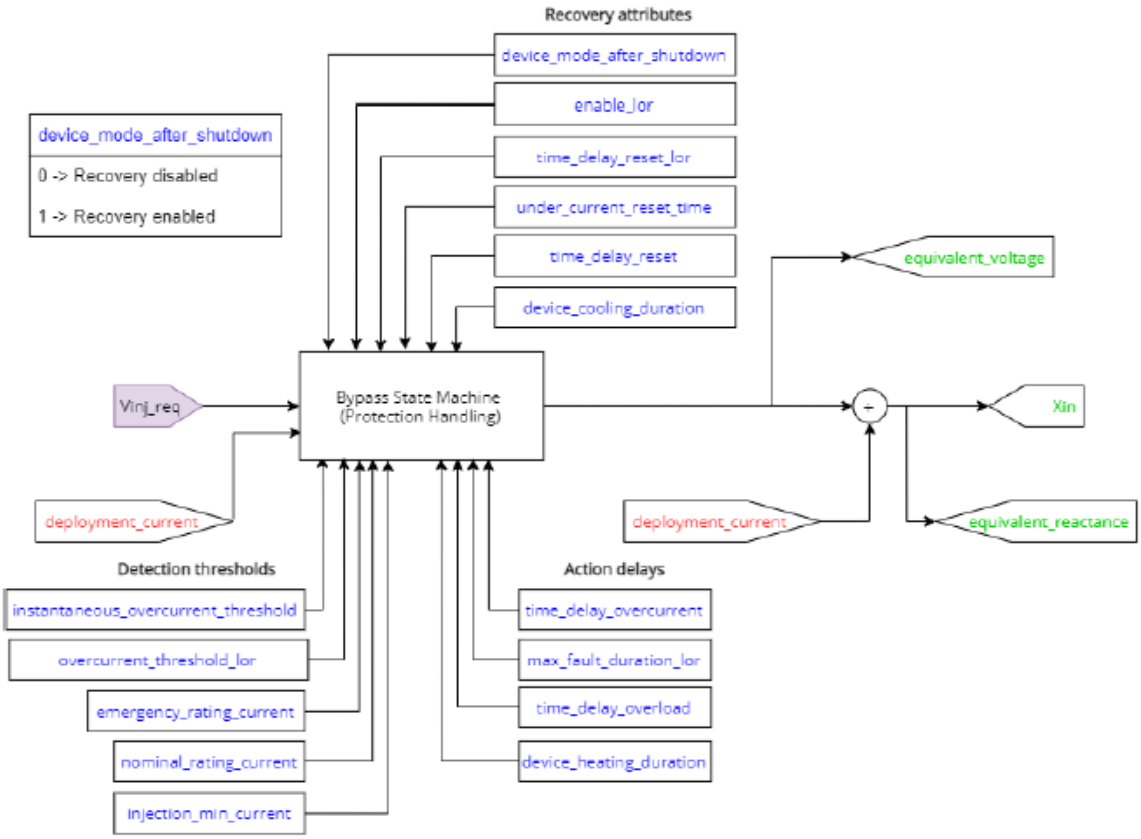
Rampas de Inyección y Limitadores:



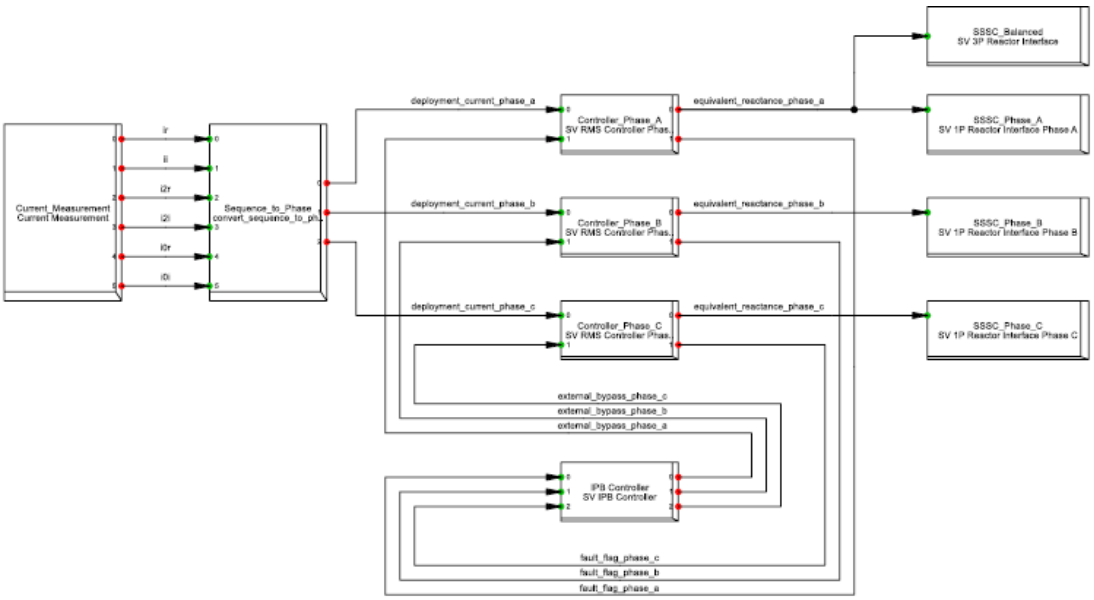
Detalle del bloque limitador de rampa:



Control Bypass:



Bloques SV RMS Frame:



Descripción de los bloques:

- Current_Measurement: Lectura de las corrientes de secuencia (i.e. 0, 1, 2) desde el modelo de red.
- Sequence_to_Phase: Conversión de corrientes de secuencia a corrientes de fase (i.e. A, B, C).
- Controller_Phase_A/B/C: Controladores de fase.
- IPB Controller: Controlador Inter-Phase Balancing.
- SSSC_Balanced: Interfaz al modelo de red para simulaciones balanceadas (i.e. Reactor trifásico).
- SSSC_Phase_A/B/C: Interfaz al modelo de red para simulaciones desbalanceadas (i.e. Reactores monofásicos).

4. PARÁMETROS

A continuación, se presentan los parámetros de los dispositivos DFACTS BL1 ENVIGADO A GUAYABAL 110 kV, BL1 ENVIGADO A ANCON SUR (EPM) 110 kV y BL1 GUAYABAL A EL RODEO 110 kV:

Parámetros Simulación RMS SmartValve Ancon Sur - Envigado 1 110 kV:

RMS_settings.qdsl

Parámetro	Unidad	Ajuste
Number of series converters per SmartValve		1
Nominal Ramp Charge Rate per SmartValve	kV/s/Converter	0.045
Nominal Ramp Discharge Rate per SmartValve	kV/s/Converter	0.18
Duration with Zero Injection Following Polarity Change	s	60
Current-Control Mode transition delay T1	s	30
Firmware Overcurrent Threshold	kApk	7.6
Time window T3 for Overcurrent Threshold	s	0.001
Time window T4 for Overload Threshold	s	2
Device Heating Duration	s	1200
Device Mode After Line Fault (0Disable Recovery, 1Enable Recovery)		1
Current Threshold for Inductive Injection Mode	kA	0.330
Current Threshold for Capacitive Injection Mode	kA	0.330
Time window T5 Before transitioning to injection from monitoring	s	1
Post-Fault Reset Time	s	60
Under Current Reset Time	s	10
Device Cooling Duration	s	7200
Enable Low Overcurrent Ride-through (0Disable, 1Enable)		1
Low Overcurrent Ride-through Threshold	kApk	3.5
Low Overcurrent Ride-through Reset Time	s	0.025
Low Overcurrent Ride-through Max Fault Duration	s	2
Enable InterPhase Balancing (0Disable, 1Enable)		1
InterPhase Balancing communication delay across deployment	s	0.1
InterPhase Balancing shut-down behavior (0Halts injection immediately, 1Ramps down un-faulted phases)		0
Enable three phase Low Overcurrent Ride-through (0Disable, 1Enable)		1
Low Overcurrent Ride-through multiple transient rejection timer	s	2
Maximum expected delay before the PLL locks	s	0.3
enable_current_deadband		0
lower_limit_current_deadband	kA	0
upper_limit_current_deadband	kA	0
enable_command_distribution		1
time_delay_low_current	s	2
injection_min_current_bootup	kA	0.04
under_current_bootup_time	s	10
regressed_role_ipb		0

SV Loadflow Controller.qdsl

Parámetro	Ajuste
control_mode (0: Mon, 1: V, 2: Ω)	2
setpoint_voltage_percentage [%]	0
setpoint_reactance [Ω]	1.21
enable_current_control (0: OFF, 1: ON)	0
setpoint_current_control_inductive [kA]	9.999
setpoint_current_control_capacitive [kA]	0

Advanced_settings.qdsl

Parámetro	Ajuste
MAX_REACTANCE_CORRECTION [Ω]	500
MAX_MISMATCH [kV]	0.003
MAX_SLOPE_CHANGE [%]	100
DELTA_REACTANCE [Ω]	1
USE_DIDV_ESTIMATION (0: No, 1: Yes)	1
SECANT_ALGORITHM_OPEN_LINE_ITERATIONS	4
ZERO_VOLTAGE [kV]	0.0001
TIME_DEPENDENT_SETPOINT (0: No, 1: Yes)	0
ALARM_SHORT_TERM_SETTLING_POINT	1
ENABLE_VERBOSE_OUTPUT (0: No, 1: Yes)	1
EPSILON [Ω]	0.1

UNBALANCED_START_TIME	-0.05
OUT_OF_BOUNDS_MAX_ITERATIONS	2
REACTANCE_SEED	0.1
ENABLE_ENTERING_INJECTION_ESTIMATION	1

LF_settings.qdsl

Parámetro	Ajuste
emergency_rating_current [kA]	2.16
nominal_rating_current [kA]	1.8
injection_min_current [kA]	0.170
injection_max_voltage_device [kV]	0.566
injection_min_voltage_device [kV]	0.056
group_count	1
kdroop_current_control_device	0
offset_exit_current_control_inductive [kA]	0.1
offset_exit_current_control_capacitive [kA]	0.2
Droop_enabled (capacitive)	0

Parámetros Simulación RMS SmartValve Rodeo - Guayabal 1 110 kV

RMS_settings.qdsl

Parámetro	Unidad	Ajuste
Number of series converters per SmartValve		1
Nominal Ramp Charge Rate per SmartValve	kV/s/Converter	0.045
Nominal Ramp Discharge Rate per SmartValve	kV/s/Converter	0.18
Duration with Zero Injection Following Polarity Change	s	60
Current-Control Mode transition delay T1	s	30
Firmware Overcurrent Threshold	kApk	7.6
Time window T3 for Overcurrent Threshold	s	0.001
Time window T4 for Overload Threshold	s	2
Device Heating Duration	s	1200
Device Mode After Line Fault (0Disable Recovery, 1Enable Recovery)		1
Current Threshold for Inductive Injection Mode	kA	0.250
Current Threshold for Capacitive Injection Mode	kA	0.250
Time window T5 Before transitioning to injection from monitoring	s	1
Post-Fault Reset Time	s	60
Under Current Reset Time	s	10
Device Cooling Duration	s	7200
Enable Low Overcurrent Ride-through (0Disable, 1Enable)		1
Low Overcurrent Ride-through Threshold	kApk	3.5
Low Overcurrent Ride-through Reset Time	s	0.025
Low Overcurrent Ride-through Max Fault Duration	s	2
Enable InterPhase Balancing (0Disable, 1Enable)		1
InterPhase Balancing communication delay across deployment	s	0.1
InterPhase Balancing shut-down behavior (0Halts injection immediately, 1Ramps down un-faulted phases)		0
Enable three phase Low Overcurrent Ride-through (0Disable, 1Enable)		1
Low Overcurrent Ride-through multiple transient rejection timer	s	2
Maximum expected delay before the PLL locks	s	0.3
enable_current_deadband		0
lower_limit_current_deadband	kA	0
upper_limit_current_deadband	kA	0
enable_command_distribution		1
time_delay_low_current	s	2
injection_min_current_bootup	kA	0.04
under_current_bootup_time	s	10
regressed_role_ipb		0

SV Loadflow Controller.qdsl

Parámetro	Ajuste
control_mode (0: Mon, 1: V, 2: Ω)	2
setpoint_voltage_percentage [%]	0
setpoint_reactance [Ω]	1.21
enable_current_control (0: OFF, 1: ON)	0
setpoint_current_control_inductive [kA]	9.999
setpoint_current_control_capacitive [kA]	0

Advanced_settings.qdsl

Parámetro	Ajuste
MAX_REACTANCE_CORRECTION [Ω]	500
MAX_MISMATCH [kV]	0.003
MAX_SLOPE_CHANGE [%]	100
DELTA_REACTANCE [Ω]	1
USE_DIDV_ESTIMATION (0: No, 1: Yes)	1
SECANT_ALGORITHM_OPEN_LINE_ITERATIONS	4
ZERO_VOLTAGE [kV]	0.0001
TIME_DEPENDENT_SETPOINT (0: No, 1: Yes)	0
ALARM_SHORT_TERM_SETTLING_POINT	1
ENABLE_VERBOSE_OUTPUT (0: No, 1: Yes)	1
EPSILON [Ω]	0.1
UNBALANCED_START_TIME	-0.05
OUT_OF_BOUNDS_MAX_ITERATIONS	2
REACTANCE_SEED	0.1
ENABLE_ENTERING_INJECTION_ESTIMATION	1

LF_settings.qdsl

Parámetro	Ajuste
emergency_rating_current [kA]	2.16
nominal_rating_current [kA]	1.8
injection_min_current [kA]	0.170
injection_max_voltage_device [kV]	0.566

injection_min_voltage_device [kV]	0.056
group_count	1
kdroop_current_control_device	0
offset_exit_current_control_inductive [kA]	0.1
offset_exit_current_control_capacitive [kA]	0.2
Droop_enabled (capacitive)	0

Parámetros Simulación RMS SmartValve Envigado - Guayabal 1 110 kV

RMS_settings.qdsl

Parámetro	Unidad	Ajuste
Number of series converters per SmartValve		2
Nominal Ramp Charge Rate per SmartValve	kV/s/Converter	0.045
Nominal Ramp Discharge Rate per SmartValve	kV/s/Converter	0.18
Duration with Zero Injection Following Polarity Change	s	60
Current-Control Mode transition delay T1	s	30
Firmware Overcurrent Threshold	kApk	7.6
Time window T3 for Overcurrent Threshold	s	0.001
Time window T4 for Overload Threshold	s	2
Device Heating Duration	s	1200
Device Mode After Line Fault (0Disable Recovery, 1Enable Recovery)		1
Current Threshold for Inductive Injection Mode	kA	0.270
Current Threshold for Capacitive Injection Mode	kA	0.270
Time window T5 Before transitioning to injection from monitoring	s	1
Post-Fault Reset Time	s	60
Under Current Reset Time	s	10
Device Cooling Duration	s	7200
Enable Low Overcurrent Ride-through (0Disable, 1Enable)		1
Low Overcurrent Ride-through Threshold	kApk	3.5
Low Overcurrent Ride-through Reset Time	s	0.025
Low Overcurrent Ride-through Max Fault Duration	s	2
Enable InterPhase Balancing (0Disable, 1Enable)		1
InterPhase Balancing communication delay across deployment	s	0.1
InterPhase Balancing shut-down behavior (0Halts injection immediately, 1Ramps down un-faulted phases)		0
Enable three phase Low Overcurrent Ride-through (0Disable, 1Enable)		1
Low Overcurrent Ride-through multiple transient rejection timer	s	2
Maximum expected delay before the PLL locks	s	0.3
enable_current_deadband		0
lower_limit_current_deadband	kA	0
upper_limit_current_deadband	kA	0
enable_command_distribution		1
time_delay_low_current	s	2
injection_min_current_bootup	kA	0.04
under_current_bootup_time	s	10
regressed_role_ipb		0

SV Loadflow Controller.qdsl

Parámetro	Ajuste
control_mode (0: Mon, 1: V, 2: Ω)	2
setpoint_voltage_percentage [%]	0
setpoint_reactance [Ω]	1.21
enable_current_control (0: OFF, 1: ON)	0
setpoint_current_control_inductive [kA]	9.999
setpoint_current_control_capacitive [kA]	0

Advanced_settings.qdsl

Parámetro	Ajuste
MAX_REACTANCE_CORRECTION [Ω]	500
MAX_MISMATCH [kV]	0.003
MAX_SLOPE_CHANGE [%]	100
DELTA_REACTANCE [Ω]	1
USE_DIDV_ESTIMATION (0: No, 1: Yes)	1
SECANT_ALGORITHM_OPEN_LINE_ITERATIONS	4
ZERO_VOLTAGE [kV]	0.0001
TIME_DEPENDENT_SETPOINT (0: No, 1: Yes)	0
ALARM_SHORT_TERM_SETTLING_POINT	1
ENABLE_VERBOSE_OUTPUT (0: No, 1: Yes)	1
EPSILON [Ω]	0.1
UNBALANCED_START_TIME	-0.05
OUT_OF_BOUNDS_MAX_ITERATIONS	2
REACTANCE_SEED	0.1
ENABLE_ENTERING_INJECTION_ESTIMATION	1

LF_settings.qdsl

Parámetro	Ajuste
emergency_rating_current [kA]	2.16
nominal_rating_current [kA]	1.8
injection_min_current [kA]	0.170
injection_max_voltage_device [kV]	0.566
injection_min_voltage_device [kV]	0.056
group_count	2
kdroop_current_control_device	0
offset_exit_current_control_inductive [kA]	0.1
offset_exit_current_control_capacitive [kA]	0.2
Droop_enabled (capacitive)	0

Elementos del modelo que deben estar habilitados para los análisis de flujo de carga:

qdsl	SV 3P Short-Circuit Interface	SV 3P Short-Circuit Interface type	☑
qdsl	SV Loadflow Controller	SV Loadflow Controller V2022 type	☐
qdsl	SV UB Short-Circuit Interface	SV UB Short-Circuit Interface type	☑
	SV 1P Reactor Interface Phase A		☐
	SV 1P Reactor Interface Phase B		☐
	SV 1P Reactor Interface Phase C		☐
	SV 3P Reactor Interface		☐
	SV Terminal 1		☐
	SV Terminal 2		☐
	SV Zf1		☐
	SV Zf2		☐