

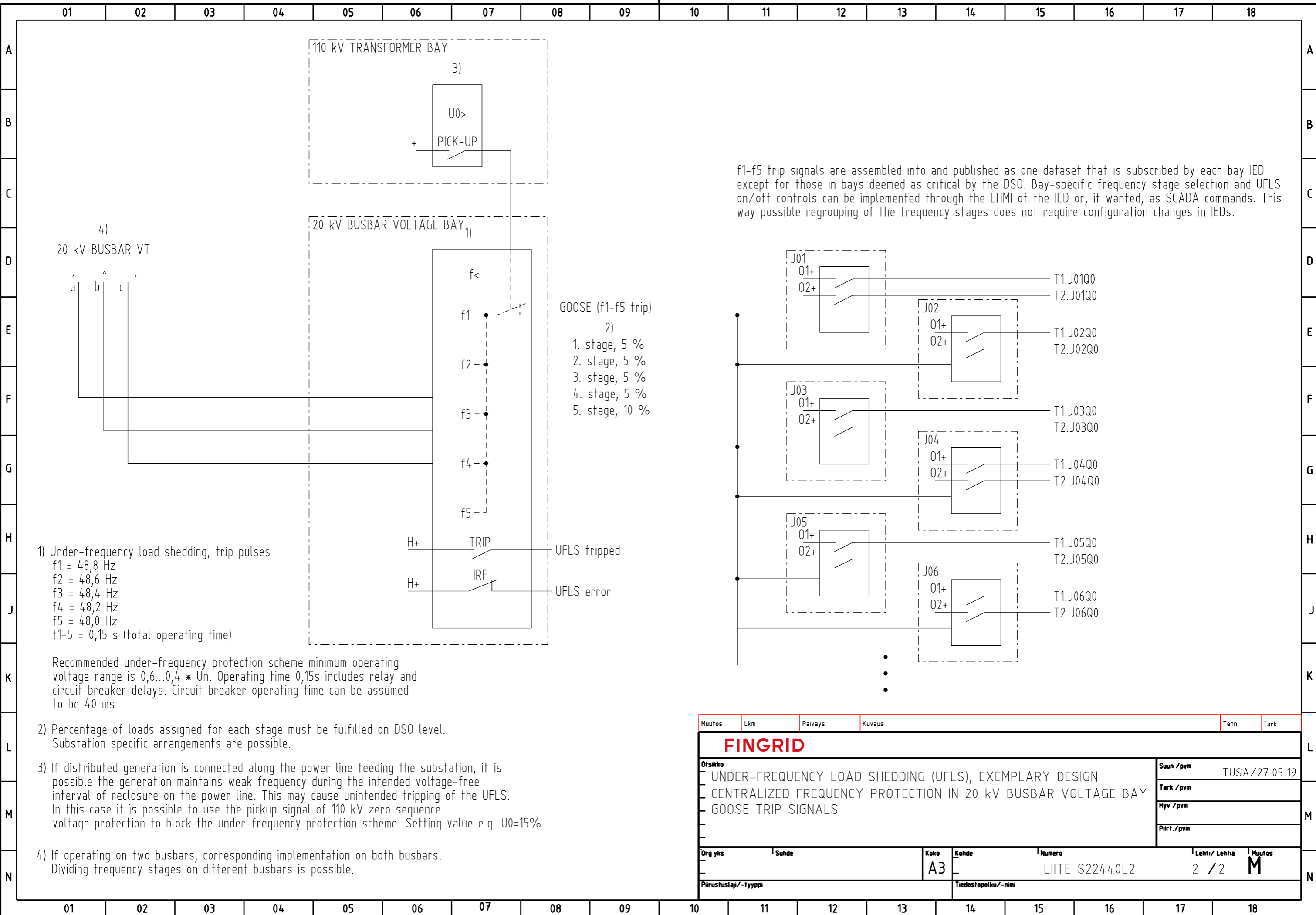
- 1) Under-frequency load shedding, trip pulses
 f1 = 48,8 Hz
 f2 = 48,6 Hz
 f3 = 48,4 Hz
 f4 = 48,2 Hz
 f5 = 48,0 Hz
 t1-5 = 0,15 s (total operating time)

Recommended under-frequency protection scheme minimum operating voltage range is $0,6...0,4 * U_n$. Operating time 0,15s includes relay and circuit breaker delays. Circuit breaker operating time can be assumed to be 40 ms.

If the relays used have less than 5 frequency stages, the functionality can be implemented with two relays OR choose stages to be used for each substation and coordinate the total load for each stage on DSO level.

- 2) Percentage of loads assigned for each stage must be fulfilled on DSO level. Substation specific arrangements are possible.
- 3) If distributed generation is connected along the power line feeding the substation, it is possible the generation maintains weak frequency during the intended voltage-free interval of reclosure on the power line. This may cause unintended tripping of the UFLS. In this case it is possible to use the pickup signal of 110 kV zero sequence voltage protection to block the under-frequency protection scheme. Setting value e.g. U0=15%.
- 4) If operating on two busbars, corresponding implementation on both busbars. Dividing frequency stages on different busbars is possible.
- 5) If the bay IED has only one trip circuit, use that.

Muutos	Lkm	Paivays	Kuvaus	Tehn.	Tark.
FINGRID					
Otsikko				Suun /pvm	
UNDER-FREQUENCY LOAD SHEDDING (UFLS), EXEMPLARY DESIGN				TUSA /27.05.19	
CENTRALIZED FREQUENCY PROTECTION IN 20 kV BUSBAR VOLTAGE BAY				Tark /pvm	
WIRED TRIP SIGNALS				Hyv. /pvm	
				Purt. /pvm	
Org yks.	Suhde	Koko	Kohde	Numero	Lehti/ Lehtia
		A3		LIITE S22440L2	1 / 2
Pirustustaj/-tyyppi			Tiedostopolku/-nimi		
			Muutos M		



f1-f5 trip signals are assembled into and published as one dataset that is subscribed by each bay IED except for those in bays deemed as critical by the DSO. Bay-specific frequency stage selection and UFLS on/off controls can be implemented through the LHMI of the IED or, if wanted, as SCADA commands. This way possible regrouping of the frequency stages does not require configuration changes in IEDs.

- 1) Under-frequency load shedding, trip pulses
 f1 = 48,8 Hz
 f2 = 48,6 Hz
 f3 = 48,4 Hz
 f4 = 48,2 Hz
 f5 = 48,0 Hz
 t1-5 = 0,15 s (total operating time)

- 2)
 1. stage, 5 %
 2. stage, 5 %
 3. stage, 5 %
 4. stage, 5 %
 5. stage, 10 %

Recommended under-frequency protection scheme minimum operating voltage range is $0,6...0,4 * U_n$. Operating time 0,15s includes relay and circuit breaker delays. Circuit breaker operating time can be assumed to be 40 ms.

- 3) If distributed generation is connected along the power line feeding the substation, it is possible the generation maintains weak frequency during the intended voltage-free interval of reclosure on the power line. This may cause unintended tripping of the UFLS. In this case it is possible to use the pickup signal of 110 kV zero sequence voltage protection to block the under-frequency protection scheme. Setting value e.g. U0=15%.
- 4) If operating on two busbars, corresponding implementation on both busbars. Dividing frequency stages on different busbars is possible.

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Otsikko UNDER-FREQUENCY LOAD SHEDDING (UFLS), EXEMPLARY DESIGN CENTRALIZED FREQUENCY PROTECTION IN 20 kV BUSBAR VOLTAGE BAY GOOSE TRIP SIGNALS					Suun./pvm TUSA/27.05.19
					Tark./pvm
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					Purt./pvm
Org yks.	Suhde	Koko	Kohde	Numero	Lehti/Lehtia
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