Table of contents

18. DIESEL/SHAFT GENERATOR SET SUPERVISION AND PROTECTION 2

INTERNAL SYSTEM SUPERVISION 2
ENGINE SUPERVISION 6
BUSBAR SUPERVISION AND PROTECTION 9
DIESEL/SHAFT GENERATOR PROTECTION 13
TRIP OF NON ESSENTIAL LOAD GROUPS 19

18. Diesel/shaft generator set supervision and protection

The DGU in the DELOMATIC system is able to handle local supervision and protection of the corresponding diesel/shaft generator set.

All local supervision and protective functions are also active during SWBD control.

Internal system supervision

The DGUs in the DELOMATIC system are implemented with an extensive number of internal system supervision functions for supervision of their ability to carry out *safe and correct operation*.

So it is recommended to read this paragraph carefully in order to get familiar with the system alarm messages, if a system failure should occur.

Each DGU continuously carries out the below-mentioned system supervision functions:

- PCM (Power Control Module) supervision of internal communication and power supply
- Supervision of the diesel/shaft generator breaker position feedback signals
- Supervision of I/O configuration (hardware)
- Supervision of the multi-transducer unit in SCM modules
- Cable supervision

An active "SYSTEM ALARM" in a DGU is indicated by means of the following hardware interface.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• SYSTEM ALARM	Relay output	(IOM 4.1)

A "SYSTEM ALARM" indicates a fault, which may prevent the DGU from carrying out safe and correct operation.

PCM supervision of the ARC network communication

The DELOMATIC software supervises if normal communication is carried out between the DGUs in the system.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• LAN	BNC ARC network connector	(PCM 4.1)

Normal activity at the ARC network is indicated by

- a *green* "**LAN OK**" LED at the PCM module

PCM indication of ARC network failure

If the PCM module detects any failures at the ARC network,

- the "**ARCnet OK**" LED at the PCM module is *turned off* (normally green)

Supervision of mutual communication between the DGUs

The Main PMS DGU and all other DGUs (called "slave" DGUs) in the DELOMATIC system carry out mutual communication in order to implement superior control of the power plant.

If a "slave" DGU is unable to communicate with the Main PMS DGU, the following alarm message is shown at the corresponding DU(s):

- Alarm **"COM. ERROR DGU x"**

The letter *n* indicates the Main PMS DGU no.

At the DU(s) of the main PMS DGU the following alarm message is displayed:

- Alarm **"COM. ERROR DGU n"**

The "slave" DGU is forced into SWBD control until the system alarm disappears, and the Main PMS DGU excludes the defective DGU until the communication is reestablished.

Breaker position supervision

Each DGU continuously supervises, if the position feedback signals from the diesel/shaft generator breaker or any other circuit breaker have a conflicting status.

The ON and OFF feedback may not have an identical status at the same time, and at least one of them must be present.

Supervision of signals for the diesel/shaft generator breakers and any other circuit breaker position feedback is controlled via the following hardware interface.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• GB/SGB/TB POSITION FEEDBACK (ON)	Binary input	(SCM)
• GB/SGB/TB POSITION FEEDBACK (OFF)	Binary input	(SCM)

If a conflicting position feedback is registered, the following alarm message is shown at the DU (DGU DG):

- Alarm **"DGB/SGB/TB POS. FAIL."**

Diesel generator:
The defective DGU is forced into SWBD control, until the system alarm disappears.

Shaft generator:
The SG plant mode is automatically cancelled (AUTO plant mode selected), until the system alarm disappears.

I/O supervision

Each DGU continuously supervises, if the actual hardware configuration is as defined in the software and generates an alarm message, if

- two modules of identical type have the same I/O address in the DGU
- the expected number of a specific module type is not present in the DGU

If a DGU detects one of the two above-mentioned I/O failures,

- the **"I/O OK"** LED at the front of the PCM is *turned off* (normally green)

In case of I/O failure, the following alarm message is shown at the DU:

- Alarm **"I/O ERROR #-##:#"**

The characters and numbers in the message **"I/O ERROR #-##:#"** is a code, by which it is possible to make a positive identification of type and I/O address of the module which caused the I/O error.

I/O ERROR	**#**	**-**	**##**	**:**	**#**
Code explanation	0 = IOM 2 = SCM		I/O address for the defective module[1)] I/O address for the defective module[1)]		M = Missing card T = Two cards with the same I/O address

[1)] Please refer to the I/O list in order to determine the physical location of a defective module.

Diesel generator:
The defective DGU is forced into SWBD control, until the system alarm disappears.

Shaft generator:
The SG plant mode is automatically cancelled (AUTO plant mode selected), until the system alarm disappears.

Power supply supervision

The Power Control Module (PCM) continuously supervises (measures) the power supply.

The measured power supply voltage is continuously compared to the minimum acceptable supply voltage: 18V DC (24V DC -25%).

The measured supply voltage is available for read-out at the DU.

If the measured supply voltage has been continuously lower than the minimum acceptable supply voltage for a programmed time, the following alarm message is shown at the DU:

- Alarm **"LOW SUPPLY VOLT."**

Diesel generator:
The defective DGU is forced into SWBD control, until the system alarm disappears.

Shaft generator:
The SG plant mode is automatically cancelled (AUTO plant mode selected), until the system alarm disappears.

Disabling DGU due to low supply voltage

At approx. 14V DC the supply voltage becomes too low for the PCM module to maintain a sufficient power supply to the DELOMATIC modules, and the entire DGU is disabled (shut off).

Disabling of a DGU due to a very low supply voltage is indicated by

- the **"POWER OK"** LED at the front of PCM being turned off

The DGU remains disabled, until the supply voltage is above 18V DC again.

Supervision of the multi-transducer in the SCM module

Each SCM module in a DGU supervises, if the multi-transducer unit is functional and transmitting valid data (measured and calculated AC values) to the PCM module.

If the data from the multi-transducer unit become invalid, the DGU may not be able to carry out safe and correct operation.

Supervision of the multi-transducer in the SCM module is controlled via the following hardware interface.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• U_{GEN}	3-phase voltage input from the diesel/shaft generator	(SCM)
• U_{BB}	3-phase current input from the busbar	(SCM)

Invalid data from the multi-transducer unit may be caused by one of the following events:

- The entered value in set point "NOM. VOLTAGE" is outside the selected measuring range at the SCM module
- The measured diesel/shaft generator frequency is outside the max. measuring range specified in the diesel/shaft generator set software with a closed circuit breaker
- The measured diesel/shaft generator voltage is below the min. acceptable measuring level with a closed circuit breaker
- Communication sequence failure from the multi-transducer unit

If an SCM module repeatedly receives invalid data from the multi-transducer unit, the following alarm message is shown at the DU:

- Alarm **"MEASURE ERROR n"**

Diesel generator:
The defective DGU is forced into SWBD control, until the system alarm disappears.

Shaft generator:
The SG plant mode is automatically cancelled (AUTO plant mode selected), until the system alarm disappears.

Cable supervision

Cable supervision is an enhanced safety function, which detects a broken cable, e.g. used for supervision of significant signals.

Cable supervision is possible for both analogue and binary input channels and is automatically activated at analogue input channels with offset (e.g. 4...20mA). Cable supervision of binary input channels is an option, please refer to the I/O list for details about which channel it is implemented on. Please notice that analogue channels, where the software expects a signal with 20% offset, are automatically included in the cable supervision function. Implementation of cable supervision requires a resistor placed in parallel with the contact function, please refer to the paragraph INSTALLATION INSTRUCTION for detailed information.

If an IOM 4.1 module detects a cable failure, the following alarm message is shown at the DU:

- Alarm **"CABLE FAIL n:C##"**

Engine supervision

Engine supervision is handled by the DELOMATIC system according to the status on a number of alarm inputs. Each DGU in the DELOMATIC system is able to carry out the following engine supervision functions:

- Tacho feedback
- 8 user programmable alarms

The engine supervision functions are disabled when the engine is not running (stand-by). Disabling of the engine supervision means that no alarms are generated by the supervision functions. The engine supervision functions are furthermore disabled during the automatic start sequence, until the auxiliary engine has obtained running status.

- VTA structure **"DGAlarmInh"**

The engine supervision is activated time delayed. The programmable timer enables the operator to adjust the delay.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Disabled engine supervision is indicated by means of

- a *yellow* "**ALARM INHIBIT**" LED at the DU

Active engine supervision is indicated by means of

- a *dark (turned off)* "**ALARM INHIBIT**" LED at the DU

Each DGU is implemented with the following hardware interface, which is used in coherence with the engine supervision functions.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• ENGINE RUNNING/ ENGINE RPM	Binary input Analogue input *)	(IOM 4.1)
• DG ALARM 1	Binary input (alarm) **)	(IOM 4.1)
• DG ALARM 2	Binary input (alarm) **)	(IOM 4.1)
• DG ALARM 3	Binary input (alarm) **)	(IOM 4.1)
• DG ALARM 4	Binary input (alarm) **)	(IOM 4.1)
• DG ALARM 5	Binary input (alarm) **)	(IOM 4.1)
• DG ALARM 6	Binary input (alarm) **)	(IOM 4.1)

*) Depending on jumper position on the IOM card
**) User programmable alarms

Tacho supervision, VTA-TachoFail

The "TACHO FAILURE" alarm is transmitted, if the running feedback (analogue or binary) disappears and normal voltage and frequency are still to be measured at the generator.

Tacho supervision is activated time delayed after running status has been detected first time during the automatic start sequence. If a tacho failure is detected, an alarm message is displayed at the DU.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

An active tacho failure alarm is furthermore indicated by

- **a *yellow* "RUN" LED**

Custom binary alarm inputs, VTA-DGAlarm(n) and VTA-DGAlarmInh(n)

Each DGU has 6 custom binary alarm inputs, which may be used e.g. for interfacing with external protective relays or other protective measurements.

The interface is carried out by the following inputs:

SIGNAL NAME	SIGNAL TYPE	LOCATION
• DG ALARM n	Binary alarm input	All DGUs (IOM 4.1)

The custom binary alarm inputs have the following features:

- Programmable alarm status at the input channel (OC or CC)
- Selection of the alarm is to be included in the alarm inhibit function (disabled when the engine is stopped and during start)
- Programmable alarm sequence
  - No alarm
  - Warning
  - Block
  - Safety stop
  - GB trip
  - GB trip without blackout start (ex. short circuit)
  - Shutdown
- Programmable alarm delay

Program DGalarms, VTA-DGAlarm(n) and VTA-DGAlarmInh(n)

The operator is able to program the VTA structure in order to adapt the custom binary alarm input n to the desired functionalism. Activation of the "DG ALARM n" input according to the programmed conditions will initiate the programmed alarm sequence, and an alarm message is displayed at the DU.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Busbar supervision and protection

The DELOMATIC busbar supervision and protective functions are activated, whenever a diesel/shaft generator set is connected to the busbar.

Busbar supervision is also activated at the Main PMS DGU, when a shore connection is supplying the busbar.

Each DGU carries out busbar supervision and protection according to individual programmable set points and delays.

This means that the DGUs may be programmed differently, but it is *highly* recommended to program the busbar supervision functions with set points and delays common for the entire DELOMATIC system.

The busbar supervision is carried out by the following hardware interface.

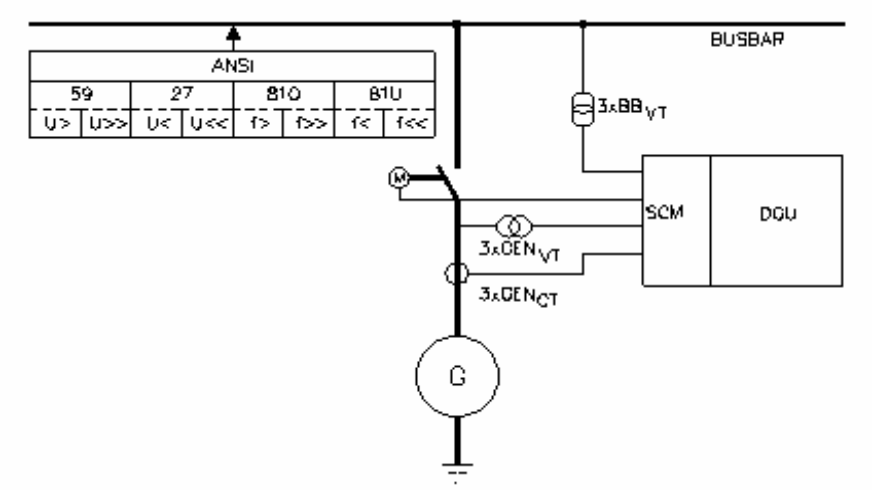
SIGNAL NAME	SIGNAL TYPE	LOCATION
• U_{BB}	3-phase voltage input from the busbar	(SCM)

Each DGU/SG-DGU implements the following busbar supervision (warning) and protective (trip of GB) functions:

- Level undervoltage, U_{BB}<
- Level overvoltage, U_{BB}>
- Level underfrequency, f_{BB} <
- Level overfrequency, f_{BB} >

Whenever the first level on a busbar is reached, the next available stand-by gen-set will start up and be running idle, until the situation is cleared. This ensures a minimum blackout time.

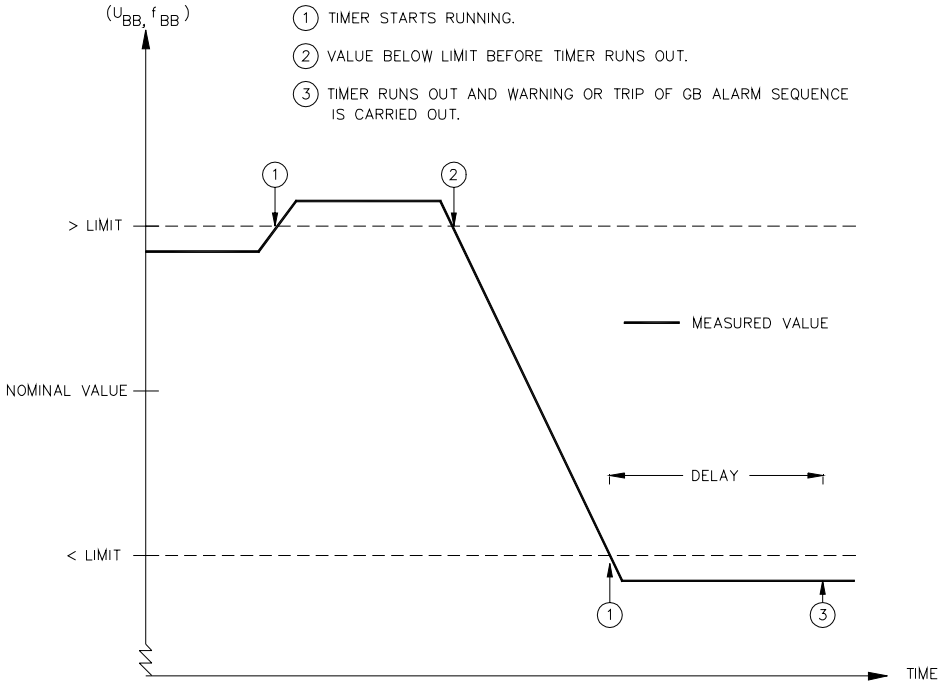
If a shaft generator breaker is tripped, the SG plant mode is cancelled and the AUTO plant mode is automatically selected.



The busbar supervision and protective functions stated with ANSI numbers (VTs may not be present)

Operating principle of the busbar supervision and protective functions

The busbar supervision and protective function operates according to the *definite time principle.*



The busbar/SG busbar supervision and protection operates according to the definite time principle

The programmable definite timer starts running when the programmed limit is exceeded and subsequently initiates the designated alarm sequence, when the delay timer runs out.

The delay timer is reset, if the measured value (here U_{BB} or f_{BB}) goes above or below the limit respectively.

The alarm regarding the supervision of the SCM module called "MEASURE ERROR" will block for the busbar protective functions.

Undervoltage supervision and protection

The undervoltage VTA structure supervises/protects, if the busbar voltage is below one of the programmed limits and carries out a warning and a trip of GB alarm sequence respectively, if the busbar voltage goes continuously *below* one of the set points (limits) during the programmed delays.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Undervoltage supervision, VTA-DGBBULowWarn

The operator is able to program the VTA structure, by which the busbar undervoltage supervision is controlled. If the busbar undervoltage supervision (warning) is activated, an alarm message is displayed at the DU (DGU, which detected the failure).

Undervoltage protection, VTA-DGBBULowTrip and VTA-DGBBULowTrip2

The operator is able to program the VTA structure, by which the busbar undervoltage protection is controlled. There are 2 levels of low voltage trips, which can be programmed individually.

The low voltage trips can be programmed as the example below:

- Low trip 1: Slow low voltage protection (long delay, low< alarm limit)
- Low trip 2: Fast low voltage protection (short delay, low<< alarm limit)

If the busbar undervoltage protection is activated, an alarm message is displayed at the DU (DGU, which detected the failure).

Overvoltage supervision and protection

The overvoltage VTA structure supervises/protects, if the busbar voltage is above one of the programmed limits. A warning or a trip of GB/SGB alarm sequence is carried out, if the busbar voltage goes continuously *below* one of the two set points (limits) during the programmed delays.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Overvoltage supervision, VTA-DGBBUHighWarn

The operator is able to program the VTA structure, by which the busbar overvoltage supervision is controlled. If the busbar supervision (warning) is activated, an alarm message is displayed at the DU (DGU, which detected the failure).

Overvoltage protection, VTA-DGBBUHighTrip and VTA- DGBBUHighTrip2

The operator is able to program the VTA structure, by which the busbar overvoltage protection is controlled. The high voltage trips can be programmed as the example below:

- High trip 1: Slow high voltage protection (long delay, high> alarm limit)
- High trip 2: Fast high voltage protection (short delay, high>> alarm limit)

If the busbar overvoltage protection is activated, an alarm message is displayed at the DU (DGU, which detected the failure).

Underfrequency supervision and protection

The underfrequency function supervises/protects the busbar frequency and carries out a warning and a trip of GB/SGB alarm sequence respectively, if the busbar frequency is continuously *below* one of the two set points (alarm limits) during the programmed delays.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Underfrequency supervision, VTA-DGfLow

The operator is able to program the VTA structure, by which the busbar underfrequency supervision is controlled. If the busbar underfrequency supervision (warning) is activated, an alarm message is displayed at the DU (DGU which detected the failure).

Underfrequency protection, VTA-DGBBfLowTrip and VTA-DGBBfLowTrip2

The operator is able to program the VTA structure, by which the busbar underfrequency protection is controlled.

The low frequency trips can be programmed as the example below:

- Low trip 1: Slow low frequency protection (long delay, low< alarm limit)
- Low trip 2: Fast low frequency protection (short delay, low<< alarm limit)

If the busbar underfrequency protection (trip of GB/SGB) is activated, an alarm message is displayed at the DU (DGU which detected the failure).

Overfrequency supervision and protection

The overfrequency function supervises/protects the busbar frequency and carries out a warning and a trip of GB/SGB alarm sequence respectively, if the busbar frequency is continuously *above* one of the two set points (alarm limits) during the programmed delays.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Overfrequency supervision, VTA-DGBBfHighWarn

The operator is able to program the VTA structure, by which the busbar overfrequency supervision is controlled. If the busbar overfrequency supervision (warning) is activated, an alarm message is displayed at the DU (DGU which detected the failure).

Overfrequency supervision, VTA-DGBBfHighTrip and VTA-DGBBfHighTrip2

The operator is able to program the VTA structure, by which the busbar overfrequency protection is controlled. The high frequency trips can be programmed as the example below:

- High trip 1: Slow high frequency protection (long delay, high> alarm limit)
- High trip 2: Fast high frequency protection (short delay, high>> alarm limit)

If the busbar overfrequency protection (trip of GB/SGB) is activated, an alarm message is displayed at the DU (DGU which detected the failure).

Diesel/shaft generator protection

The DELOMATIC diesel/shaft generator set protection is separated into the following parts:

Common protection:

- A set of protective functions, which are active when the breaker is closed

Diesel generator:

- Supervision of the generator during an idle run (the breaker is open)

Shaft generator:

- Supervision of the shaft generator during the SGB ON sequence

The diesel/shaft generator supervision and protection is carried out by means of the following hardware interface.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• I_{GEN}	3-phase current input from the diesel/shaft generator	(SCM)
• U_{GEN}	3-phase voltage input from the diesel/shaft generator	(SCM)

The following diesel/shaft generator supervision and protective functions are implemented in each DGU in the DELOMATIC system:

Common protection:

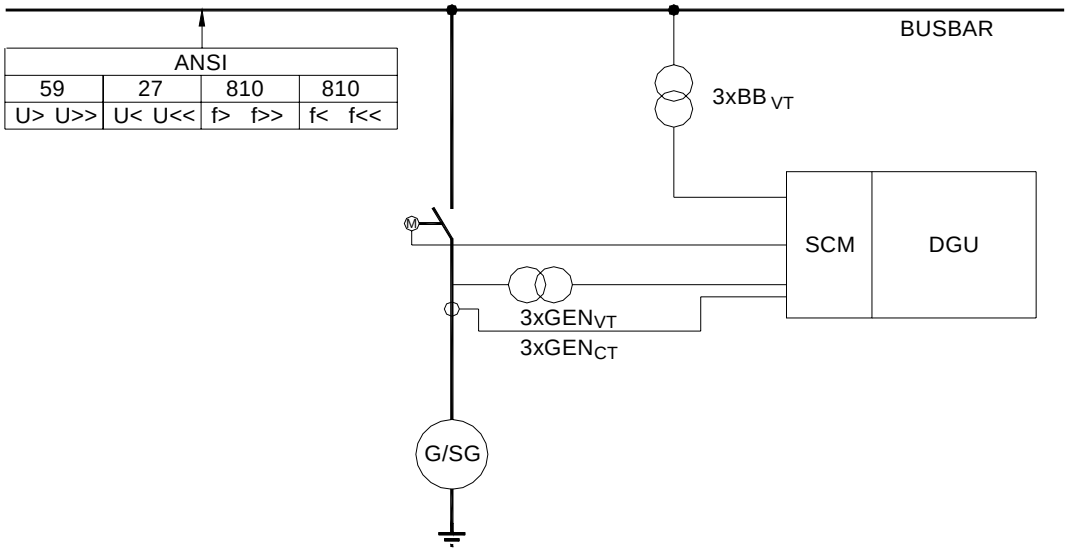
- Protection against overcurrent; I > (4 steps, 2 slow and 2 fast)
- Protection against reverse power; -P> (2 steps)
- Protection against overload; P > (3 steps, 1 high load and 2 overload)
- Other protections/protection levels on request

Diesel generator:

- Supervision of generator voltage and frequency during idle run

Shaft generator:

- Supervision of shaft generator voltage and frequency

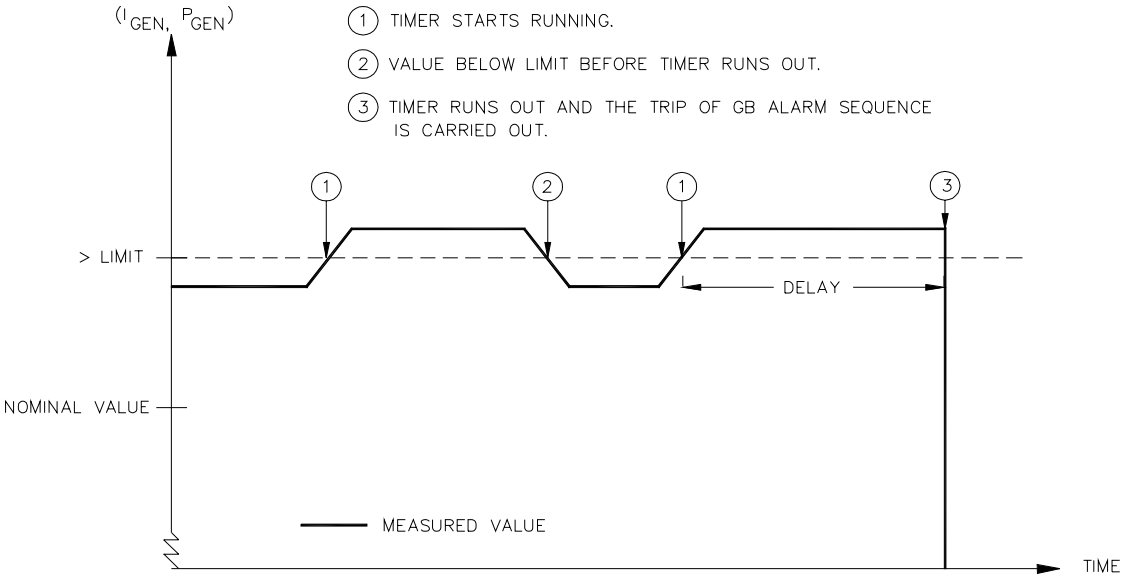


The diesel/shaft generator protection stated with ANSI numbers (VTs may not be present)

Each DGU carries out the diesel/shaft generator protection according to individual programmable set points and delays.

Operating principle of the diesel/shaft generator protective functions

The diesel/shaft generator protective functions operate according to the *defined time principle*.



The diesel/shaft generator supervision and protection operates according to the definite time principle

A programmable definite alarm timer starts running, when the programmed limit is exceeded. The designated alarm sequence is initiated, when the alarm timer runs out. The alarm timer is reset, if the measured value goes below the limit.

The programmable set points (alarm limits) are all stated in percentage of the corresponding nominal value.

Voltage and frequency supervision, VTA-DGVoltFreqOk

The diesel/shaft generator frequency and voltage are supervised according to the principle described under the “BUSBAR SUPERVISION AND PROTECTION” in this paragraph.

Diesel generator:
From the time the generator set obtains a running status and until the generator breaker is closed, the DGU supervises the generator voltage and frequency.

Shaft generator:
During the SGB ON sequence (shaft generator breaker is still open), the SG DGU will supervise the shaft generator voltage and frequency.

The diesel/shaft generator voltage and frequency are examined according to programmed alarm limits for *supervision*:

- $f_{GEN}<$ is compared with **VTA-DGfLowWarn**
- $f_{GEN}>$ is compared with **VTA-DGfHighWarn**
- $U_{GEN}<$ is compared with **VTA-DGULowWarn**
- $U_{GEN}>$ is compared with **VTA-DGUHighWarn**

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

The diesel/shaft generator frequency and voltage have to be continuously *within* the above-mentioned limits for the programmed delay in order to achieve the internal "DGVoltFreqOK" status. This allows the DGU to continue operating the diesel/shaft generator set, e.g. synchronisation.

The programmable VTA structure enables the operator to adjust the delay of obtaining the "DGVoltFreqOK" status.

- **VTA-DGVoltFreqOk**

Diesel/shaft generator voltage and frequency status

Common:
If the diesel/shaft generator voltage and frequency are continuously *outside* the above-mentioned limits, an alarm message is displayed in the corresponding DU.

Diesel generator:
If the diesel generator voltage and frequency are continuously *outside* the above-mentioned limits, the generator set is blocked for *any further participation* in automatic sequences.

Shaft generator:
If the diesel generator voltage and frequency are continuously *outside* the above-mentioned limits, the shaft generator is designated with the "U/f FAIL" status.

An active "U/f FAIL" status during an ongoing SGB ON sequence will block the shaft generator breaker and cancel the SG plant mode.

Overcurrent, I>

The diesel/shaft generator overcurrent protection is based on a comparison between the programmed limits and the largest measured phase current. All 3-phase currents (I_{L1}, I_{L1} and I_{L1}) are continuously measured and supervised. Set point limits are stated in percentage of I-Nom, and I-Nom is calculated on the basis of “DG U-NOM.” and “DG S-NOM.”, please refer to paragraph FACTORY SETTINGS.

The overcurrent protection is implemented in levels:

- Slow overcurrent protection (long delay, low alarm limit)
- Fast overcurrent protection (short delay, high alarm limit)

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Slow overcurrent protection, VTA-DGIOverSlow and VTA-DGIOverSlow2

The operator is able to program the VTA structure, by which the *slow* diesel/shaft generator overcurrent protection is controlled.

The slow overcurrent protection is implemented in levels:

- Slow overcurrent protection (long delay, low alarm limit)

If one of the overcurrent alarms are activated, an alarm message is displayed at the DU (DGU which detected the failure).

Fast overcurrent protection, VTA-DGIOverFast and VTA-DGIOverFast2

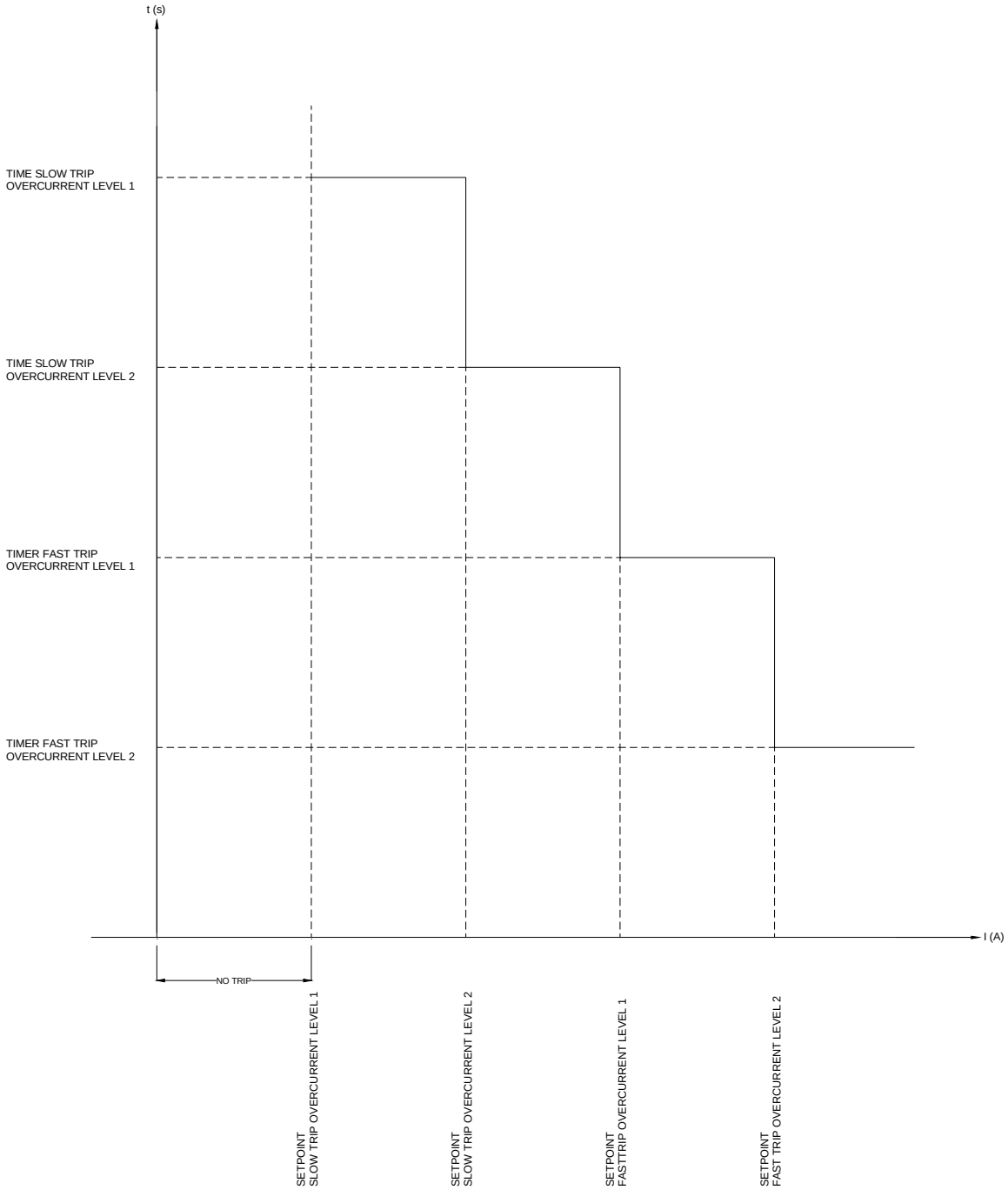
The operator is able to program the VTA structure, by which the *fast* diesel/shaft generator overcurrent protection is controlled.

The fast overcurrent protection is implemented in levels:

- Fast overcurrent protection (short delay, high alarm limit)

If one of the overcurrent alarms are activated, an alarm message is displayed at the DU (DGU which detected the failure).

The fast overcurrent protection of the diesel/shaft generator set is *not* a short circuit protection!



Overcurrent protection levels

Reverse power -P>, VTA-DGPRev and VTA-DGPRev2

The diesel/shaft generator power is continuously measured by the DGU. The power flow is considered to be positive *from the diesel/shaft generator and towards the busbar*.

This means, if power starts flowing into the diesel/shaft generator instead of out from the diesel/shaft generator, the sign of the measured power is thus changed to minus (-). The (-) signed power is referred to as *"reverse" power*.

The operator is able to program the VTA structure, by which the reverse power protection is controlled.

The reverse power trips can be programmed as the example below:

- Low trip 1: Slow reverse power protection (long delay, low< alarm limit)
- Low trip 2: Fast reverse power protection (short delay, low<< alarm limit)

If the reverse power protection is activated, an alarm message is displayed at the DU (DGU which detected the failure).

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Overload P>

The diesel/shaft generator overload function is separated into two levels:

- Supervision, high load warning on the diesel/shaft generator set
- Protection, trip of the diesel/shaft generator breaker due to overload

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Overload P> supervision, VTA-DGPHigh

The operator is able to program the VTA structure, by which the diesel/shaft generator load supervision is controlled. If the diesel/shaft generator load supervision is activated, an alarm message is displayed at the DU (DGU which detected the failure).

Overload P> protection, VTA-DGPOver and DGPOver2

The operator is able to program the VTA structure, by which the diesel/shaft generator *overload protection* is controlled.

The overload trips can be programmed as the examples below:

- High trip 1: Slow overload protection (long delay, high> alarm limit)
- High trip 2: Fast overload protection (short delay, high>> alarm limit)

If the diesel/shaft generator overload protection is activated, an alarm message is displayed at the DU (DGU which detected the failure).

Trip of non essential load groups

The trip of Non Essential Load (NEL) groups is carried out in order to protect the busbar against an imminent blackout situation due to either a high load on a diesel/shaft generator set or a low busbar frequency.

The trip of NEL groups function is implemented in *each* DGU. This means that each DGU executes the trip of NEL groups according to individual settings. But it is *highly* recommended to program all DGUs with identical settings in order to obtain a uniform operation.

Each DGU is able to trip NEL groups due to

- the measured load of the diesel/shaft generator set

and

- the measured frequency at the busbar/SG busbar

The groups are tripped as individual load groups. This means that the trip of load group no. 1 has no direct influence on the trip of load group no. 2 etc. *Only* the measurement of either the busbar frequency or the load on the diesel/shaft generator set is able to trip the load groups.

Trip of the non-essential load groups is controlled via the following hardware interface.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• U_{GEN}	3-phase voltage input from the diesel/shaft generator	(SCM)
• I_{GEN}	3-phase current input from the diesel/shaft generator current transformers	(SCM)
• TRIP OF NEL 1	Relay output	(IOM 4.1)
• TRIP OF NEL 2	Relay output	(IOM 4.1)

The outputs for trip of NEL on all DGUs should be connected in parallel (all NEL 1 connected in parallel and all NEL 2 connected in parallel etc.).

Trip of NEL groups due to high load

Trip of the NEL groups due to the load of a running diesel/shaft generator set will reduce the load on the busbar and thus reduce the load percentage on the running diesel/shaft generator set. This may prevent a possible blackout at the busbar caused by an overload on the running diesel/shaft generator.

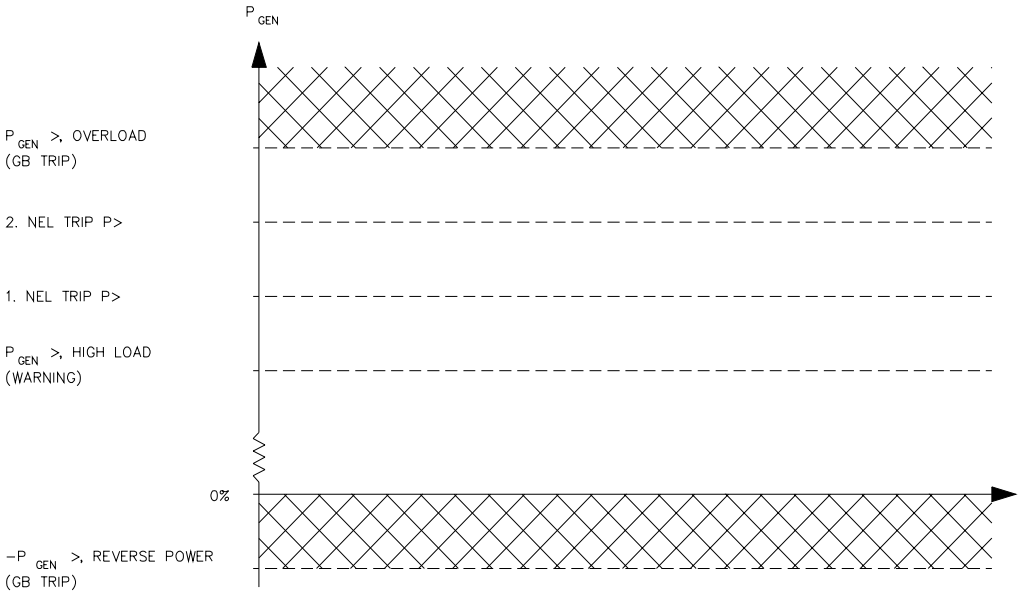
Furthermore, both steps of NEL groups are tripped at the same time by the DGU, if the corresponding diesel/shaft generator breaker is tripped.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Programming trip of NEL groups due to high load, VTA-DGPNEL(n)Trip

The operator is able to adjust the VTA structure, by which the trip of NEL groups due to high load at the diesel/shaft generator is controlled. If one of the NEL groups is tripped due to high load, an alarm message is displayed at the DU (DGU which has tripped the NEL group).

The Operator is given the possibility to choose between trip of NEL due to High Load and High Current.



A suggestion on how to achieve selectivity between the real power protective functions with trip of 2 NEL groups

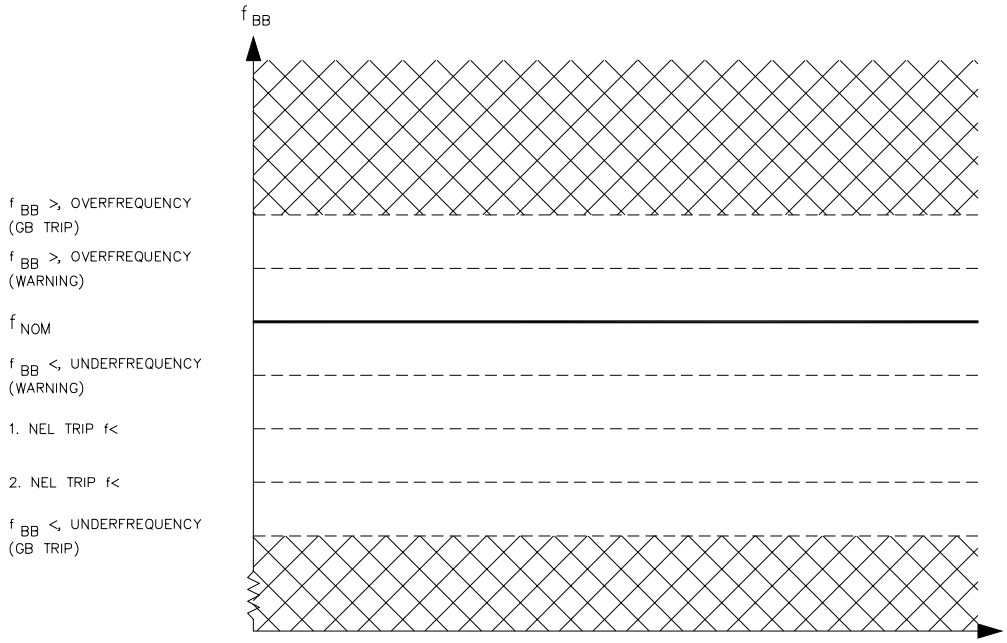
Trip of NEL groups due to low busbar frequency

Trip of the NEL groups due to a low busbar frequency will reduce the real power load at the busbar and thus reduce the load percentage on all the running diesel/shaft generator sets. This may prevent a possible blackout at the busbar.

Please refer to technical manual part 1, paragraph 4 for a detailed description of the VTA structure.

Programming trip of NEL groups due to low frequency, VTA-DGfNEL(n)Trip

The operator is able to adjust the VTA structure, by which the trip of NEL groups due to low frequency at the diesel/shaft generator is controlled. If one of the NEL groups is tripped due to low frequency, an alarm message is displayed at the DU (DGU which has tripped the NEL group).



A suggestion on how to achieve value selectivity between the frequency protective functions with trip of 2 NEL groups