## PREFACE

This document is a brief description of the 5 basic Delomatic Power Management Systems for marine plants. Each basic system can easily be extended with 7 optional add-on functions.

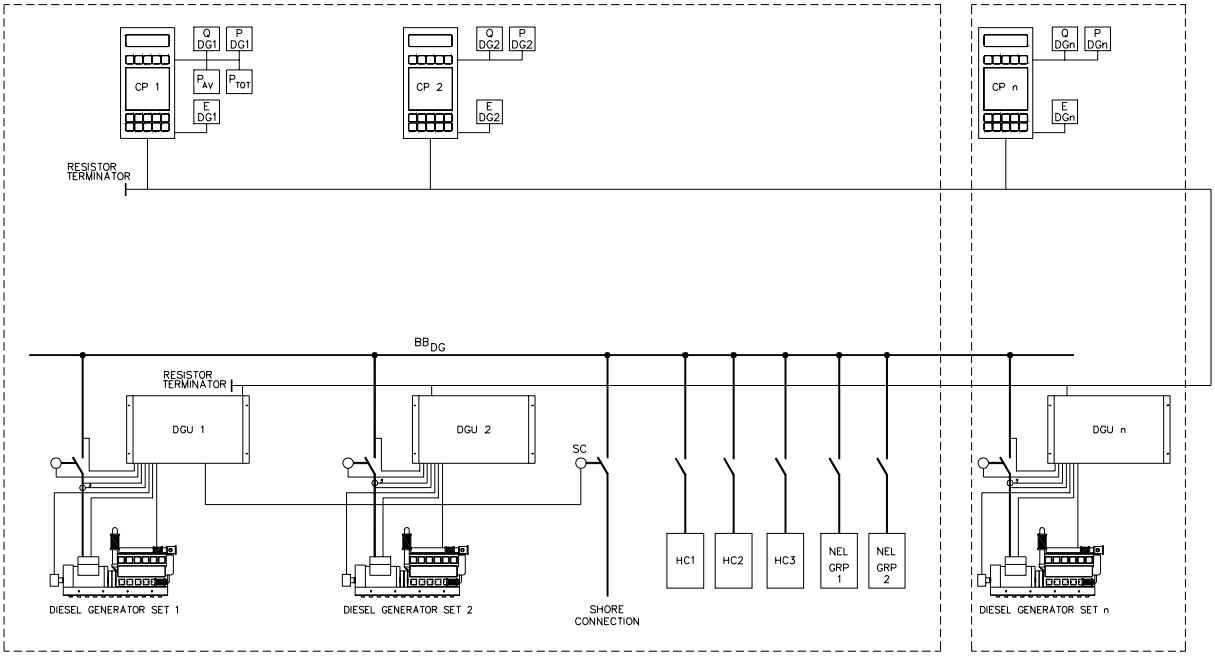
Each basic system works as a complete system but can also be used as a platform for more complex applications containing more bus tie breakers, special heavy consumers and/or a customer's specific running modes etc.

If you cannot find a technical solution to your application please send your inquiry and we will prepare a technical solution.

## CONTENT

## I Delomatic system for 2 diesel gen-sets (DG1 + DG2) incl. supervision of shore connection breaker

configuration according to the below principle block diagram




**The system is inclusive of the following common and gen-set functions:**

**Common functions (total plant)**

- Plant modes: - SEMI-AUTO
  - AUTOMATIC
  - SECURED

- User-programmable start priority

- Automatically start priority control with regards to running hours

- Load dependent start/stop function incl.:
  - transmission of PMS start/stop commands
  - safety start of stand-by generator sets due to expected stop of a running generator set
  - transfer of PMS start command in case of failed engagement of the generator set

- Common black-out detection and subsequently black-out start of two generator sets

- Load sharing:
  - symmetrical load sharing
  - asymmetrical load sharing

- Conditional connection of 3 heavy consumers with fixed or variable load

- Supervision of the shore connection position

**Gen-set functions (for each gen-set)**

- Internal system supervision comprising:
  - I/O error; supervision of hardware configuration
  - breaker position feedback supervision
  - supervision of ARC-network communication
  - supervision of the power supply
  - cable supervision

- Selection of local control for each generator set
  - *PMS control*; the generator set is included in the PMS functions
  - *SWBD control*, the generator set is excluded from all automatic functions and can only be controlled manually (protection functions are still active)

- Automatically start sequence
  - programmable start prepare output
  - programmable number of start attempts
  - programmable pause stop during the start sequence
  - programmable priming output

- Automatically stop sequence
  - programmable cooling down time
  - programmable stop time

- GB ON sequence; dynamical synchronization of the generator set to the busbar
  - programmable dynamical synchronization parameters (concerning voltage and frequency)
  - supervision of positive sequential order of phase before synchronization
  - supervision of generator voltage and frequency before synchronization
  - programmable closing time for the breaker

- GB OFF sequence:
  - deloading the generator set before opening the generator breaker

- Generator set load control
  - load share supervision

- Generator protection:
  - supervision of generator voltage and frequency
  - over-current, I> (two step protection)
  - overload, P> (both protection and supervision)
  - reverse power, -P> (protection)

- Busbar supervision and protection:
  - undervoltage, $U_{BB}$< (both protection and supervision)
  - overvoltage, $U_{BB}$> (both protection and supervision)
  - under-frequency, $f_{BB}$< (both protection and supervision)
  - over-frequency, $f_{BB}$> (both protection and supervision)

- 5 different alarm sequences
  - DG warning (only information for operator)
  - DG blocked (inhibit of automatic functions of the DG)
  - Safety stop (expected stop when DG has been replaced by another unit)

  - Trip of the generator breaker (immediately opening of CB)
  - Shutdown of entire gen-set
  -
- Trip of two non-essential loads groups in case of:
  - trip of the generator breaker
  - high load at the generator set
  - low frequency at the busbar

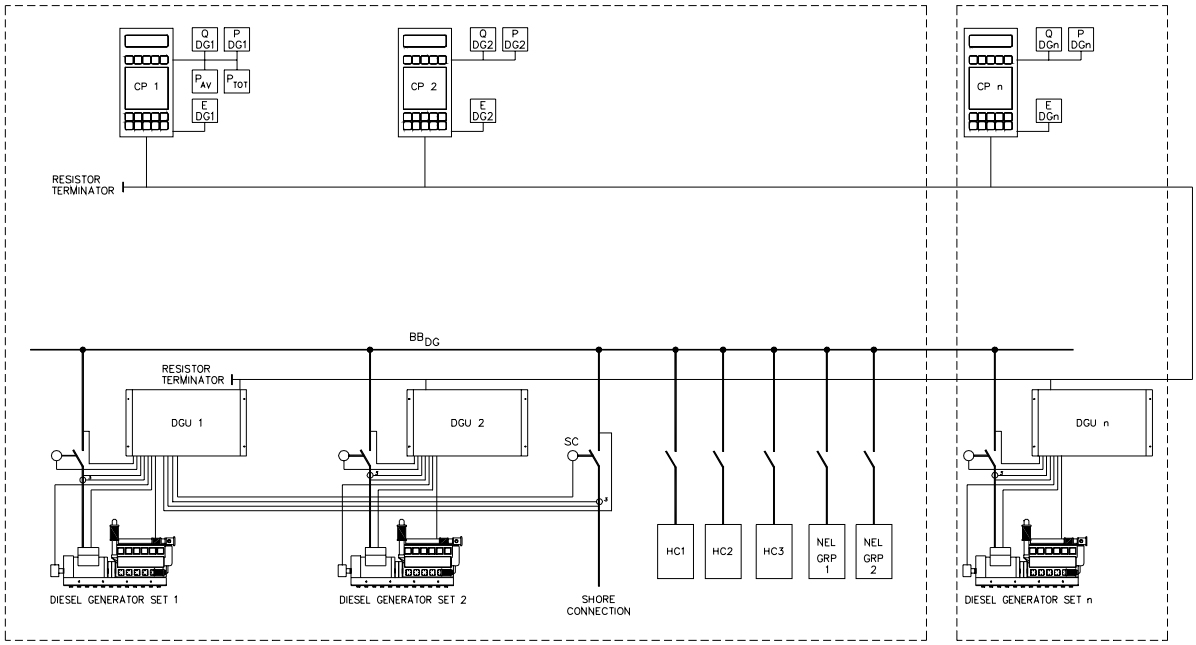
- User setup of all relevant parameters of the DG and the entire plant from the control panel
- User scalable instrument outputs from the control panel
- Cable supervision for digital and analogue inputs
- Alarm test function of all implemented alarms
- "Test mode" function indicates when a timer is running.
- Operator programmable binary alarm input function (machine interface):
  - programmable selection of designated alarm sequence
  - programmable alarm delay
  - programmable status for alarm detection
  - programmable connection to the alarm inhibit function
- Relay- or Analogue output for the speed governor
- Running hour indication on display of the Control Panel
- Indication of rpm on the Control Panel in case of analogue running feedback

***User's Manual Part 1 of 2 "BASIC 01" (DG1 + DG2)***

| Chapter No. | Description | Document No. |
|---|---|---|
| **1.** | Introduction In The Present System | 4189230101 |
| **2.** | The Present Power Management | 4189230102 |
| **3.** | Alarm List | 4189230103 |
| **4.** | System Setup | 4189230104 |
| **5.** | I/O List | 4189230105 |
| **6.** | Fat Report | 4189230106 |
| **7.** | Present Serial Communication (STD) | 4189230107 |
| **8.** | The Present Menu System | 4189230108 |
| **9.** | - | - |
| **10.** | - | - |

## II Delomatic system for 2 diesel gen-sets (DG1+DG2+SC) incl. sync. of shore connection breaker

configuration according to the below principle block diagram




**The system is inclusive of the following common and gen-set functions:**

**Common functions (total plant)**

- Plant modes:
  - SEMI-AUTO
  - AUTOMATIC
  - SECURED
  - SHORE
- User-programmable start priority
- Automatically start priority control with regards to running hours
- Load dependent start/stop function incl.:
  - transmission of PMS start/stop commands
  - safety start of stand-by generator sets due to expected stop of a running
  - generator set
  - transfer of PMS start command in case of failed engagement of the generator set
- Common black-out detection and subsequently black-out start of two generator sets
- Load sharing
  - symmetrical load sharing
  - asymmetrical load sharing

- Conditional connection of 2 heavy consumers with fixed or variable load

- Control and supervision of a shore connection offering:
  - dynamical synchronization of shore connection breaker
  - load transfer from diesel generator set(s) to the shore connection and back
  - shore connection protection
  - supervision of shore busbar

**"Gen-set" functions**

- Internal system supervision comprising:
  - I/O error; supervision of hardware configuration
  - breaker position feedback supervision
  - supervision of ARC-network communication
  - supervision of the power supply
  - cable supervision

- Selection of local control for each generator set
  - *PMS control*; the generator set is included in the PMS functions
  - *SWBD control*, the generator set is excluded from all automatic functions and can only be controlled manually (protection functions are still active)

- Automatically start sequence
  - programmable start prepare output
  - programmable number of start attempts
  - programmable pause stop during the start sequence
  - programmable priming output

- Automatically stop sequence
  - programmable cooling down time
  - programmable stop time

- GB ON sequence; dynamical synchronization of the generator set to the busbar
  - programmable dynamical synchronization parameters (concerning voltage and
  - frequency)
  - supervision of positive sequential order of phase before synchronization
  - supervision of generator voltage and frequency before synchronization
  - programmable closing time for the breaker

- GB OFF sequence:
  - deloading the generator set before opening the generator breaker

- Generator set load control
  - load share supervision

- Generator protection:
  - supervision of generator voltage and frequency
  - over-current, I> (two step protection)
  - overload, P> (both protection and supervision)
  - reverse power, -P> (protection)
- Busbar supervision and protection:

  - undervoltage, $U_{BB}$< (both protection and supervision)
  - overvoltage, $U_{BB}$> (both protection and supervision)
  - under-frequency, $f_{BB}$< (both protection and supervision)
  - over-frequency, $f_{BB}$> (both protection and supervision)

- 8 different alarm sequences
  - DG warning (only information for operator)
  - DG blocked (inhibit of automatic functions of the DG)
  - Safety stop (expected stop when DG has been replaced by another unit)
  - Trip of the generator breaker (immediately opening of CB)
  - Shutdown of entire gen-set
  - SC warning (only information for operator)
  - SC blocked (inhibit of automatic functions of the SC)
  - Trip of the shore connection breaker (immediately opening of CB)

- Trip of two non-essential loads groups in case of:
  - trip of the generator breaker
  - high load at the generator set
  - low frequency at the busbar

- User setup of all relevant parameters of the DG, SG and the entire plant from the control panel

- User scalable instrument outputs from the control panel

- Cable supervision for digital and analogue inputs

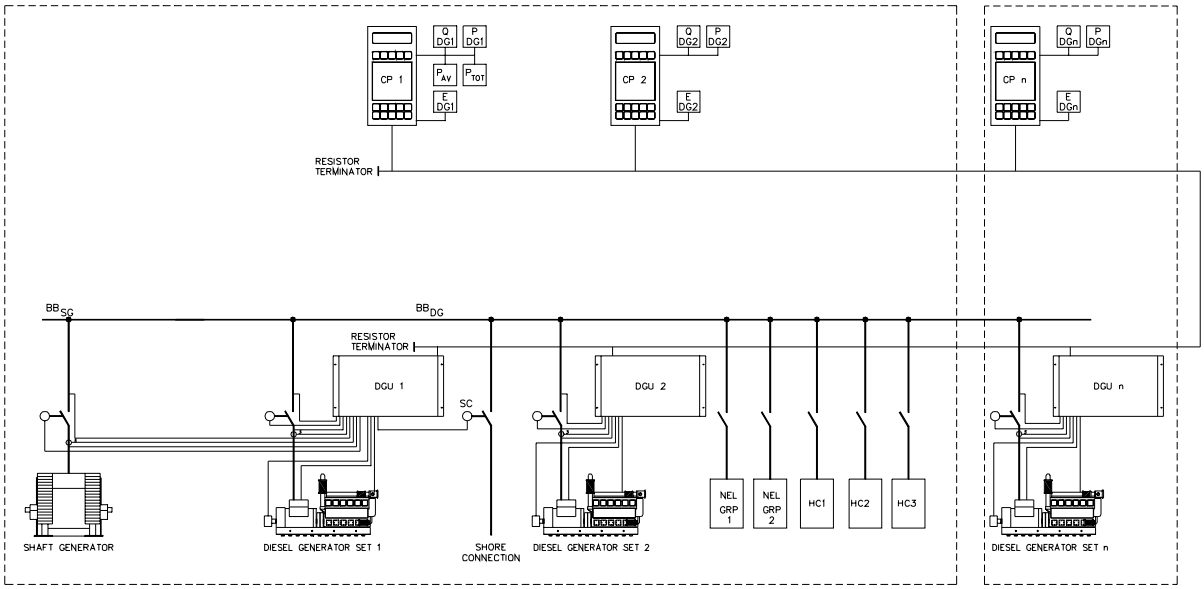
- Alarm test function of all implemented alarms
- "Test mode" function indicates when a timer is running
- Operator programmable binary alarm input function (machine interface):
  - programmable selection of designated alarm sequence
  - programmable alarm delay
  - programmable status for alarm detection
  - programmable connection to the alarm inhibit function
- Relay- or Analogue output for the speed governor
- Running hour indication on display of the Control Panel
- Indication of rpm on the Control Panel in case of analogue running feedback

**User's Manual Part 1 of 2 "Basic 02" (DG1 + DG2 + SC)**

| Chapter No. | Description | Document No. |
|---|---|---|
| 1. | Introduction In The Present System | 4189230201 |
| 2. | The Present Power Management | 4189230202 |
| 3. | Alarm List | 4189230203 |
| 4. | System Setup | 4189230204 |
| 5. | I/O List | 4189230205 |
| 6. | Fat Report | 4189230206 |
| 7. | Present Serial Communication (STD) | 4189230207 |
| 8. | The Present Menu System | 4189230208 |
| 9. | - | - |
| 10. | - | - |

## III Delomatic system for 2 diesel gen-sets and 1 shaft generator (DG1+DG2+SG) Incl. supervision of shore connection breaker

configuration according to the below block diagram




**The system is inclusive of the following common and gen-set functions:**

### Common functions (total plant)

- Plant modes:
  - SEMI-AUTO
  - AUTOMATIC
  - SECURED
  - SG
- User-programmable start priority
- Automatically start priority control with regards to running hours
- Load dependent start/stop function incl.:
  - transmission of PMS start/stop commands
  - safety start of stand-by generator sets due to expected stop of a running generator set
- Common black-out detection and subsequently black-out start of two generator sets
- Load sharing:
  - symmetrical load sharing
  - asymmetrical load sharing
- Conditional connection of 3 heavy consumers with fixed or variable load
- Supervision of the shore connection position

- Control and supervision of a shaft generator offering:
  - dynamical synchronization of shaft generator breaker
  - load transfer from diesel generator set(s) to the shaft generator(s) and back
  - shaft generator protection
  - supervision of shaft generator busbar
  - trip of non-essential load groups due to the shaft generator conditions

**"Gen-set" functions**

- Internal system supervision comprising:
  - I/O error; supervision of hardware configuration
  - breaker position feedback supervision
  - supervision of ARC-network communication
  - supervision of the power supply
  - cable supervision

- Selection of local control for each generator set
  - *PMS control*; the generator set is included in the PMS functions
  - *SWBD control*, the generator set is excluded from all automatic functions and can only be controlled manually (protection functions are still active)

- Automatically start sequence
  - programmable start prepare output
  - programmable number of start attempts
  - programmable pause stop during the start sequence
  - programmable priming output

- Automatically stop sequence
  - programmable cooling down time
  - programmable stop time

- GB ON sequence; dynamical synchronization of the generator set to the busbar
  - programmable dynamical synchronization parameters (concerning voltage and
  - frequency)
  - supervision of positive sequential order of phase before synchronization
  - supervision of generator voltage and frequency before synchronization
  - programmable closing time for the breaker

- GB OFF sequence:
  - deloading the generator set before opening the generator breaker

- Generator set load control
  - load share supervision

- Generator protection:
  - supervision of generator voltage and frequency
  - over-current, I> (two step protection)
  - overload, P> (both protection and supervision)
  - reverse power, -P> (protection)

- Busbar supervision and protection:
  - undervoltage, $U_{BB}$< (both protection and supervision)
  - overvoltage, $U_{BB}$> (both protection and supervision)
  - under-frequency, $f_{BB}$< (both protection and supervision)
  - over-frequency, $f_{BB}$> (both protection and supervision)

- 8 different alarm sequences
  - DG warning (only information for operator)
  - DG blocked (inhibit of automatic functions of the DG)
  - Safety stop (expected stop when DG has been replaced by another unit)
  - Trip of the generator breaker (immediately opening of CB)
  - Shutdown of entire gen-set
  - SG warning (only information for operator)
  - SG blocked (inhibit of automatic functions of the SG)
  - Trip of the shaft generator breaker (immediately opening of CB)

- Trip of two non-essential loads groups in case of:
  - trip of the generator breaker
  - high load at the generator set
  - low frequency at the busbar

- User setup of all relevant parameters of the DG, SG and the entire plant from the control panel

- User scalable instrument outputs from the control panel
- Cable supervision for digital and analogue inputs
- Alarm test function of all implemented alarms
- “Test mode” function indicates when a timer is running
- Operator programmable binary alarm input function (machine interface):
  - programmable selection of designated alarm sequence
  - programmable alarm delay
  - programmable status for alarm detection
  - programmable connection to the alarm inhibit function

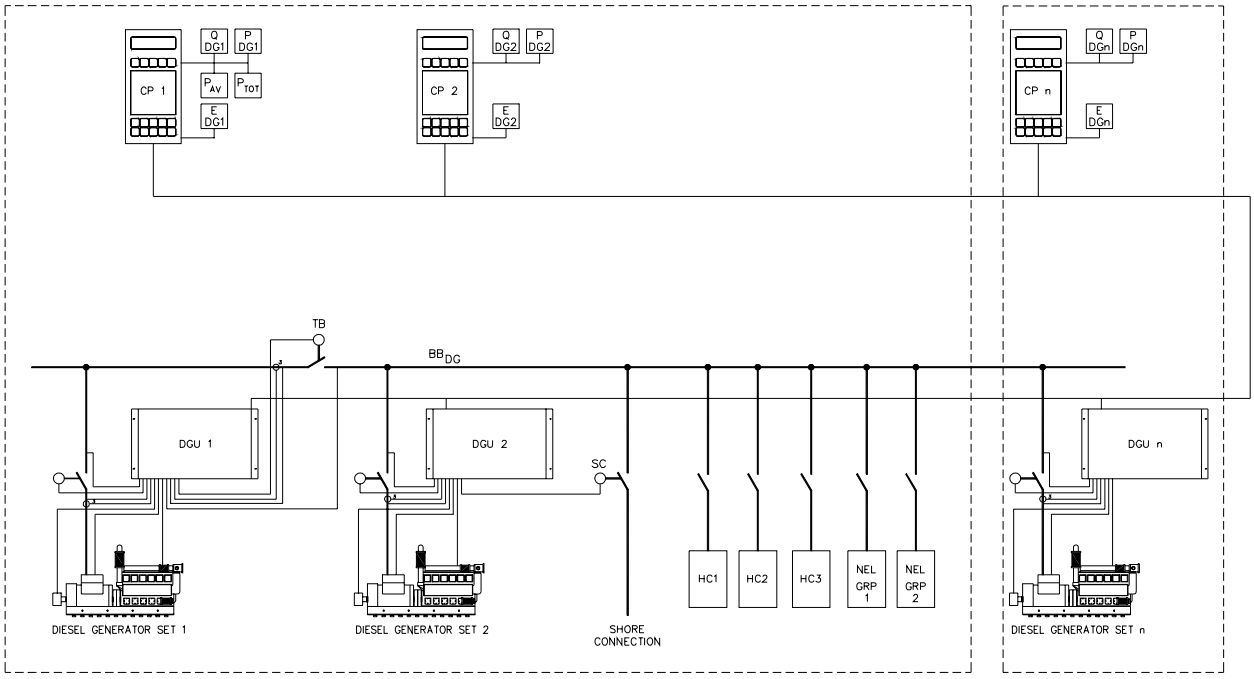
- Relay- or Analogue output for the speed governor
- Running hour indication on display of the Control Panel
- Indication of rpm on the Control Panel in case of analogue running feedback

**User’s Manual Part 1 of 2 ”Basic 03” (DG1 + DG2 + SG)**

| Chapter No. | Description | Document No. |
|---|---|---|
| 1. | Introduction In The Present System | 4189230301 |
| 2. | The Present Power Management | 4189230302 |
| 3. | Alarm List | 4189230303 |
| 4. | System Setup | 4189230304 |
| 5. | I/O List | 4189230305 |
| 6. | Fat Report | 4189230306 |
| 7. | Present Serial Communication (STD) | 4189230307 |
| 8. | The Present Menu System | 4189230308 |
| 9. | - | - |
| 10. | - | - |

## IV Delomatic system for 2 diesel gen-sets (DG1+DG2+TB) incl. sync of tie breaker and supervision of shore connection breaker

configuration according to the below principle block diagram




**The system is inclusive of the following common and gen-set functions:**

**Common functions (total plant)**

- Plant modes: - SEMI-AUTO
  - AUTOMATIC
  - SECURED
- User-programmable start priority
- Automatically start priority control with regards to running hours
- Load dependent start/stop function incl.:
  - transmission of PMS start/stop commands
  - safety start of stand-by generator sets due to expected stop of a running generator set
- Common black-out detection and subsequently black-out start of two generator sets *(with split busbar, black-out start on each side)*
- Load sharing:
  - symmetrical load sharing
  - asymmetrical load sharing

- Conditional connection of 3 heavy consumers with fixed or variable load
- Supervision of the shore connection position
- Control and supervision of bus tie breaker offering:
  - dynamical synchronization of bus tie breaker
  - tie breaker protection
  - supervision of both sides of the tie breaker busbar

**"Gen-set" functions**

- Internal system supervision comprising:
  - I/O error; supervision of hardware configuration
  - breaker position feedback supervision
  - supervision of ARC-network communication
  - supervision of the power supply
  - cable supervision
- Selection of local control for each generator set
  - *PMS control*; the generator set is included in the PMS functions
  - *SWBD control*, the generator set is excluded from all automatic functions and can only be controlled manually (protection functions are still active)
- Automatically start sequence
  - programmable start prepare output
  - programmable number of start attempts
  - programmable pause stop during the start sequence
  - programmable priming output
- Automatically stop sequence
  - programmable cooling down time
  - programmable stop time
- GB ON sequence; dynamical synchronization of the generator set to the busbar
  - programmable dynamical synchronization parameters (concerning voltage and frequency)
  - supervision of positive sequential order of phase before synchronization
  - supervision of generator voltage and frequency before synchronization
  - programmable closing time for the breaker
- GB OFF sequence:
  - deloading the generator set before opening the generator breaker
- Generator set load control
  - load share supervision
- Generator protection:
  - supervision of generator voltage and frequency
  - over-current, I> (two step protection)
  - overload, P> (both protection and supervision)
  - reverse power, -P> (protection)

- Busbar supervision and protection:
  - undervoltage, $U_{BB}$< (both protection and supervision)
  - overvoltage, $U_{BB}$> (both protection and supervision)
  - under-frequency, $f_{BB}$< (both protection and supervision)
  - over-frequency, $f_{BB}$> (both protection and supervision)
- 8 different alarm sequences
  - DG warning (only information for operator)
  - DG blocked (inhibit of automatic functions of the DG)
  - Safety stop (expected stop when DG has been replaced by another unit)
  - Trip of the generator breaker (immediately opening of CB)
  - Shutdown of entire gen-set
  - TB warning (only information for operator)
  - TB blocked (inhibit of automatic functions of the TB)
  - Trip of the bus tie breaker (immediately opening of TB)

- Trip of two non-essential loads groups in case of:
  - trip of the generator breaker
  - high load at the generator set
  - low frequency at the busbar

- User setup of all relevant parameters of the DG, SG and the entire plant from the control panel

- User scalable instrument outputs from the control panel
- Cable supervision for digital and analogue inputs
- Alarm test function of all implemented alarms
- “Test mode” function indicates when a timer is running

- Operator programmable binary alarm input function (machine interface):
  - programmable selection of designated alarm sequence
  - programmable alarm delay
  - programmable status for alarm detection
  - programmable connection to the alarm inhibit function

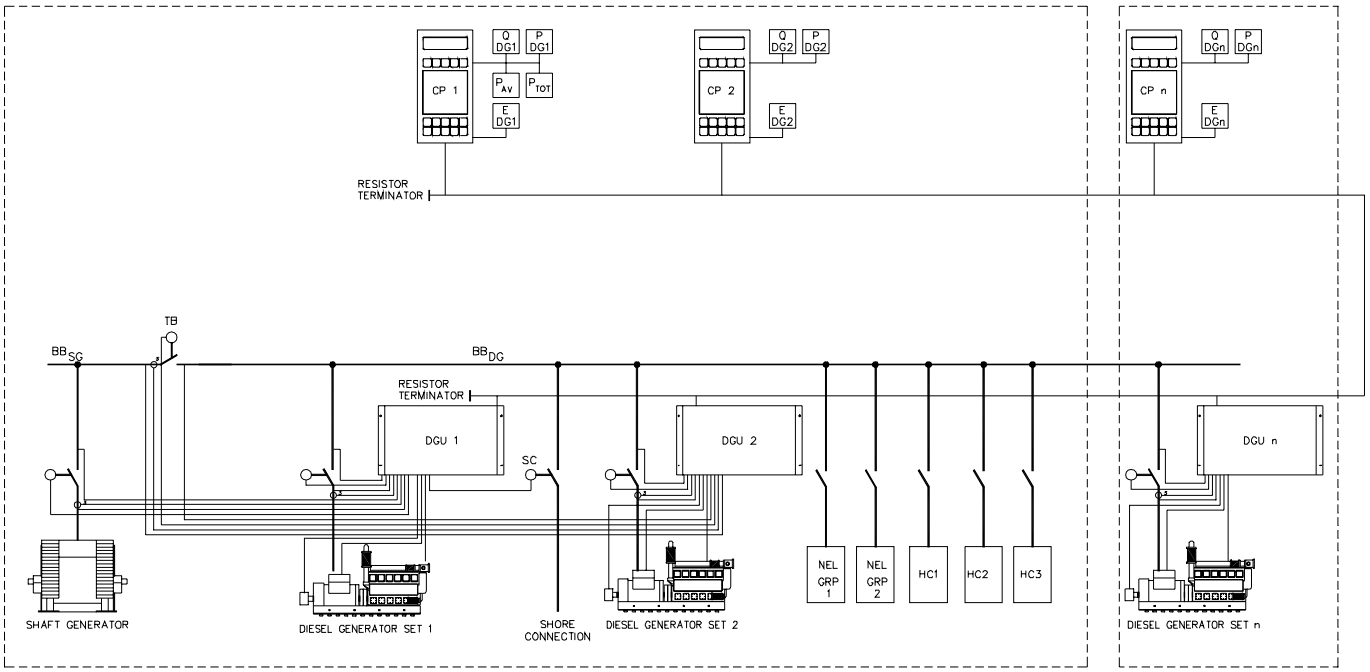
- Relay- or Analogue output for the speed governor
- Running hour indication on display of the Control Panel
- Indication of rpm on the Control Panel in case of analogue running feedback

**User’s Manual Part 1 of 2 ”Basic 04” (DG1 + DG2 + TB)**

| Chapter No. | Description | Document No. |
|---|---|---|
| 1. | Introduction In The Present System | 4189230401 |
| 2. | The Present Power Management | 4189230402 |
| 3. | Alarm List | 4189230403 |
| 4. | System Setup | 4189230404 |
| 5. | I/O List | 4189230405 |
| 6. | Fat Report | 4189230406 |
| 7. | Present Serial Communication (STD) | 4189230407 |
| 8. | The Present Menu System | 4189230408 |
| 9. | - | - |
| 10. | - | - |

## VII Delomatic system for 2 diesel gen-sets (DG1+DG2+SG+TB) incl. sync of tie breaker and supervision of shore connection breaker

configuration according to the below principle block diagram




**The system is inclusive of the following common and gen-set functions:**

**Common functions (total plant)**

- Plant modes:
  - SEMI-AUTO
  - AUTOMATIC
  - SPLIT BUSBAR
  - SG

  *NOTE ! It is only possible to select SPLIT BUSBAR or SG (Shaft Generator) mode when the shaft generator is selected to be in PMS control and AUTO mode.*

- User-programmable start priority
- Automatically start priority control with regards to running hours
- Load dependent start/stop function incl.:
  - transmission of PMS start/stop commands
  - safety start of stand-by generator sets due to expected stop of a running generator set
- Common black-out detection and subsequently black-out start of two generator sets

- Load sharing:
  - symmetrical load sharing
  - asymmetrical load sharing

- Conditional connection of 3 heavy consumers with fixed or variable load

- Supervision of the shore connection position

- Control and supervision of a shaft generator offering:
  - dynamical synchronization of shaft generator breaker
  - load transfer from diesel generator set(s) to the shaft generator(s) and back
  - shaft generator protection
  - supervision of shaft generator busbar
  - trip of non-essential load groups due to the shaft generator conditions

- Control and supervision of bus tie breaker offering:
  - dynamical synchronization of bus tie breaker
  - tie breaker protection
  - supervision of both sides of the tie breaker busbar

**"Gen-set" functions**

- Internal system supervision comprising:
  - I/O error; supervision of hardware configuration
  - breaker position feedback supervision
  - supervision of ARC-network communication
  - supervision of the power supply
  - cable supervision

- Selection of local control for each generator set
  - *PMS control*; the generator set is included in the PMS functions
  - *SWBD control*, the generator set is excluded from all automatic functions and can only be controlled manually (protection functions are still active)

- Automatically start sequence
  - programmable start prepare output
  - programmable number of start attempts
  - programmable pause stop during the start sequence
  - programmable priming output

- Automatically stop sequence
  - programmable cooling down time
  - programmable stop time

- GB ON sequence; dynamical synchronization of the generator set to the busbar
  - programmable dynamical synchronization parameters (concerning voltage and frequency)
  - supervision of positive sequential order of phase before synchronization
  - supervision of generator voltage and frequency before synchronization
  - programmable closing time for the breaker

- GB OFF sequence:

- deloading the generator set before opening the generator breaker

- Generator set load control
  - load share supervision

- Generator protection:
  - supervision of generator voltage and frequency
  - over-current, I> (two step protection)
  - overload, P> (both protection and supervision)
  - reverse power, -P> (protection)

- Busbar supervision and protection:
  - undervoltage, $U_{BB}$< (both protection and supervision)
  - overvoltage, $U_{BB}$> (both protection and supervision)
  - under-frequency, $f_{BB}$< (both protection and supervision)
  - over-frequency, $f_{BB}$> (both protection and supervision)

- 11 different alarm sequences
  - DG warning (only information for operator)
  - DG blocked (inhibit of automatic functions of the DG)
  - Safety stop (expected stop when DG has been replaced by another unit)
  - Trip of the generator breaker (immediately opening of CB)
  - Shutdown of entire gen-set
  - TB warning (only information for operator)
  - TB blocked (inhibit of automatic functions of the TB)
  - Trip of the bus tie breaker (immediately opening of TB)
  - SG warning (only information for operator)
  - SG blocked (inhibit of automatic functions of the SG)
  - Trip of the shaft generator breaker (immediately opening of CB)

- Trip of two non-essential loads groups in case of:
  - trip of the generator breaker
  - high load at the generator set
  - low frequency at the busbar

- User setup of all relevant parameters of the DG, SG and the entire plant from the control panel

- User scalable instrument outputs from the control panel
- Cable supervision for digital and analogue inputs
- Alarm test function of all implemented alarms
- “Test mode” function indicates when a timer is running

- Operator programmable binary alarm input function (machine interface):
  - programmable selection of designated alarm sequence
  - programmable alarm delay
  - programmable status for alarm detection
  - programmable connection to the alarm inhibit function

- Relay- or Analogue output for the speedgovernor
- Running hour indication on display of the Control Panel
- Indication of rpm on the Control Panel in case of analogue running feedback

**User's Manual Part 1 of 2 "Basic 07" (DG1 + DG2 + SG + TB)**

| Chapter No. | Description | Document No. |
|---|---|---|
| 1. | Introduction In The Present System | 4189230701 |
| 2. | The Present Power Management | 4189230702 |
| 3. | Alarm List | 4189230703 |
| 4. | System Setup | 4189230704 |
| 5. | I/O List | 4189230705 |
| 6. | Fat Report | 4189230706 |
| 7. | Present Serial Communication (STD) | 4189230707 |
| 8. | The Present Menu System | 4189230708 |
| 9. | - | - |
| 10. | - | - |

## Optional ADD-ON functions

**1** **Delomatic system for 1 additional diesel gen-set (DGn)**
inclusive of all common and gen-set functions described in the basic system.
Max. 8 DGs (DGUs) totally in one system.

**2** **External communication (1 per plant)**
"The Delomatic system operates indepently but may easily work in conjunction with an alarm, monitoring and control system connected through a bi-directional serial interface RS485 (modbus) providing access to:

- system control commands
- set-points and timers
- measure and calculated values
- system status
- ”alarm status"

**3** **Additional control panel (CP)**
Extra control panels, CPn, for example to be installed on the bridge or in the control desk.
Max. 3 control panels can be installed for each diesel gen-set.

**4** **Short-circuit protection**
Short circuit protection (I>>) by
one current relay module, CRM-1, to be mounted in the relevant DGU.

**5** **Differential protection (non compensated)**
Differential protection by (Id>) by
one current relay module, CRM-1, diff, to be installed in the relevant DGU.

**6** **Analogue outputs**
Analogue outputs (current or voltage with or without offset) for measured data by
one1 analogue output module, AOM-1, to be installed in the relevant DGU.

**7** **Additional 3 heavy consumers**
Conditional and sequential connection of 1…3 additional heavy consumers (HC4…HC6) with constant or variable power consumption.

## Additional Documentation

### User's Manual Part 2 of 2 "Generel Description"

| Chapter No. | Description | Document No. |
|---|---|---|
| 11. | Generel Introduction | 4189230111 |
| 12. | - | - |
| 13. | Alarm Handling | 4189230113 |
| 14. | - | - |
| 15. | The Generel Menu System | 4189230115 |
| 16. | Power Management Unit | 4189230116 |
| 17. | Generator Set Control | 4189230117 |
| 18. | Generator Set Protection | 4189230118 |
| 19. | Shaft Generator | 4189230119 |
| 20. | Shore Connection | 4189230120 |
| 21. | Tie Breaker | 4189230121 |
| 22. | Generel Serial Communication (STD) | 4189230122 |
| 23. | Service Guide | 4189230123 |
| 24. | MODBUS Communication | 4189230124 |
| 25. | Installation Instruction | 4189230125 |
| 26. | - | - |
| 27. | Commissioning Guide | 4189230127 |
| 28. | - | - |
| 29. | Data Sheets | 4189230129 |
| 30. | - | - |