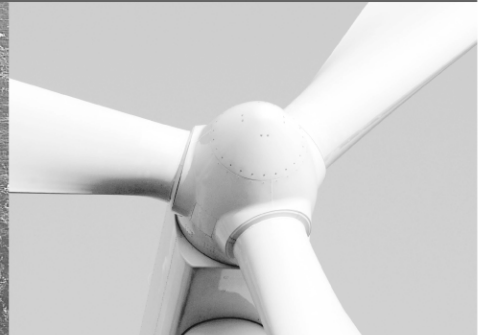




-power in control



APPLICATION NOTES



DELOMATIC 400

Safety system



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Table of contents

1. ABOUT THIS DOCUMENT	3
GENERAL PURPOSE.....	3
INTENDED USERS	3
CONTENTS/OVERALL STRUCTURE.....	3
2. WARNINGS AND LEGAL INFORMATION.....	4
LEGAL INFORMATION AND RESPONSIBILITY.....	4
ELECTROSTATIC DISCHARGE AWARENESS	4
SAFETY ISSUES	4
DEFINITIONS	4
3. GENERAL OVERVIEW	5
4. TERMINAL LAYOUTS	6
5. WIRING.....	7

1. About this document

General purpose

This document contains the safety system application notes for DEIF's Delomatic 400, DM-400, used in gas engine /hydro turbine driven generator applications.

The general purpose of the application notes is to offer the designer information about the safety system functions and I/O assignment list.



Please make sure to read this application note before working with the DM-4 controller and the gen-set to be controlled. Failure to do this could result in damage to the equipment or human injury.

Intended users

The document is mainly intended for the person responsible for designing DM-400 systems. In most cases, this would be a panel builder designer. Naturally, other users might also find useful information in this document.

Contents/overall structure

The document is divided into chapters, and in order to make the structure of the document simple and easy to use, each chapter will begin from the top of a new page.

2. Warnings and legal information

Legal information and responsibility

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the generator set controlled by the unit, the company responsible for the installation or the operation of the set must be contacted.

Electrostatic discharge awareness

Sufficient care must be taken to protect the terminals against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

Safety issues

Installing the unit implies work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.



Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

Definitions

Throughout this document, a number of notes and warnings will be presented. To ensure that these are noticed, they will be highlighted in order to separate them from the general text.

Notes



The notes provide general information which will be helpful for the reader to bear in mind.

Warnings



The warnings indicate a potentially dangerous situation which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

3. General overview

3.1 Delomatic 400 safety system in general

The Delomatic 400 safety system is an integrated part of the control system, and ensures a safe shutdown of the generator set in case of critical errors and/or events.

Such events are:

- Emergency stop.
- Delomatic 400 main processor failure (watchdog system)

For shutdown alarms in general, a safety assessment is needed. If software based shutdown is considered not safe enough and if the assessment results in a situation that demands for a higher reliability of the protection, you need a second separate protection device. To make it simple you can choose a hardwired solution for those protections that act independent from the software. This is what is called the safety chain.

If the safety system is triggered and/or the safety chain opened, the generator breaker must be tripped and the prime mover stopped (for a gas engine this means closing gas solenoids and blocking of the starter).

This is achieved using a number of inputs and outputs in the Delomatic 400 rack.



The inputs and outputs used by the safety system are all fixed to their functions and cannot be used for any other purpose

Alarms that take part of the safety chain are e.g.:

- Fire alarm
- Gas alarm stage 2 (explosion hazard, for gas engines only)
- Safety temperature limiter
- Safety pressure limiter
- Overspeed

For some gas engines the overspeed is a part of the ignition system, if it triggers, the gas supply must be cut off.

4. Terminal layouts

4.1 General information

For terminal layouts not represented below, please refer to the Installation Instructions.



The terminal used in the following is DEIF standard for the safety system. This layout of terminals cannot be changed. Functions marked * are dependent on software and are not necessarily part of the safety system, but are mentioned to complete the list of IO's that cannot be assigned to other tasks

4.1.1 Terminal layout PCM 4-2 watchdog output (module #1)

Text	Term.
Watchdog relay out	3-4

4.1.2 Terminal layout SCM 4-1 (module #2)

Text	Term.
Synchro-check relay*	15
	16
Breaker trip relay	17
	18
Breaker ON feedback*	19
Breaker feedback COMMON*	20
Breaker OFF feedback*	21

The breaker trip relay is used for the breaker undervoltage coil for trip
The breaker feedbacks require dry contacts (isolated from other circuits).

4.1.3 Terminal layout IOM 4-2 (module #3)

The safety system is handled via the IOM4-2 module #3 only. Any other modules do not participate.

Digital inputs

Text	Term.
Emergency stop	24
Watchdog PCM 4-1	25
Safety chain closed	26
Common	29

Transistor (digital) outputs

Text	Term.
Supply +	34
Rearm safety chain	35
Open safety chain	36
Close GCB*	37
Trip GCB*	38
Open GCB*	39
Supply -	40

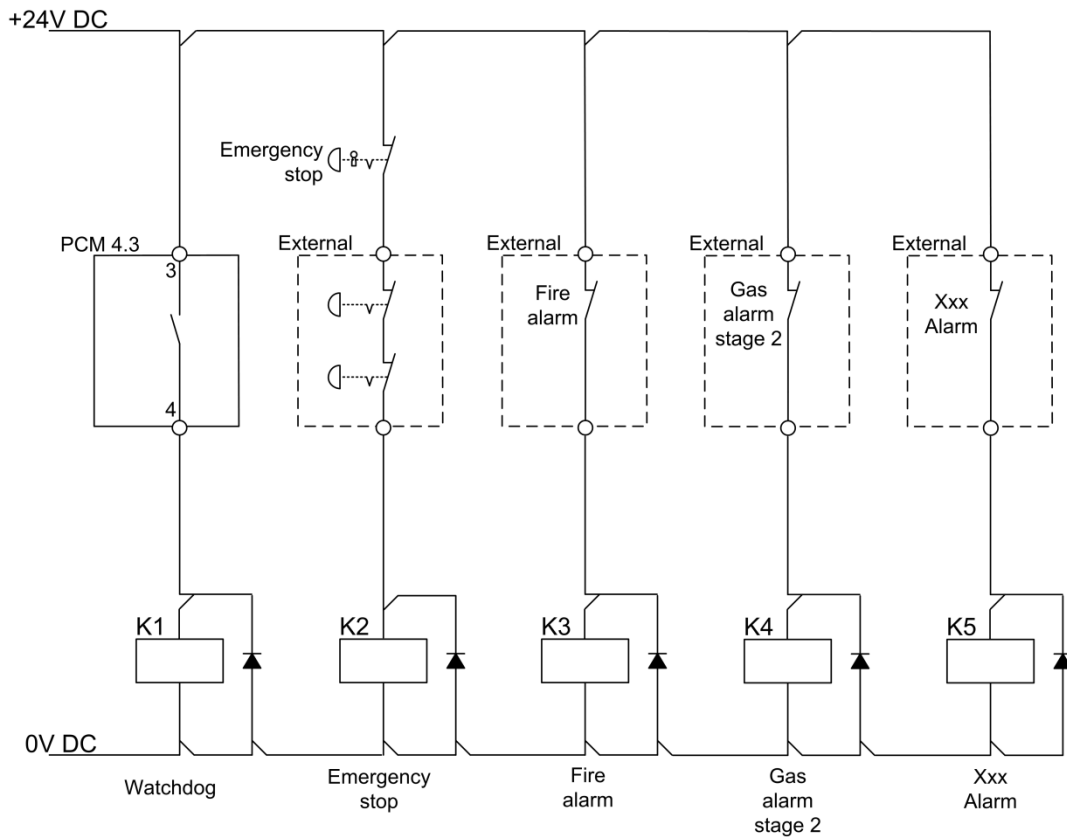
5. Wiring

5.1 PCM 4.3 watchdog/other alarms

The watchdog relay (terminals 3-4) output on PCM 4.3 module is closed under normal operation. Power loss or main processor malfunction will cause the relay to open.

Besides the alarms shown, further alarms can be added based on necessity.

For every alarm that affects the safety chain, a separate transfer relay is needed, in order not only to trip the safety chain but also to send a signal to the Delomatic 400 that this particular safety function has tripped, in order for the Delomatic 400 to be able to present the message on the user interface in clear text.

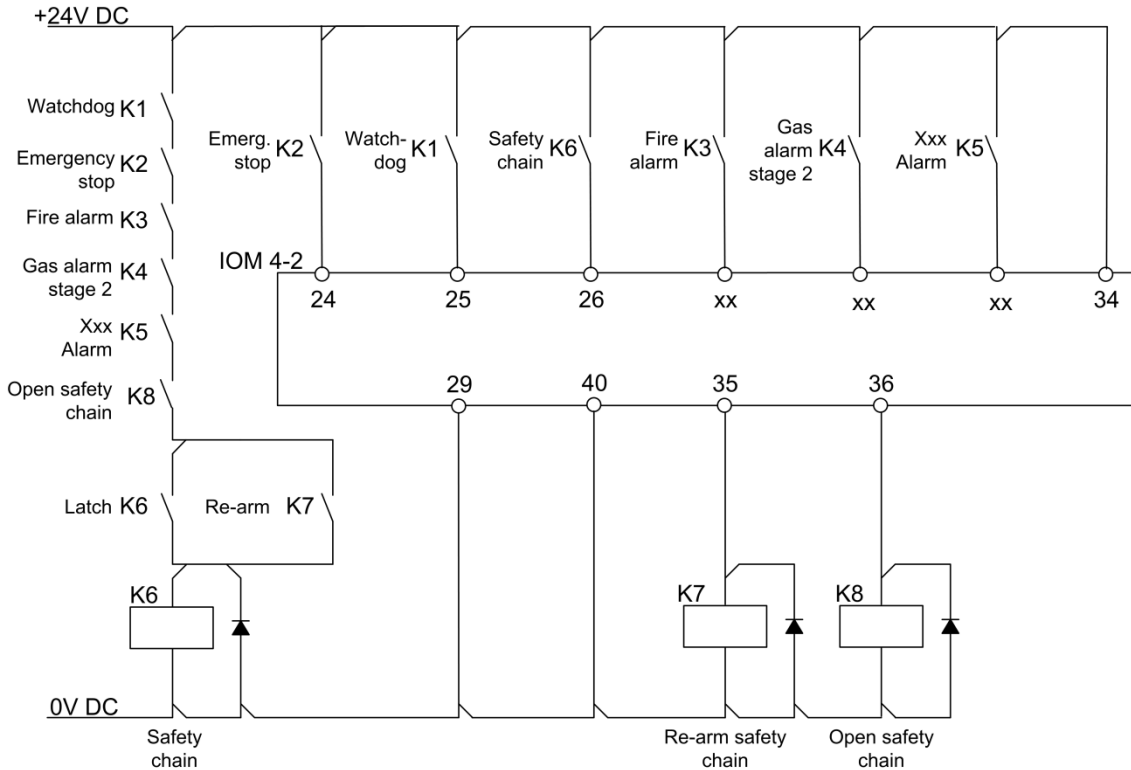


5.2 Safety chain

Below is an example of the safety chain and alarm message wiring. Please note that it is an example only, your system may have more or less alarms being a part of the safety chain.

Not shown is how to make the safety chain stop the prime mover, since it is very specific for the prime mover in question (for GAS engine: Close the gas shutoff valves and block the starter, for HYDRO: Close the turbine wicket gate/nozzles/spears as well as closing main valve/ open bypass/ activate deflector).

In the safety chain, once armed, the relay K9 will hold itself latched in the energized position until the safety chain falls (circuit opened up).



5.3 IOM 4.2 and SCM 4.1 breaker control

Although the normal closing (synchronising) and opening of the breaker does not participate in the safety chain, the features are so critical that they are included in the document.

Breaker trip is a part of the safety chain.

The breaker control is divided in to 3 functions:

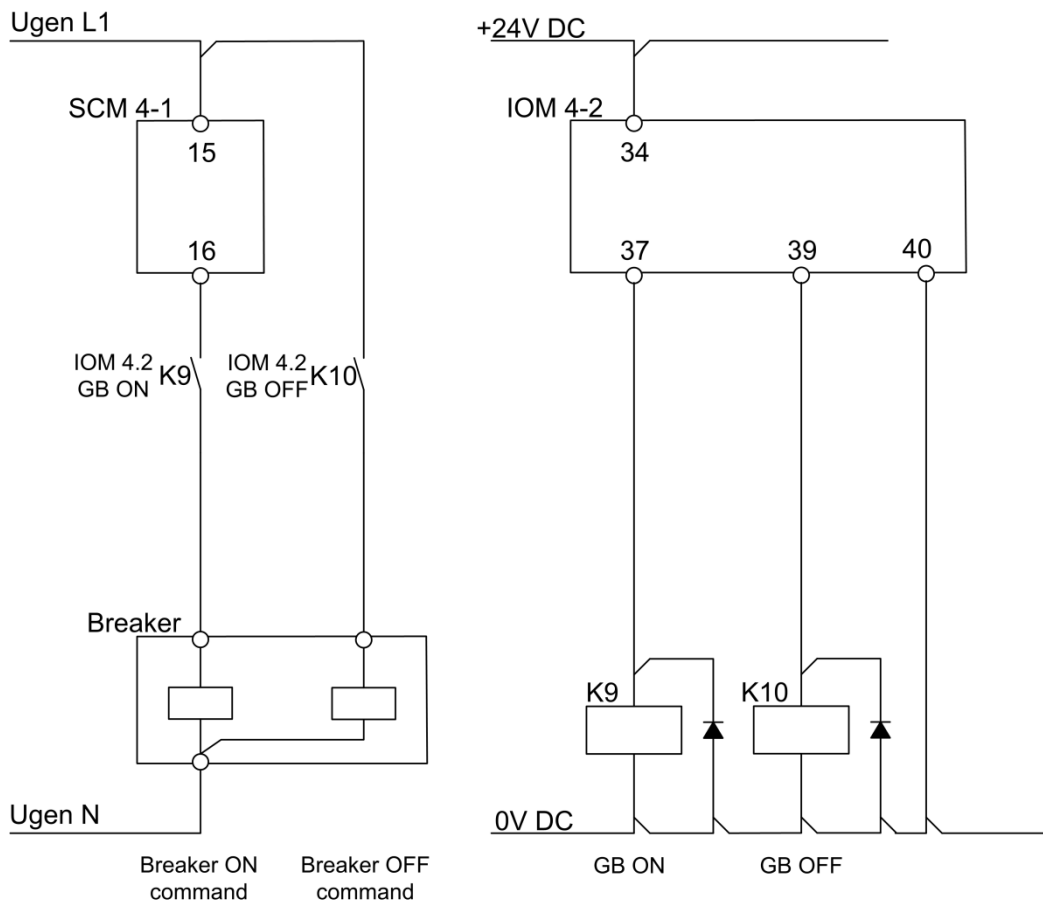
- Close breaker (synchronisation)
- Open breaker (normal opening of breaker as a part of a soft stop sequence)
- Trip breaker (break undervoltage coil circuit for fast trip)

5.3.1 IOM 4.2 and SCM 4.1 close breaker/open breaker

Synchronising the breaker is made by 2 independent outputs, one from the SCM 4.1 (sync check) and one from the IOM 4.2 (GB ON). Connecting the 2 in series forms a double safety that it is OK to close the breaker.

If further safety is required, a separate sync check unit like the DEIF CSQ-96 sync check scope can be connected in series with the other units.

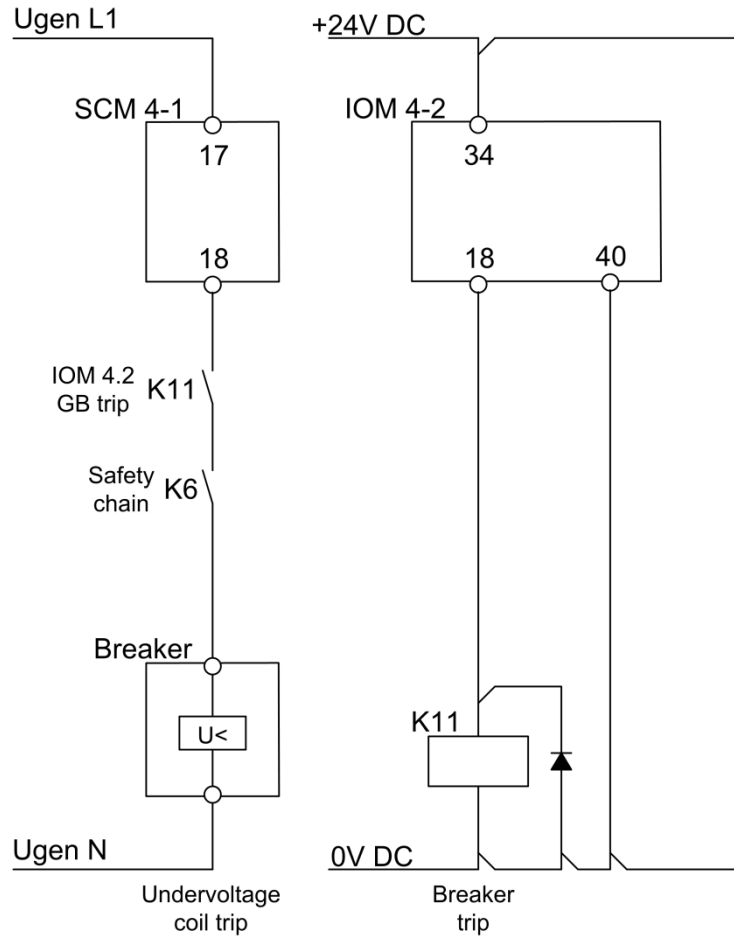
Opening breaker (GB OFF, normal operation) is done by a digital output command from the IOM 4.2 in pos.#3.



5.3.2 IOM 4.2/SCM 4.1/Safety chain breaker trip

The breaker trip is done by breaking the AC power supply to the breaker undervoltage coil. 3 events/commands can trip the breaker:

- SCM 4.1 trip relay output opens (closed under normal operation)
- IOM 4.2 trip output disappears (+24VDC under normal operation)
- The safety chain falls (safety chain main relay is de-energized)



5.4 Approved safety chain relay

Especially in Europe a safety chain may per requirement be fitted with an approved safety chain relay (acc. to EN 954-1) in order to increase the safe operation of the safety chain.

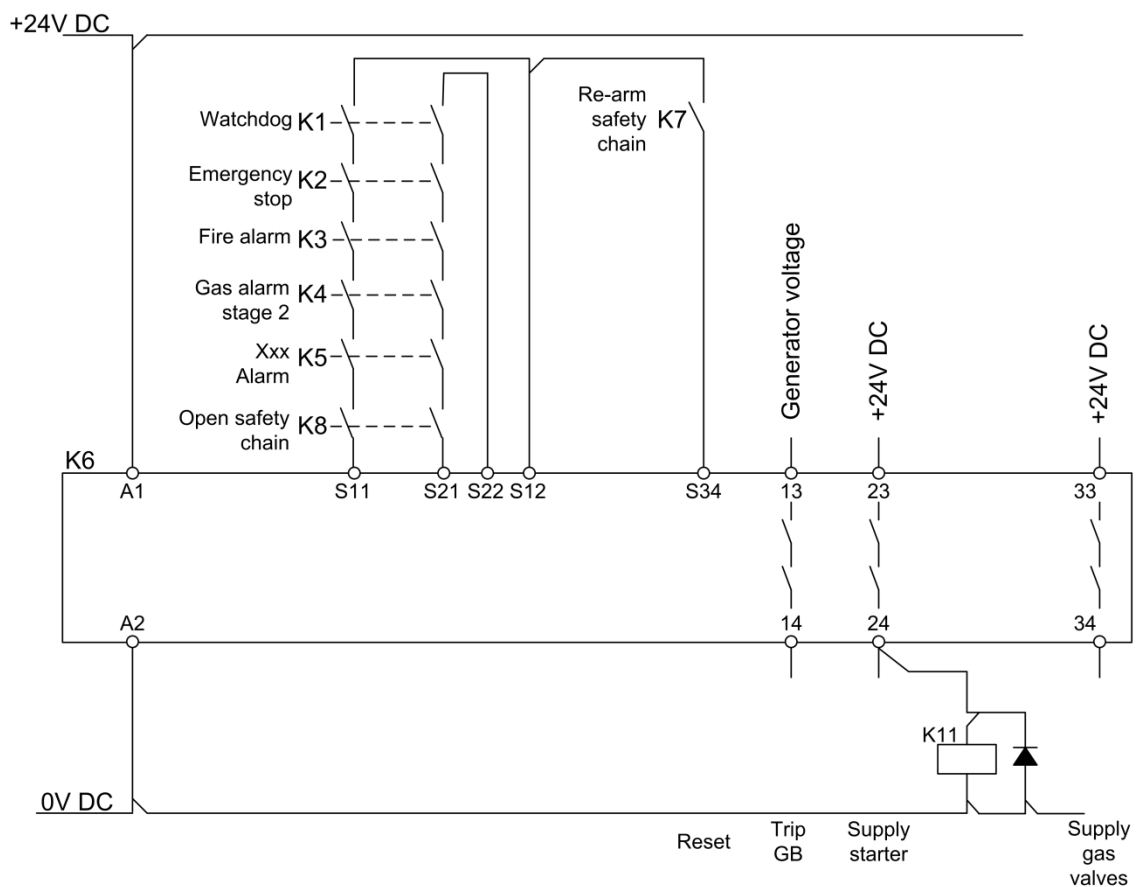
If such an approved relay is required, the wiring of the safety chain is a bit different than the one previously shown.

In the following example, a Pilz PNOZ s4 safety relay (up to category 4, EN 954-1) is used. Other manufactures also exists.

The alarm signals are still transferred to the Delomatic 400 GAS/HYDRO using separate relay contacts for the single alarms.

5.4.1 Safety relay

The relay numbers are the same as for the system without approved safety relay.

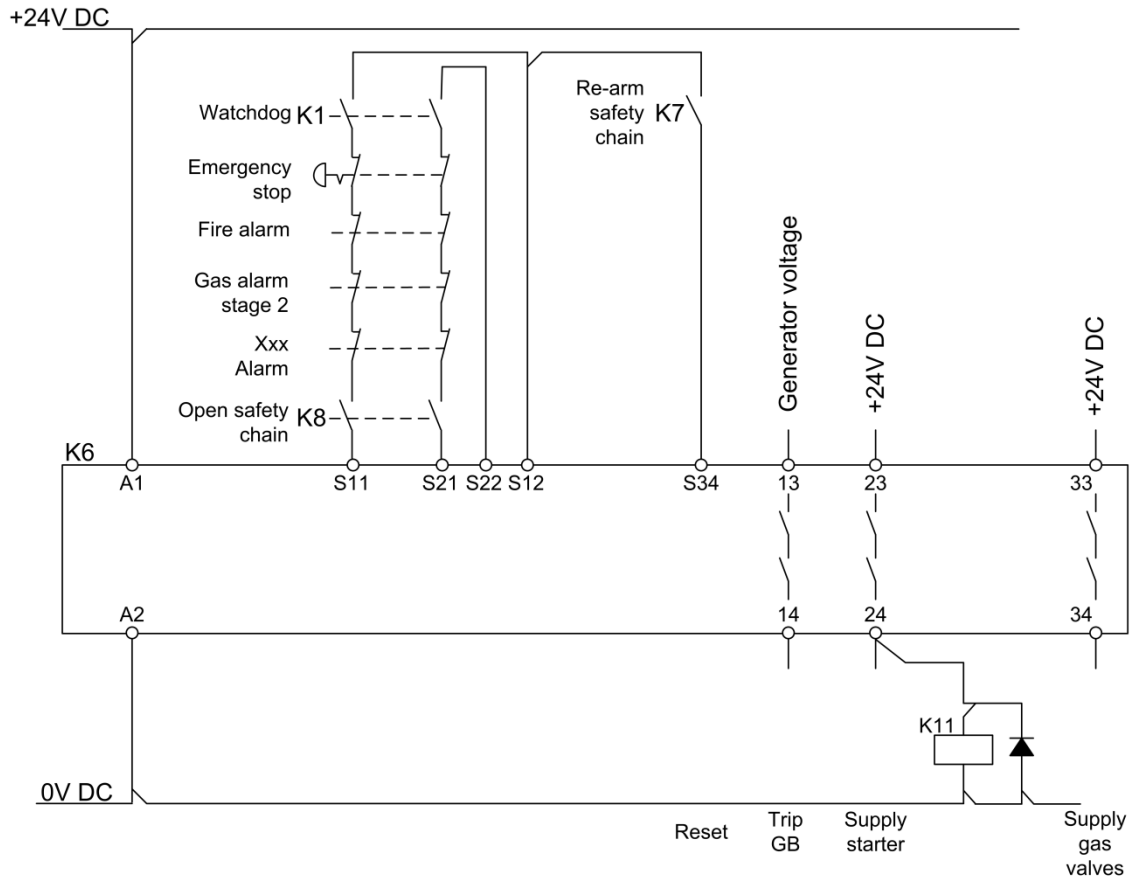


This example is for a gas engine. The outputs terminals 13-14, 23-24 and 33-34 will open the connection in case of faults, cutting the supply to breaker undervoltage coil, starter and gas valves; will naturally have different functions for a hydro turbine system.

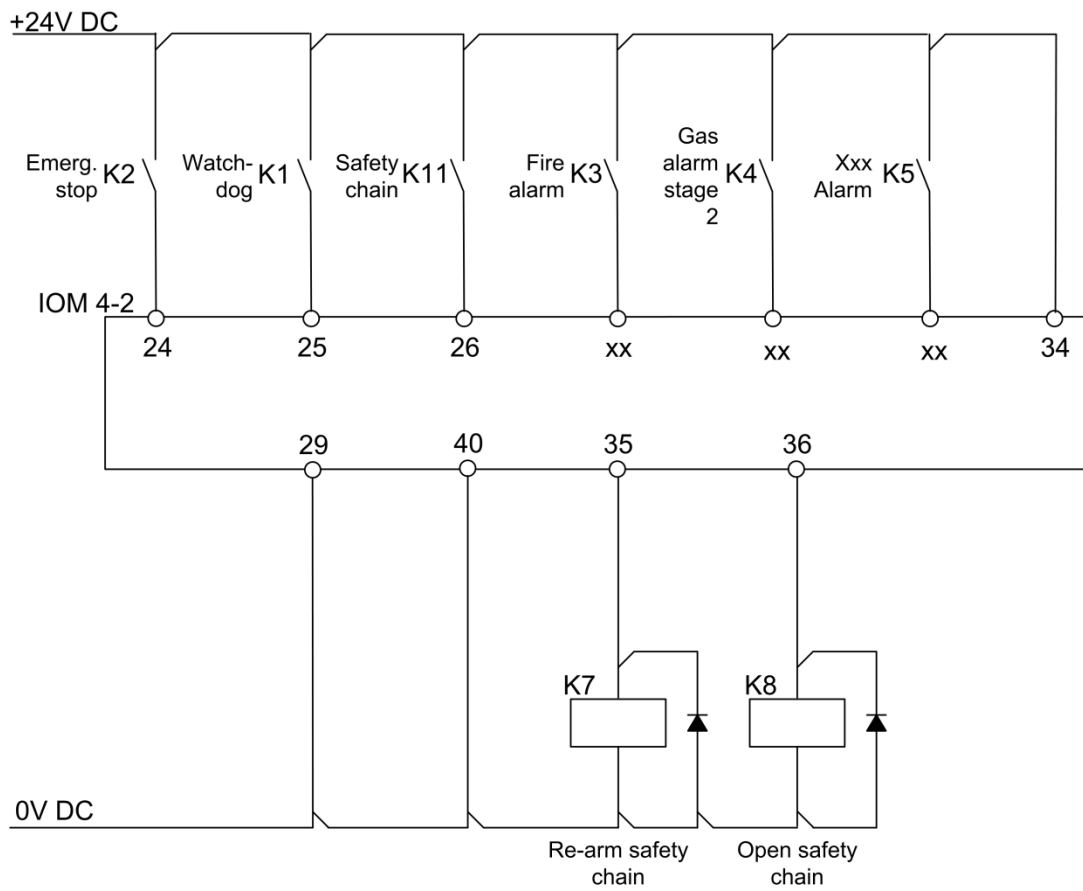
5.4.2 Safety relay, redundant sensor wiring

The major difference is that the inputs on the relay (s11 and s21) are now connected directly to double contacts on the alarms in question.

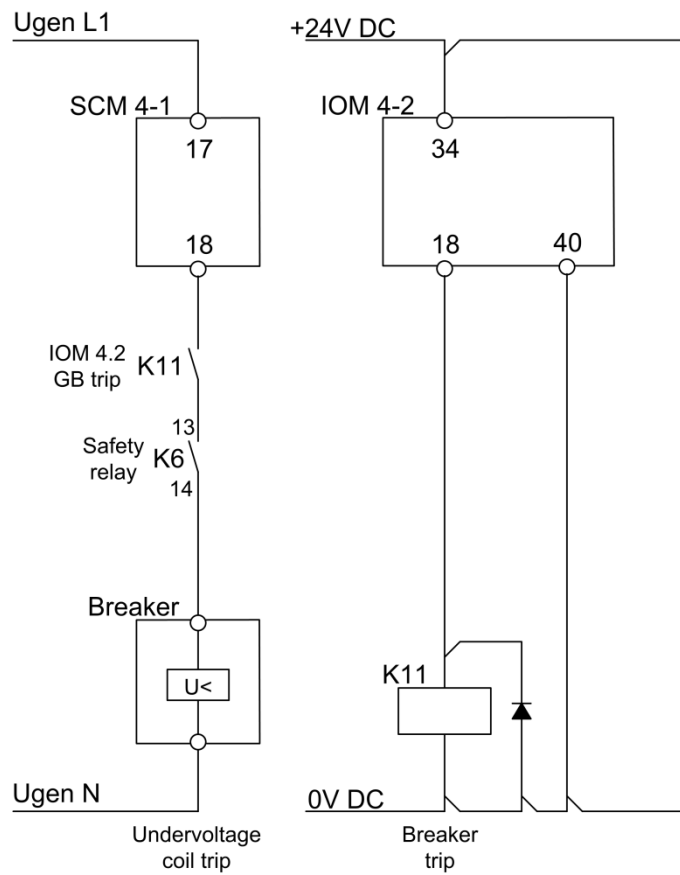
Note that the transfer relays (K2-K5) are still required for signalling to the Delomatic 4 Gas, and must be powered/controlled using a separate circuit.



5.4.3 IOM 4-2 Safety chain interface



5.4.4 IOM 4-2/SCM 4-1/Safety chain breaker trip



DEIF A/S reserves the right to change any of the above.