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SYSTEM DESCRIPTION CAA PROTECTION SYSTEM	Respons. dept GPEL	Date 040216	Reg. E DB 101
	Prepared T.Cota		YAMAMA CEMENT

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## PURPOSE OF THE SYSTEM

The purpose of the system is to protect from human injury and large machine damage due to faults in the gas turbine or the auxiliary systems. When an abnormal condition occurs, the system interrupts the fuel supply to the gas turbine and isolates the generator from the grid.

## GENERAL DESCRIPTION OF THE SYSTEM

The protection system is as a double channel system. The most critical parameters is configured in a one out of two (1oo2) configuration, i.e. double measuring points connected to separate channels which operates independently from each other. The channels or protection systems are named station/node 2 and 3. Most parameters though are connected to only one of the channels in a one out of one (1oo1) configuration.

The protection system is realized in Advant Controller 100, a microprocessor based control system, by two systems working independently from each other. For more information about the Advant Controllers, please see system description for computer system CWA.

The system communicates with the operator station where all system information can be observed.

The system works with the “fail safe” principle, i.e. the input device is energized during service. This is in general valid for those connected to the alarm system as well.

The fuel shut-off valves are for safety reasons of the type that is open/energized type.

Process signals connected to the system are treated and compared with internal set values. If exceeding the set limits in the system, outputs will activate the shut off valves, the GCB and the “lock out trip relay”. The protection system works with the tripping schemes 1oo1 and 1oo2. Please see system configuration.

The following trip signals are duplicated and thereby working on the 1oo2 principle:

- Over speed turbine
- Flame out detection
- Purge monitoring
- Exhaust temperature high
- Lubricating oil pressure low
- Lubricating oil temp high
- Gas detection

Emergency stop, over speed turbine and fire alarm is part of the hardwired trip execution chain, please see system configuration.

All shutdown and alarm signals of the gas turbine are being displayed on the operator station. The alarm/shutdown signals will be displayed in a list form where all signals are time marked for easy troubleshooting and fault/event analysis. A printer is included to ensure a proper documentation of occurring alarms and events.

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PROTECTION SYSTEM

Respons. dept  
GPEL

Date  
040216

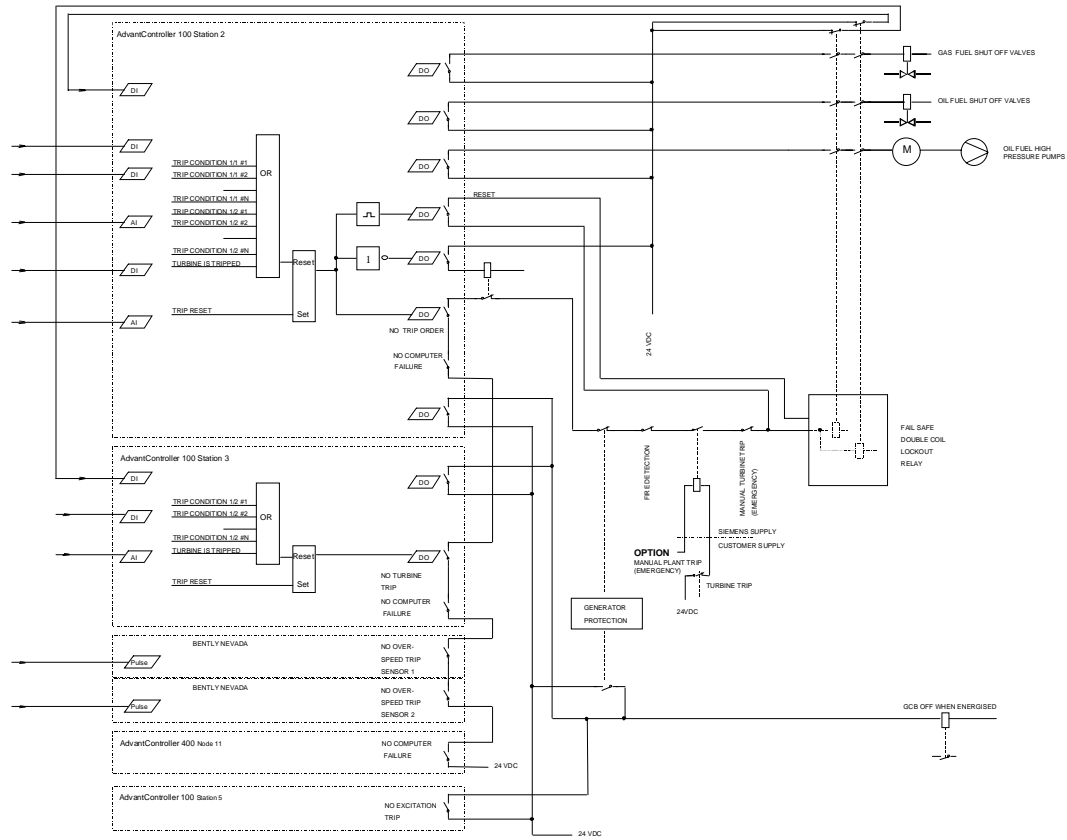
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SIEMENS GT10B2 TRIP PHILOSOPHY



## MAIN COMPONENTS

### Hardware

AC100 computers keep the application software of protection system 1 and 2 (including turbine governor) and handle all measurements needed for control of the turbine except electrical signals.

The computers consist of following parts:

- 1) Basic unit, comprising CPU and rack with back plane bus.
- 2) Communication board.
- 3) Speed measurement board (pulse counting) for protection system 2.
- 4) Analogue input board.
- 5) Analogue output board.
- 6) Digital input board.
- 7) Digital output board.

### Basic unit

The basic unit is the AC100 equipped with the latest function libraries available.

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### Communication board

Board for Advant Fieldbus communication. The communication speed is 1.5 Mbit/s.

### I/O boards

#### Analogue inputs

Input board	4..20mA	Pt100	Thermocouple
Type of input	single ended	3-wire	Type N/K
Resolution	12bits	13bits	18µV
Accuracy	<0.2%	<0.05%	<0.2%
Conv. time/Cycle time	<20ms	<1.2ms	<1.4ms
Input resistance	100Ω	>1MΩ	>1MΩ
Overflow	>22.4mA	-	-
Underflow	<2mA	-	-

#### Pulse inputs

Pulse input	12-24V, RS-485 compatible
Frequency measurement	5...20000Hz
Frequency measurement accuracy	<0.01%

#### Analogue outputs

Signal range	0..+/-10V, 4..20mA, 0..+/-20mA
Resolution	12bits+sign

#### Digital inputs

Type of input	Opto isolated in groups of 8
Rated voltage	24V DC
Input current typical	8.3 mA
Input voltage "0"	<5V
Input voltage "1"	>13V

#### Digital outputs

Type of output	Relay contact
Load supply max	230V DC or AC
Load supply min	12 V DC or AC
Output current, rated	2A
Output current, min	20mA
DC output load max	40W

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## HARDWIRED TRIP CHAIN RELAYS

The emergency stop, external gas turbine shutdown, relay protection, vibration, over speed, fire and flame detection relays, as well as digital outputs from computer energises the Trip relay master. This relay needs to be reset from the Computer, even if the trip chain is OK. The master trip relay energises or deenergizes the slave trip relays. All these trip relays controls the operating voltage for fuel shutoff, ignition, purge air valves and the fuel pump.

### EMERGENCY STOP, EXTERNAL GAS TURBINE SHUTDOWN AND RELAY PROTECTION RELAYS

Output 2 NO contacts  
 Output rated voltage 250V AC  
 Output current, rated 6A

### TRIP RELAY MASTER

Output 3 NO contacts , 1 NC contact ,  
 1delay-release NO contact  
 Output rated voltage 250V AC  
 Output current, rated 5A

### TRIP RELAYS SLAVE

Output 7 NO contacts , 1 NC contact  
 Output rated voltage 250V AC  
 Output current, rated 5A

## Software

### Over speed protection

The over speed protection is an independent unit from Bently Nevada. The unit comprises two separate speed measurement channels for gas turbine speed and two for power turbine speed. The over speed protection is configured 1oo2. The shutdown is performed within the speed measuring system and opens a contact in the **hardwired trip chain**.

### Flame out protection

The flame out protection comprises two flame detectors one for main flame and one for pilot flame. The flame out protection is configured 1oo2. During transient there is a short time delay if only one detector indicates flame out.  
 It is time delayed during ignition.

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### Fire protection

The fire protection is an independent system, which handles turbine shutdown, fire detection and extinguishing. The fire protection is configured 1oo1 for turbine shutdown. The shutdown is performed within the fire protection system and opens a contact in the **hardwired trip chain**. The fire-fighting unit covers the gas turbine room. The fire fighting equipment is powered from a separate battery/charger set.

On the front panel there is a blocking key switch by which the fire-fighting unit can be blocked. The central unit triggers the initiator upon a signal in the detector line either from the fire-detectors or upon a manual release order. Immediately the sirens and flashlights are turned on and the fire dampers are released, the turbine is tripped and the auxiliary equipment is stopped accordingly. The CO<sub>2</sub> will be released after a certain time delay. Fire protection equipment failure and fire alarms are indicated in the operator station.

### Gas detection

The system consists of two gas detectors, located in ventilation outlet of the gas turbine room, connected to a central unit. Each detector signal is converted in the central unit and is sent to the control system where alarm and trip levels are situated. When the high concentration level is exceeded a gas turbine shutdown is initiated.

The central unit supervises the detectors and detector failure alarm is provided in the operator station. The gas detection system is configured 1oo2.

### Purge monitoring

The purge monitoring is performed in two separate channels (one channel is the automatic and sequencing computer). Both channels must indicate that the purge time has elapsed before the start sequence is allowed to go to ignition.

### Vibration monitoring

The vibration monitoring is performed in the Bently Nevada measuring system. The system converts the vibration signals and sends them to the control system, which performs a shutdown at high level.

### Exhaust temperature protection

The exhaust temperature is measured in 16 measuring points, each point equipped with triple elements. One element is connected to the first protection channel, the other element to the second channel. The average temperature is monitored and high temperature will cause a shutdown. Also 3 different ring averages are calculated. The temperature spread is also monitored and corresponding high to corresponding ring average and corresponding ring average to corresponding low will also cause a shutdown. The exhaust temperature average protection is configured 1oo2.

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## FUNCTION

### *Start up*

At stand still, the safety system is released, i.e. the trip relay is deenergized and the fuel SOV's/pump are closed/stopped. At start up the auxiliary systems are started, then the protection system is restored.

### *Continuous operation*

During operation the system is active.

### *Turbine stop*

At stand still, the safety system is released, i.e. the trip relay is deenergized and the fuel SOV's/pump are closed/stopped.

### *Stand still*

At stand still, the safety system is released, i.e. the trip relay is deenergized and the fuel SOV's/pump are closed/stopped.

## DISTURBANCES

### *Gas turbine trip*

N/A

### *Generator breaker trip*

N/A

### *Loss of power supply*

Loss of power supply will not directly affect the system, since power supply to the safety system is taken from UPS.

### *System faults*

The safety system is of "fail safe" design and will trip the gas turbine if the system fails.

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## TECHNICAL SPECIFICATION

### *Design criteria and standards*

The protection system is of “fail safe” design.

### *Dimensioning data*

N/A

### *Engineering data*

N/A

### *Emergency power supply*

Power supply to the protection system is taken from UPS.

### *Installation*

Refer to system description for BRA.

### *Materials*

N/A

### *Component data*

The protection system is realized in two Advant Controllers, working independently from each other. For more information about the Advant Controllers please see computer system description CWA.

## TESTING AND SERVICE

### *Testing during normal operation*

N/A

### *Accessibility during normal operation*

N/A

## INDEX OF COMPONENTS

N/A

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