KELI 2008

Field Report : Control System ME 4012 for gas turbine A (93.0 V) at unit 4 Power plant Altbach / Deizisau

EnBW
Elektro-/ Leittechnik
Dipl. Ing. David Maier
da.maier@enbw.com
+49 7153 602 - 55 24 0

Helmut Mauell GmbH
Dipl. Ing. Detlef Baran
dba@mauell.com
+49 2053 - 13 478

06th of Mai 2008

EnBW
Energy
needs Impulses

mauell

Table of contents

1. Tasks of the new Gas Turbine Control System ME 4012 slide

- Principle of process Combined Cycle Unit 4 3
- ME-VIEW scheme of control loops and functional groups 4
- Air system and combustion process of the gas turbine 5
- Air / exhaust gas of the gas turbine 6
- Ignitiongas and naturalgas system 7
- Heating oil system of gas turbine (Draft sketch according to VGB R 170 C) 8
- Deionized water injection for NO_x-reduction during oil operation 9
- Auxiliary oil / lube oil system of the gas turbine 10
- Turbine Protection System (Turbine surveillance supervision) 11
- Electrical Integration 12

2. Solution: Functions and Control Strategy

- Speed-, power-, frequency- and temperature-control 13
- Speed-, power-, frequency-, temperature- and fuel-control 14
- Turbine controller (1oo2), Turbine protection (2oo3, SIL3) 15
- Turbine speed measurement for controller and fail-safe (SIL 3) overspeed protection 16
- Gas turbine protection: Overview machine protection 17
- Gas turbine protection: Overview fuel trip system 18
- Operator system ME VIEW and location involvement 19
- Automation Unit AE 4012 and location involvement 20

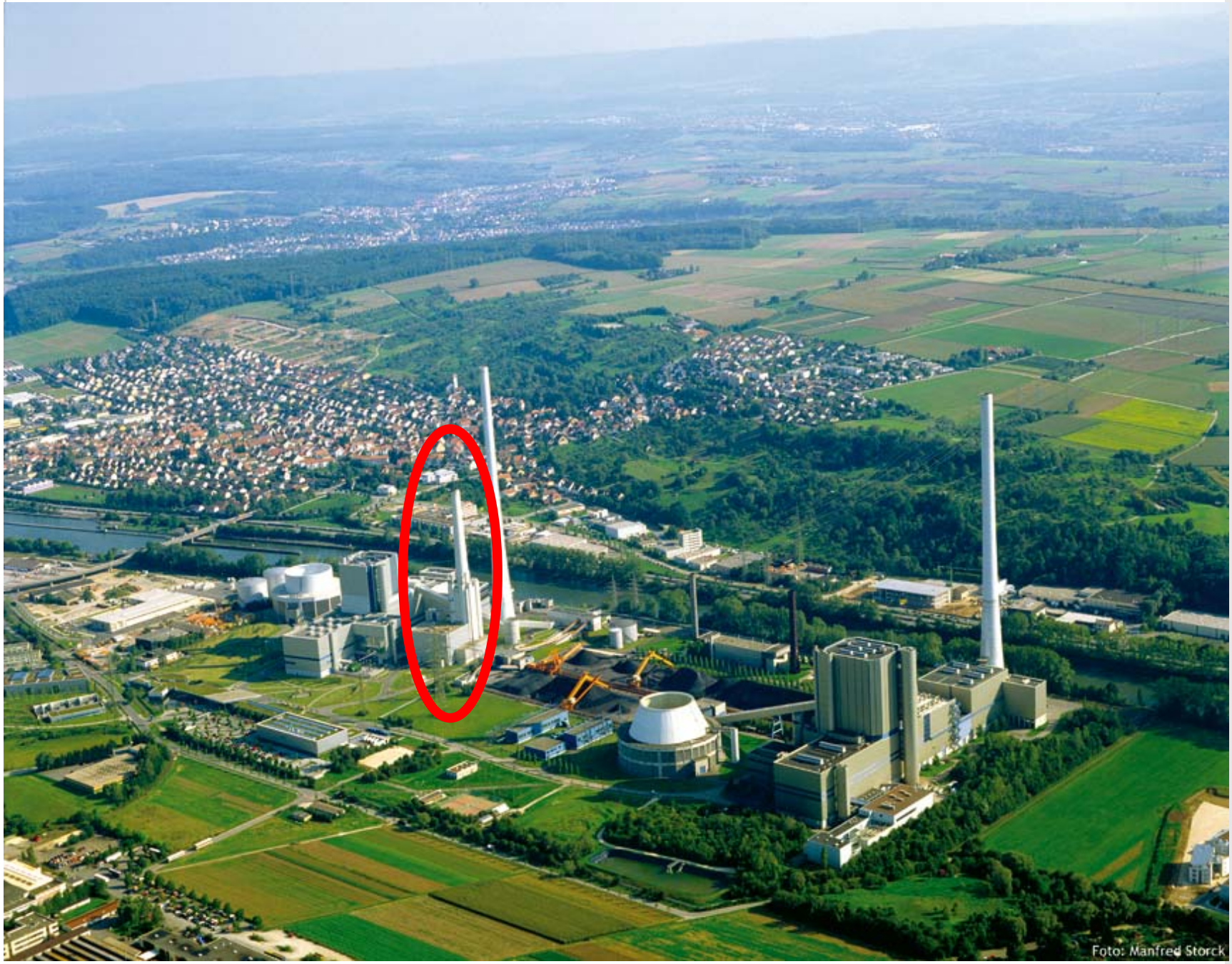
3. Achieved objectives and operational experience: Control System replacement of gas turbine A slide

- Turbine behavior during start-up and load operation 21
- ME4012 System overview Unit 4, Altbach / Deizisau 22
- Control System characteristics 23
- Contract Award 24
- Planning and Manufacturing 24
- Mounting 24
- Commissioning 25
- Acceptance 26

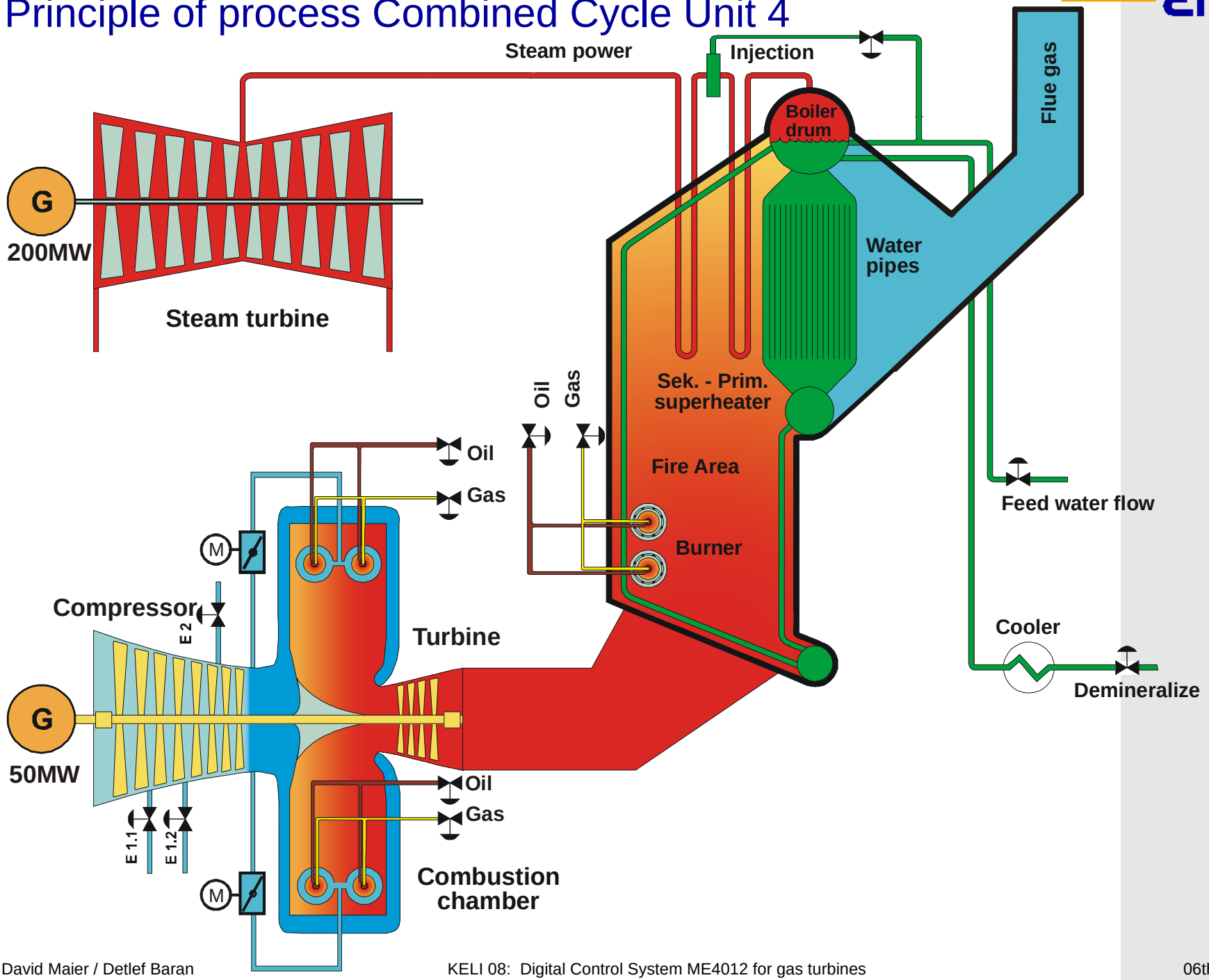
4. Summary after 5 years of plant operation 27

5. Reference List Process Control System ME4012: Gas turbines and Combined Cycle Plants 28

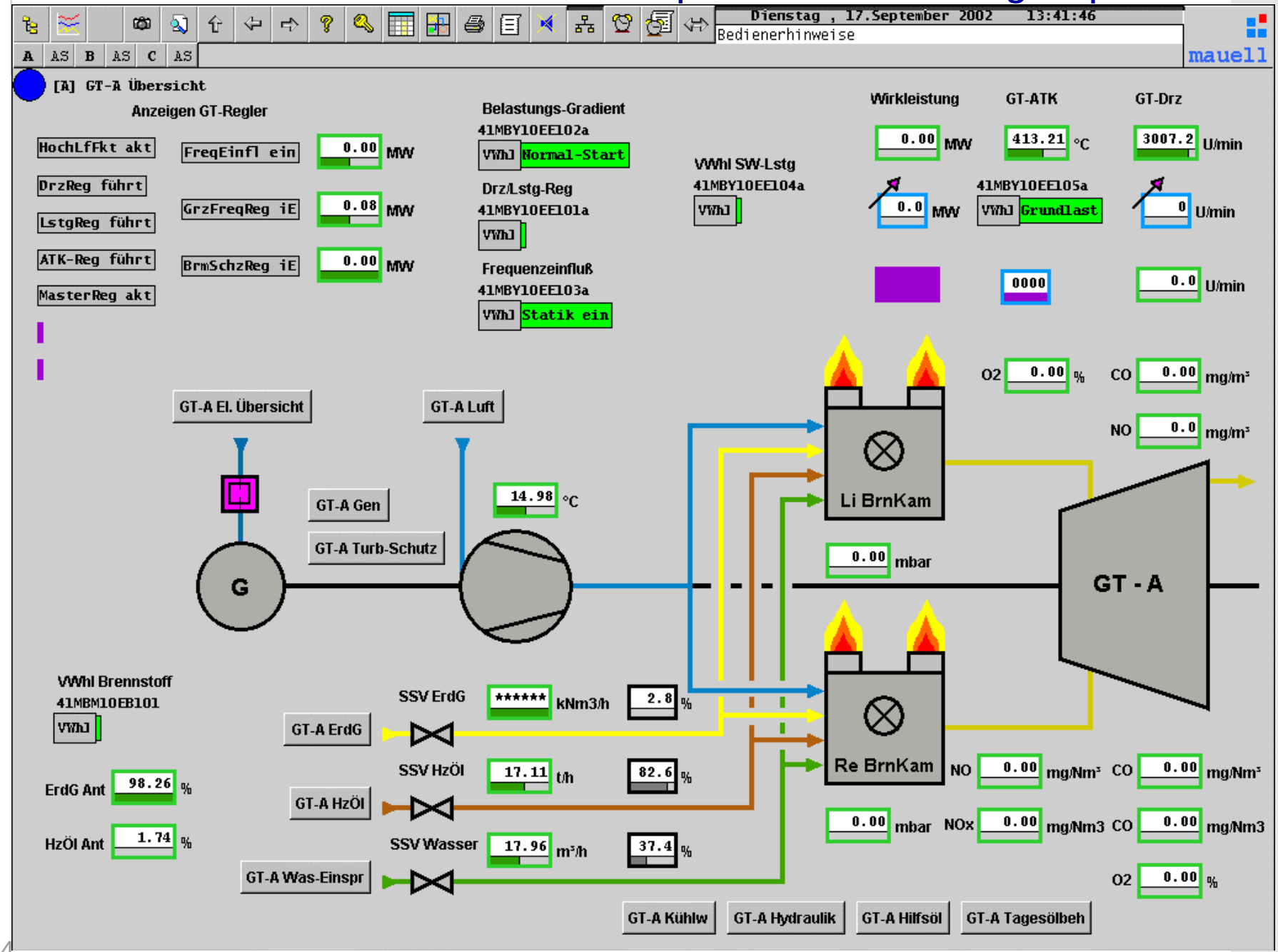
Power plant Altbach / Deizisau, Unit 4



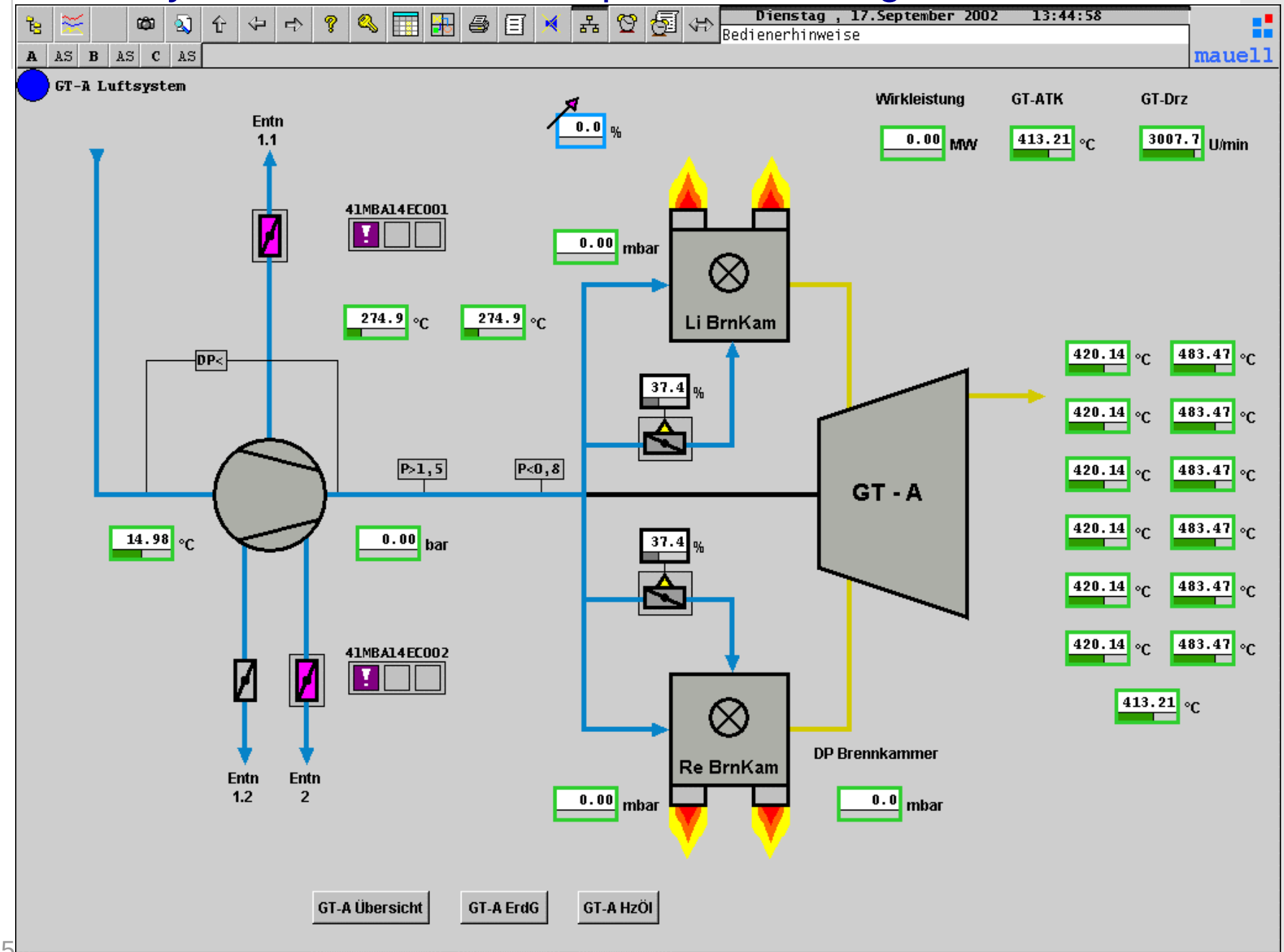
- Tasks of the new gas turbine control system ME 4012: Principle of process Combined Cycle Unit 4



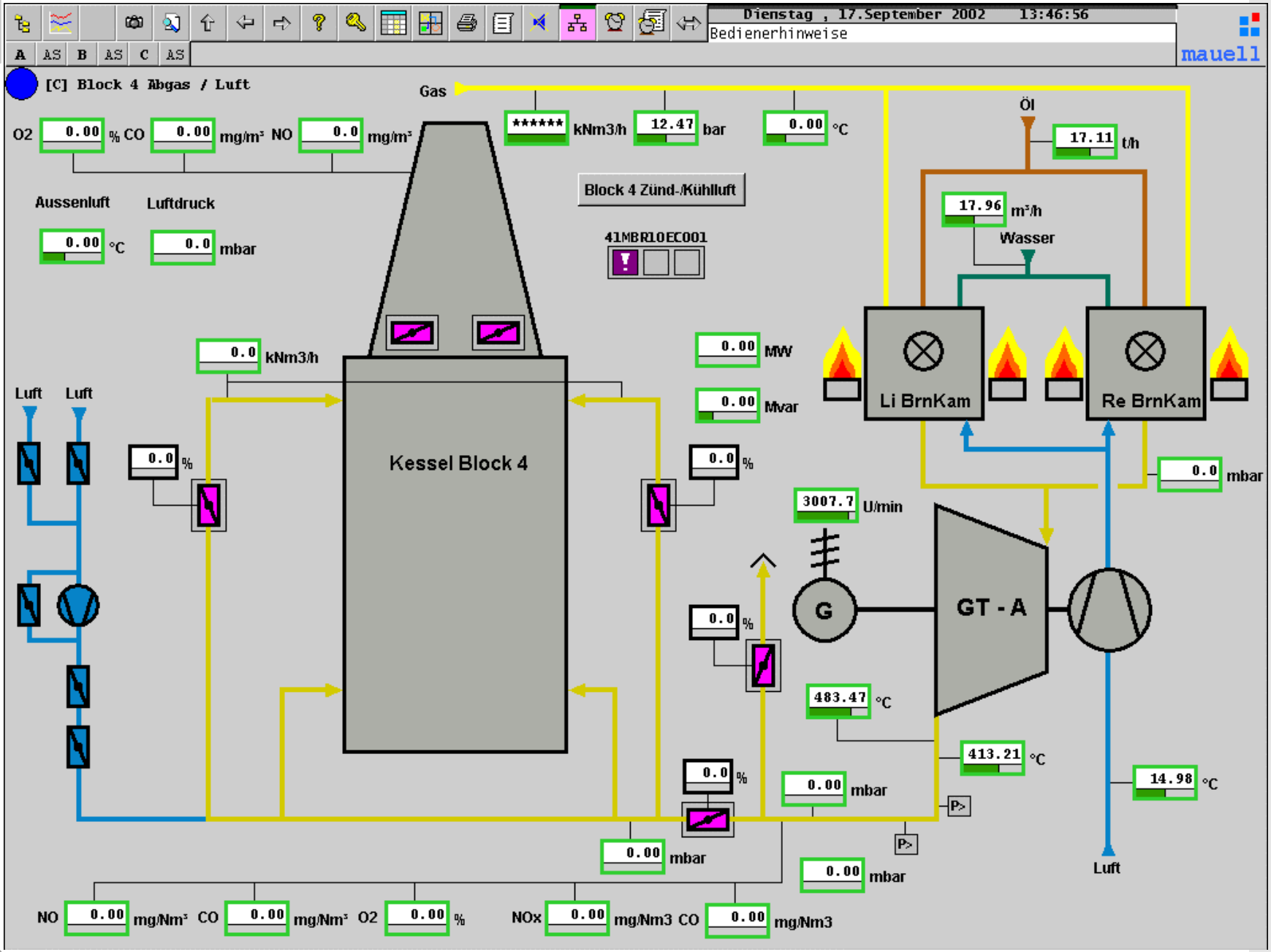
- Tasks of the new gas turbine control system ME 4012:
  ME-VIEW scheme of control loops and functional groups



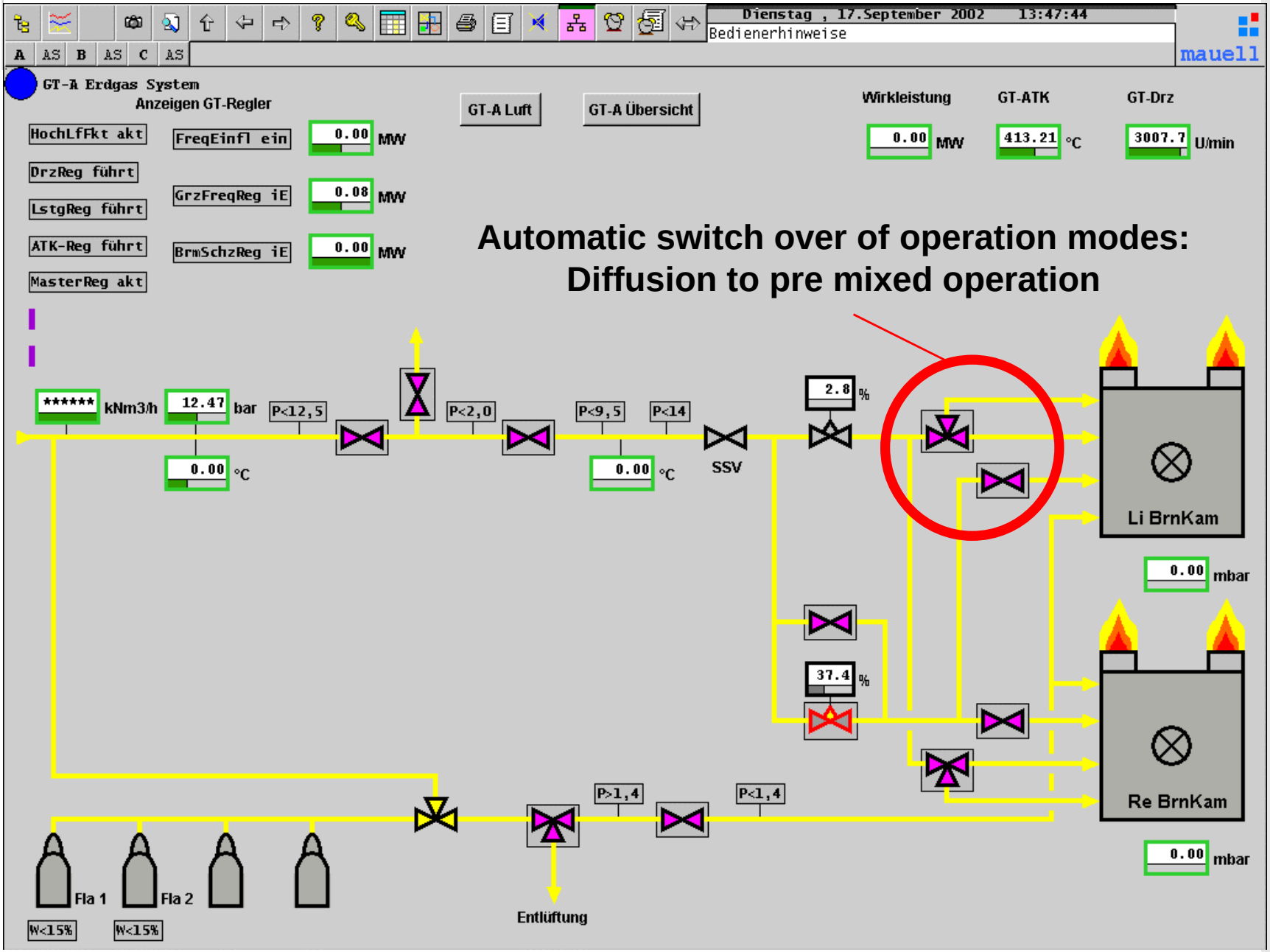
- Tasks of the new gas turbine control system ME 4012: air system and combustion process of the gas turbine



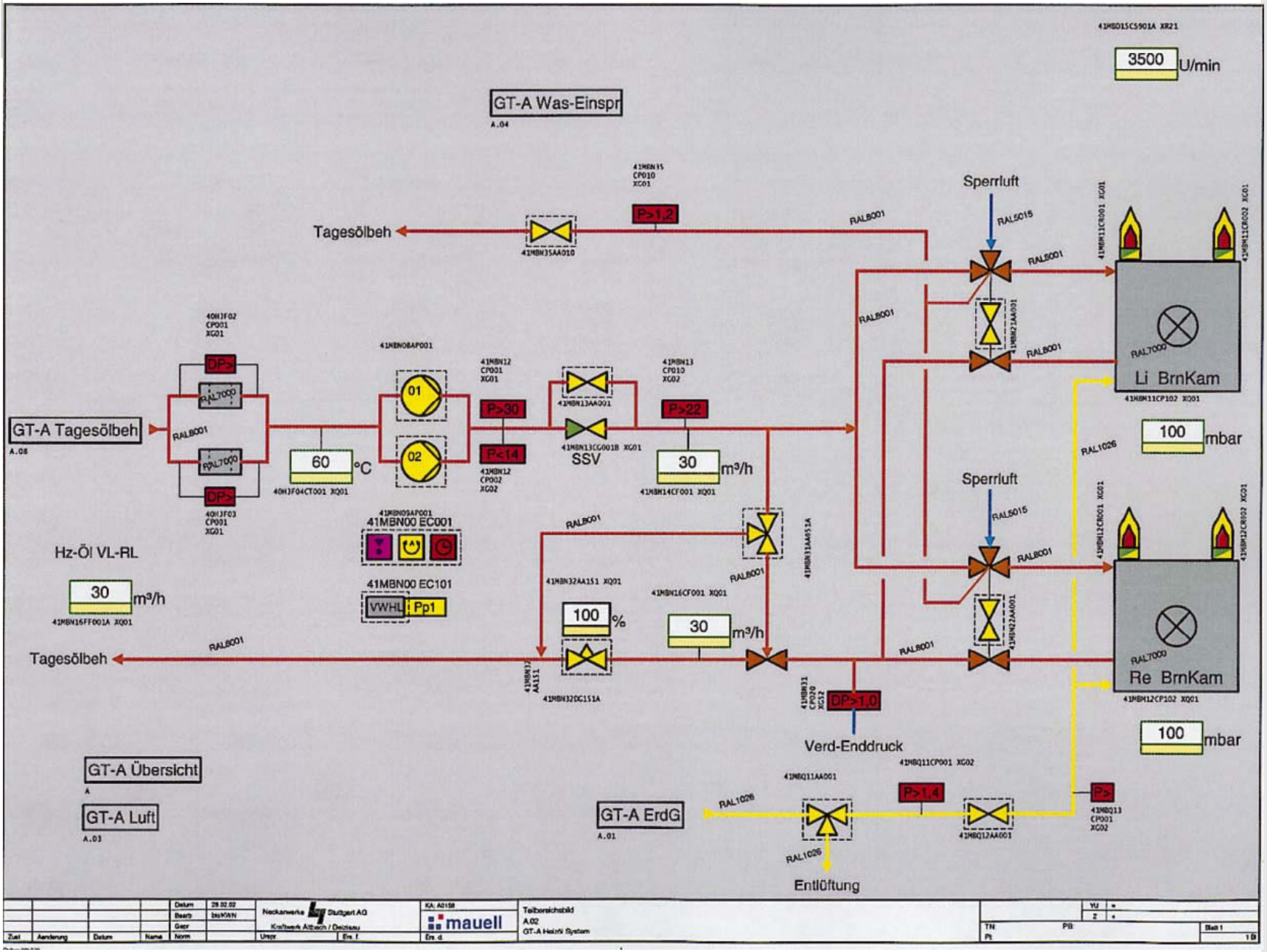
- Tasks of the new gas turbine control system ME 4012:
  Air / exhaust gas of the gas turbine



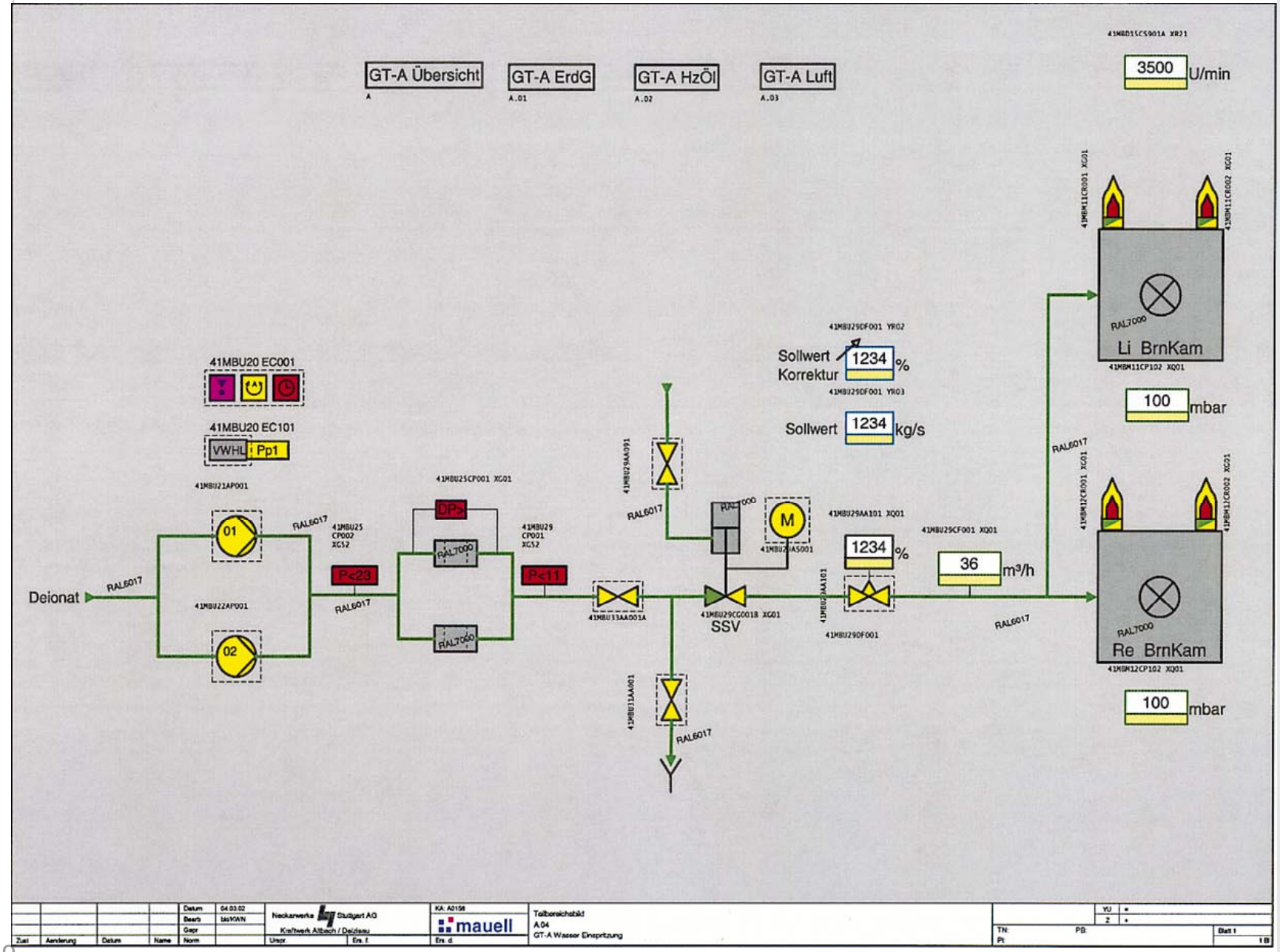
- Tasks of the new gas turbine control system ME 4012: Ignitiongas and naturalgas system



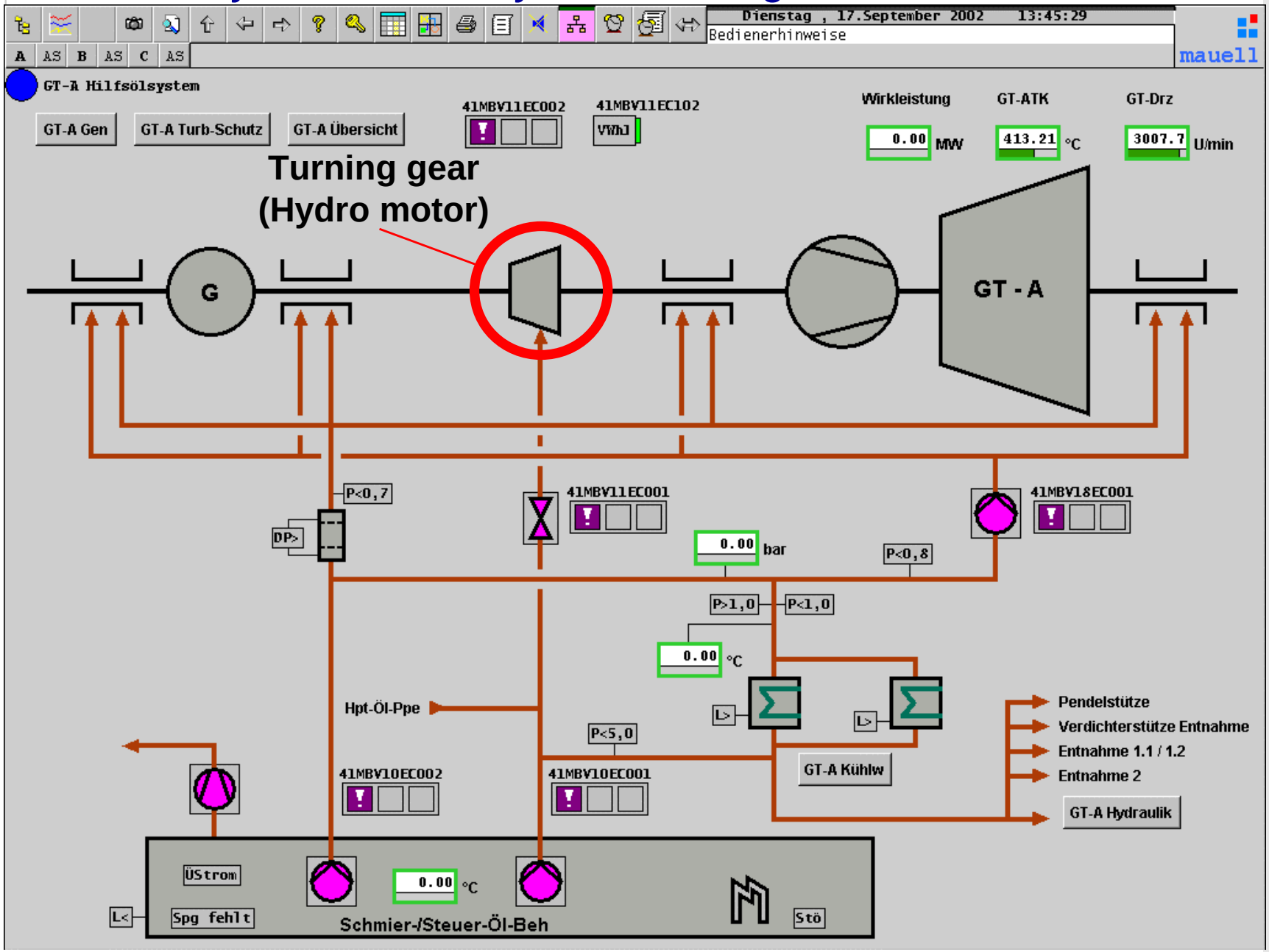
- Tasks of the new gas turbine control system ME4012:
  Heating Oil system of gas turbine (draft sketch according to R170C)



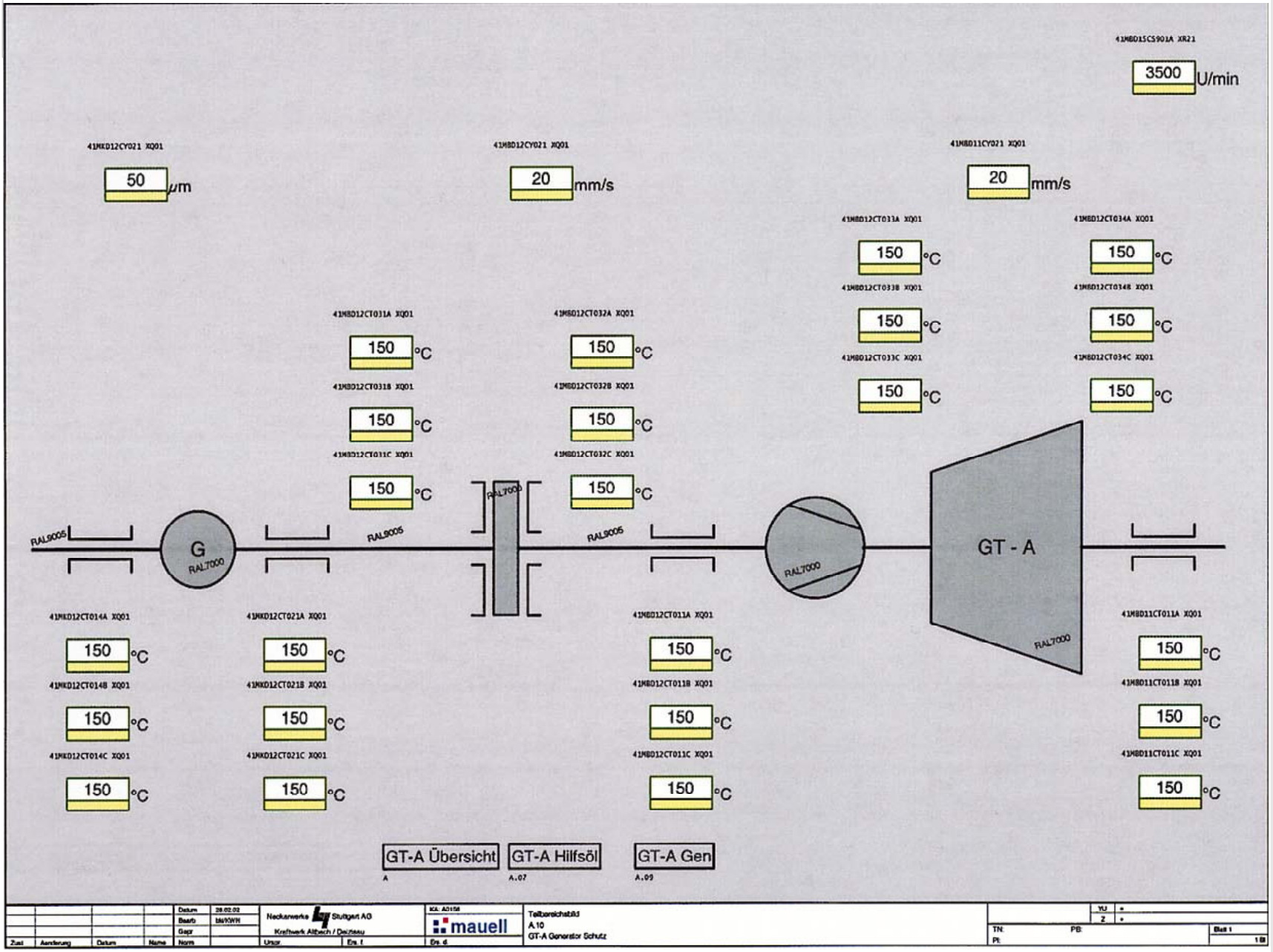
- Tasks of the new gas turbine control system ME 4012:
  Deionized water injection for NO_x reduction during oil operation



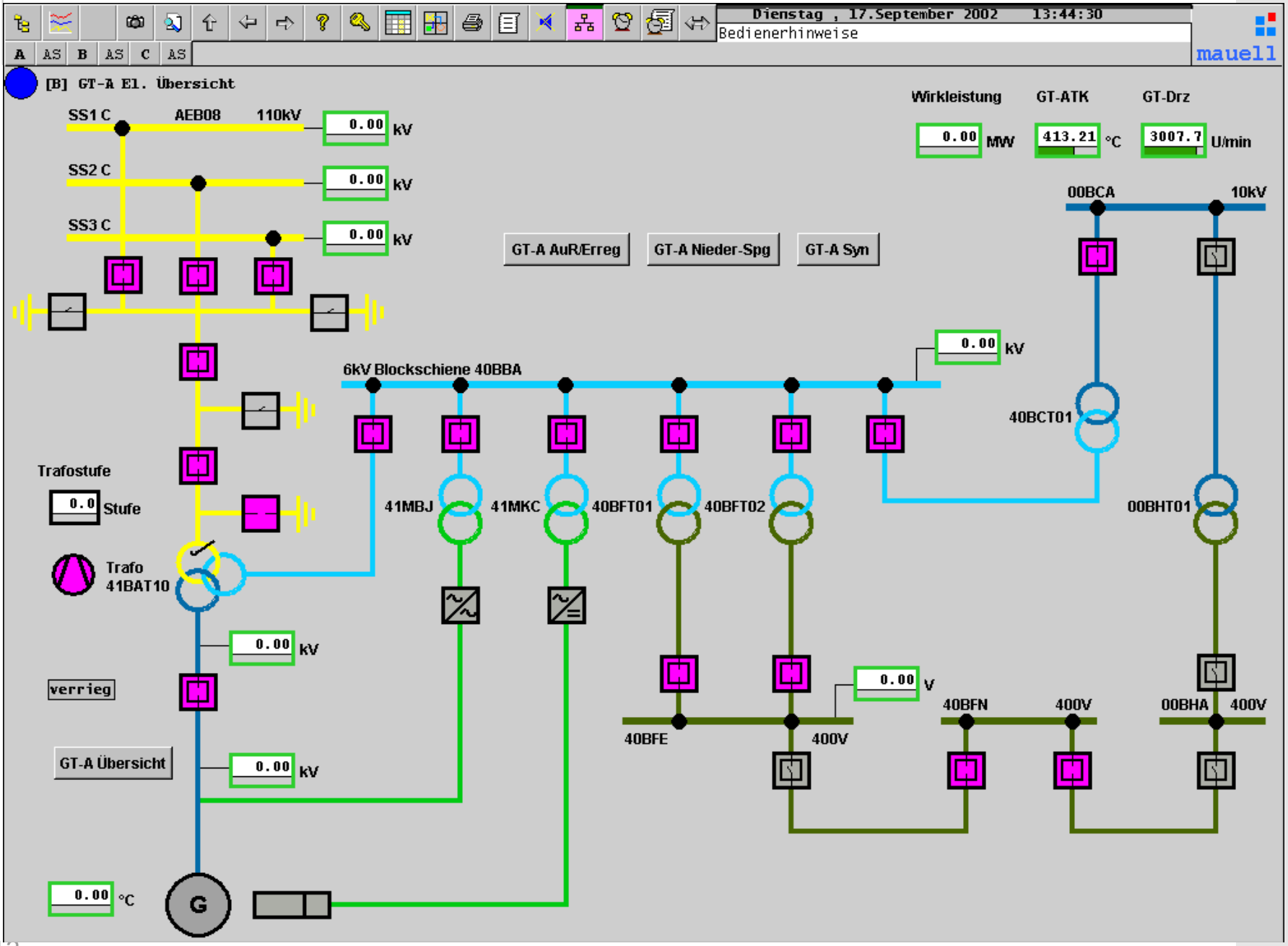
- Tasks of the new gas turbine control system ME 4012:
  Auxiliary oil / lube oil system of the gas turbine



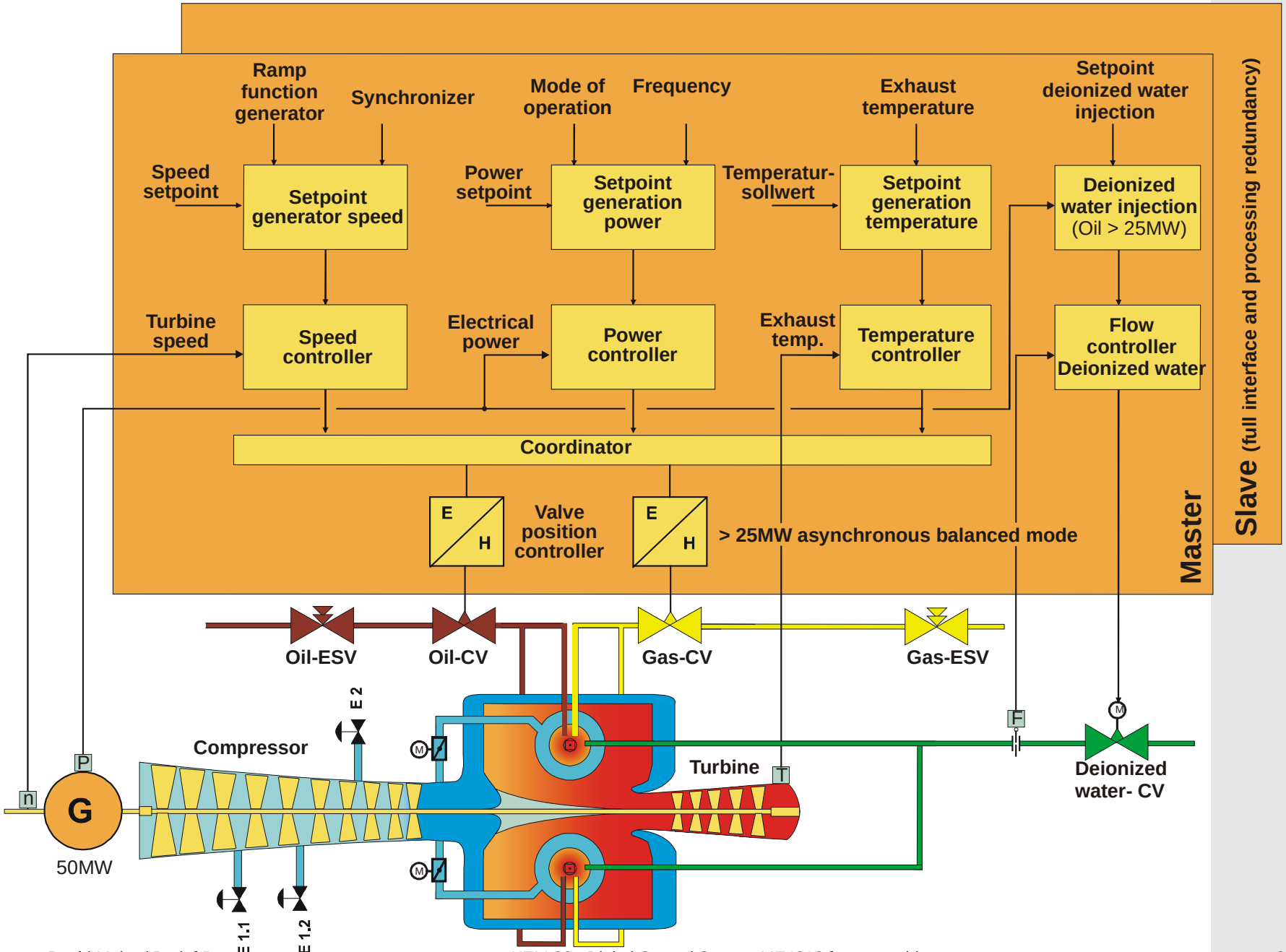
- Tasks of the new gas turbine control system ME 4012:
  Turbine Protection System (Turbine surveillance supervision)



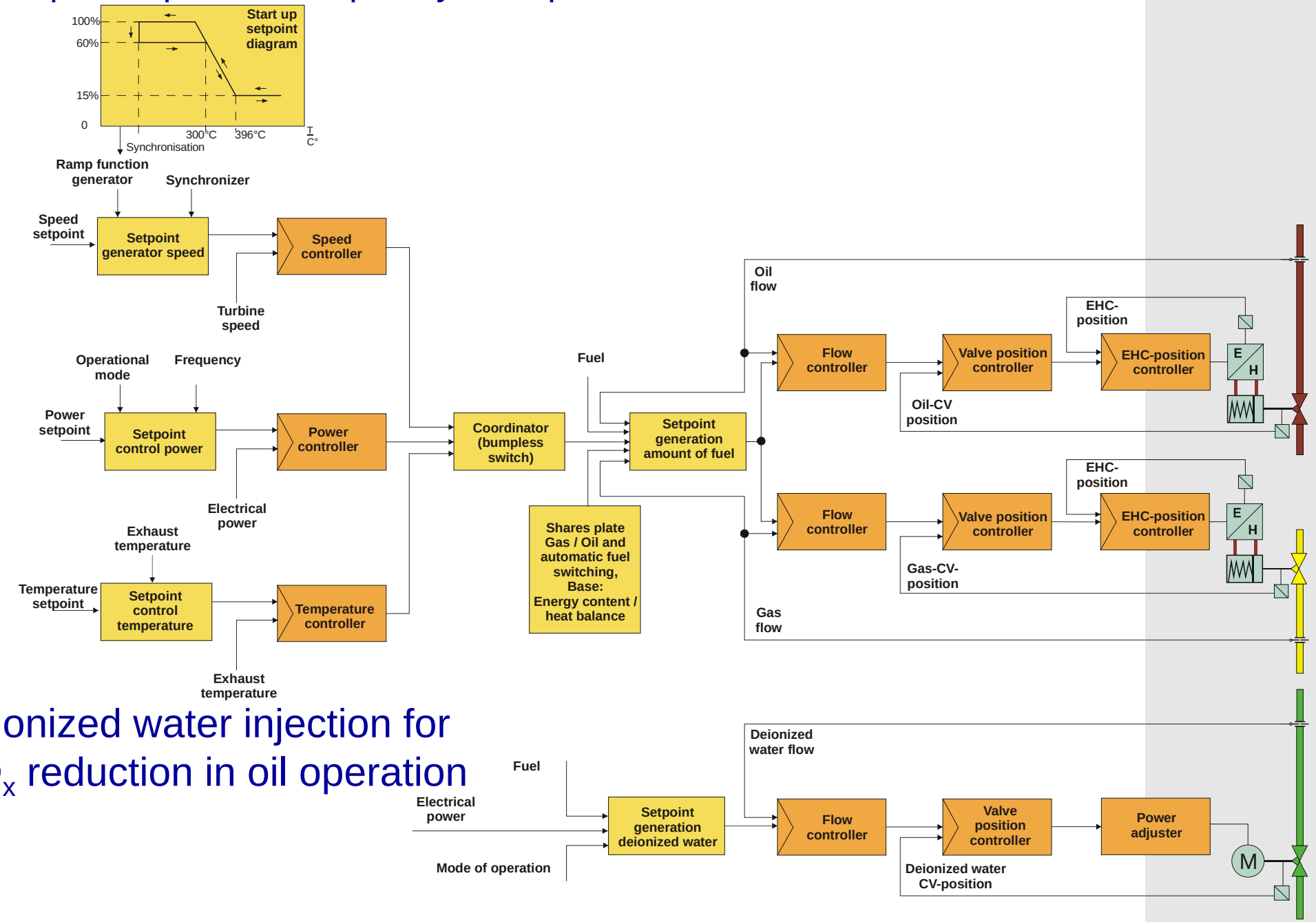
- Tasks of the new gas turbine control system ME 4012: Electrical Integration



2. Solution: Functions and Control Strategy
Speed-, power-, frequency- and temperature-control

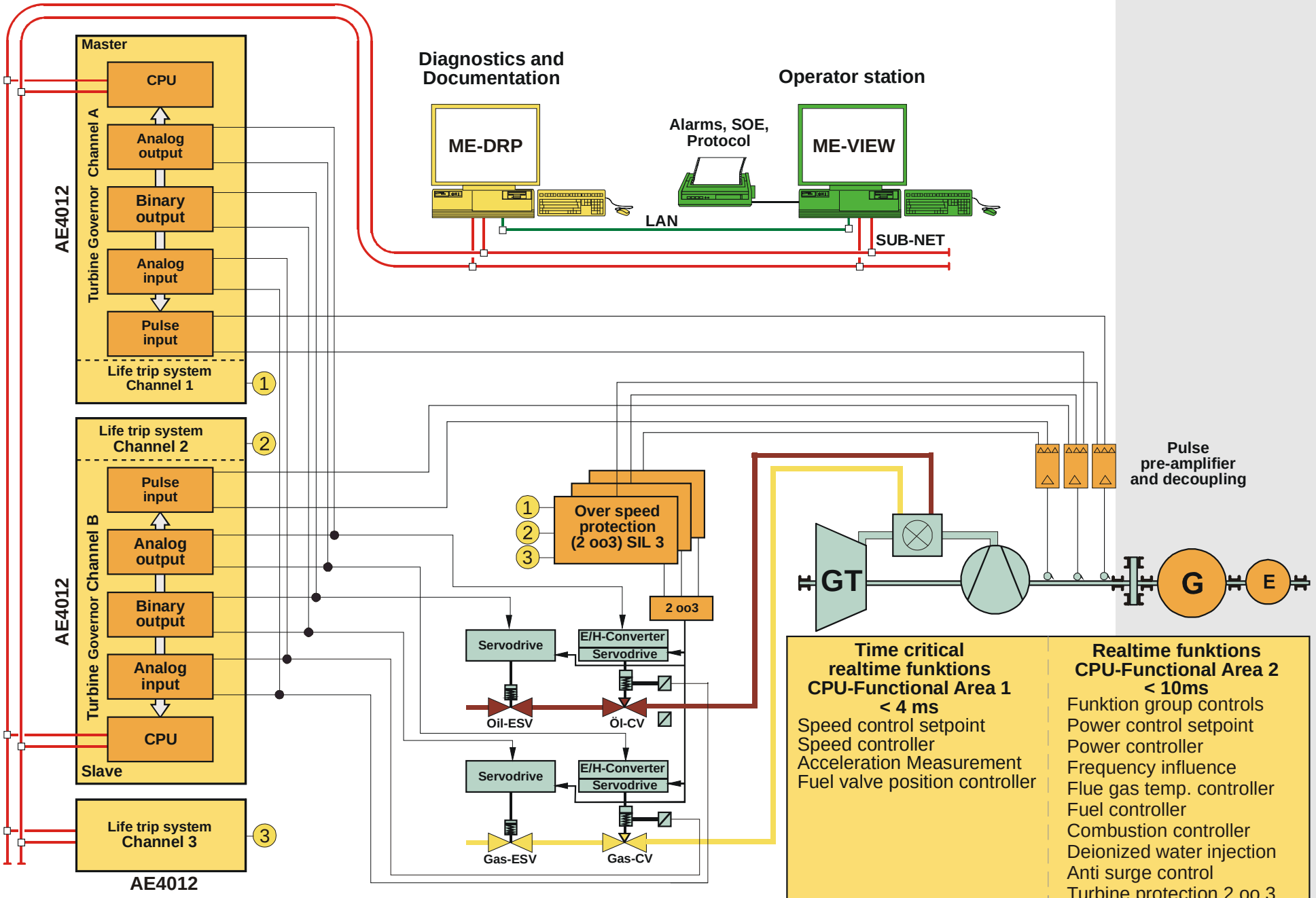


2. Solution: Functions and Control Strategy: Speed-, power-, frequency-, temperature- and fuel-control

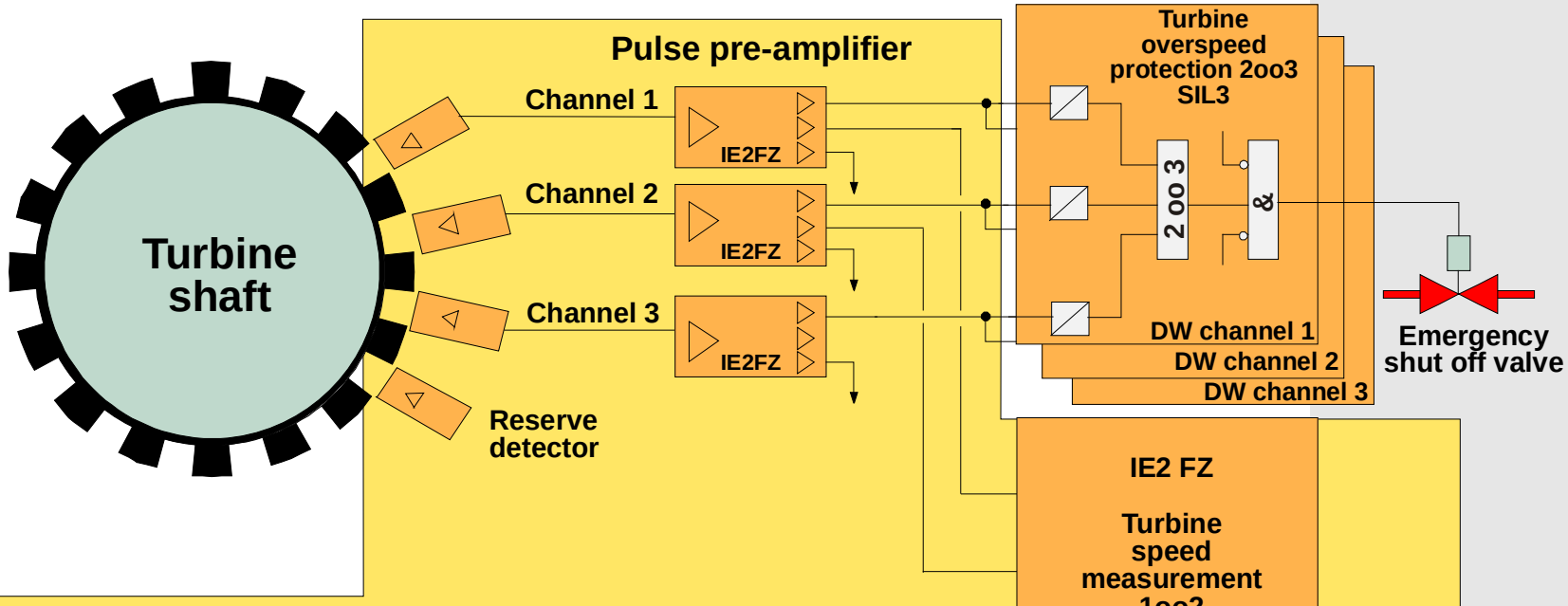


Deionized water injection for NO_x reduction in oil operation

2. Solution: Functions and Control Strategy
Turbine controller (1oo2), Turbine protection (2oo3, SIL3)



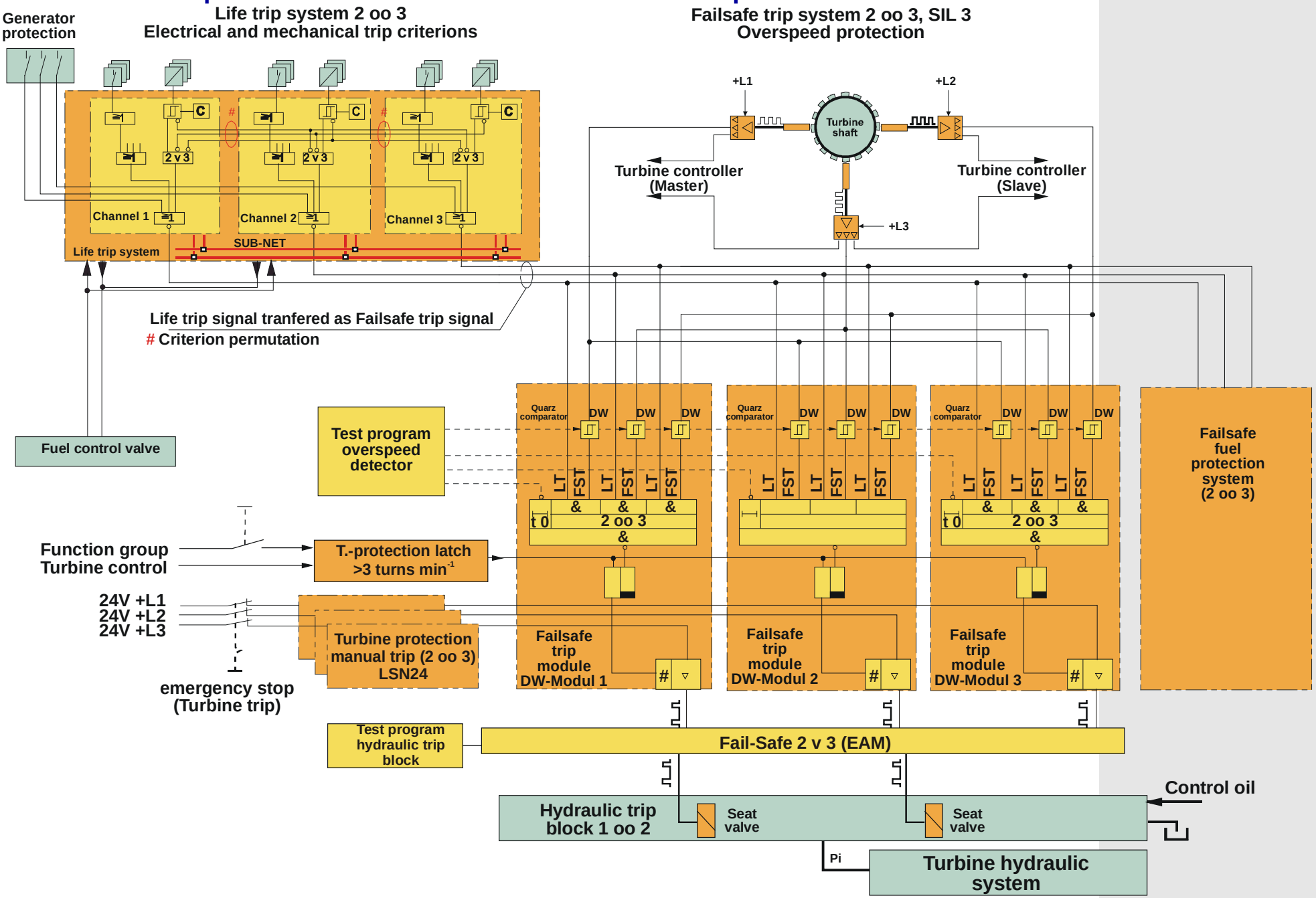
2. Solution: Functions and Control Strategy
Turbine speed measurement for controller and fail-safe (SIL 3) overspeed protection



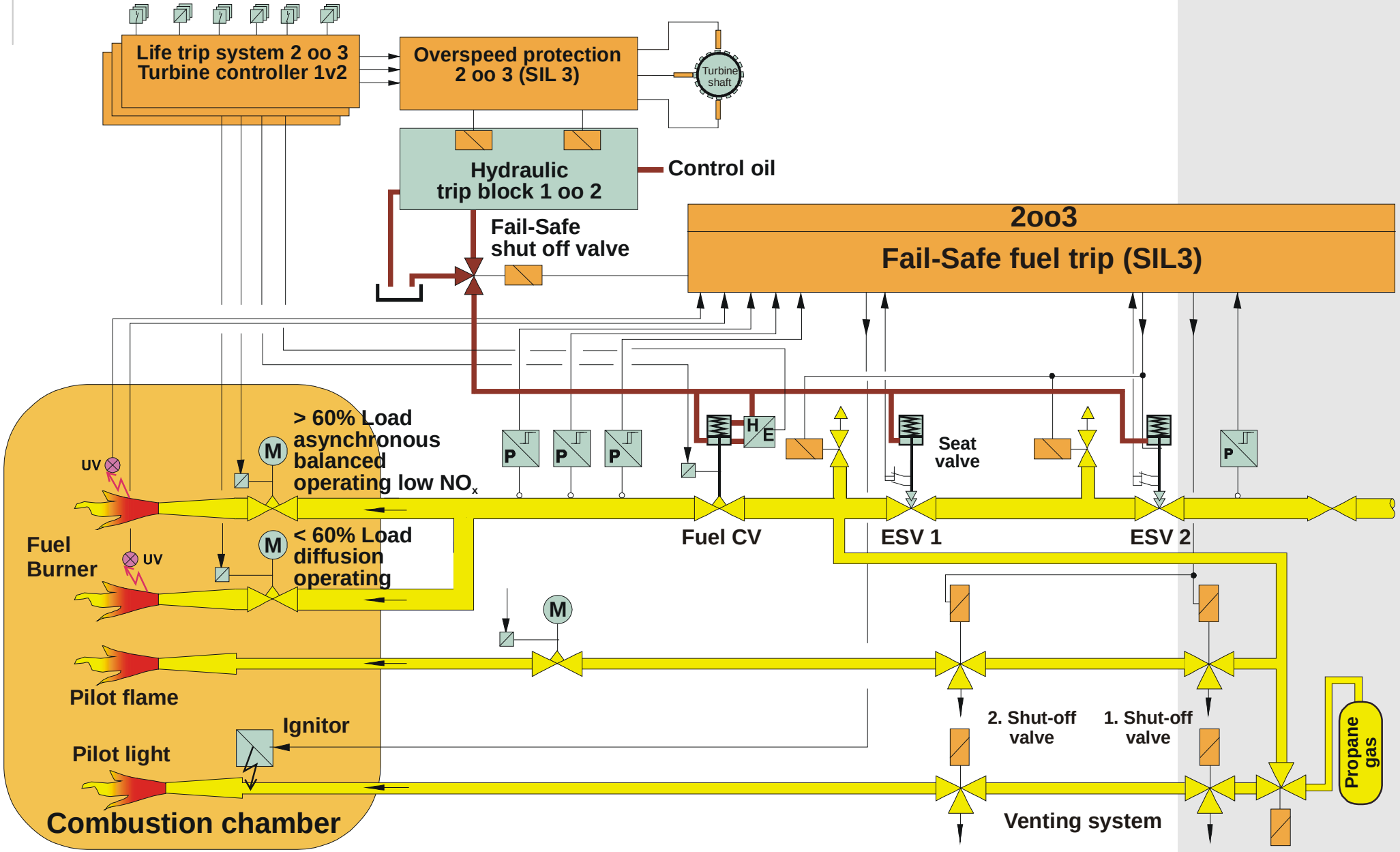
ME4012 Processinterface

Digital speed measurement :
Accuracy : 0,004 % = +/- 2mHz at 50 Hz netw. frequency
Signal resolution : 0,5 mHz
Signal scan cycle : 4 ms
Measuring range : >3 - 3600 U min $^{-1}$
Long-term- and temperature- stability due to digital acquisition and processing

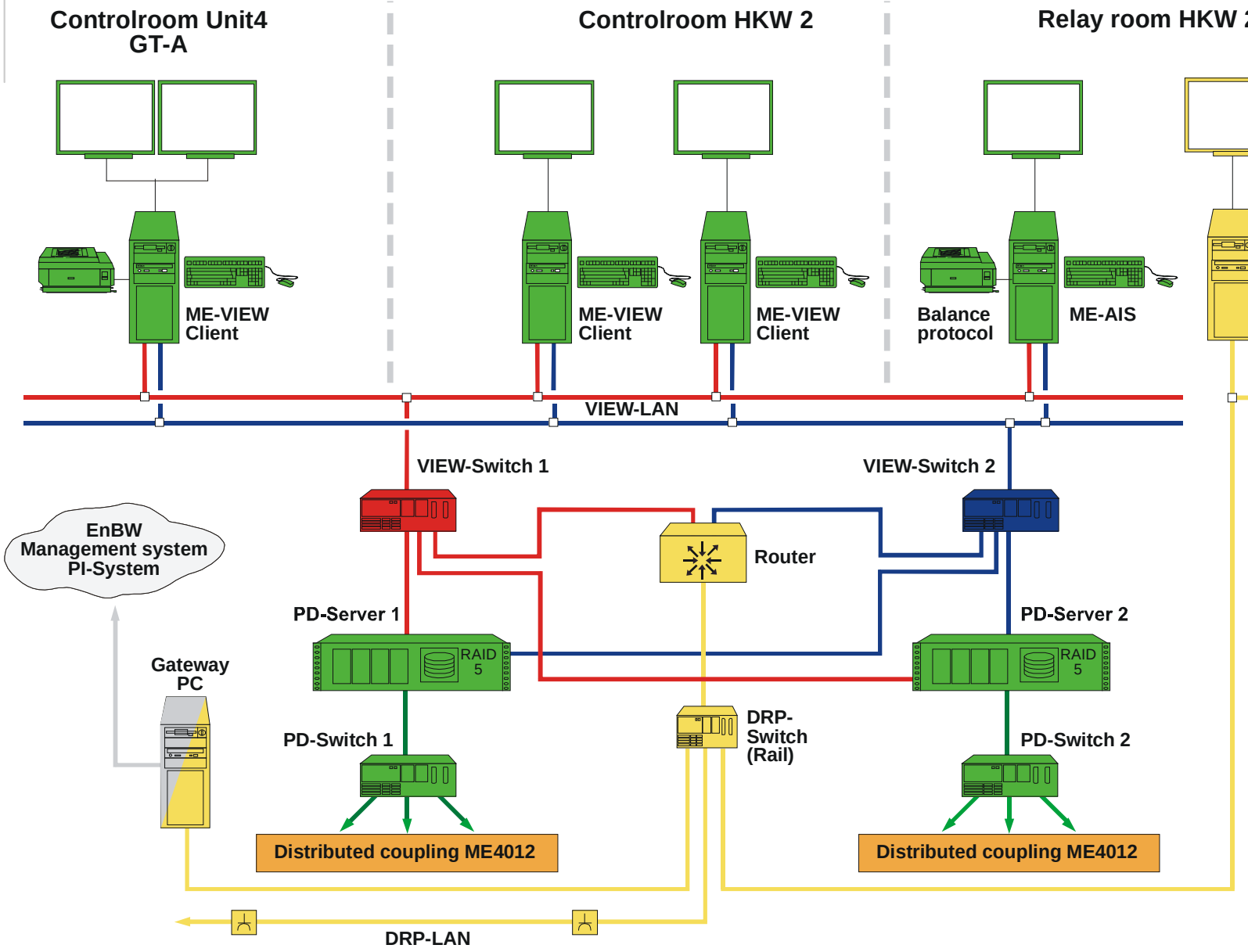
2. Solution: Functions and Control Strategy
Gasturbine protection: Overview machine protection



2. Solution: Functions and Control Strategy
Gasturbine protection: Overview fuel trip system



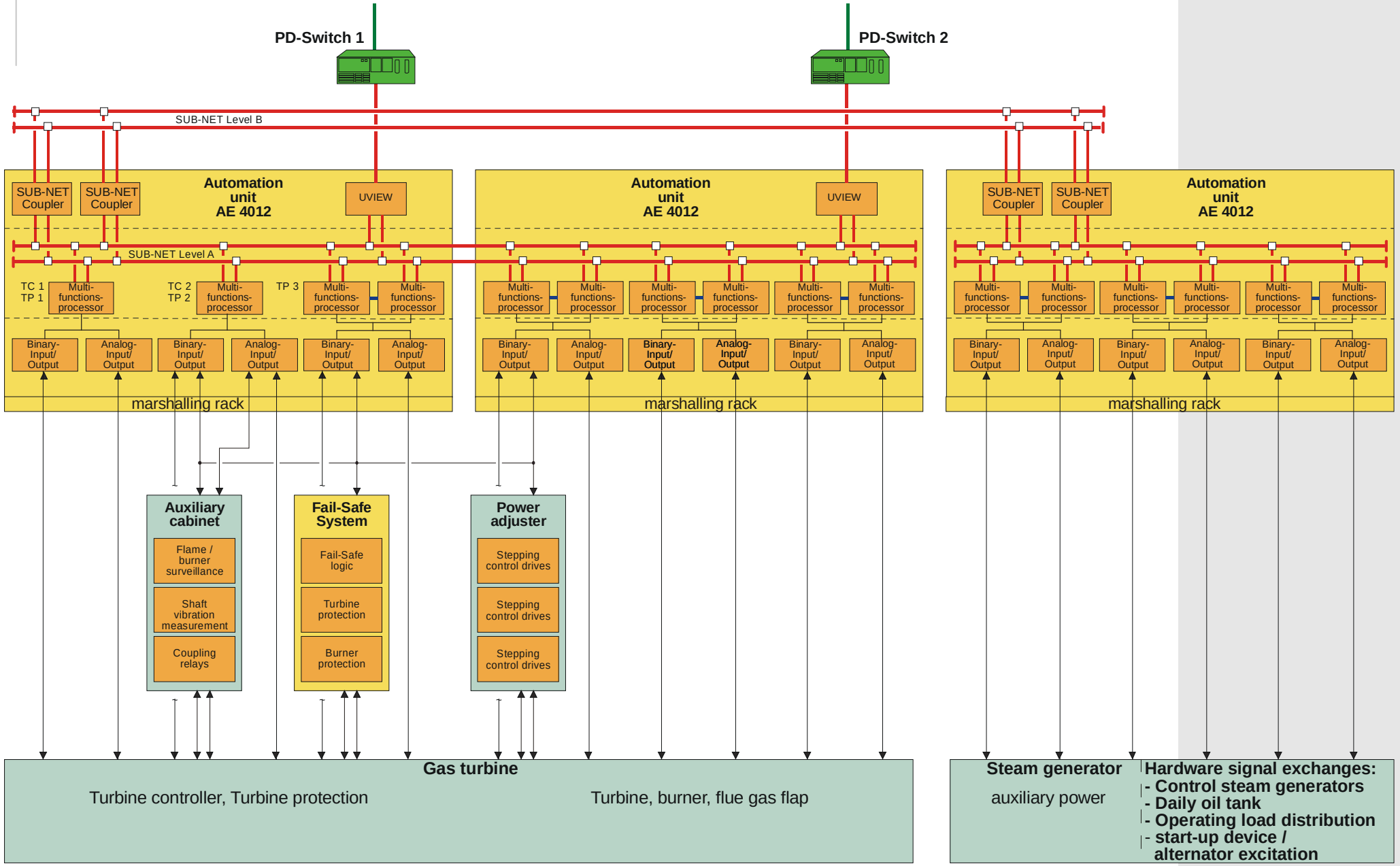
2. Solution: Functions and Control Strategy
Operator system ME VIEW and location involvement



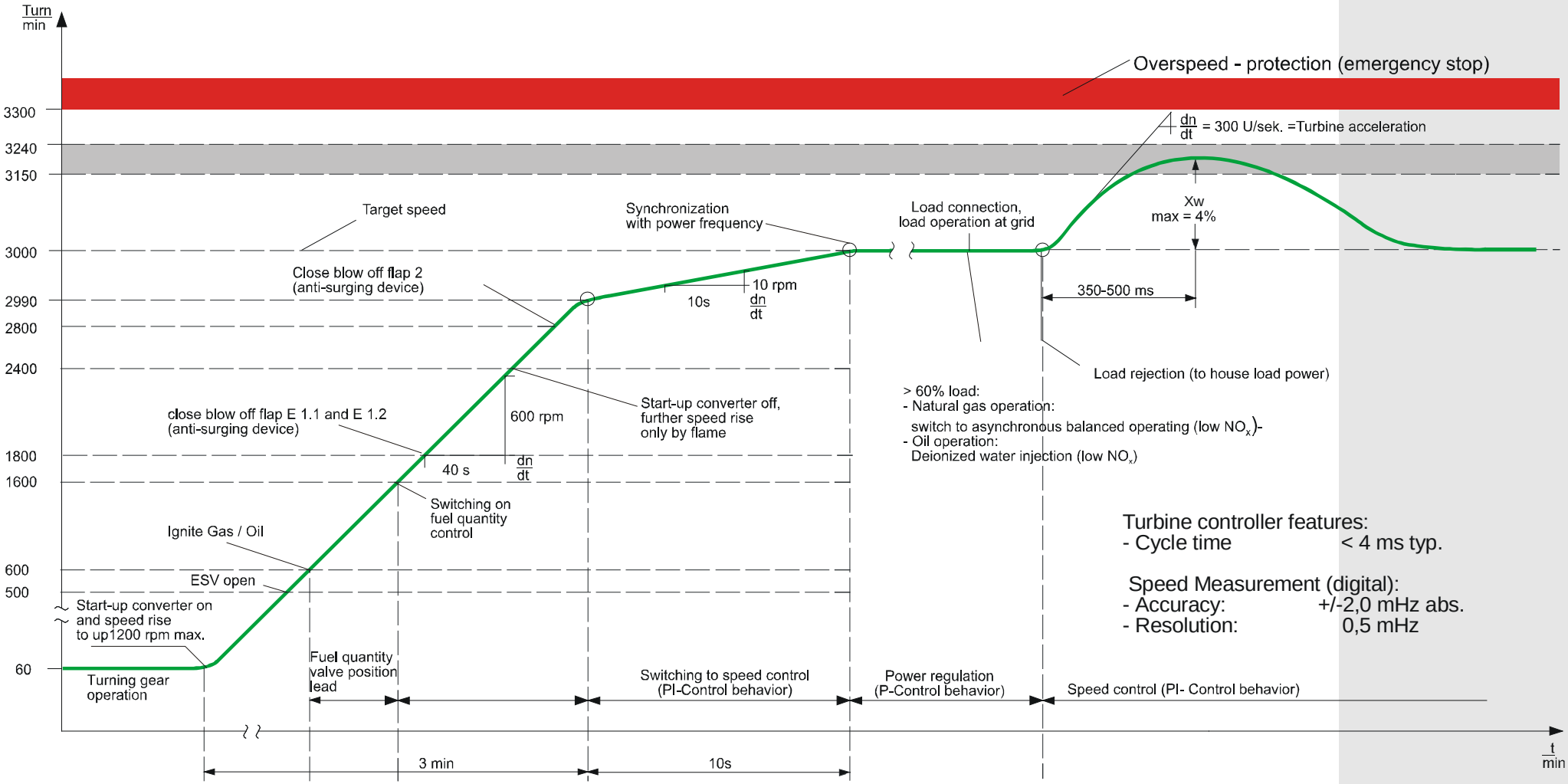
Documentation
VGB standard R 170 C

On-line features:
-- Diagnosis
-- Configuration
-- Simulation

2. Solution: Functions and Control Strategy
Automation Unit AE 4012 and location involvement

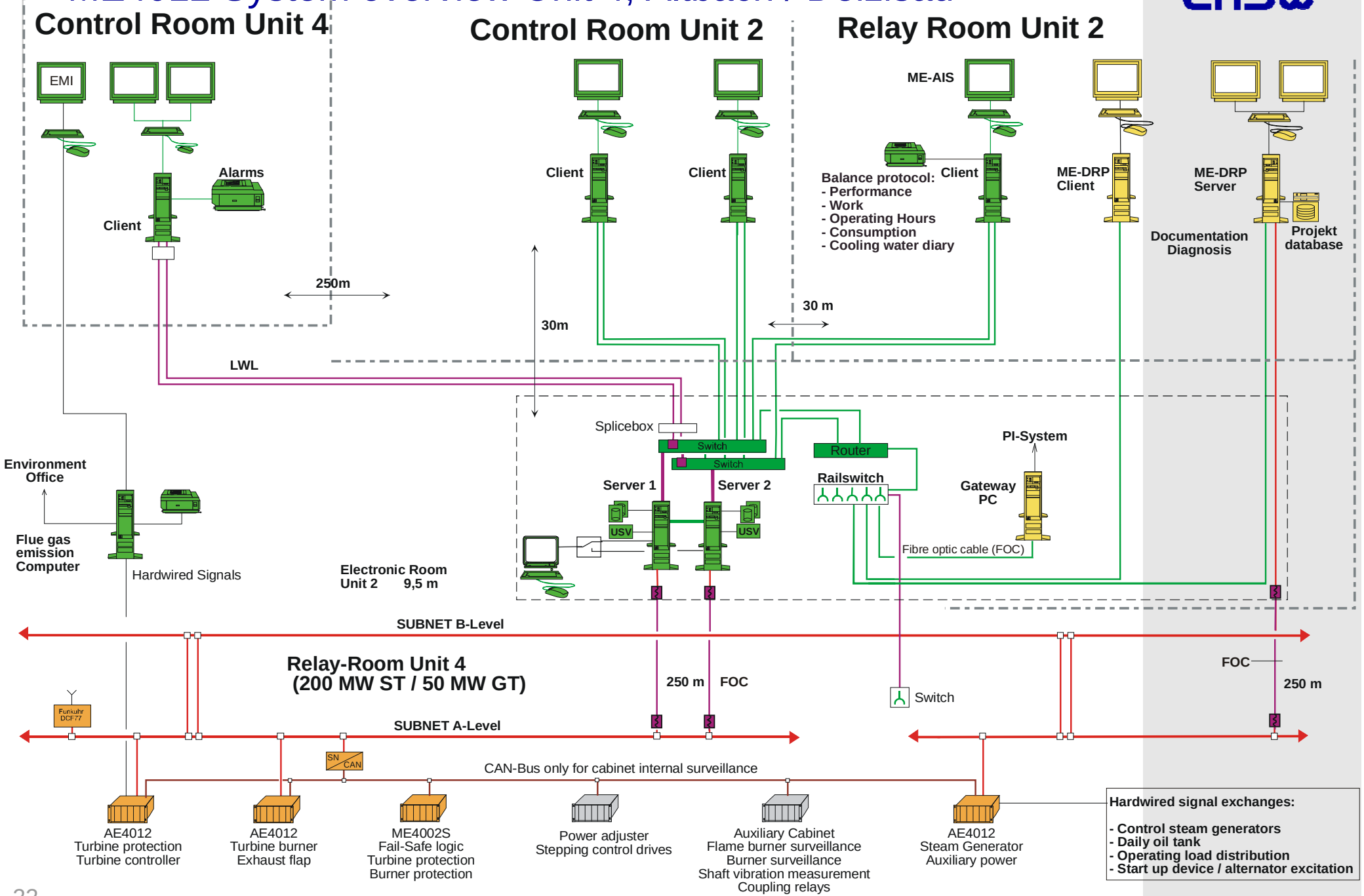


3. Achieved objectives and operational experience
Turbine behavior during start-up and load operation, total system integration, efficient control algorithms, high degree of automation



3. Achieved objectives and operational experience

ME4012 System overview Unit 4, Altbach / Deizisau



3. Achieved objectives and operational experience
Control system ME 4012 characteristics for GT-A

- **Plant functionality corresponds to the expectations of the plant operator**
- **Old documentation evaluated with red marks updated or scrapped**
- **New documentation strictly according VGB Directive: R 170 C**
- **Improving the control behaviour and the stability of operating transitions**
- **System-hardware and -software based on standard components of the Process Control System ME 4012, (replacement for Transidyn (controller), Transicont Protection), Simatic P and N)**
- **Redundant, highly accurate and extremely fast speed detection / control**
- **High availability with full redundancy of the overall system:**
  - **Signal interface, - processing, - communication,**
  - **Digital valve positioner (Cycle Time: < 4 ms)**
  - **Operator system**
- **Fully message processing with a time stamp at the signal source: accuracy and resolution: 1ms**
- **Turbine protection:**
  - **Over Speed Trip (SIL3, 2 oo 3)**
  - **Machinery protection (2 oo 3)**
  - **Rapid fuel shutdown (SIL3, 2 oo 3)**

3. Achieved objectives and operational experience in the power plant Altbach / Deizisau

Contract Award: August 2001

Mauell won the competition although:
not machinery supplier, not Station-control system.

Planning and Manufacturing: up July 2002

Control strategy:
- Implementation old / new through intensive cooperation Mauell / EnBW.
- Mauell adopted the plant functionality to the state of the art.
- Existing weaknesses were analyzed and eliminated by new concepts.

Mounting: September / October 2002

During the next major GT revision.

3. Achieved objectives and operational experience in the power plant Altbach / Deizisau

Commissioning: January / February 2003

- Re-commissioning of fuel oil after 13 starts
- Re-commissioning of fuel gas after 8 Starts
- Optimization of all transitions
- Involvement in the site control system:
  - PI- System (Process Information System)
  - Unit Control System
  - operational load dispatcher

Acceptance: March 2003

Extensive functional testing of the turbine control:

- Automatic start-up of the gas turbine to rated speed
- Automatic Synchronization
- Automatic load increase at about 7 MW / min. to base load
- Speed controller load operation:
  switching speed controller to load controller under load
- Interception security from full load to house load (GT or Unit 4)
- Redundancy test at all operating conditions and loads
- Flying fuel change (gas / oil and oil / gas) under load
- Testing the primary control
- Testing the limit frequency control
- Hot start tests
- Trip tests of protection system
  (Shaft vibration monitoring, over speed, fuel-trip)

Summary: (After 5 years of plant operation)

- Excellent system technology with outstanding performance
- Very good teamwork of EnBW / Mauell employees in the field of special process engineering expertise
- Highest level of automation to secure / easy and fast unit start-up
- Modern control concepts for robustic and efficient plant operation
- Fully Integrated Control concepts for all operating modes and transitions
- Reducing the risk of “combustion chamber drone“
- High reliability for all applications
- Long-term assets-backed operation (spare parts and service)

Reference List Process Control System ME4012: Gasturbines and Combined Cycle Plants

No.	Plant Operator	Country	Manufacturer DT / GT	Steam turbine / Gas turbine	Function
1	HKW Halle / Trotha	D	Siemens / Siemens V64.3	60 MW / 25 MW	Serial integration of GT- and DT-control system in the Process Control System ME 4012
2	Stadtwerke Munich Heizkraftwerk Süd Combined Cycle 1	D	Siemens / Siemens V94.1	105 MW / 2x 100 MW	Plant Control System ME 4012 for control and protection
3	Stadtwerke Munich Heizkraftwerk Süd Combined Cycle 2	D	ALSTOM Power / General Electric Frame 9E	140 MW / 2x 140 MW	Plant Control System ME 4012 for control and protection Integration of process-bus into Mark 5-GT-control system
4	EnBW PP Altbach / Deizisau, GT-A	D	Siemens V93.0	50 MW	Plant Control System ME 4012 for control and protection
5	Industry Power Plant Carl Freudenberg, Weinheim, GT1	D	Ruston Tornado	6,3 MW	Hard-wired interfacing to Unit Control System Boiler 4
6	Industry Power Plant Carl Freudenberg, Weinheim, GT2	D	Turbomach Caterpillar, Taurus T60	5,5 MW	Hard-wired interfacing to Unit Control System Boiler 5

A01.4012.11E08

EnBW

Energy
needs Impulses

mauell