

# TMOS

Gas Turbine HMI



*Over 400 clients, 90 countries, and more than 30 years in the turbine industry.*

Since 1983, TTS has provided innovation, high quality solutions and engineering expertise to clients worldwide.

Our offering to the mature gas turbine market includes:

- Parts supply
- Conversions, modifications and upgrades
- Engineering and on site services
- Power plant services
- Combustion and performance services

We know gas turbines.



# Why upgrade your operator interface?

## ISSUES WITH ORIGINAL <I> & <HMI> SYSTEMS

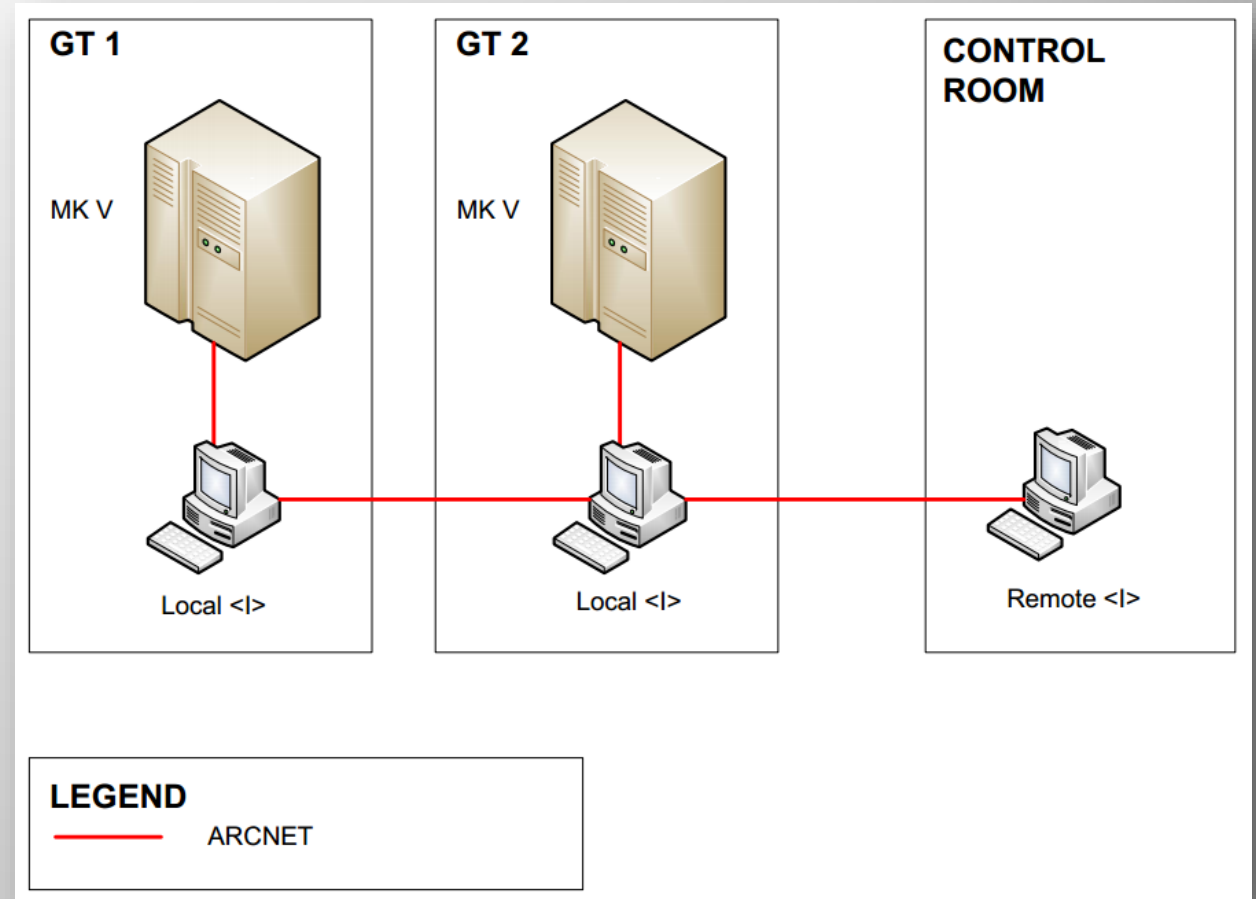
- Current system is based on obsolete hardware and software
- Not user friendly
- Difficult to get spares and or support
- Decreasing reliability
- Limited functionality, flexibility and connectivity
- No automatic fail over redundancy
- New plant layout engineering



# Outdated Network

## ORIGINAL OEM DESIGN

- Point to Point Architecture
- Limited Update Speeds
- Limited Redundancy
- No Auto Failover
- One license per HMI



# Introducing TMOS

SPECIFICALLY DESIGNED HMI FOR POWER GENERATION INDUSTRY

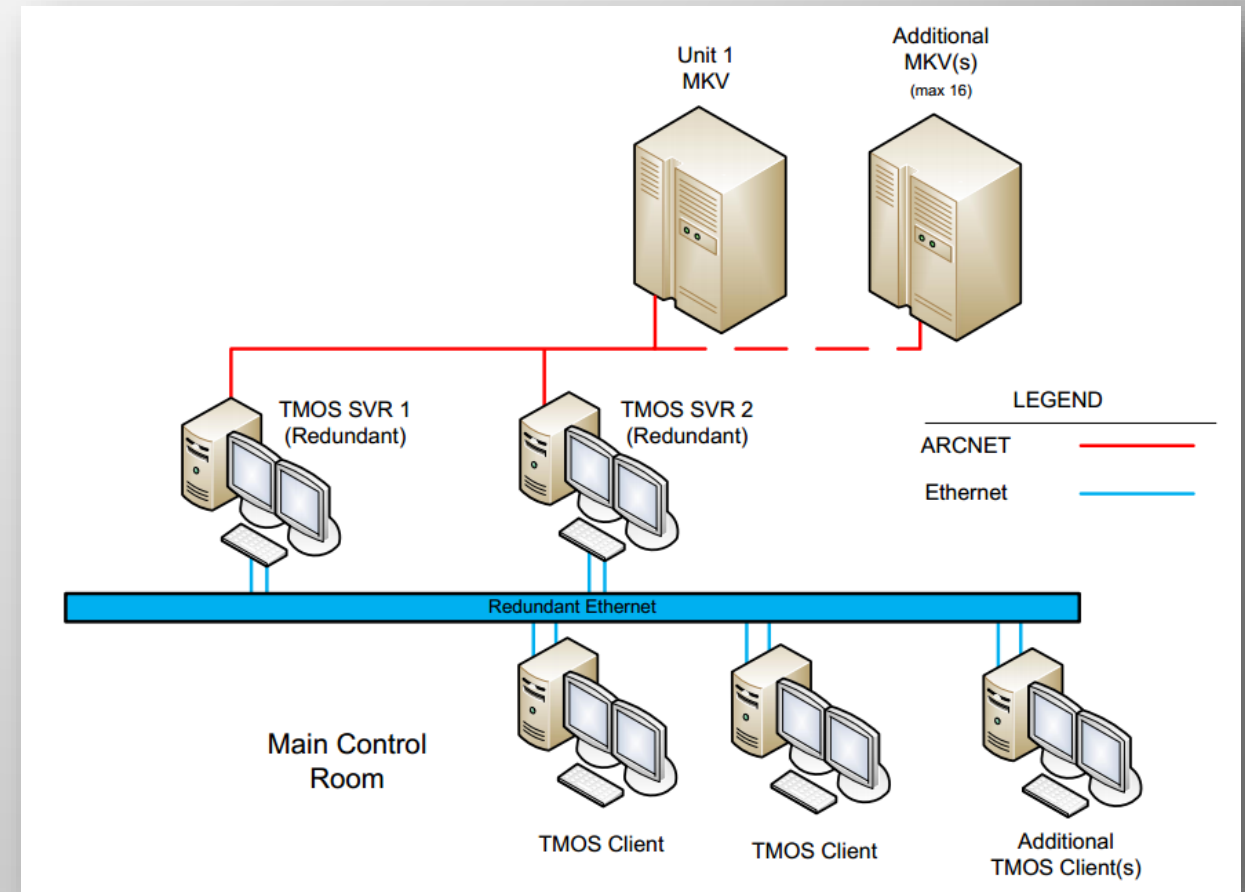
With its unmatched performance, high reliability and ease of functionality, TMOS is being used on 110+ units with millions of running hours and 4,177 MW at ISO conditions.

# Server Client Network

## TMOS Redundant Architecture



- Server – Client Architecture
- Redundant Servers Possible
- Redundant Comms Network
- Auto Failover Design
- One License per Server



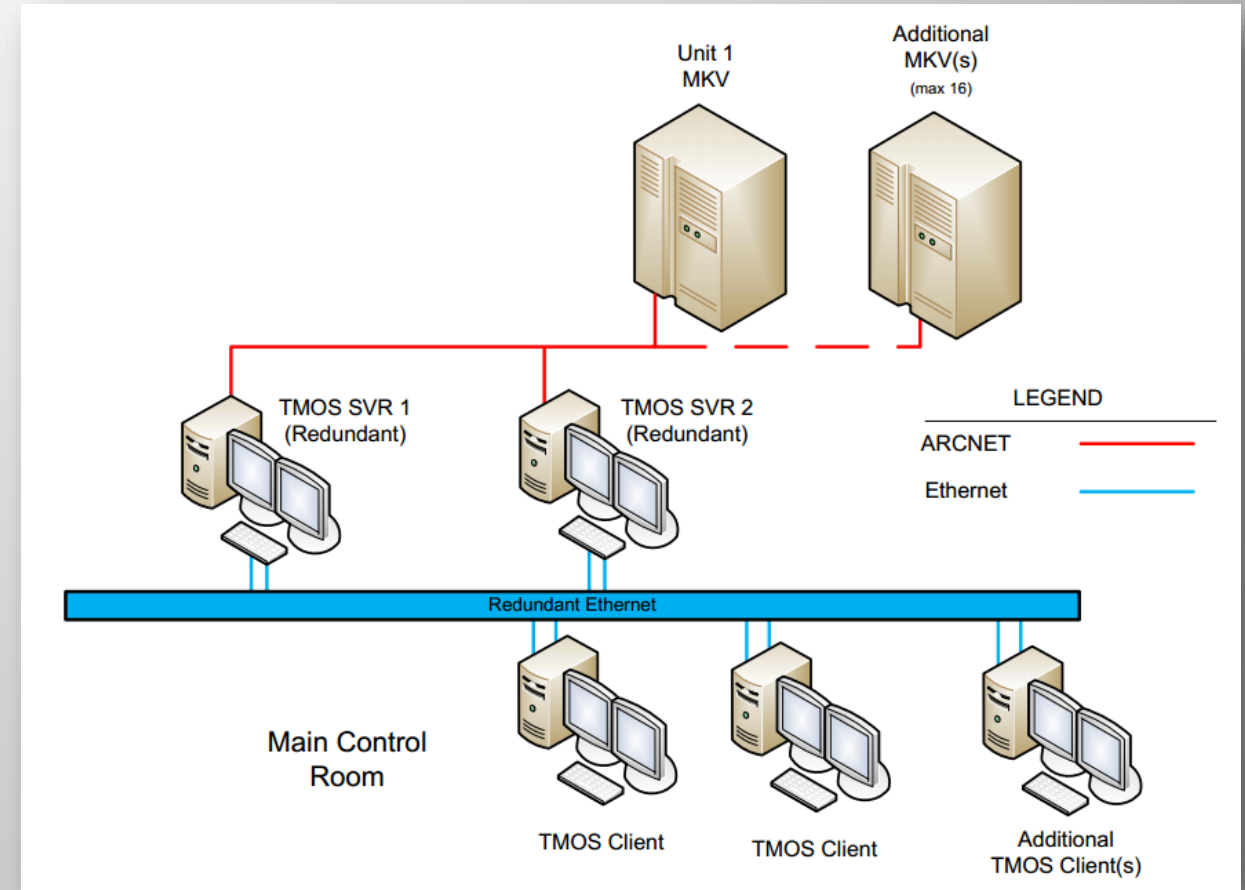
# Server Client Network

## TMOS REDUNDANT ARCHITECTURE



### Benefits

- Optimized Comms
- Can parallel to old system
- No shutdown required
- No PROM change required
- Upgrades provided across network
- Expandable
- Increased reliability/availability
- RAID 5



# TMOS Features & Benefits

SPECIFICALLY DESIGNED HMI FOR POWER GENERATION INDUSTRY

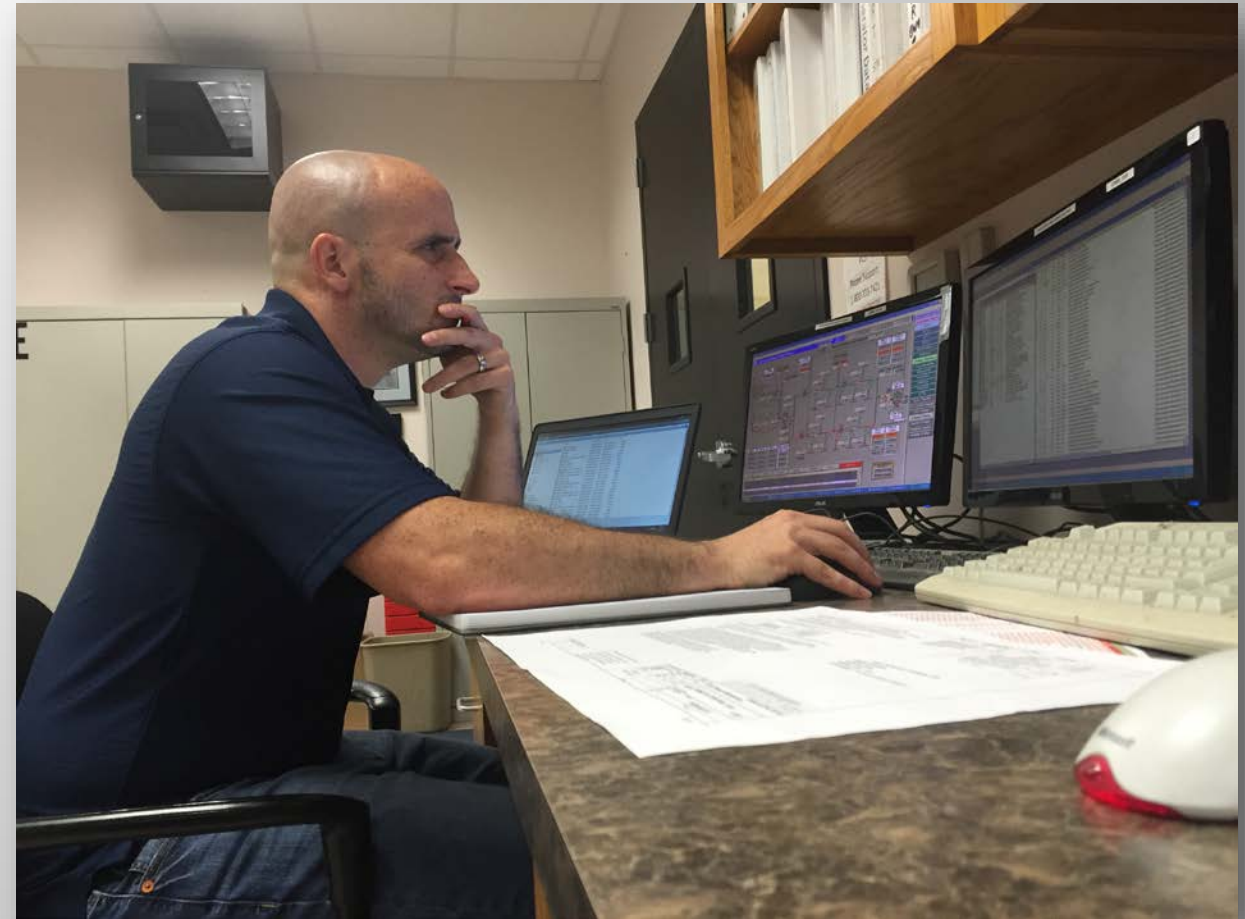
With its unmatched performance, high reliability and ease of functionality, TMOS is being used on 110+ units with millions of running hours and 4,177 MW at ISO conditions.



# Features Overview

PROVEN & FIELD TESTED

- Signal Information
- Historian
- Alarms Help
- Dynamic Rung Display
- Logic Forcing
- Control Constants Adjust
- SERVO Auto Calibrator
- Pre-vote Data Display
- EEPROM Programmer
- ARCNet Diagnostic
- Mark V Diagnostic Counters
- I/O Config



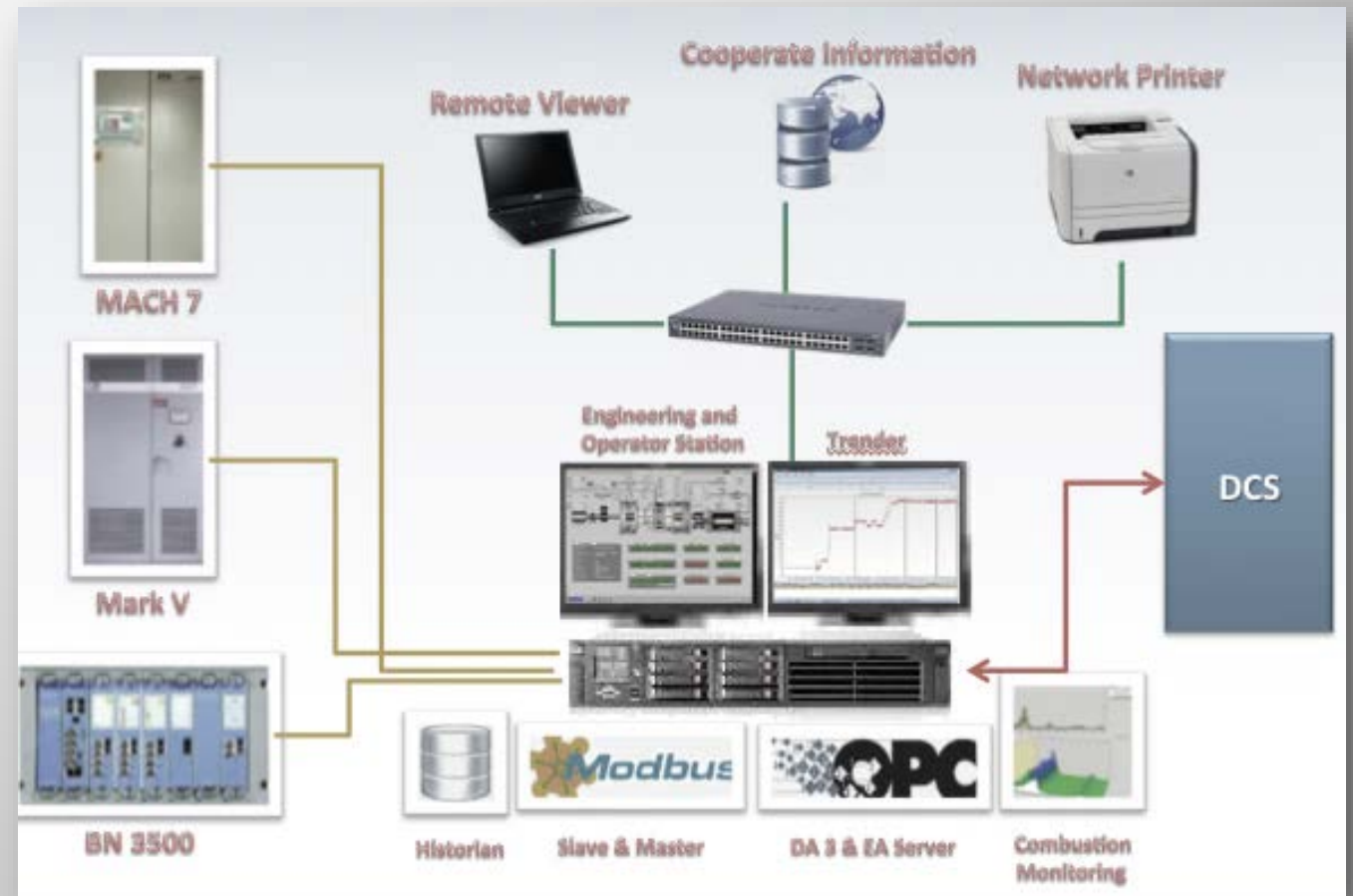
# Historian

- Historian included in base offering
- Stores desired signals in hard disks (analog and digital)
- Customizable sampling rates (up to max 62.5 ms/sample)
- Easy to retrieve information for trend analysis
- Log view for Alarms and Events, with printable report style



# Interface Options

- STAGELINK
- MODBUS
- OPC DA (3.0)
- OPC EA (1.0)
- GE GSM
- PROFIBUS
- DDUMP
- MAMSP
- EGD
- CUSTOMIZED options



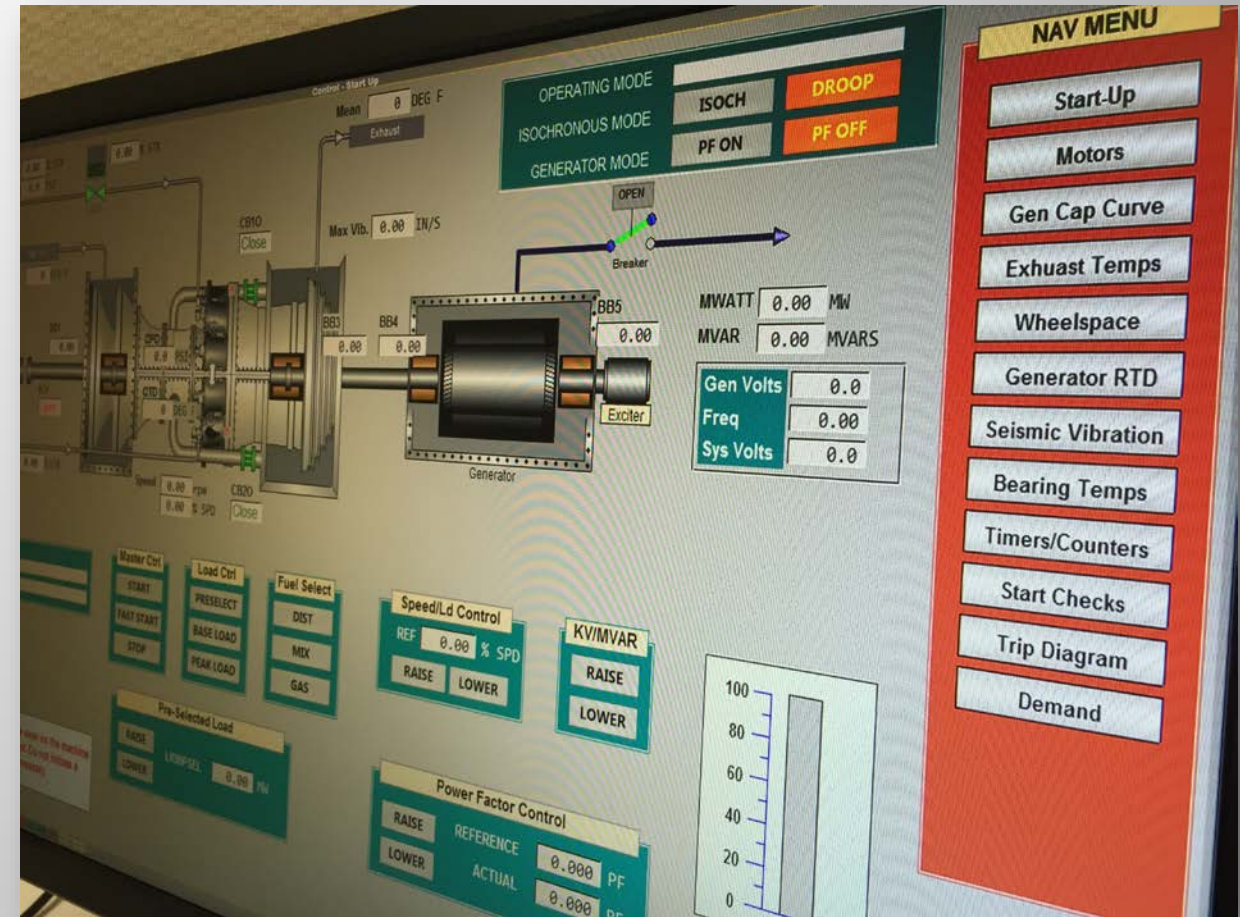
# TMOS Key Benefits

- No shutdown or unit outage required
- No Mark V EEPROM upgrade required
- Works in parallel with existing <HMI> or <I>s
- Customizable Solutions
- Maximized User Experience



# Upgrade Considerations

- Important to consider life cycle cost
- Hardware costs
- Software costs
- Installation costs
- Validation costs
- Support costs
- Maintenance costs
- Expansion/Migration costs



# Sample Screens

SPECIFICALLY DESIGNED HMI FOR POWER GENERATION INDUSTRY

With its unmatched performance, high reliability and ease of functionality, TMOS is being used on 110+ units with millions of running hours and 4,177 MW at ISO conditions.

# Signal Information

FUNCTION

**T1:FSGR**

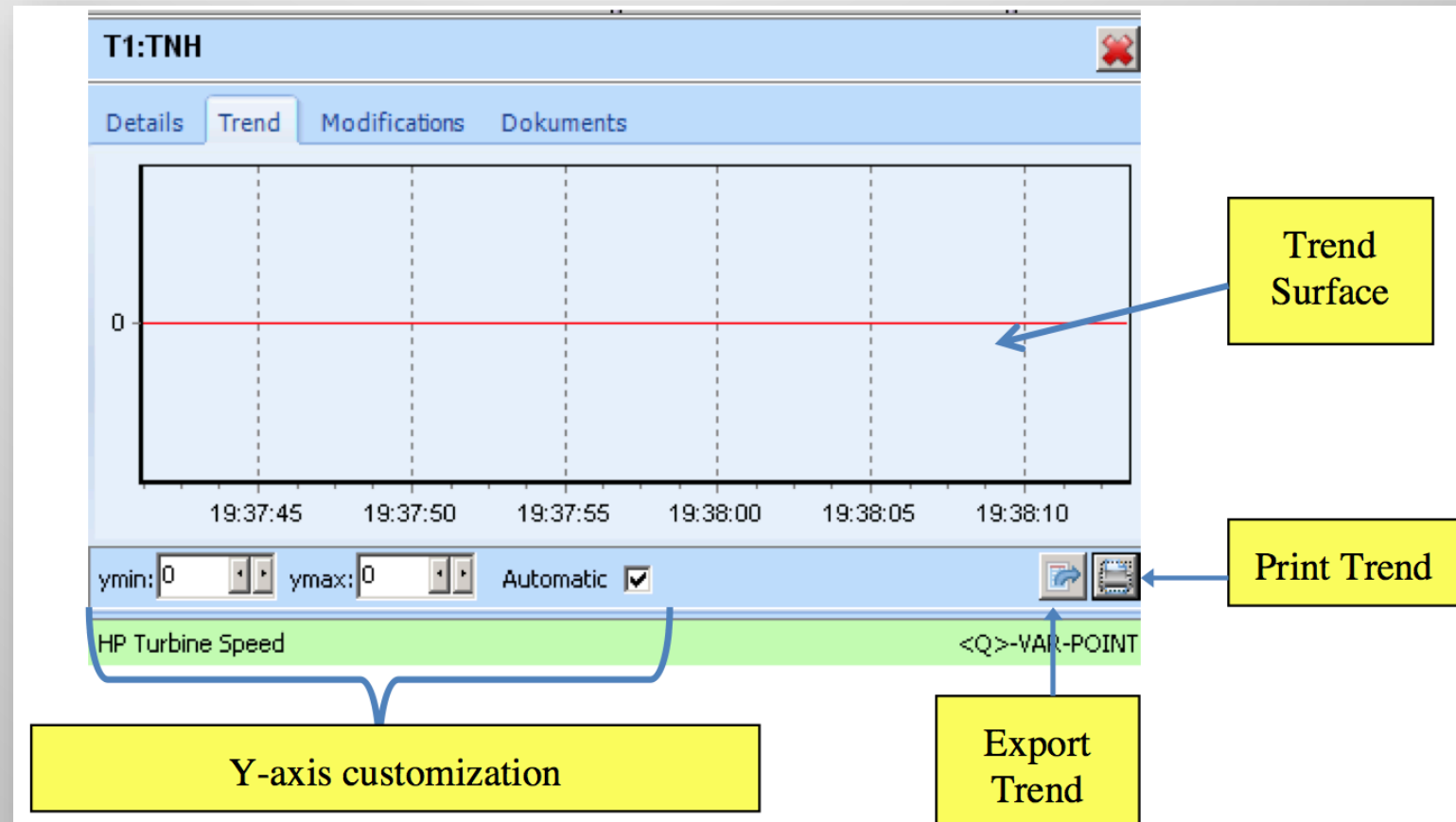
Details Trend Modifications Dokument

Item	Value
Unit	1
Signalname	FSGR
Last update timestamp	30.12.1899 00:00:00.000
Raw_Value	0
Value	0.00
Eng.Unit	%
Quality	0
Longname	Q -TBQC-001 Position fdbck srv (high value selected)
Synonym	
ANSI	

Q -TBQC-001 Position fdbck srv (high value selected) <PV><Q>-VAR-POINT

# Signal Information

TREND





# Signal Information


## MODIFICATION

T1:L33CB20

Details Trend Modifications Dokuments

Representation	Eng.Unit	Actual Value	Set to Value
DEZ	BYTE	0	
INT	BYTE	0	
HEX	HEX_2	00	
BIN	HEX_8	00000000	
FLOAT[0]	LOGIC	0	
FLOAT[1]	LOGIC	0	

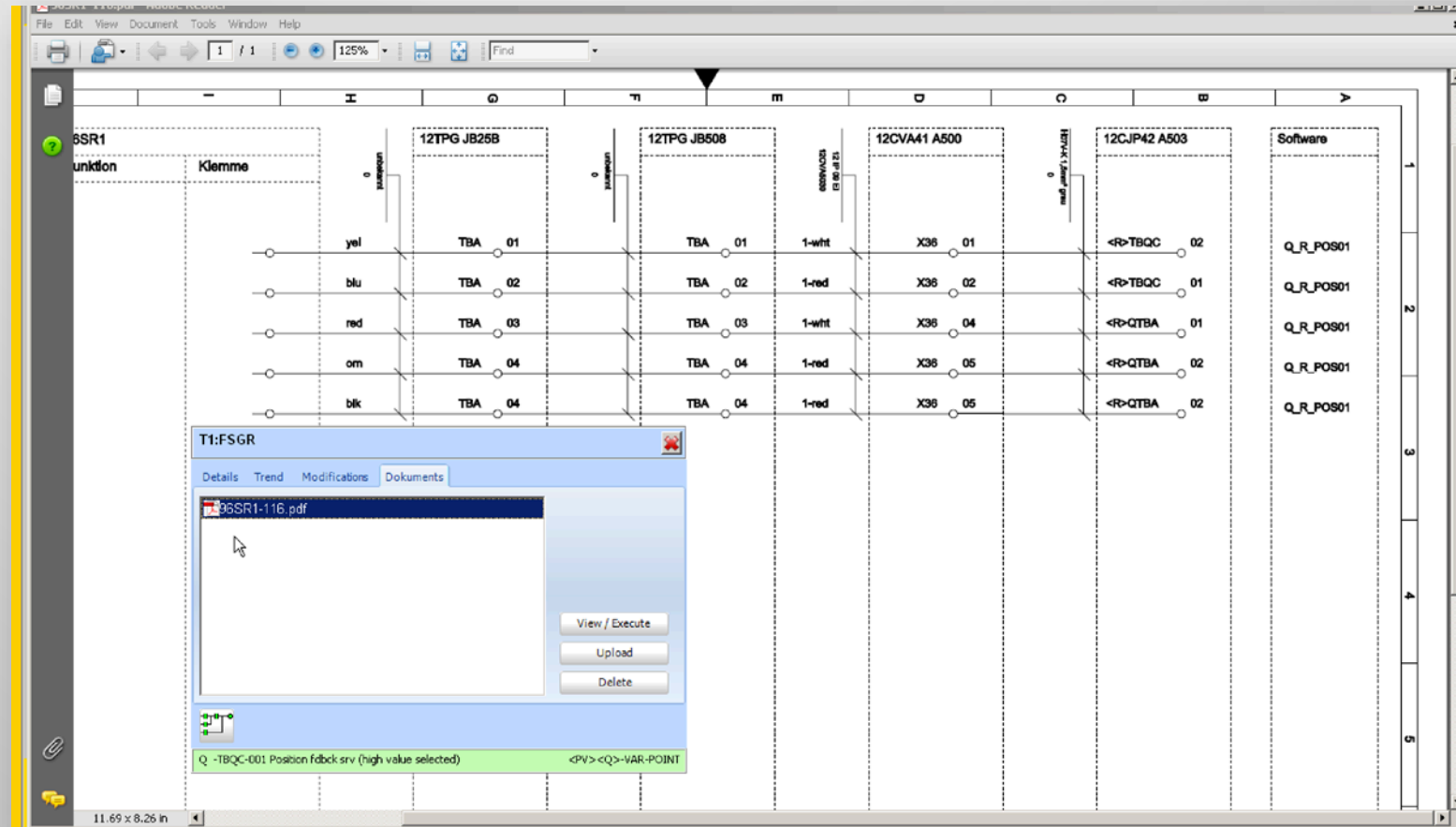
Force to <1> Force to <0> Un-Force Un-Force All



QD2-DTBB-017 Compressor bleed valve #2 open [33CB-2] <PV><Q>-VAR-POINT

# Signal Information

## DOCUMENTS



# Historian

## LOGICS & ANALOGS



# Historian

## ALARMS & EVENTS

**D.E.A.-Viewer**

viewed types: % viewed time frame: 7/16/2007 3:23:07 PM -> 7/17/2007 3:23:07 PM page: 1 / 14

filter / options: show last hours 1 6 24 timestamp from: 7/17/2007 12:00:00 A to: 7/17/2007 3:23:07 F reload every 0 sec.

Row	T	Timestamp	U	S	L	A	P	Nr	Signalname	Longname
1	D	17.Jul.2007 15:13:13.000	T3	✓			T	1217		TCQA memory change made by UDM
2	D	17.Jul.2007 15:12:31.000	T3	✓			S	1217		TCQA memory change made by UDM
3	D	17.Jul.2007 15:11:35.000	T3	✓			R	1217		TCQA memory change made by UDM
4	L	17.Jul.2007 15:11:01.406	T2	✗			R	0	L63TK1L	QD1-DTBB-055 Turb shell & exhaust frame blower dsch press sw [63TK-
5	L	17.Jul.2007 15:11:01.375	T2	✓			R	0	L63TK1L	QD1-DTBB-055 Turb shell & exhaust frame blower dsch press sw [63TK-
6	D	17.Jul.2007 15:08:40.000	T3	✗			S	1217		TCQA memory change made by UDM

# Alarm Help & Rung Display

QUICK ACCESS SHORTCUT



## Process Alarms

ACC All RESET All ACC Alarm RESET Alarm LOCK Alarm

Timestamp	Unit	S	L	A	P	Alarm Nr.	Description
07.Mar.2013 14:24:26.969	T1				C	0000	DIAGNOSTIC ALARM <C><Q>
07.Mar.2013 14:22:25.531	T1				C	0062	COMMON IO COMMUNICATION LOSS
07.Mar.2013 14:22:04.469	T1				C	0277	COMP INLET TEMP TC TROUBLE
07.Mar.2013 14:21:55.594	T1				C	0276	COMP DISCHARGE TEM
07.Mar.2013 14:21:55.594	T1				C	0389	AMBIENT TEMP THERMOCOUPL

Information  
Signalname: L3TCI\_ALM

# Alarm Help & Rung Display

## QUICK ACCESS SHORTCUT

T1:L3TCI\_ALM

Details Trend Modifications Dokuments

Item	Value
Unit	1
Signalname	L3TCI_ALM
Last update timestamp	30.12.1899 00:00:00.000
Raw_Value	0
Value	0
Eng.Unit	LOGIC
Quality	0
Longname	ALMTXT:'COMP INLET TEMP TC TROUBLE'
Synonym	
ANSI	

ALMTXT:'COMP INLET TEMP TC TROUBLE' <Q>-ALARM

# Alarm Help & Rung Display

## QUICK ACCESS SHORTCUT

The screenshot shows the RUNGDISPLAY software interface. The main window displays a ladder logic rung with a normally open contact labeled 'L3TCI' and a coil labeled 'L3TCI\_AL M'. The status bar indicates 'SEGMENT: SEQ\_TRB2 RUNG 56 OFF 267 SCR LINE: 686'. The left sidebar shows a tree view with 'SEQ\_TRB2' selected. The bottom panel contains search and navigation controls.

**Search control:**

- Search All
- Search Coils
- Automatic view of first rung in search result:
- Enable cross link search:

**Block Signals:**

- Show Signalnames:
- Show Signalvalues:
- Show Automatics:

**Value Format:**

- Calc:
- DEC:
- HEX:

**Signal scaling:**

- METRIC:
- ENGLISH:

**Navigation buttons:** Prev. Rung, Last Rung [2], Prev. Segment, Next Segment, Next Rung, Goto [1], Actual Rung

Signalname:	Val:	Unit:	Addr.:	Type:	C_Type:
Longname:					
HW Description:					

# Logic Forcing & Control Constants Adjust

The screenshot displays the 'Signal View' software interface for 'Logic Forcing + Control Constant Adjust GT#1'. The interface is divided into several sections:

- Signal Database:** Includes 'Select options' (All Signals, C-Const only, Logic only) and a list of signal names.
- Signalist:** A table showing signal details for selected signals.
- EDIT SIGNAL:** Fields for 'Signal to edit' and 'MKV Addr.'.
- Force Logic Signals:** Buttons for 'Force to <D>', 'Force to <1>', 'Unforce Single', and 'Unforce All'.
- Control Constant Adjust:** Fields for 'Value', 'New', 'Change' (per second), and buttons for 'Change in steps', 'Change in one step', 'STOP Stepchange', 'Per click value', 'Raise/Lower', and 'EEPROM Update'.

**Signalist Table:**

Signalname	POS	<C> VALUE	<R> VALUE	<S> VALUE	<T> VALUE	UNIT	SIGNAL KIND	F/A
CSKRPRDB	7001					RES_R	<D>-CCONST	↔
CSKRIHX2	6694					%	<Q>-CCONST	↔
CSKRIHX1	6693					%	<Q>-CCONST	↔
CSKRIHX3	6695					%	<Q>-CCONST	↔

**History:** LOGIC SIGNAL CODE: 1: ● 0: ● FORCED: ● Search for forced signals F / A COLUMN: Logic Forcing is enabled. Control Constant Adjust is enabled.



# Automatic Servo Regulator Calibration Tool

**Servo Valve calibration**

Available Regulators

Reg.	Regulator Title
1	GAS STOP RATIO VALVE
2	GAS CONTROL VALVE
3	Unused Servo Output Loop #3
4	Unused Servo Output Loop #4
5	INLET GUIDE VANES
6	Unused Servo Output Loop #6
7	Unused Servo Output Loop #7
8	Unused Servo Output Loop #8

Calibration Messages

R: IDLE

S: IDLE

T: IDLE

Control

ENABLE MANUAL AUTO CALIBRATE IDLE

EXECUTE

Manual Valve manipulation

0 SET RAISE LOWER

List View

	<R>	<S>	<T>	
Calibration Buffer	9138	9138	9138	HEX
Calibration Buffer Command	0	0	0	BYTE
SVD Number	1	1	1	HEX
Regulator Position POS SAT	-0.09	-0.09	-0.09	%
Regulator Position NEG SAT	100.00	100.00	100.00	%
Regulator Manual Position	0.00	0.00	0.00	%
Calibration Mode	0	0	0	BYTE
Calibration State	15	15	15	BYTE
Node in charge with calibration	0	0	0	BYTE
Regulator type	77	77	77	HEX
LVDT #1 Voltage	0.758	0.770	0.787	Vrms
LVDT #1 Offset	0.757	0.773	0.789	Vrms
LVDT #1 Gain	0.0341	0.0342	0.0341	Vrms/%
LVDT #2 Voltage	0.785	0.783	0.804	Vrms
LVDT #2 Offset	0.788	0.786	0.805	Vrms
LVDT #2 Gain	0.0335	0.0334	0.0334	Vrms/%
Capture Buffer Pointer	0501	0501	0501	HEX
Capture Buffer Addr.	9E06	9E06	9E06	HEX
Capture Buffer Content	4330	4330	4330	HEX
Required Position	-2.50	-2.50	-2.50	%
Calibration Reference	-2.50	-2.50	-2.50	%
Servo current output	-97.33	-97.33	-97.33	%
Servo current measurement	56.61	58.22	53.34	%
Actual Position	0.06	-0.10	-0.06	%
LVDT #1 0% cal. ref.	0.757	0.773	0.789	VRMS
LVDT #1 100% cal. ref.	3.161	3.172	3.193	VRMS
LVDT #2 0% cal. ref.	0.788	0.786	0.805	VRMS
LVDT #2 100% cal. ref.	3.240	3.243	3.263	VRMS

# Pre-vote Data Display

Prevote Data Display GT-1A

DATA VIEW

POINTNAME	VOTED	<R> VAL	<S> VAL	<T> VAL	UNITS
L28FDA	1	1	1	1	LOGIC
L28FDB	1	1	1	1	LOGIC
L28FDC	0	0	0	0	LOGIC
L28FDD	0	0	0	0	LOGIC
L28FDE	0	0	0	0	LOGIC
L28FDF	0	0	0	0	LOGIC
L28FDG	0	0	0	0	LOGIC
L28FDH	0	0	0	0	LOGIC
L5E_TCEA	1	1	1	1	LOGIC
L4_FB	1	1	1	1	LOGIC
L52B_SEL	1	1	1	1	LOGIC
L12H_P	0	0	0	0	LOGIC
L12L_P	0	0	0	0	LOGIC
L14H_ZE	0	0	0	0	LOGIC
L14L_ZE	1	1	1	1	LOGIC
L25	0	0	0	0	LOGIC
L30AS1	0	0	0	0	LOGIC
L30AS2	0	0	0	0	LOGIC
L30AS3	0	0	0	0	LOGIC
_L0051_SP	1	1	1	1	?

624 280

Load Logics Load Analogs

Prev Page Next Page

# EEPROM Programming Interface

The screenshot shows the 'MKV Software Upload / Download' window with the 'LOGGING' tab selected. The 'MONITOR' section displays a 'SEQ' download status: 'DOWNLOADING to Offset:4900 Bytes:CD RESULT:OK'. Below this, there are two tables: 'Offline' and 'Online'. The 'Offline' table has four rows, with the last row highlighted in green. The 'Online' table has six rows, with the second row highlighted in yellow. A progress bar at the bottom of the monitor section shows 22% completion. The 'SELECT FILE' section contains several checkboxes for file types: FORMAT, SEQ (checked), CONST, IOCFG, UBBL, HIST, EPA, MAOUT, EVENT, CHNG, BOI, TOTT, TOTD, and CBLR. The 'PROCESSOR SELECT' section has checkboxes for <C>, <D>, <R> (checked), <S>, and <T>. The 'CONTROL' section shows 'DOWNLOAD RUNNING' in red text and buttons for 'UPLOAD', 'DOWNLOAD', and 'CHECK'.

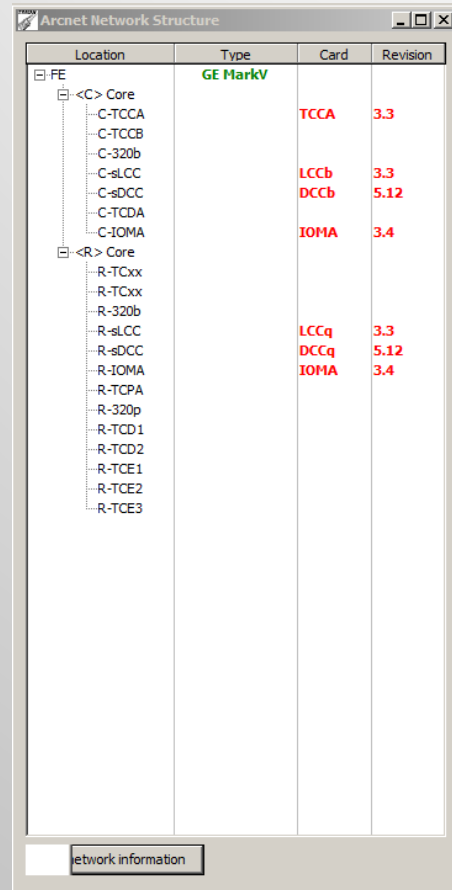
	File Timestamp	Datasize	Checksum
<B>	00-JAN-1980 00:00:00	0000	0000
<C>	00-JAN-1980 00:00:00	0000	0000
<D>	00-JAN-1980 00:00:00	0000	0000
<Q>	11_Mar.2007 19:34:16.000	246C	005B

	File Timestamp	Datasize	Checksum
<C>	00-JAN-1980 00:00:00	0000	0000
<D>	00-JAN-1980 00:00:00	0000	0000
<R>		09C0	0000
<S>	00-JAN-1980 00:00:00	0000	0000
<T>	00-JAN-1980 00:00:00	0000	0000

22%

**DOWNLOAD RUNNING**

# ARCWHO and PROM Version Checker



The screenshot shows a window titled "Arcnet Network Structure" with a tree view on the left and a table on the right. The tree view shows a hierarchy starting with "FE", followed by "<C> Core" and "<R> Core". Under "<C> Core", there are sub-items: C-TCCA, C-TCCB, C-320b, C-slCC, C-sDCC, C-TCDA, and C-IOMA. Under "<R> Core", there are sub-items: R-TCxx, R-TCxx, R-320b, R-slCC, R-sDCC, R-IOMA, R-TCPA, R-320p, R-TCD1, R-TCD2, R-TCE1, R-TCE2, and R-TCE3. The table on the right has columns for "Location", "Type", "Card", and "Revision". The "Type" column contains "GE MarkV" for the FE node. The "Card" and "Revision" columns contain values for various components, such as "TCCA 3.3", "LCCb 3.3", "DCCb 5.12", "IOMA 3.4", "LCCq 3.3", "DCCq 5.12", and "IOMA 3.4".

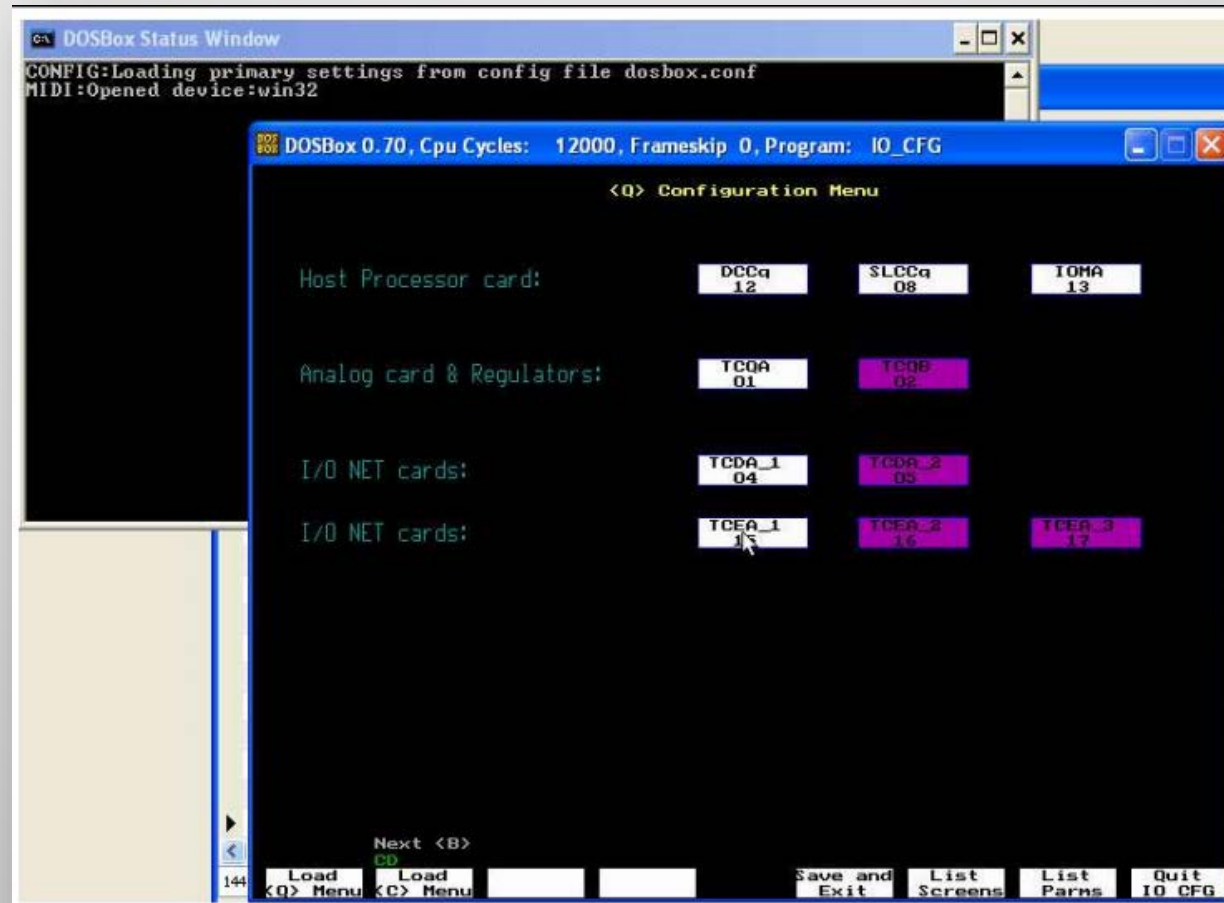
Location	Type	Card	Revision
FE	GE MarkV		
<C> Core			
C-TCCA		TCCA	3.3
C-TCCB			
C-320b			
C-slCC		LCCb	3.3
C-sDCC		DCCb	5.12
C-TCDA			
C-IOMA		IOMA	3.4
<R> Core			
R-TCxx			
R-TCxx			
R-320b			
R-slCC		LCCq	3.3
R-sDCC		DCCq	5.12
R-IOMA		IOMA	3.4
R-TCPA			
R-320p			
R-TCD1			
R-TCD2			
R-TCE1			
R-TCE2			
R-TCE3			

# Diagnostic Counter Display

The screenshot shows a software interface titled "Diagnostic Counter Display". On the left is a tree view under "TCCA#B Diagnostics" with "Processor Data" selected. On the right, the "Mainmenu: TCCA#B Diagnostics" and "Submenu: Processor Data" are shown. Below this, there are two processor selection buttons labeled "C" and "D", both with green progress bars. The main display area shows the following text:

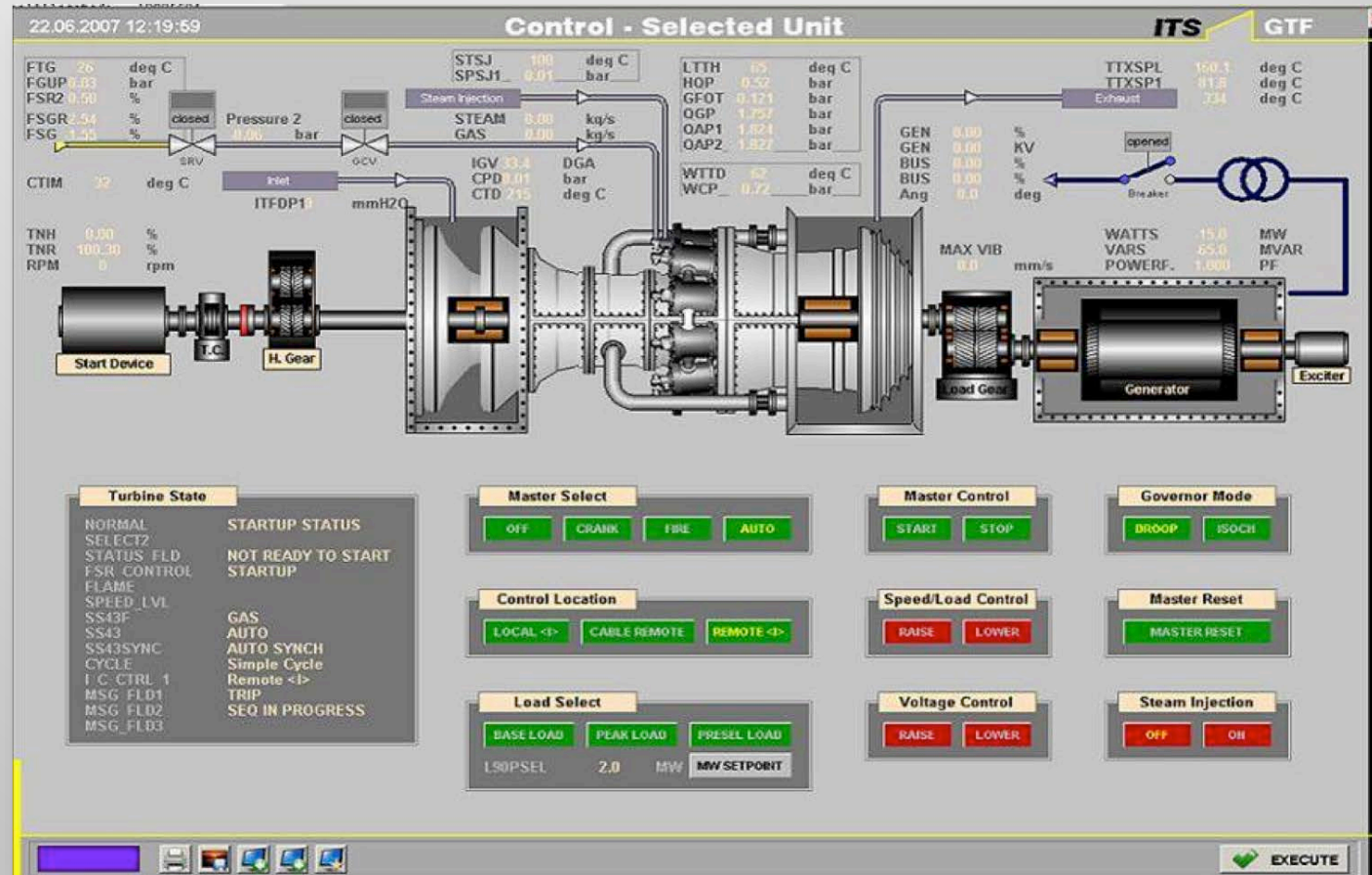
```
eprom date code= 00/00/00 00:00  
processor idle = 0%  
  
Firmware running=0. 0=TCCA#A firmware. 1=TCCA#B firmware.
```

# I/O Configurator



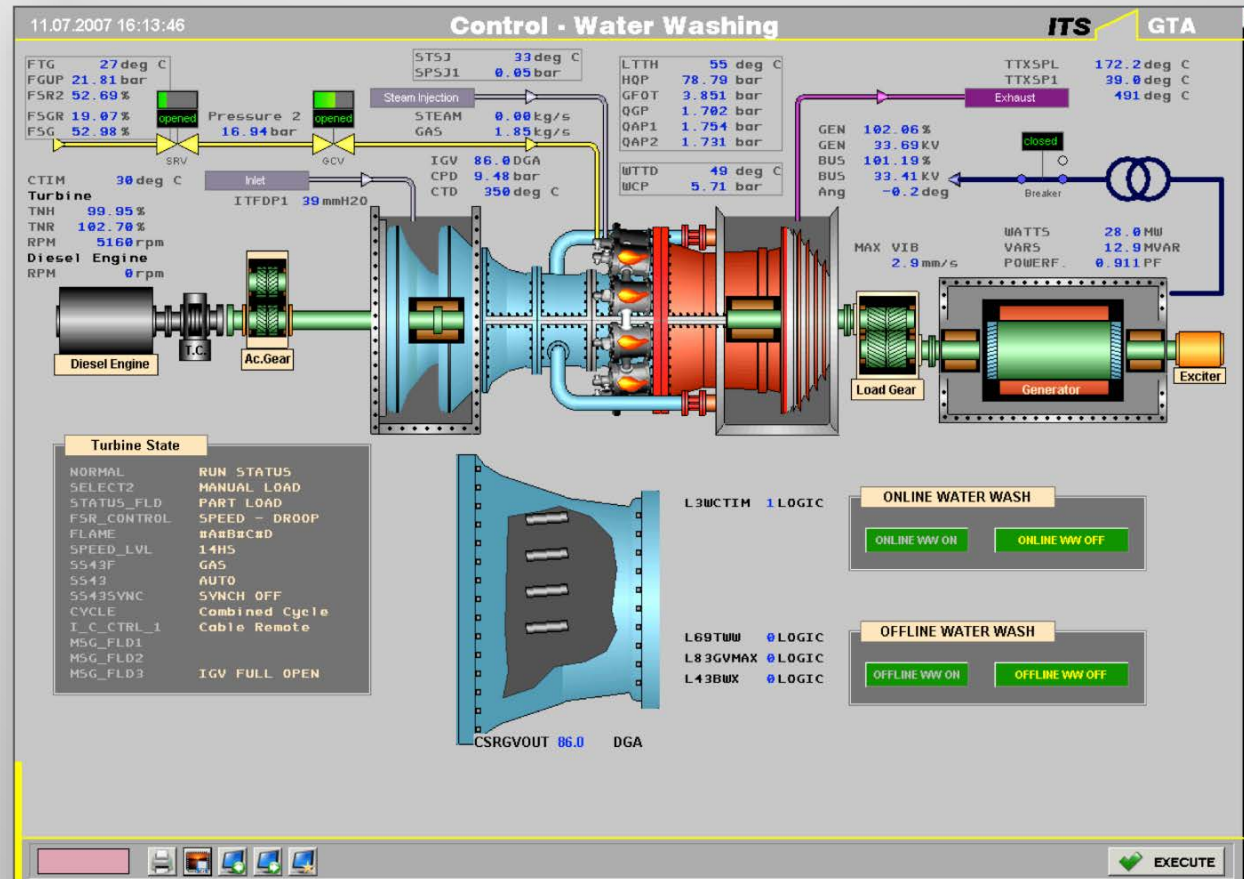
# Customized Display

## UNIT STARTUP



# Customized Display

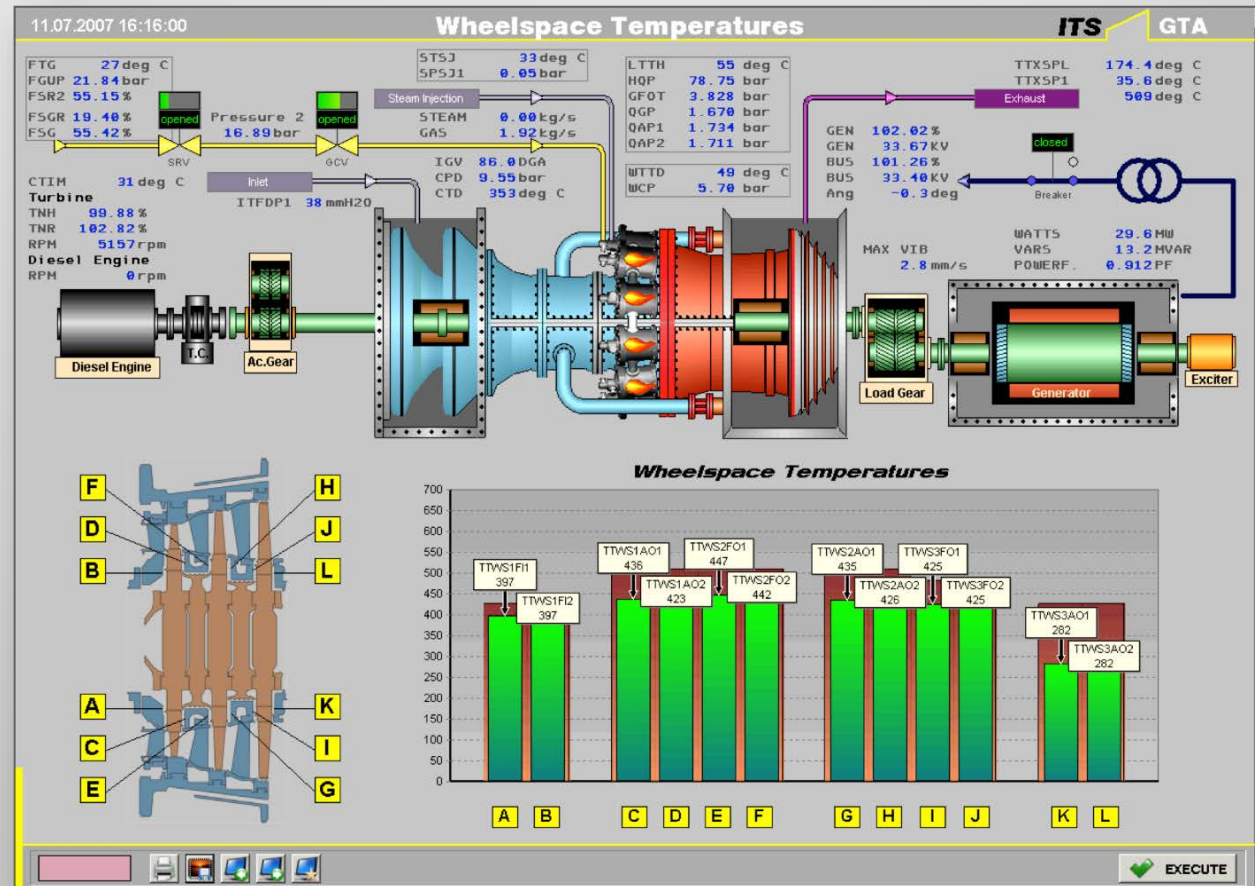
## UNIT IGV CONTROL





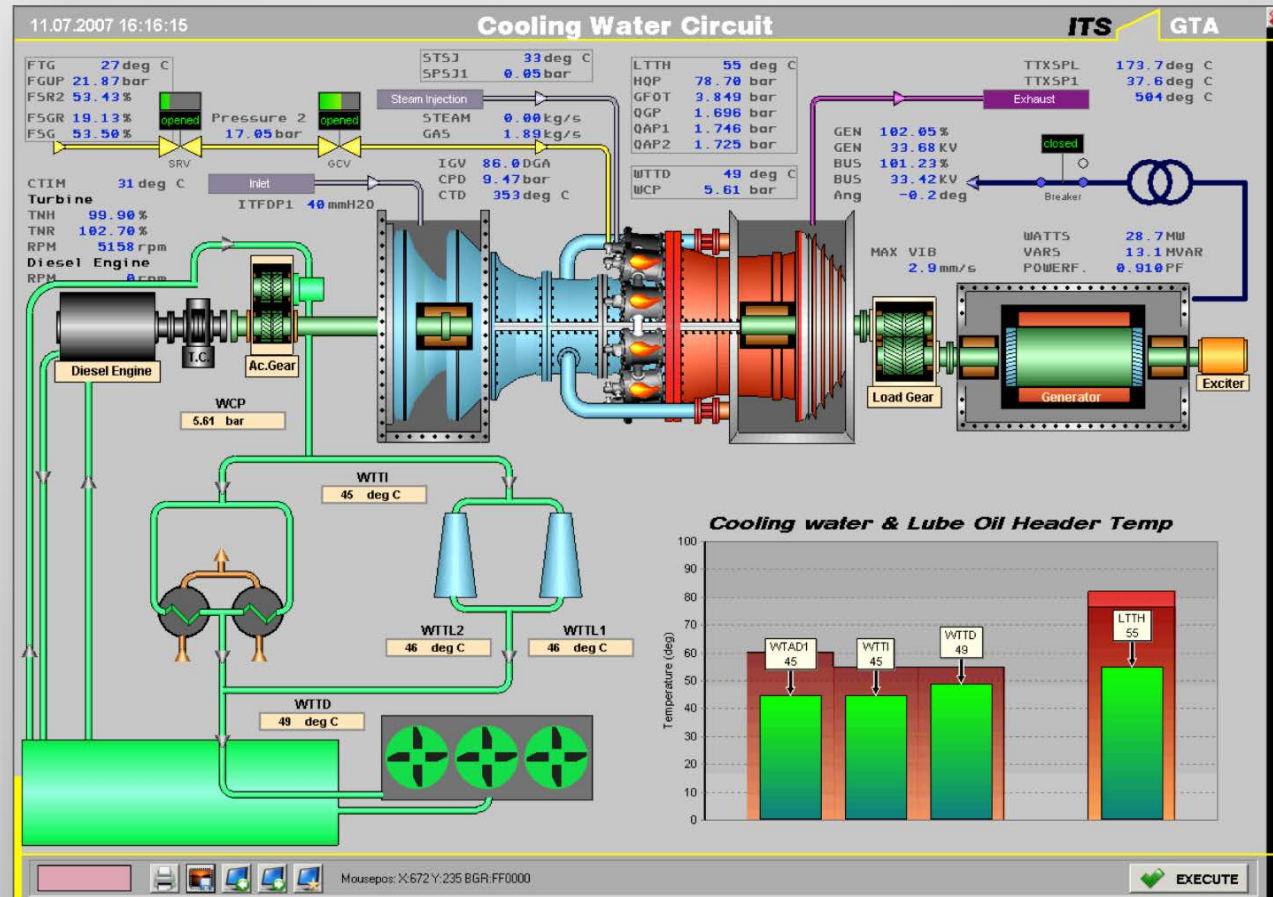
# Customized Display

## UNIT WHEELSPACE TEMPERATURES MONITORING



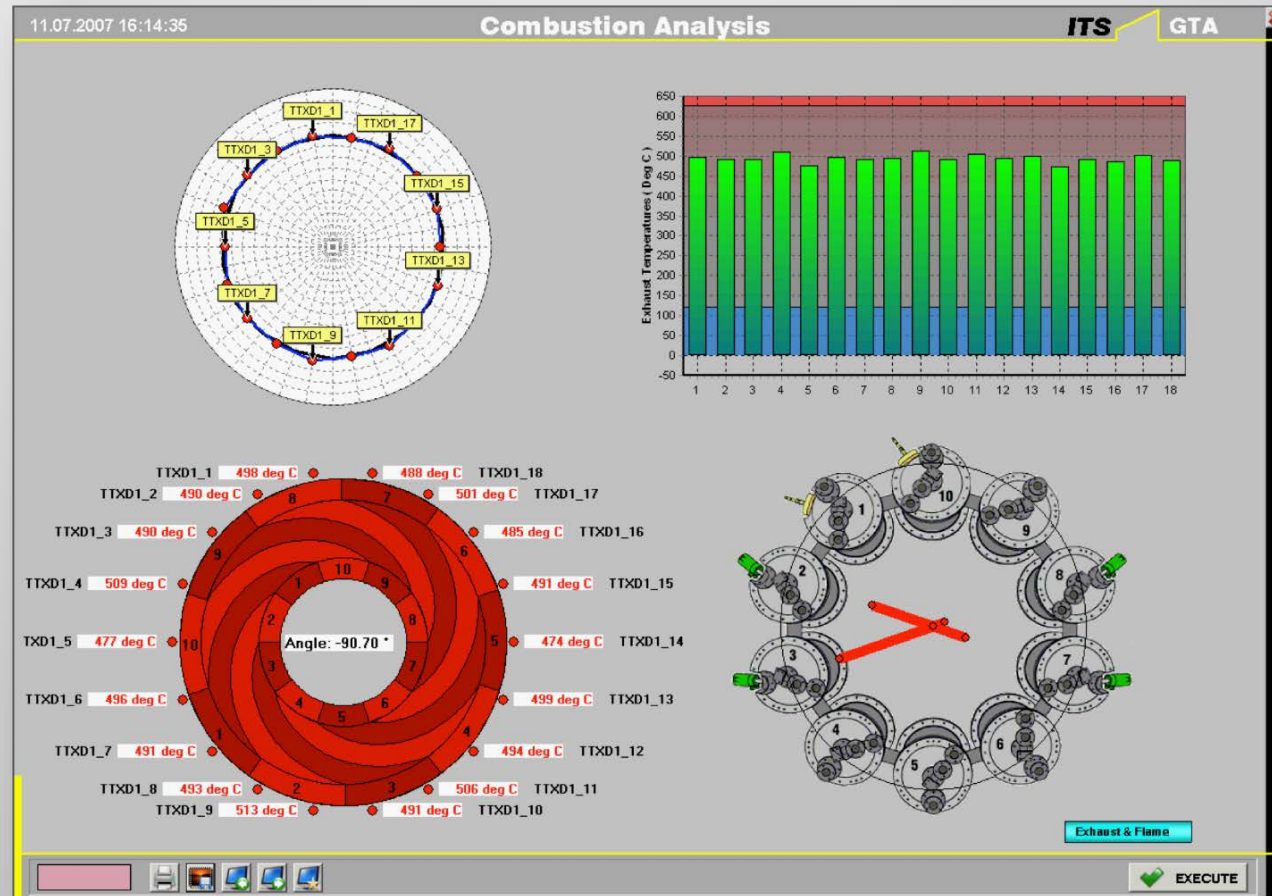
# Customized Display

## UNIT LUBE OIL MONITORING



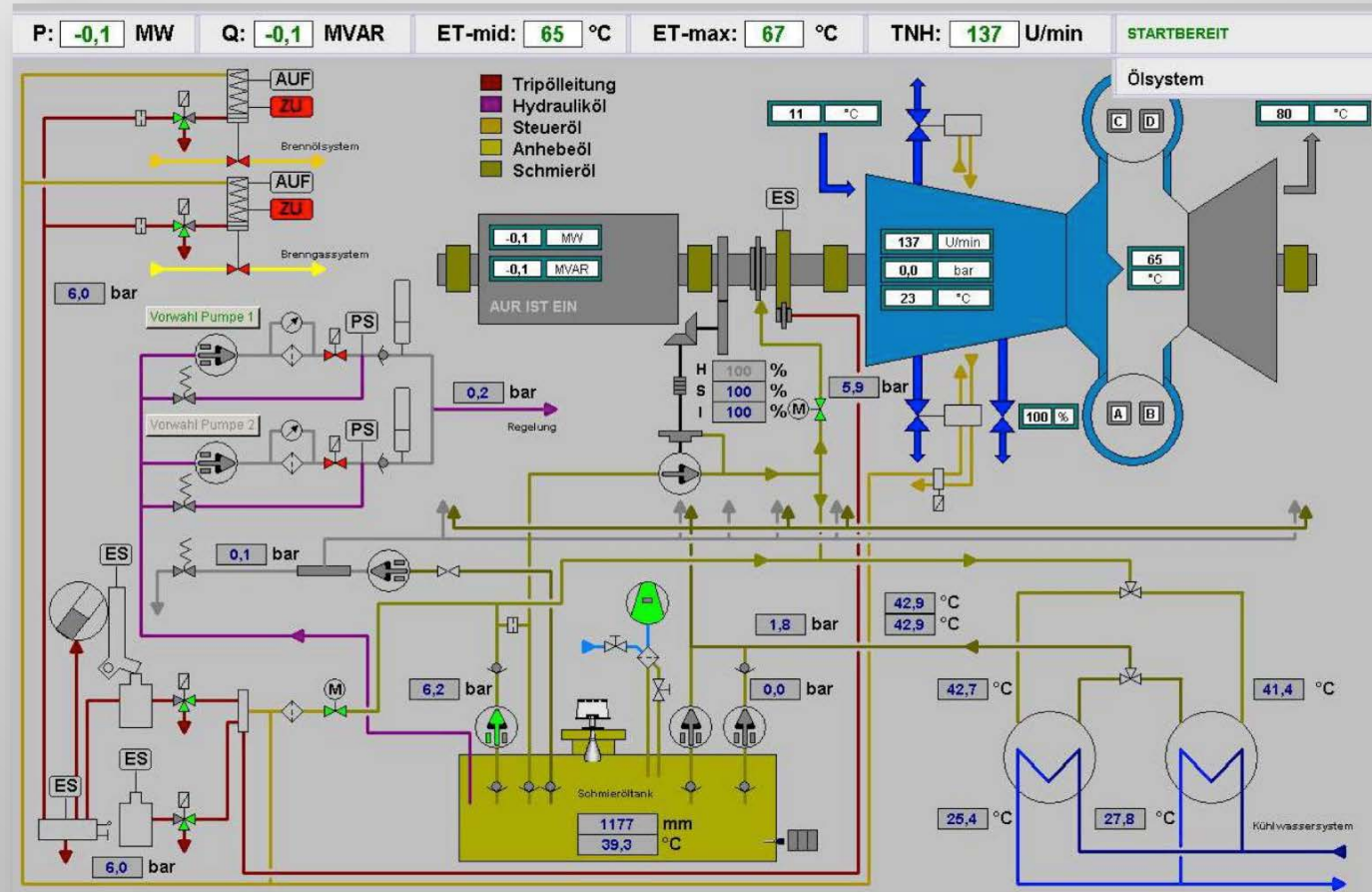
# Customized Display

## COMBUSTION ANALYSIS MONITORING



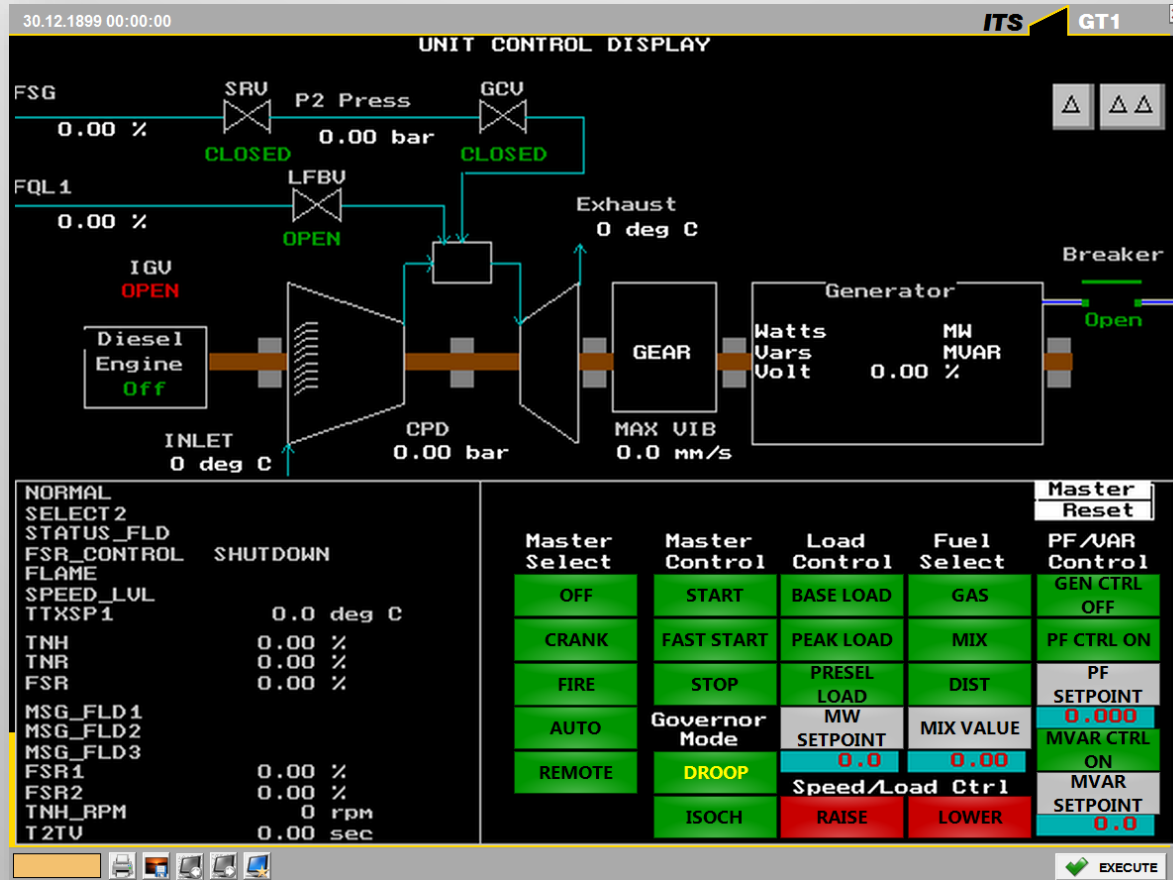
# Customized Display

LUBE OIL PID



# <I> Display

## UNIT CONTROL



# <I> Display

## MOTORS STATUS AND CONTROL

30.12.1899 00:00:00 ITS GT1

### Lead / Lag Control

Dist Fuel Fwd Pumps		Lead Lag
88FD-1 Pump 1 Lead	88FD-2 Pump 2 Lead	AUTO LAG
Pump 1 Stop	Pump 2 Stop	
Pump 1 Lead	Pump 2 Lag	MANUAL LAG
Pump O.K.	Pump O.K.	

Cooling Water Pumps		Lead Lag
88WC-1 Pump 1 Lead	88WC-2 Pump 2 Lead	AUTO LAG
Pump 1 Stop	Pump 2 Stop	
Pump 1 Lead	Pump 2 Lag	MANUAL LAG
Pump O.K.	Pump O.K.	

### Misc Motors & Heaters

AC	Run Status	Overload Status
23HG Gen. Compt Heater	OFF	O.K.
88BA Load Compt Fan	OFF	O.K.
88UG Load Compt Fan	OFF	O.K.
52QC Cooldown L.O. Pump	OFF	O.K.
23QT L.O. Sys. Im. Heater	OFF	O.K.
23HT Turbine Compt. Heater	OFF	O.K.
88FC Cooling Water Fan #1	OFF	O.K.
88FC Cooling Water Fan #2	OFF	O.K.
4GL1 Generator Louver #1	OFF	n/a
4GL2 Generator Louver #2	OFF	n/a
88CA Gas Nozz Prg Compr	OFF	O.K.
DC		
88QE Emerg Lube Oil Pump	ON	O.K.
88DS Diesel Engine Start.	OFF	n/a
88HR Hydr. Ratchet Pump	OFF	O.K.

EXECUTE

# Case Study

## TNB PAKA MALAYSIA HMI TO TMOS UPGRADE



Site Information	3 x blocks of 2 GE Frame 9E
Upgrade from	6 HMI Servers + 9 HMI Viewers (total block)
Upgrade to	6 redundant TMOS SCADA Servers with Historian + 9 Clients + new Server Cabinets
Project Execution	Partial Upgrade with HMI and TMOS running parallel for Operators to be familiarized with TMOS for 1 week, then proceed to total replacement. No shutdown caused. Finished in around 2 weeks (including training).



*We know gas turbines.*