WHRS for low-speed marine applications

Service experience;
control concept;
user interface;
basic trouble shooting.

Waste Heat Recovery Systems in low-speed marine applications

Background & service experience:

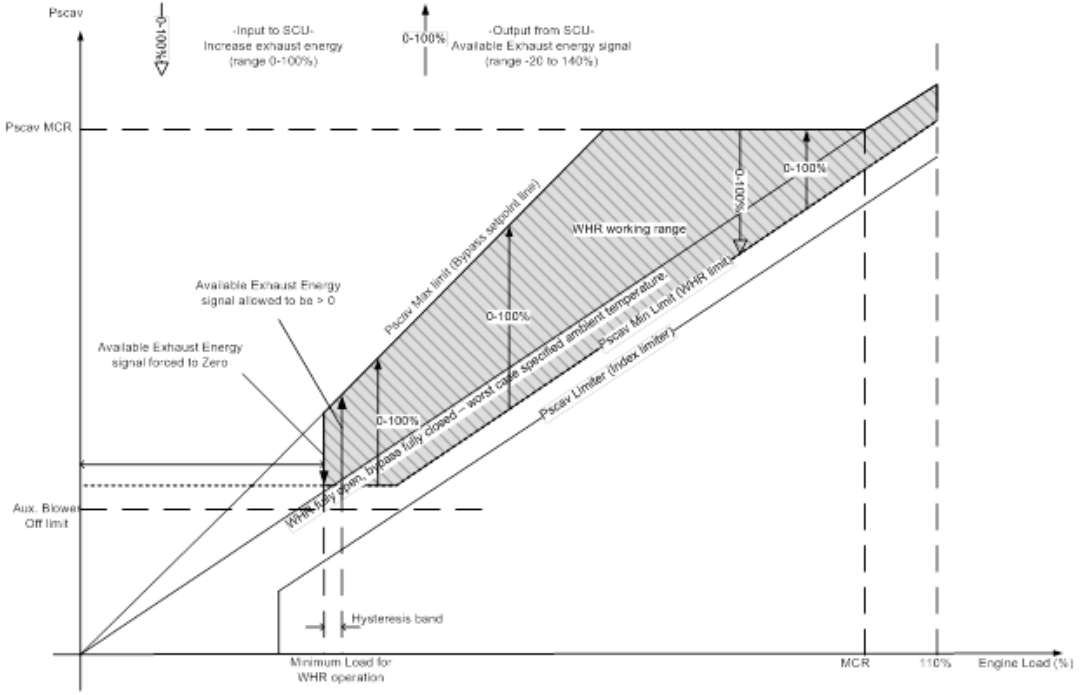
- ”Scavenge air” control.
  - Concept.
  - User Interface.
- New control concept ”load control”:
  - APMM ”South America Max” (SAM-class) case.
  - A13 vs. A14/18.
- MOP-interface.
- ”Trouble shooting”.

”Scavenge air” control

First generation of the automated Exhaust Gas Bypass (EGB) system for WHR applications, was called “P.scav. Control”.

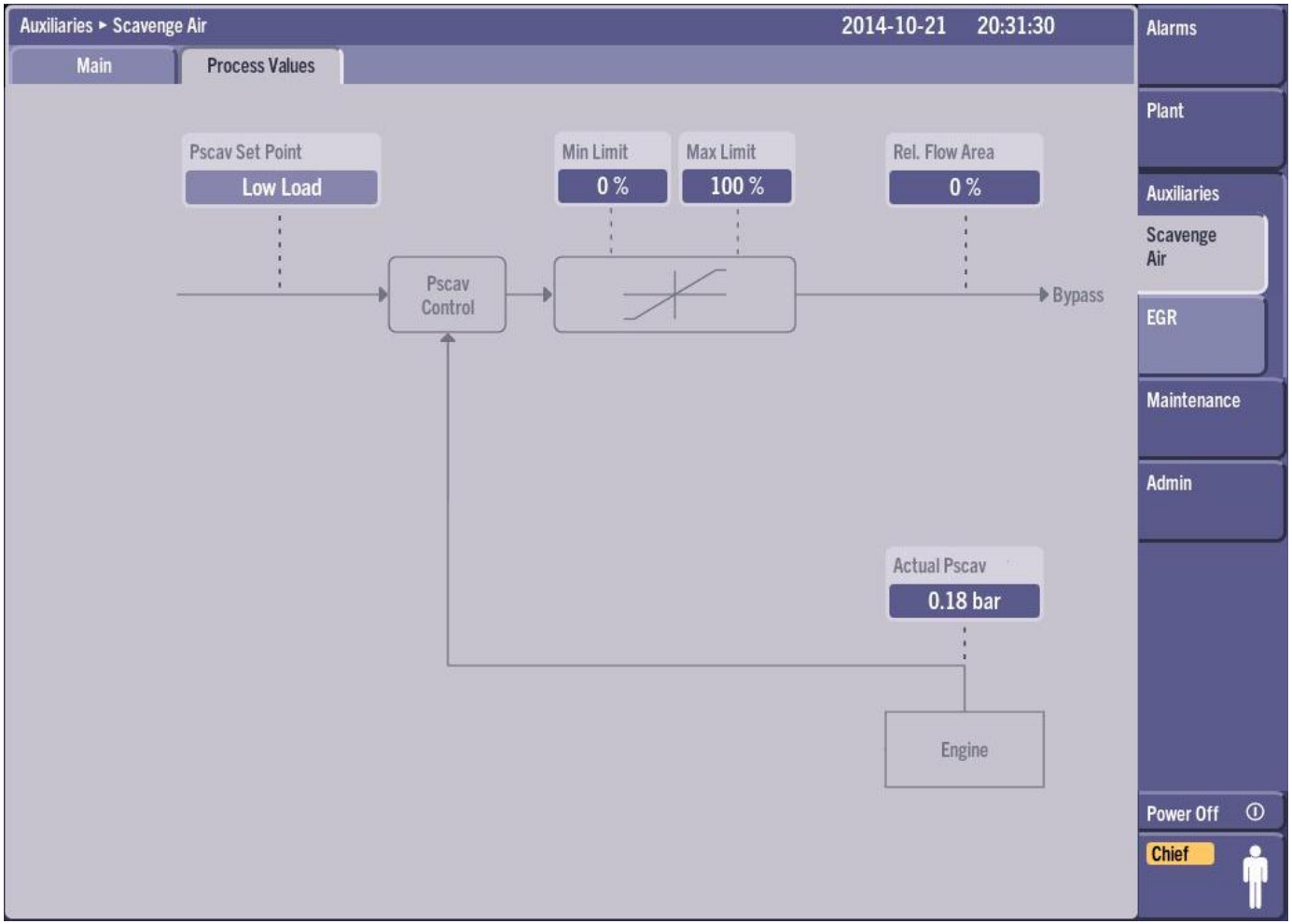
The EGB amount was controlled according to a predefined scavenge air pressure level at a certain load.

When requested by the Turbine Control Panel via ”Increase”-signal the EGB amount would be increased to allow for a larger production on the power turbine.



”Scavenge air pressure” control

Simple user interface, but not very informative..



”Load” control

Second generation of the automated EGB system in WHR applications, is called “load Control”.

The EGB amount is controlled according to a predefined EGB ”flow area” corresponding to engine load.

Flow area is defined as the sum of areas through EGB (V803) and Power Turbine Control Valve (V802).

The APMM South America Max (SAM) and West AFrica max (WAF) vessels were both delivered with ”P.Scav” control.

Service experience from these vessel lead to the development of the load control concept, which is now MDT standard for both WHRS and part/low-load tuning via EGB.

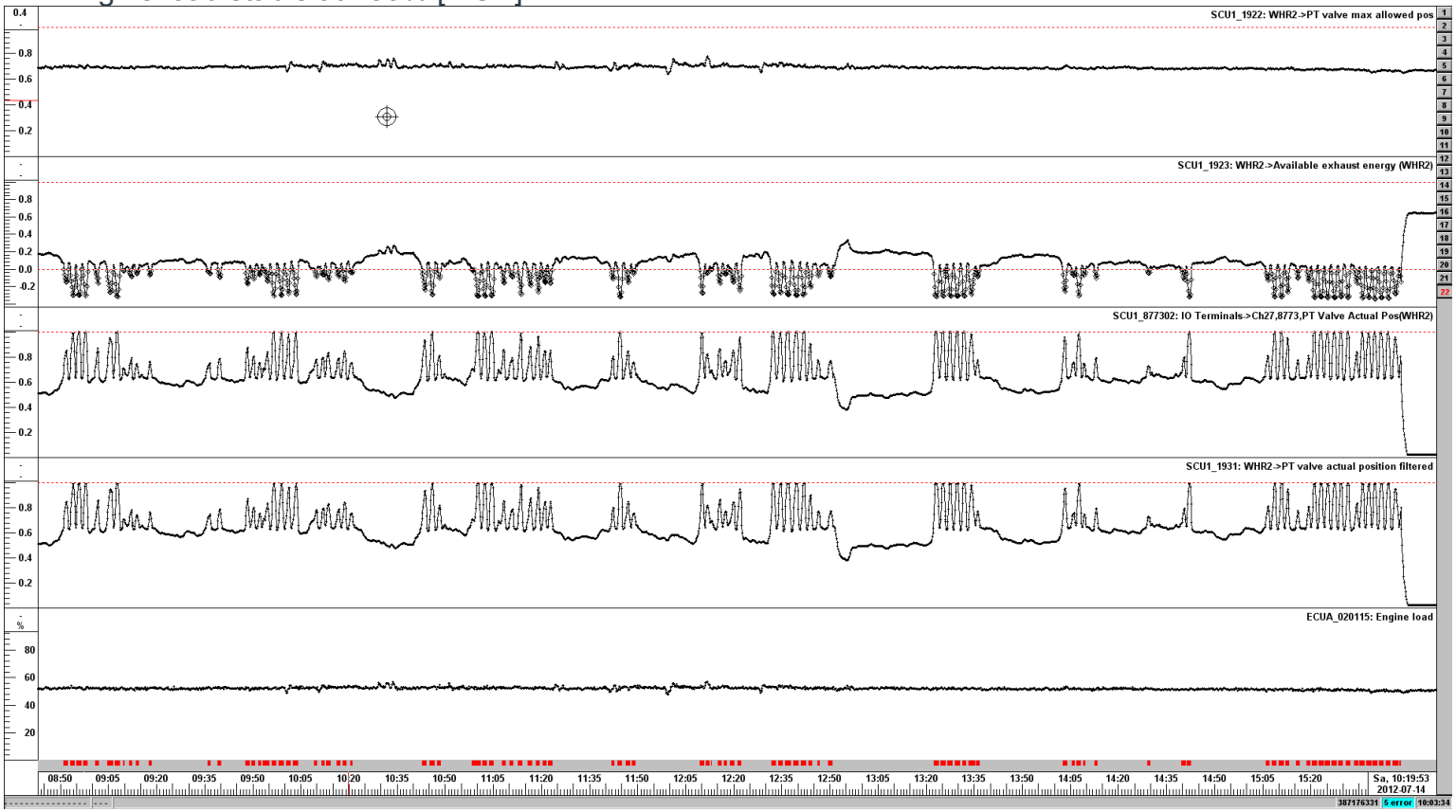
Issues which surfaced were:

- Fluctuations in scavenge air pressure during normal running:
  - →Fluctuations in power turbine electric production.
  - →Fluctuations in auxillary engine power production.
- Fluctuations in P.Scav. During P/T start.

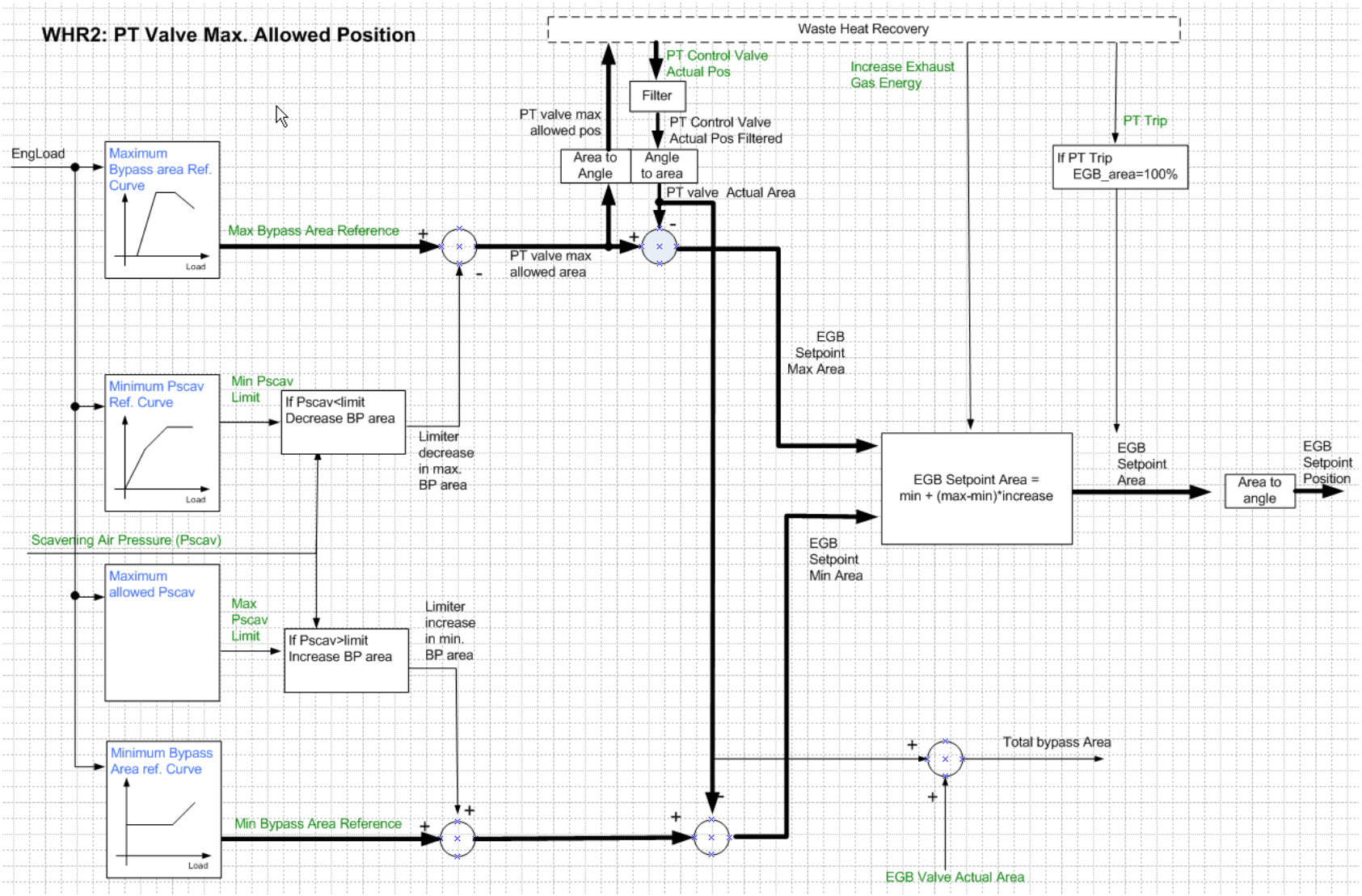
”Load control”

Example of P.scav. Control, APMM SAM-class:

- 9000 TEU container carrier.
- 9S90ME-C Mk8.1, MHI P/T, no SG/M.
- Engine load stable at ≈50% [MCR]



”Load” control



A13 vs. A14/18

Following differences between A13 and A14/18, regarding interface from M/E to foreign systems:

- EGB amount is controlled according to Maximum Power Turbine Control Valve (MAPTV) position signal to TCP.
- Minimum EGB amount is handled by ECS via EGB-valve (V803).
- TCP can request increased EGB via ”Increase Exhaust Gas Energy” (IEGA).
- A specific load point will always correspond to the same EGB amount/area.

- The WHRS handshake signals to/from Power Management System (PMS) are omitted.

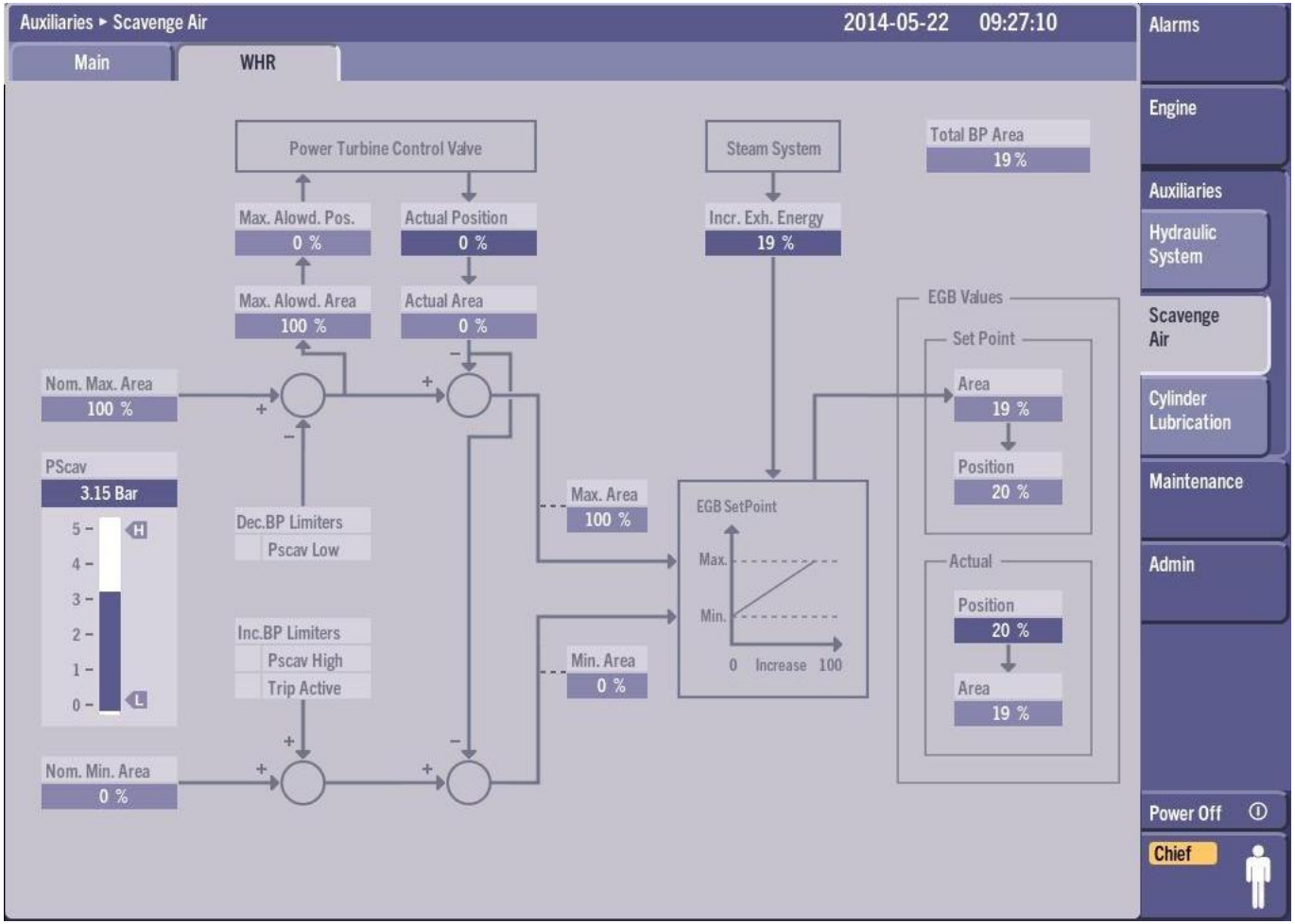
- The Shaft Generator/Motor (SGM) handshake signals to/from PMS are still in place but with an altered functionality.

  SG/M minimum speed, defines slowdown speed.

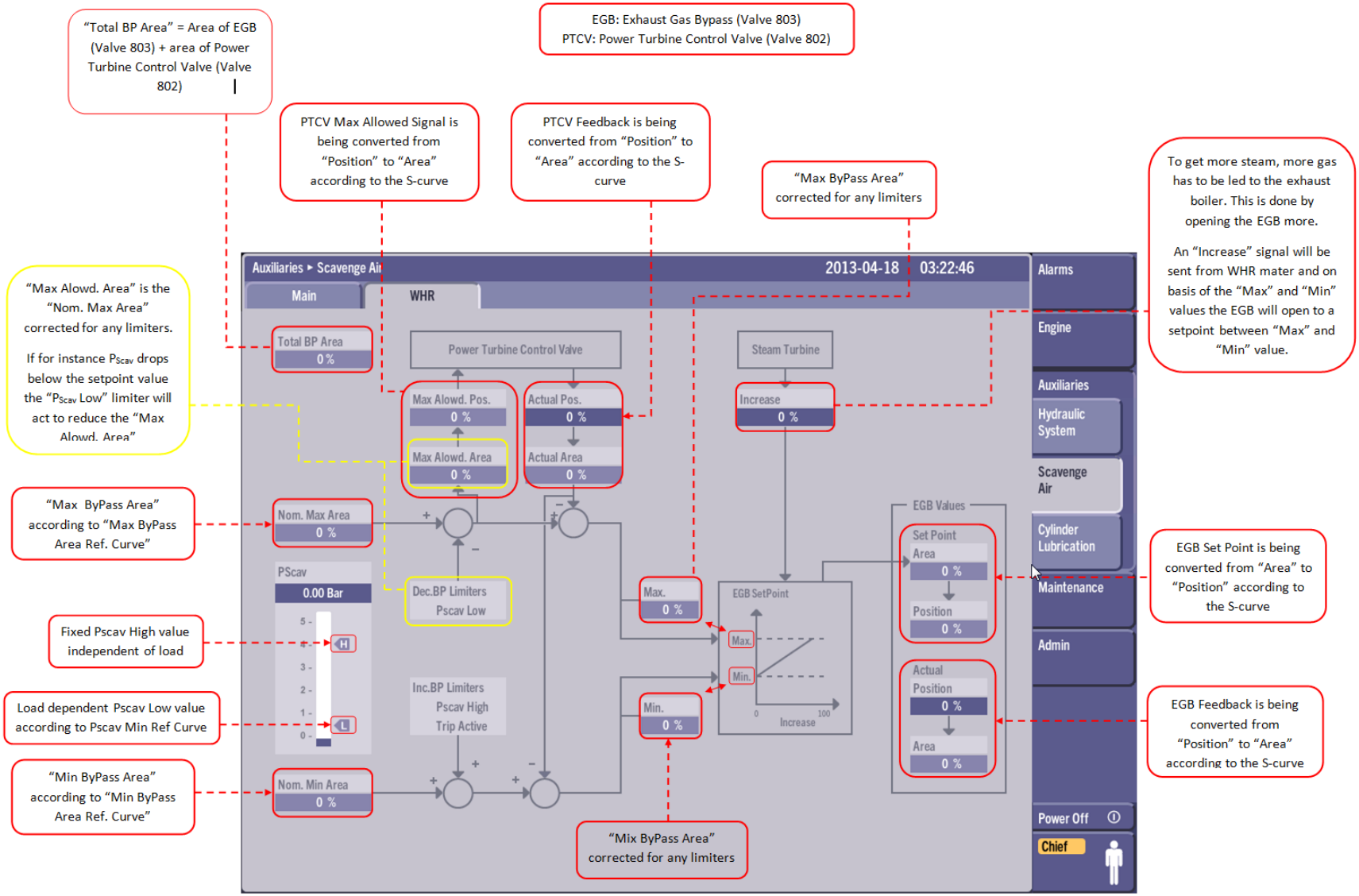
  SG/M start stop 38 RPM.

”Load” control

Load control EGB/WHRS MOP screen:



”Load” control



”Trouble shooting”

Read and understand alarm texts!

- Usually this will lead to an understanding of the problem and suggest where to start troubleshooting.

Interface, valves:

- V802 and V803 valves and controllers (pneumatic positioner) - MHI.
- Set point and feedback signals for V803 - MDT.

Interface, TCP:

- Analog/digital input, ECS:
  - PTC-valve (V802) position feedback (AI).
  - P/T trip signal (DI).
- Analog/digital output, ECS:
  - Maximum Allowed Power Turbine Control Valve position (AO).

SG/M handshake interface:

- Digital Input, ECS:
  - ”Handshake Request”*
- Digital Output, ECS:
  - ”Handshake Allowed”*
  - ”Handshake Permission”*

**PMS & SG/M makers interpretation of these signals are ”Allowed/Permitted” thus the system is not able to operate without handshake.*