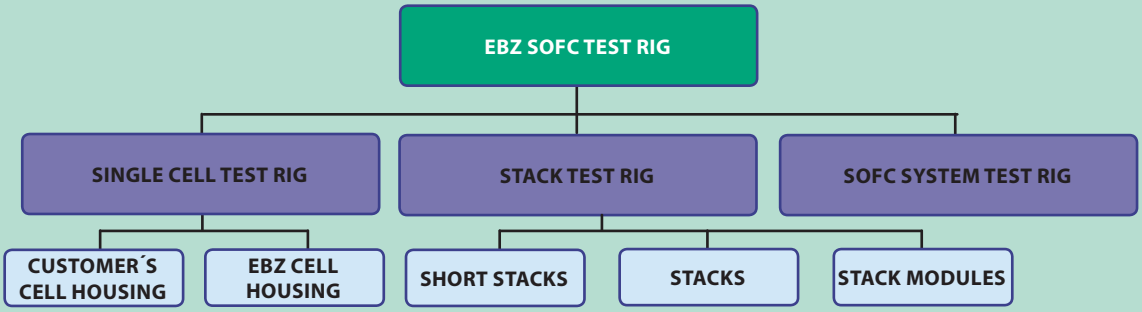
AST Gruppe
Angewandte System Technik

SOFC / SOEC Test Rig

EBZ

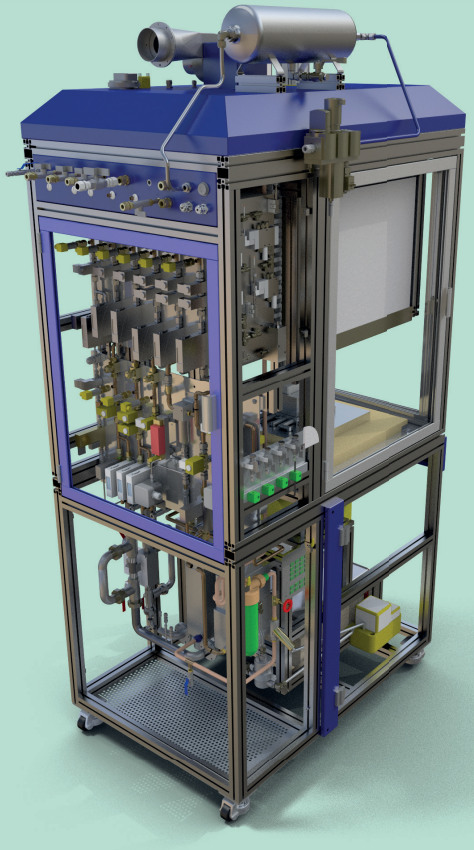


KEY FEATURES

- EBZ systems and components based on **customer specific** demands and on latest EBZ **R&D results**
- testing facilities for single cells, stacks, stack modules and complete SOFC systems
- testing **up to 1000°C** using furnaces or hotboxes
- available with power **feed-in** or **electronic load**
- six-stage safety management system
- easy to operate NI laboratory software with graphical user interface (**GUI**)
- configurable limit monitoring
- easy programmable process control: **EBZ ProControl**
- starter software: **EBZ Plug & test**
- sophisticated data management solutions
- remote maintenance

OPTIONAL

- air and gas manifolds different suppliers for stacks and cells
- fuel desulphurising
- fuel reforming (CPOX, steam reforming, ATR)
- exhaust gas and waste heat usage (gas/gas heat-exchanger)
- safety equipment (gas sensors, monitored ventilation)
- event messaging via e-mail and SMS available
- supervisory and data acquisition PC with several client PCs at single test-rigs (for huge laboratories)
- remote access



example: stack test rig with liftable hood-type furnace

Fuel Cells

HARDWARE

Test rig dimensions

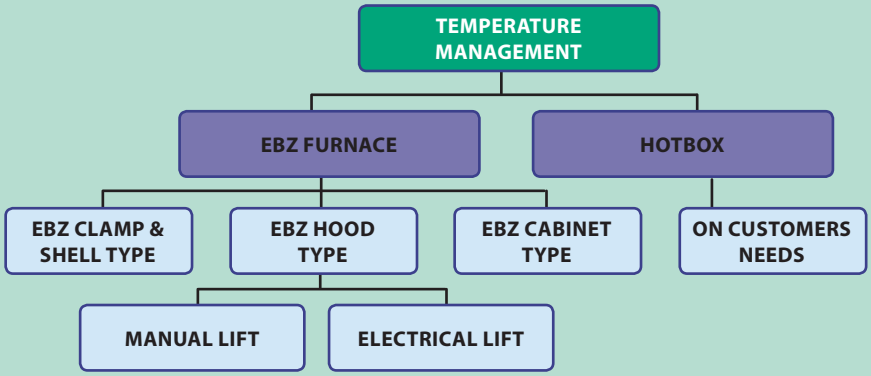
	FOOTPRINT	NO. OF FLUIDS
FCTR-S	1300 × 1000 mm²	up to 8
FCTR-E	1700 × 1000 mm²	up to 12
height depending on application **customer specific dimensions possible**		

example: test rigs

EBZ FURNACE FEATURES

TYPE	INNER DIMENSIONS
hood	450 × 450 × 450 mm³ 600 × 600 × 600 mm³
clamp & shell	200 × 200 × 200 mm³
cabinet	900 × 900 × 1300 mm³
customer specific dimensions possible	

- high-grade thermal insulation
- *optional:* active cool-down



HOTBOX CONCEPTS

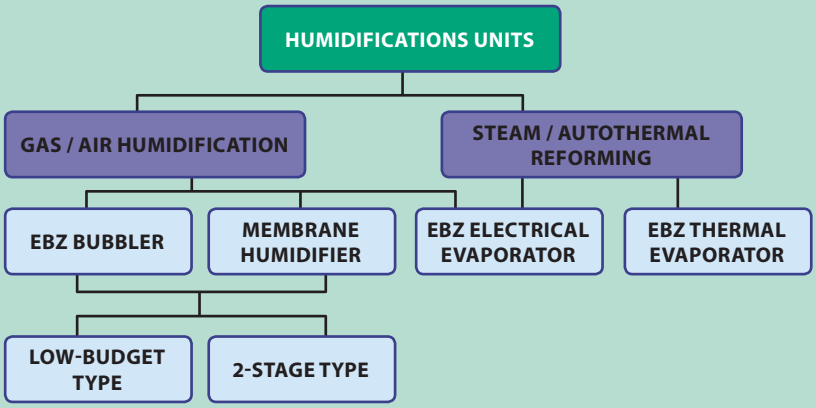
- integration of any hotbox

COMPRESSION CONCEPTS

- pneumatic system
- mechanical weights system
- spring tension

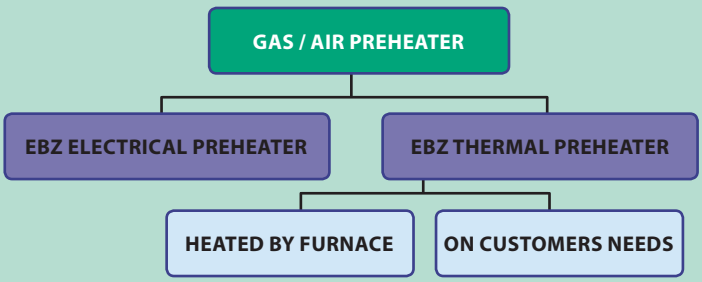
EBZ HUMIDIFICATION UNITS

- broad variety of humidification units
- various performance classes
- optimised concerning stability
  → low fluctuations in cell OCV
- standard units as well as on customers needs



EBZ GAS PREHEATERS

- electrical heaters for highest requirements
  → for durability tests
  → for thermal cycling tests
- easy to handle due to solid housing
- connections acc. to customers needs
- optimised temperature management
  → minimised radiation influence
- custom solutions possible



SAFETY MANAGEMENT SYSTEM

STAGED SYSTEM DESIGN

- optimum safety combined with high degree of freedom for the user
- hard-wired to guarantee safety of people
- configurable safety measures to protect hardware

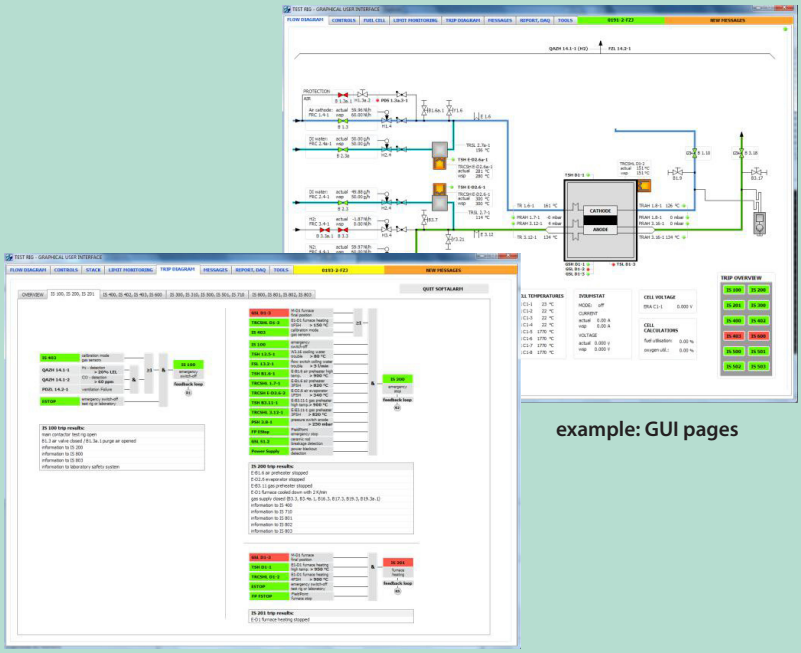
LEVEL 5 **emergency switch-off**	**dangers for life and limb**
LEVEL 4 **emergency stop**	**critical parameters according to safety**
LEVEL 3 **trouble break-off**	**troubles causing malfunctioning**
LEVEL 2 **gas warning**	**noncritical release of dangerous gases**
LEVEL 1 **soft alarm**	**noncritical trouble**
LEVEL 0 **normal operation**	**operation without any troubles**

HARDWARE

- safety PLC acc. to EN 954-1, cat. 2
- modular system independent of control system
- sensors and actors according to analysed safety requirements

GRAPHICAL USER INTERFACE (GUI)

- clear data display
- easy access to all functions organised in pages
- easy but error-tolerant input of setpoints
- separate pages for
  - P&ID
  - manual operation
  - safety functions
  - limit monitoring
  - error history
  - software tools

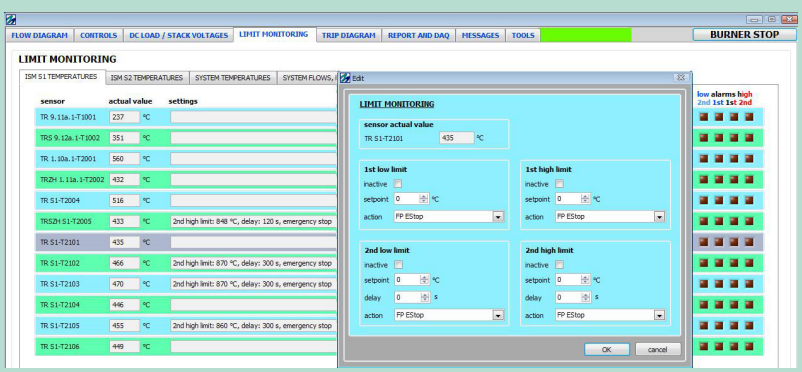


example: GUI pages

LIMIT MONITORING

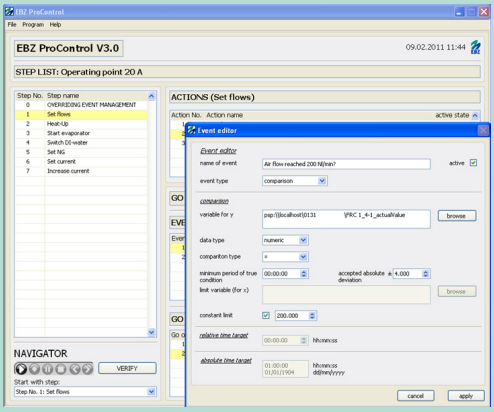
- 4 limits for each sensor
- 2 limits with delay function
- choice of 5 safety levels to be tripped
- easy configuration by drag & drop
- no overriding of safety measures protecting life and limb

example: GUI page “LIMIT MONITORING”

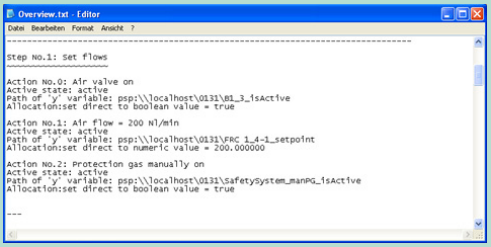


SOFTWARE TOOL FOR SEQUENTIAL PROGRAMMING

- easy programmable process control software
- graphical programming without scripting language
- choice of
  - → time-controlled serial execution
  - → event-controlled execution
  - → mixed mode
- control structures support
  - → logical connections (and, or, not)
  - → conditions (if-then-else)
  - → loops (while, for, case)
  - → timers
  - → comparisons (<, >, =, !=, >=, <=)
- process variables can be
  - → set to a dedicated value,
  - → increased and decreased using gradients
- sequences can be saved and reloaded



example: GUI page "performance measurement"

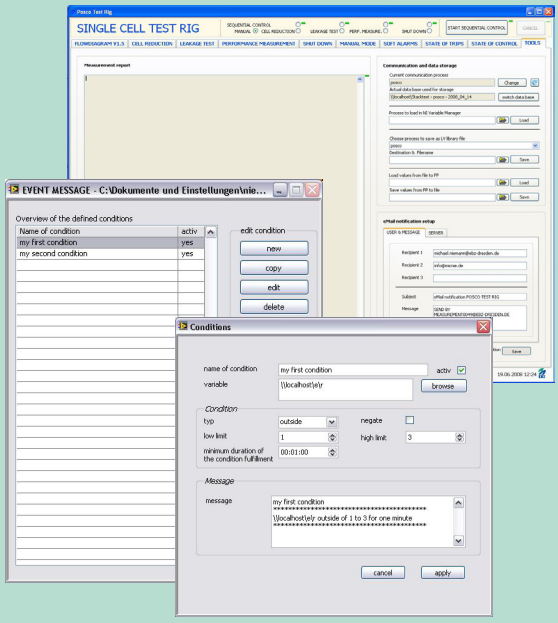


example: sequence overview txt-file

EBZ EVENT MESSENGER

notification tool

- separate software for fast reaction to test rig events
- SMS or e-mail, if a certain event occurred
- all registered data usable for event definition, e.g.
  - → results
  - → status
  - → errors



example:
event messaging
e-mail version

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