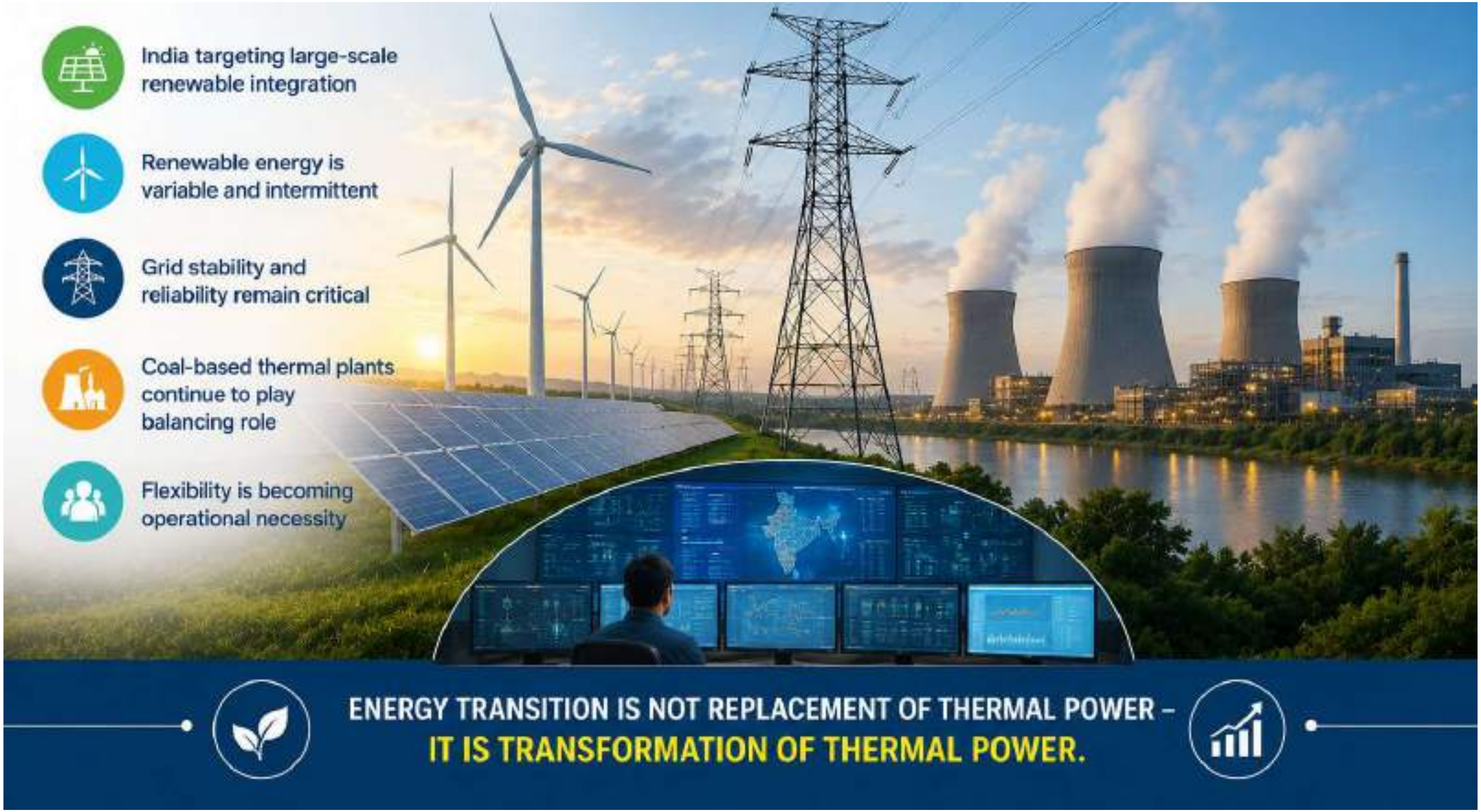
STEAG's Experience in Energy Transition – Flexible Operation of Thermal Power Plants

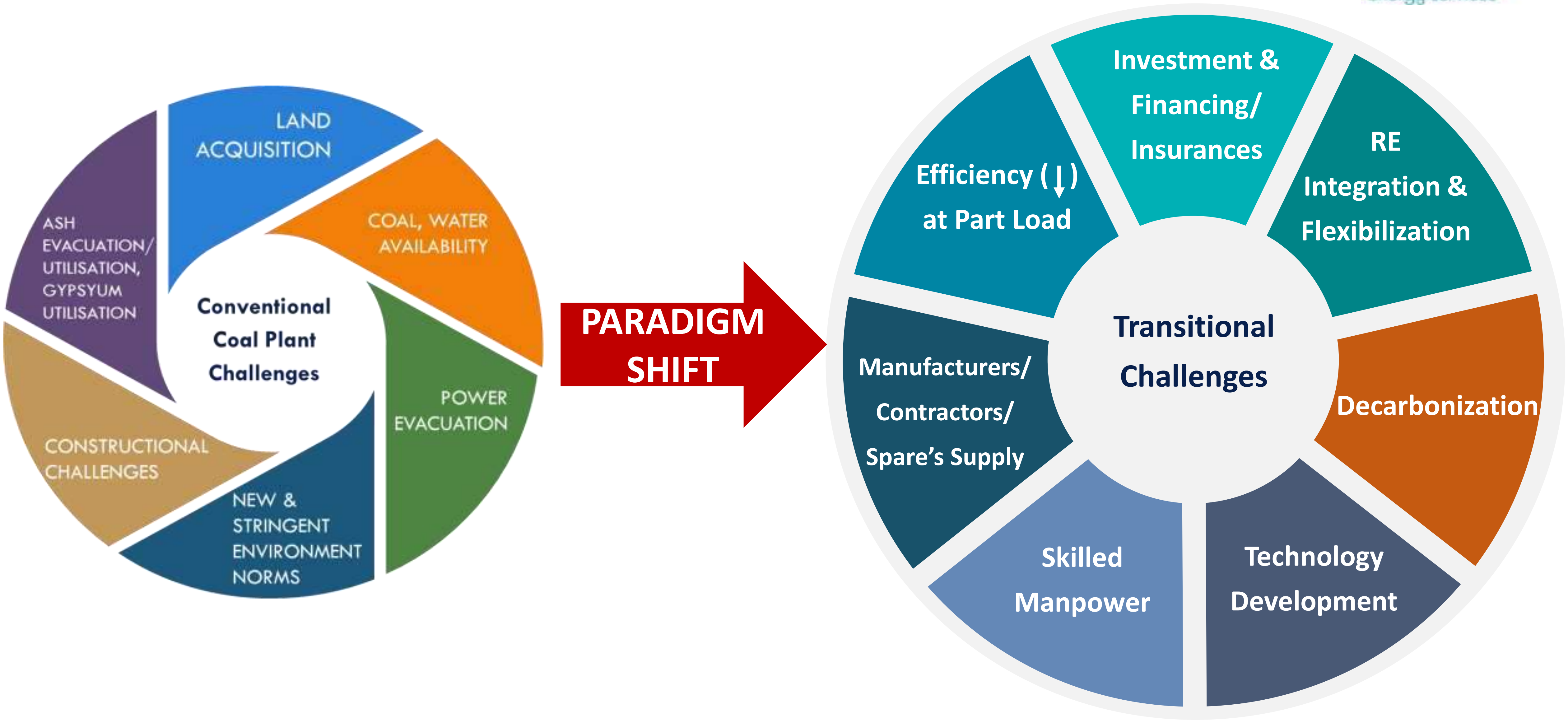
FLEXPERT

A Joint Initiative with IGEF-GIZ, VGBE and EEC

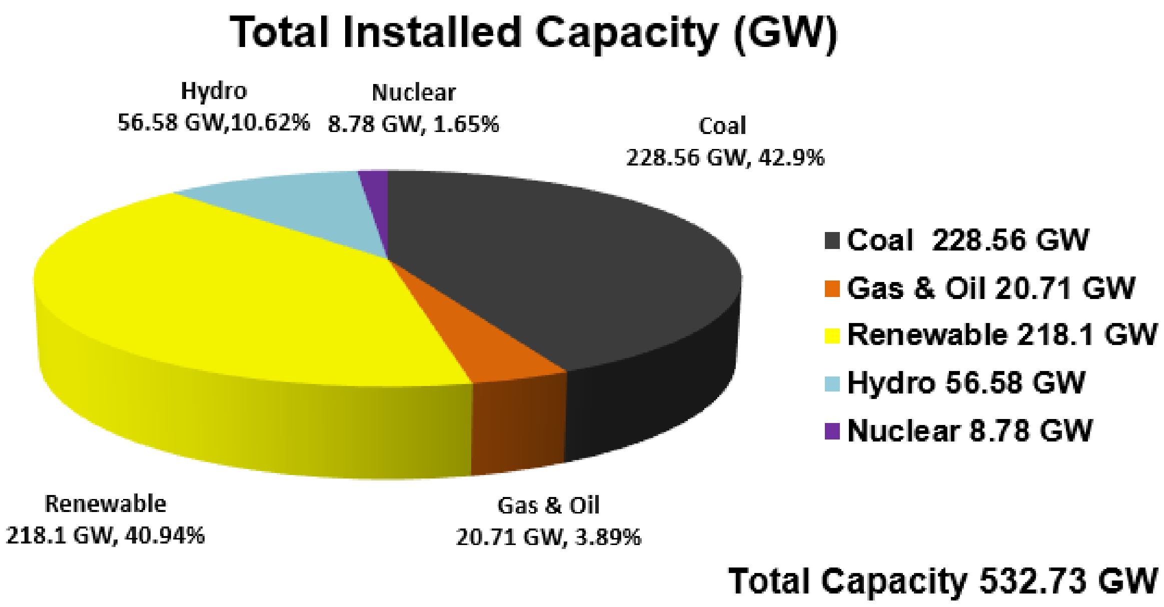
Energy Transition – Indian Power Sector Perspective

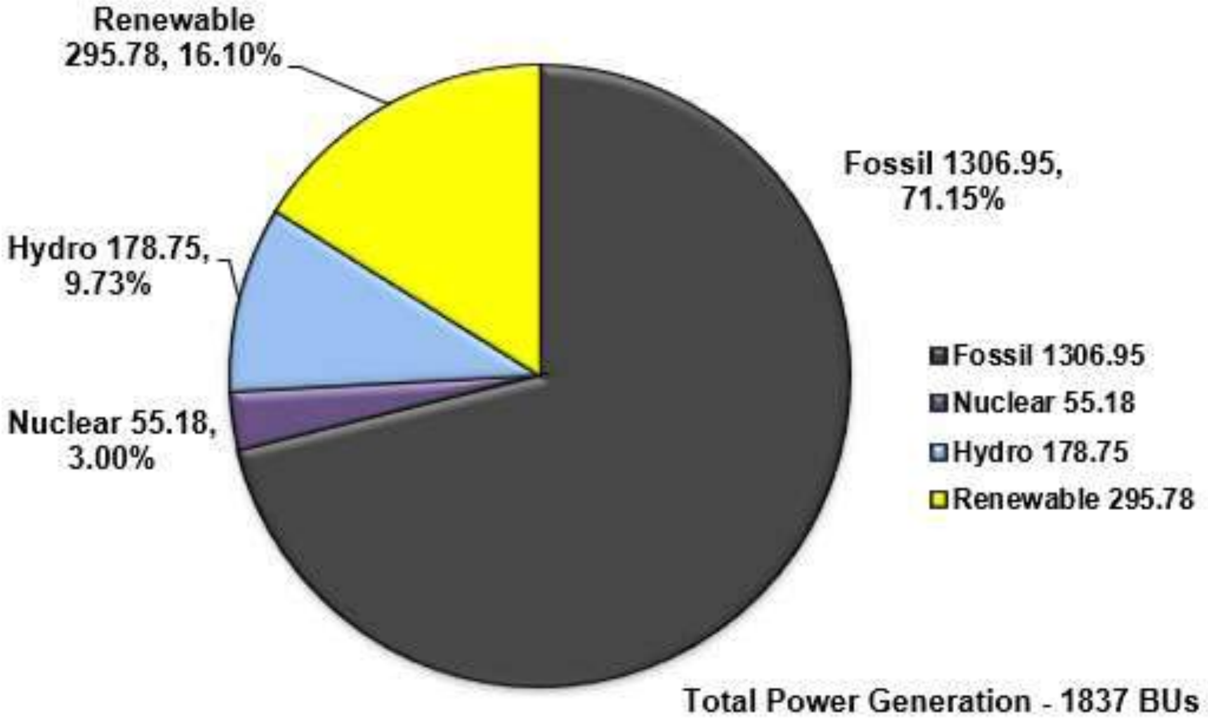


Challenges with Energy Transition



Thermal Power: Reality of the Indian Grid





Fossil Fuels	249.27 GW
Non Fossil Fuels	283.46 GW

Efficient coal-based thermal power with flexible operation capability will continue to play a critical balancing role in the Indian power system

The Importance of Thermal Power Generation as Baseload Power for Grid Stability

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Integration, Not Replacement

Coal plants must now operate flexibly:

- Ramp down to level well below 55% and possibly up to 40% load
- Ramp up rapidly during peaks in the morning and evening
- Operate in cyclic and two-shift modes as required
- Operate with least oil support while ensuring boiler safety

Flexible operation is no longer an exception, it is the new normal.

Flexible Operation – Key Challenges

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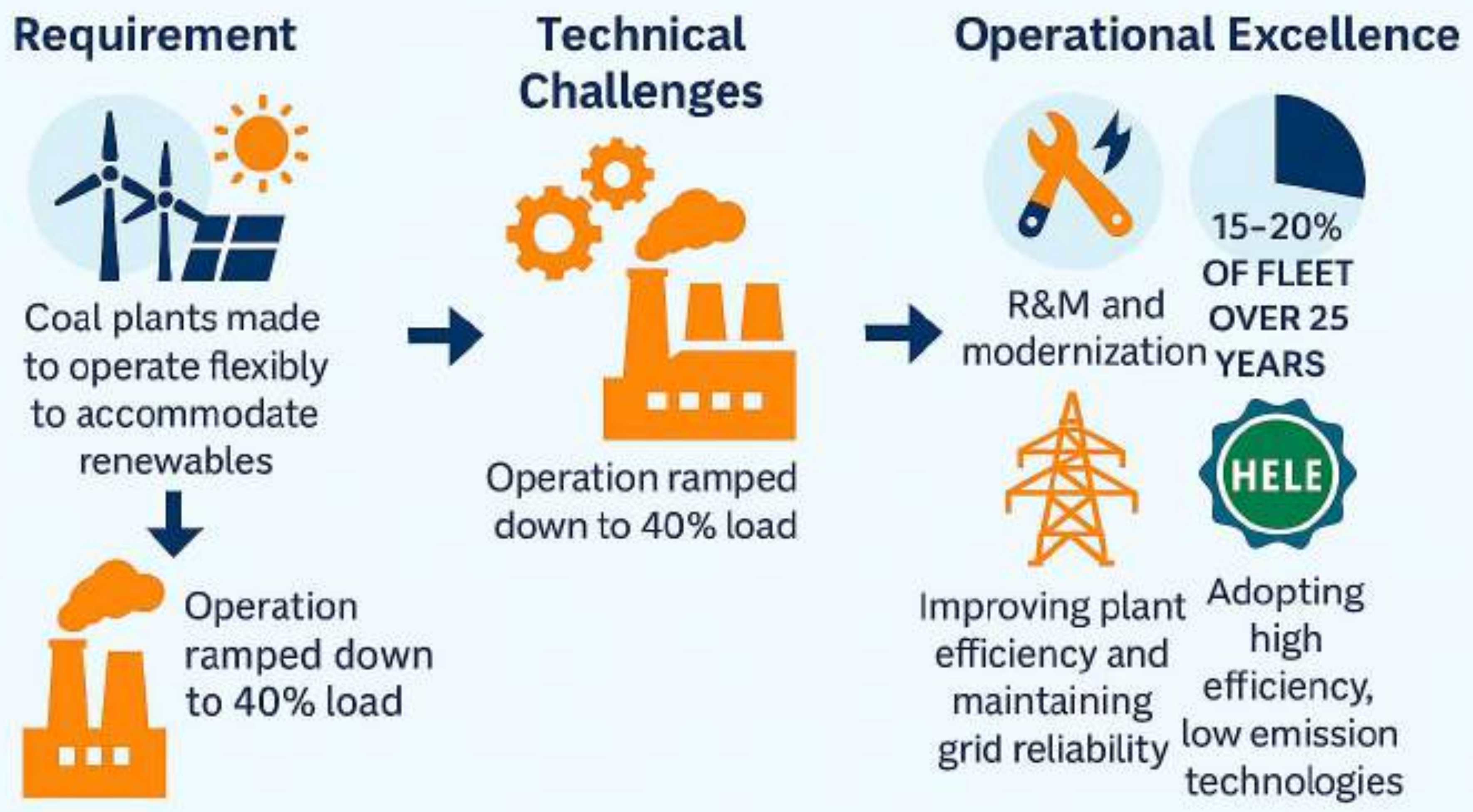
Earlier Operation	Present Requirement	New Challenges
Base load operation	Frequent ramping	Thermal stress
Stable operation	Low load operation	Flame instability
Predictable dispatch	Faster start/stop	Equipment fatigue
Limited cycling	Renewable balancing	Operator preparedness

Human capability and operational confidence are critical for successful flexibilization.

The Challenge and Opportunity of Flexible Thermal Plant Operation



CEA Notifications

CEA Notifications on Flexible Operation and Phasing Plan

- **CEA has already come out with a time bound mandate to achieve Flexibilization by coal-based power plants.**

- Coal fired generating units shall achieve 40% technical minimum load

- The preliminary phasing has been worked out in the CEA report "Flexibilization of coal fired power plant – **A road map for achieving 40% technical minimum load published in Feb 2023**

- Subsequently a draft phasing plan has been prepared for coal based generating units.

People Capability: The Defining Challenge of the Transition

Aging Workforce, Shrinking Experience Base

Equipment Can Be Procured – Experience Cannot

Capability Building Is Now Mission-Critical

STEAG’s Experience in Energy Transition

Flexible Operation Expertise

- Decades of experience in operating & maintaining thermal power plants
- Proven methodologies for flexibilization
- Supporting plants to achieve low load & high ramp capability

Operator Training & Flexibilization Programs

- Structured training to build operator competency
- “Flexpert” development through simulator-based learning
- Practical programs aligned with CEA roadmap

High Fidelity Simulator Solutions

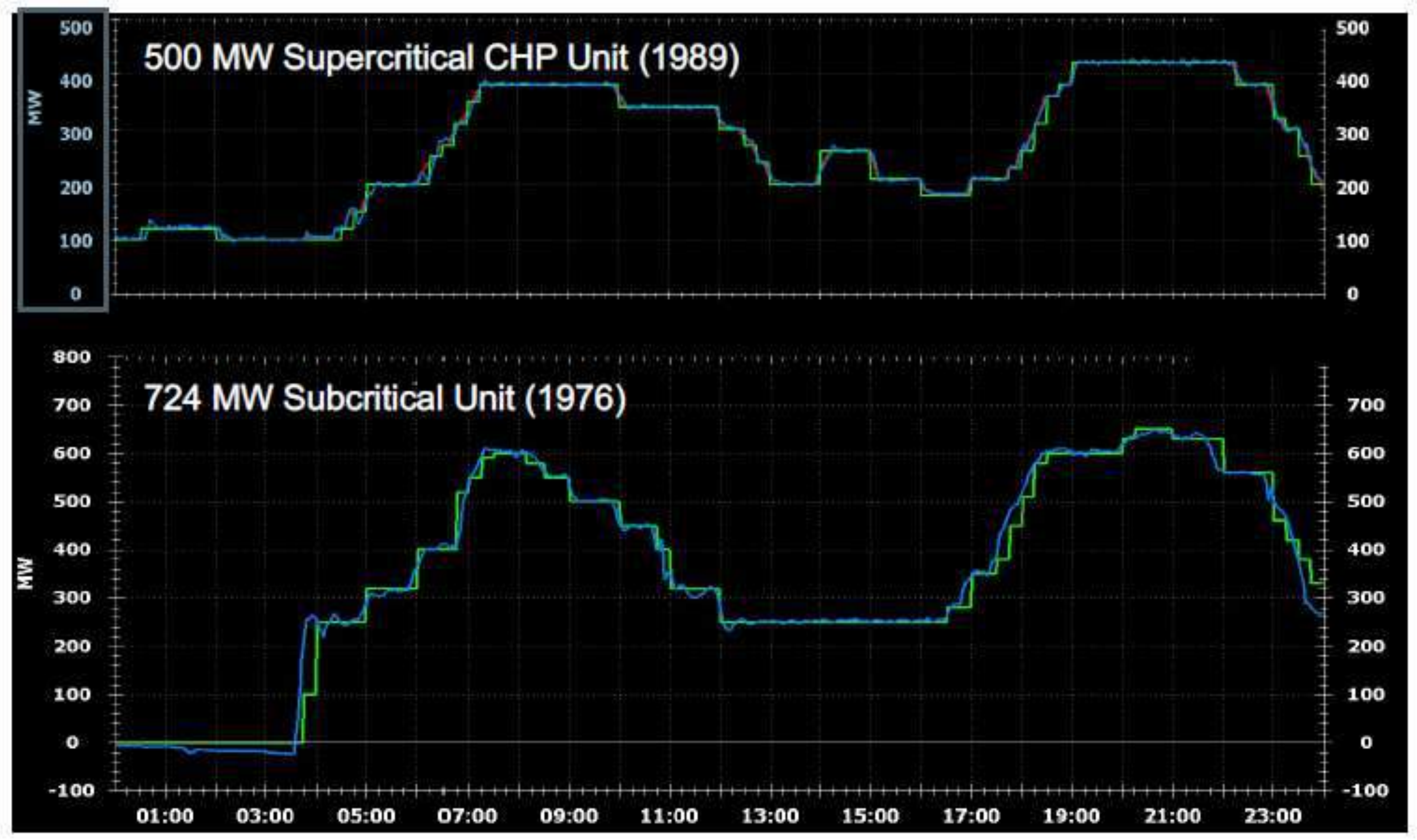
- High fidelity, plant-specific simulators
- Realistic replication of plant dynamics & controls
- Safe environment to practice ramping, low load & transients

Digital & Performance Optimization

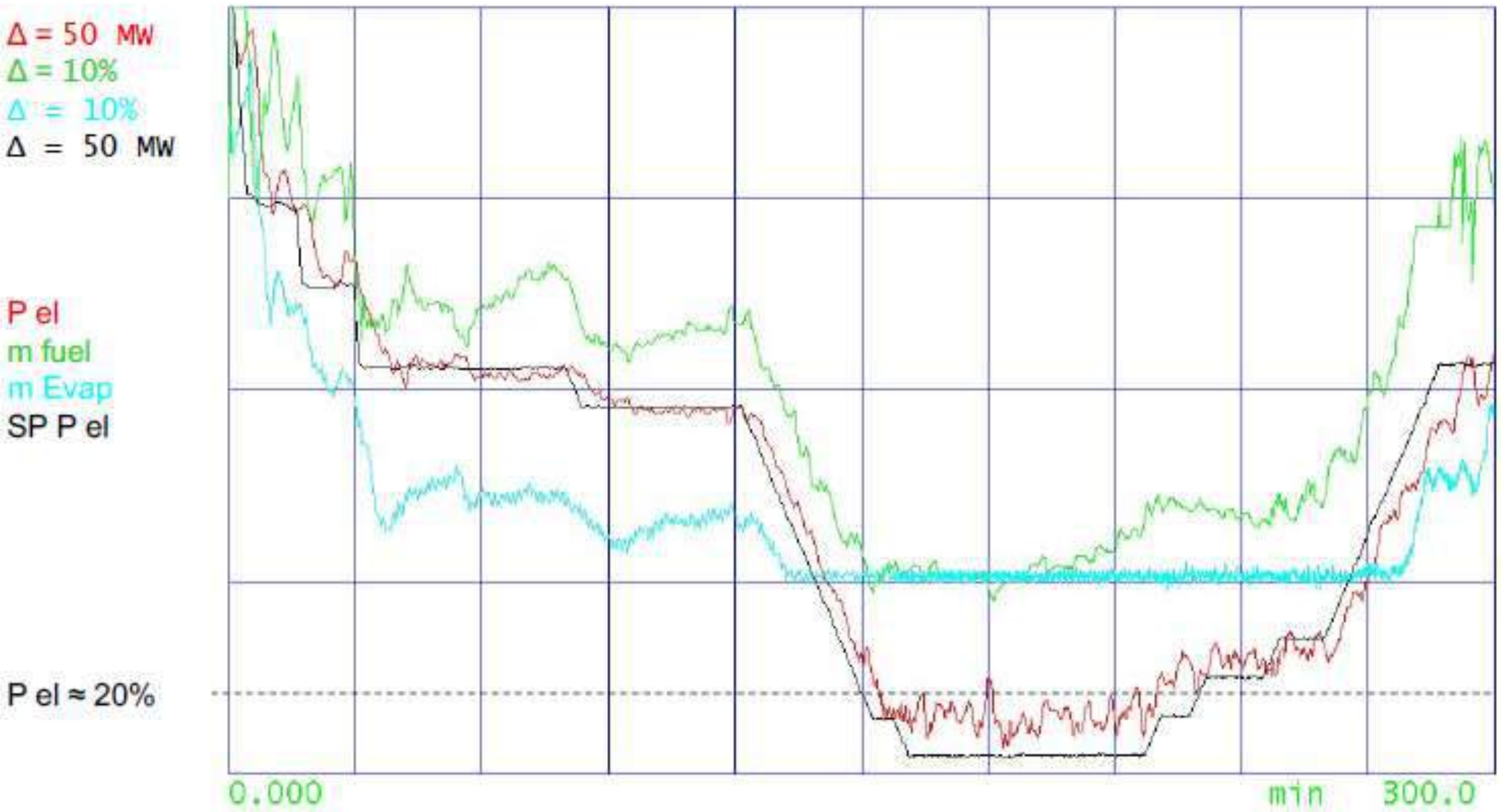
- Data-driven insights for better decision making
- Performance improvement & reliability enhancement
- Enabling smarter & sustainable plant operation

STEAG supports the energy transition through practical implementation, operator competency development, and flexible operation readiness.

Optimization of low load operations



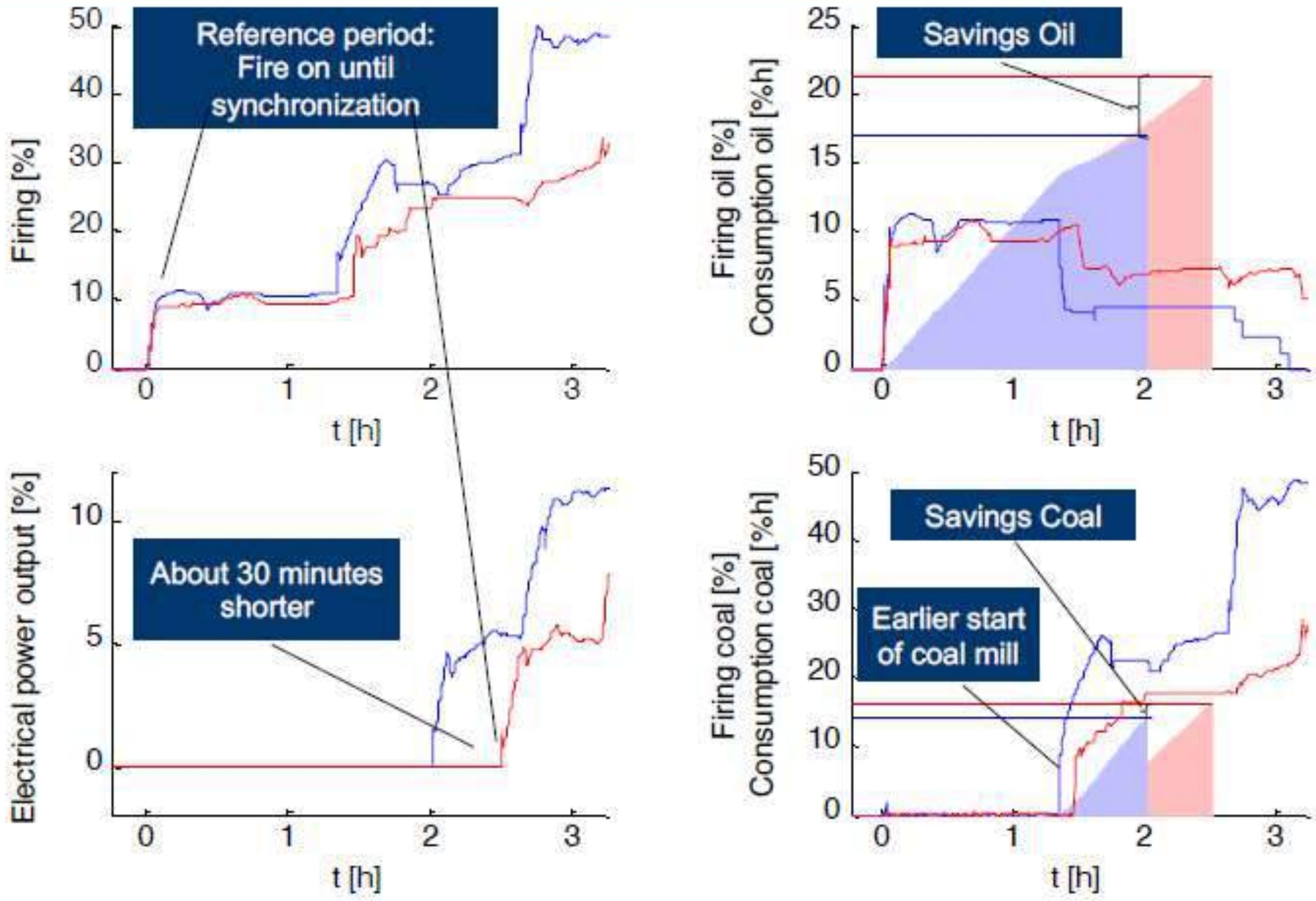
Results in a STEAG power plant



APC based optimization without any process modifications required

Results in a STEAG power plant

Automated start-up vs. Good manual start-up



Results in a STEAG power plant
Automated start-up vs. Good manual start-up

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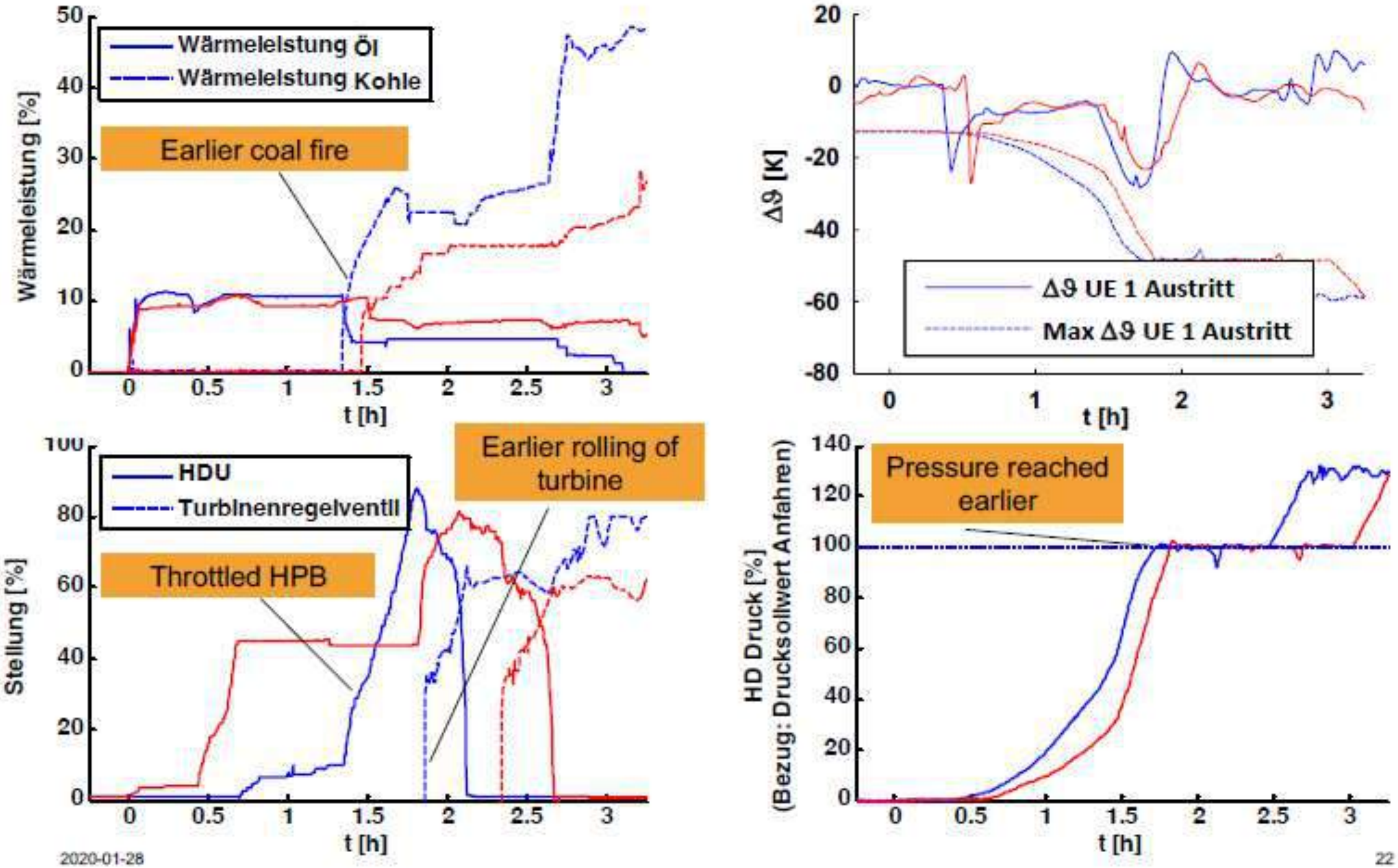


Training Objective

Importance for any Power Plant

- **Safe, reliable and efficient O&M**
- Require **competent O&M staff.**

Concerns

- A single mistake on the part of an operator can result in **huge production loss**
- Practical experience can only be achieved through hands-on working experience and long years of service

Training is whole gamut of plant operation

- Companies can increase profitability through increase in efficiency and minimum failures
- Simulator is an advanced hands-on-training tool, used mainly for training in areas such as unit start-up, shut-down, load ramping, emergency handling etc.
- Simulator gives the feeling of operating a real power plant without incurring any generation loss or damaging any plant equipment's.
- It raises the level of proficiency and builds up confidence required to handle emergencies in an actual plant operation.

Simulator is the best tool for an operator to build, practice, keep up to date and develop confidence on their skill

Simulator Training Benifits

Special skills and confidence are required for coal-fired power plant operators to adapt fluctuation due to renewables.

Flexibilization operation is new for the operators.

A training simulator is required for the operator **to practice and build up confidence.**

Operator will learn fast ramp up and ramp down as well as minimum stable load operation – with necessary monitoring of the parameters.

Learning flexibilization operation effects on critical parameters; MST, Spray, A/F ratio, FW flow, Turbine operation

“Simulator-based learning enables operators to practice flexibility safely without risk to actual plant equipment.”

A Systematic Training Approach

Study

- E-learning, awareness workshops and professional seminars

- Target: acknowledge the need for flexibility, understand principles of operation of flexible power plant

Try

- Using Simulator: Try out flexible operation on Power plant operator training Simulator

- Test runs at own plant as per CEA guidelines

Apply

- Implement new procedures in the operational scheme (e.g. mill scheduler, switch over of pumps and fans)
- Increase level of automation for routine sequences and optimize control system
- Implement advanced control solutions.

To upskill Operation engineers as **“Flexperts”** for smooth operation of coal based generating units

STEAG's Unique capabilities on Simulator

STEAG's experience as power plant owner, operator and training provider adds significant value in developing realistic simulator solutions including flexibilization scenarios.

STEAG's exclusive collaboration with TRAX , USA, TRAX is world's famous Simulator tool developer and supplier of more than 300 simulators globally

STEAG's Training Centre is recognized by CEA, Ministry of Power, Government of India

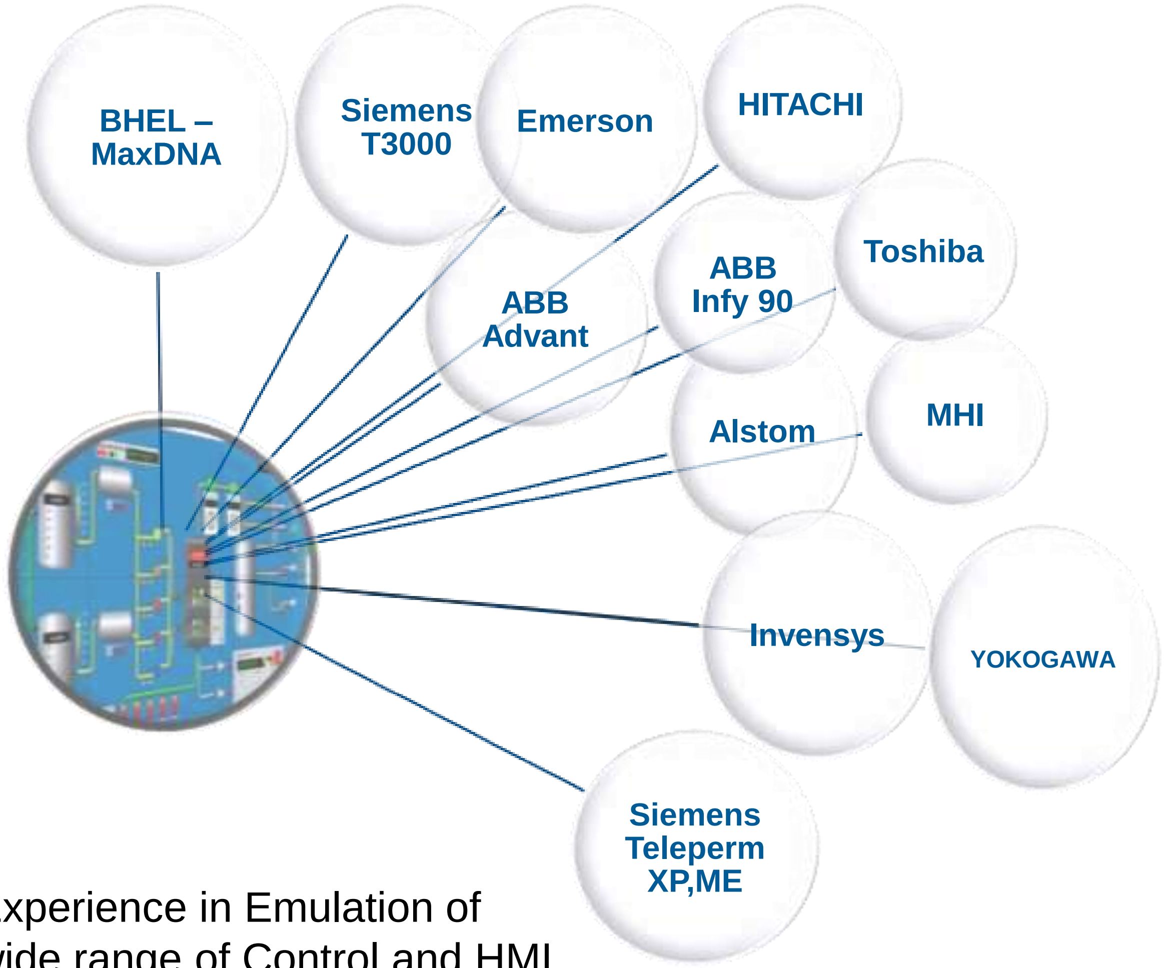
STEAG Training Centre has various simulators with knowledge of knowhow to set up training centre with various simulators.

STEAG has successfully executed a turnkey project for setting up training centre with 11 high fidelity Simulators for NTPC Ltd.

Apart from NTPC, STEAG helped to set up training centre for RAWEC-KSA,HIWPT-KSA, NAPTIN- Nigeria, ZPC – Zimbabwe, BPC- Botswana, various Indian state utilities

STEAG's experience in Simulators covers most of the fuel technologies (coal, gas, hydro, oil, solar, Biomass) and key global OEMs of equipment and DCS.

Simulator Credentials

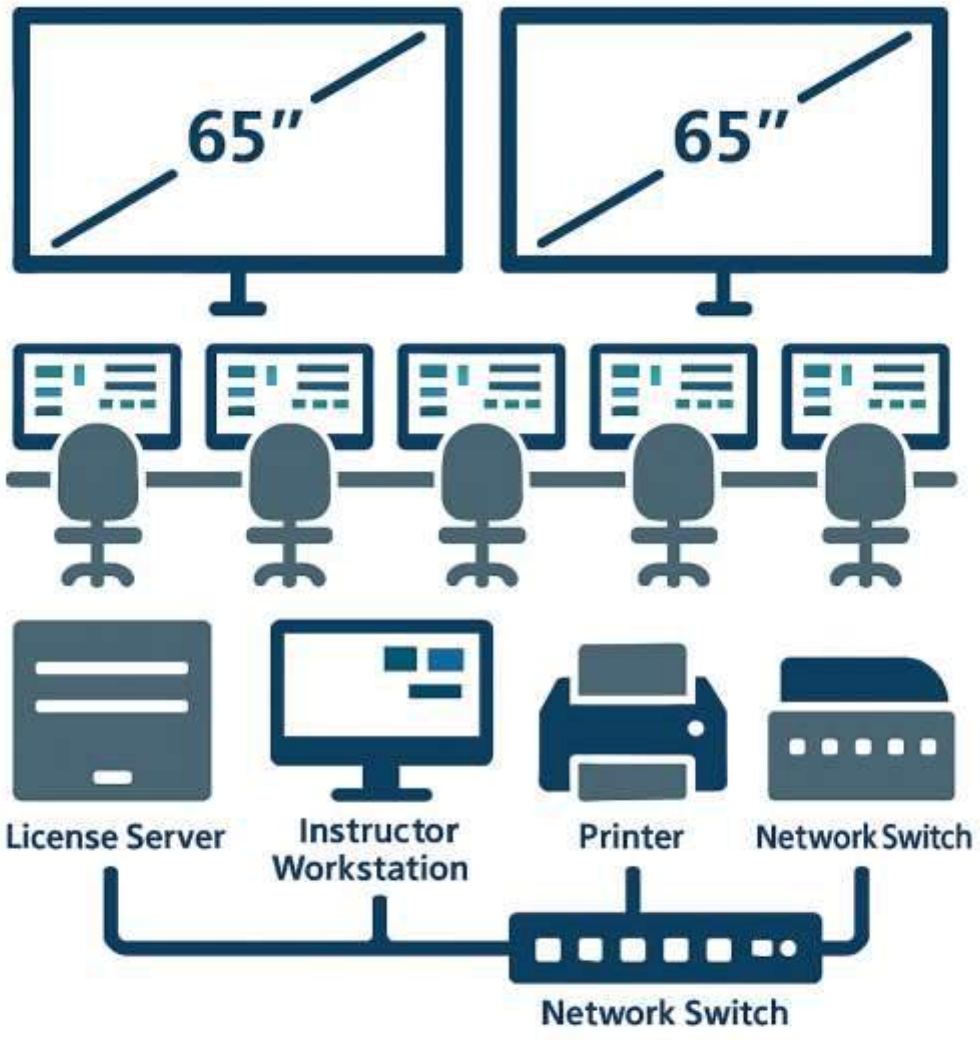


Experience in Emulation of wide range of Control and HMI

Sr. no.	Type of Simulators	Credential Nos.
1	Coal Fired	25
2	CCGT	6
3	Solar Thermal	1
4	Oil fired	1
5	Hydro	1
6	Biomass	1
7	RO & FGD	1

Simulation of Different Fuel Technology

General Network Architecture of a Simulator

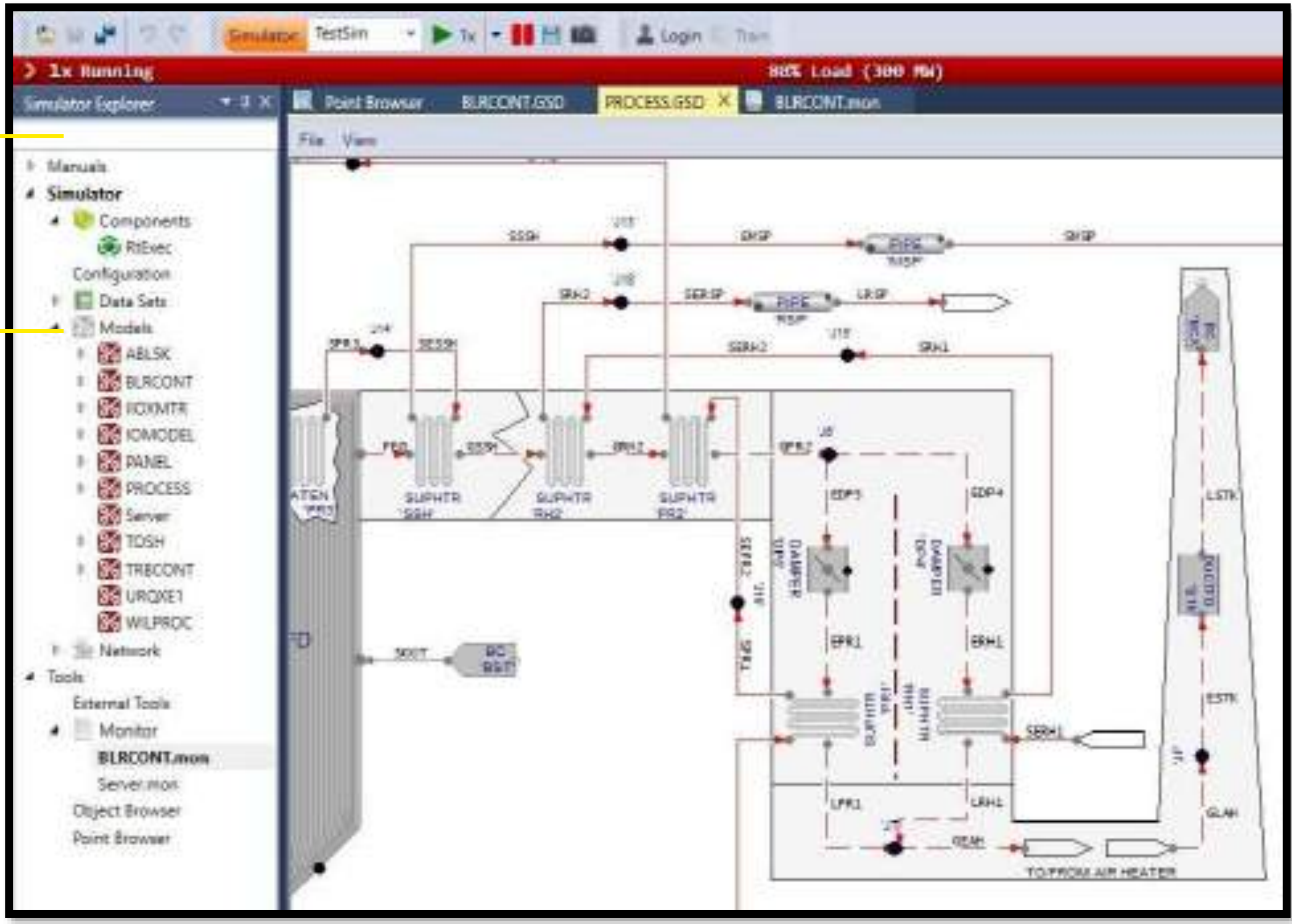


General Network Architecture of a Simulator

ProTRAX- Simulation Tool

ProTRAX instructor function, Training proficiency, Malfunctions, etc.

Modeling of the Plant process model and Controls



Matured

Precise

All International standards for Accuracy

Simulation Tool: ProTRAX

STEAG is exclusive partner of TRAX in India .

For over 30 years, TRAX has been the world’s leading supplier of high-fidelity power plant operator training simulators.

Extraordinary experience: over 300 simulators delivered

ProTRAX, is a modular, dynamic simulation tool*

Software is mature, precise, and comply to all international standards for accuracy.*

ProTRAX Features

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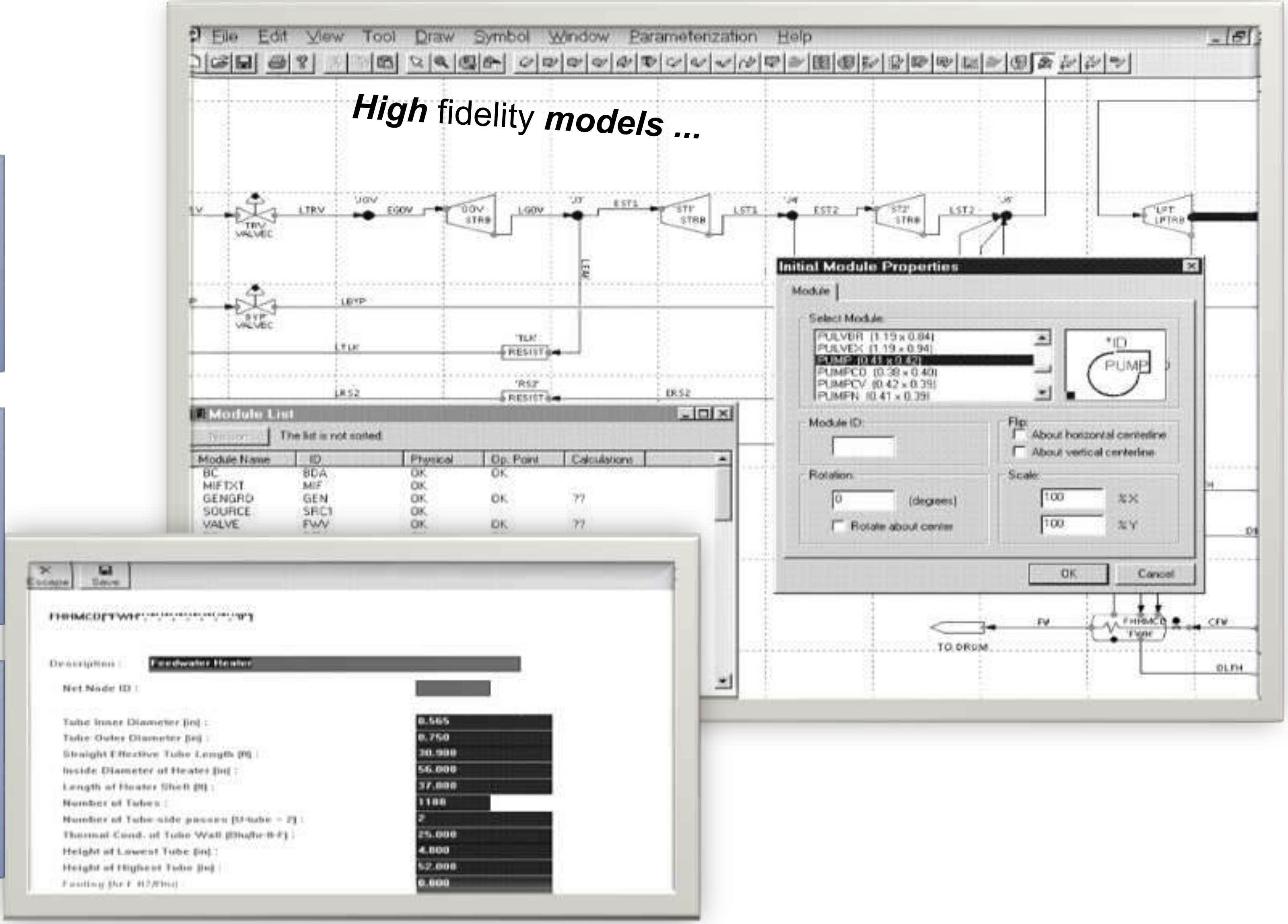
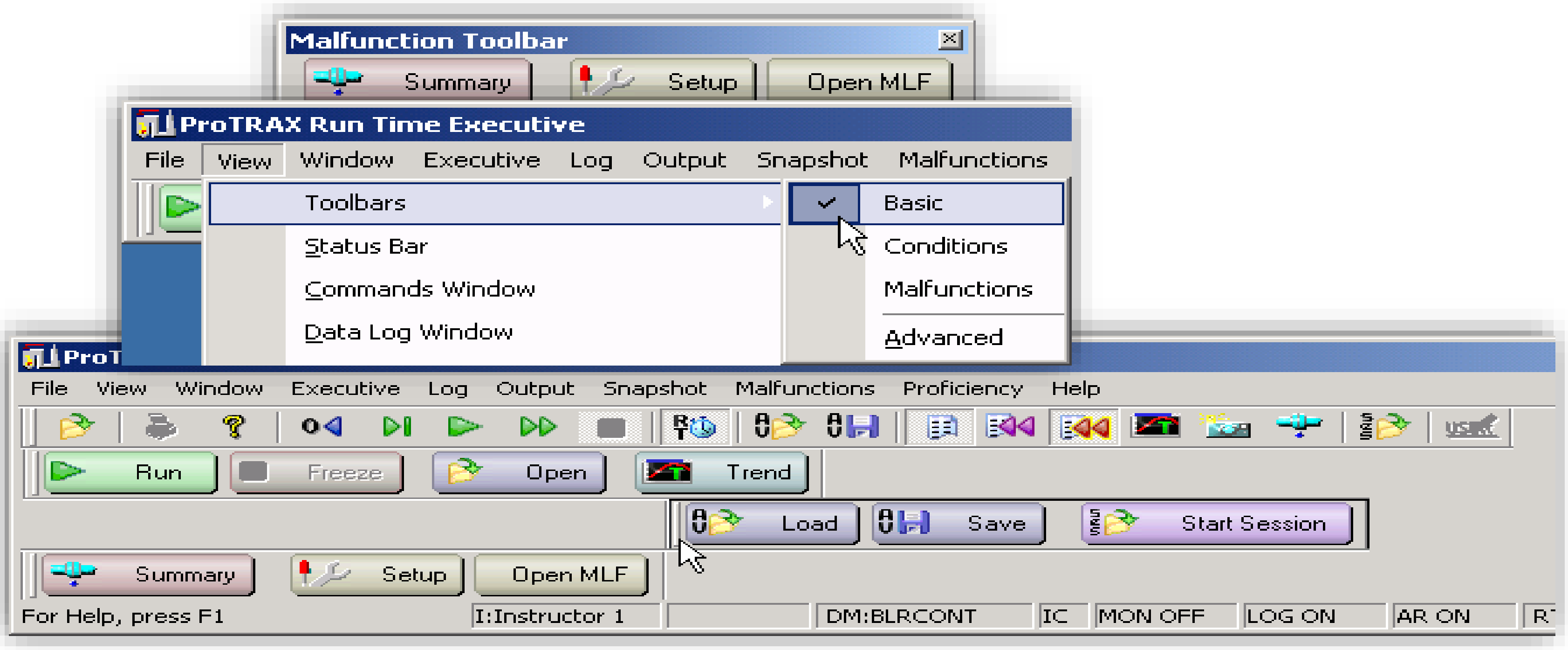
Ease of Model Development –
Drag and drop of components...

Object oriented GUI based model building and runtime software since 1989	**Windows operating system**
Large library of component models (Plant Equipment)	**Structured data entry**
First principles modeling	**Training features**

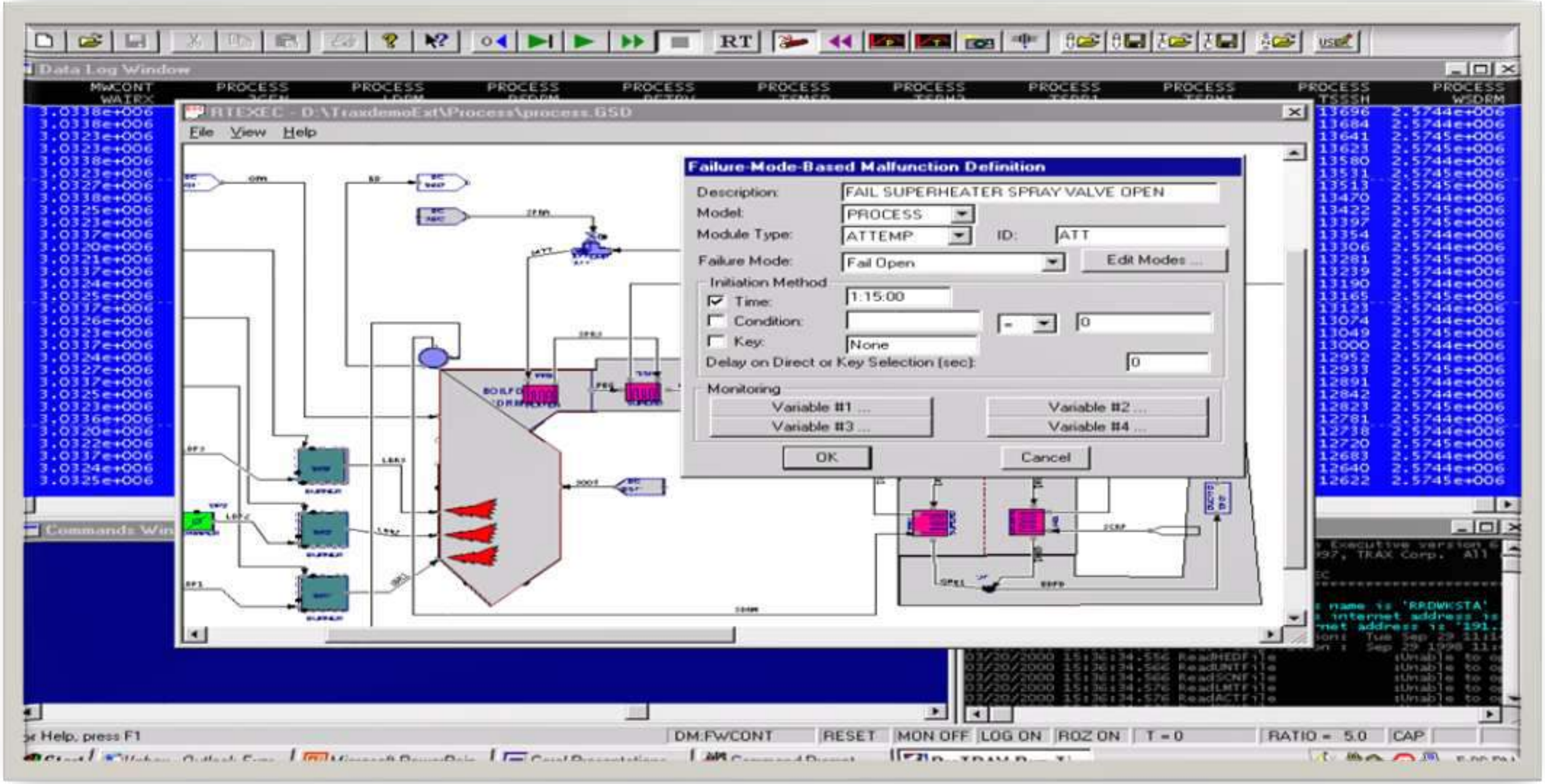


ProTRAX – Instructor Functions

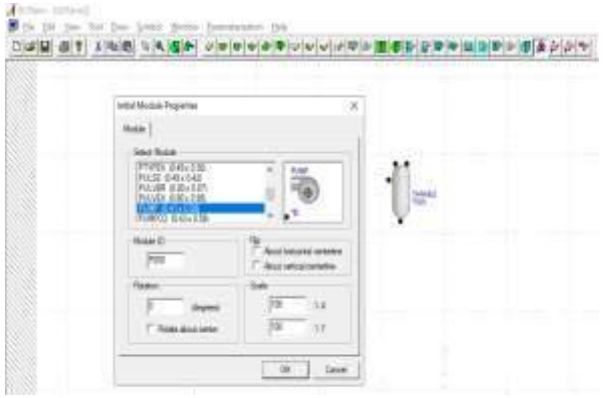
- Training Scenarios
- Trends
- Plot
- Logs
- Initial Condition
- Run/Freeze
- Fast/Slow Time
- Dynamic Schematic
- Malfunctions
- Parameter Changes
- Snapshots



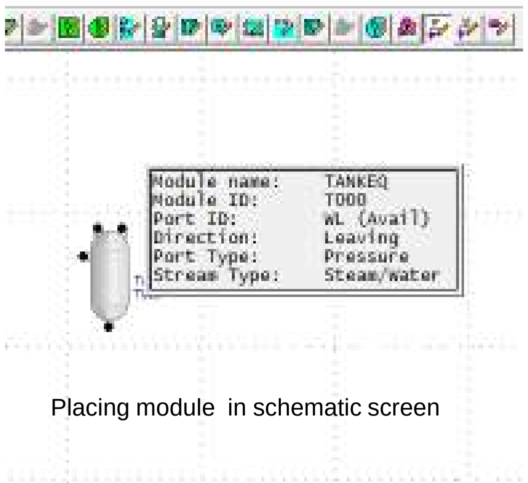
ProTRAX - Malfunctions



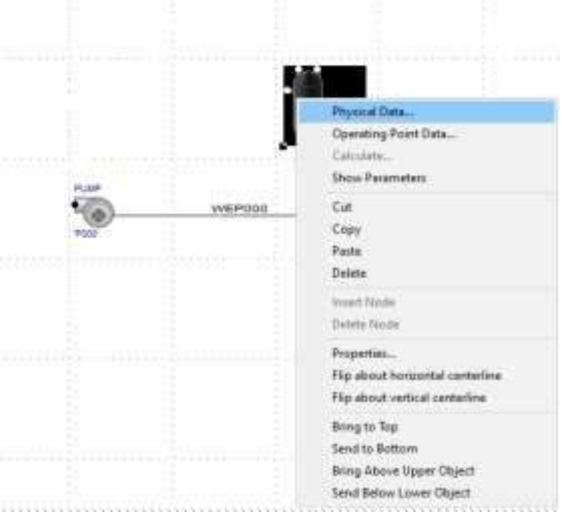
Basic Model Development steps



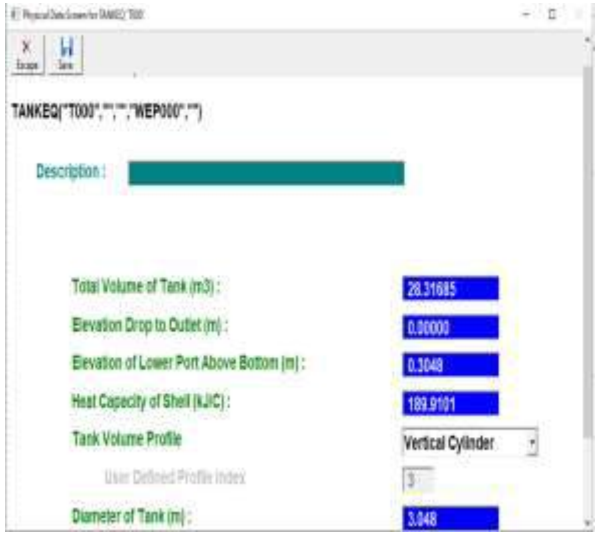
Selection of suitable component



Placing module in schematic screen

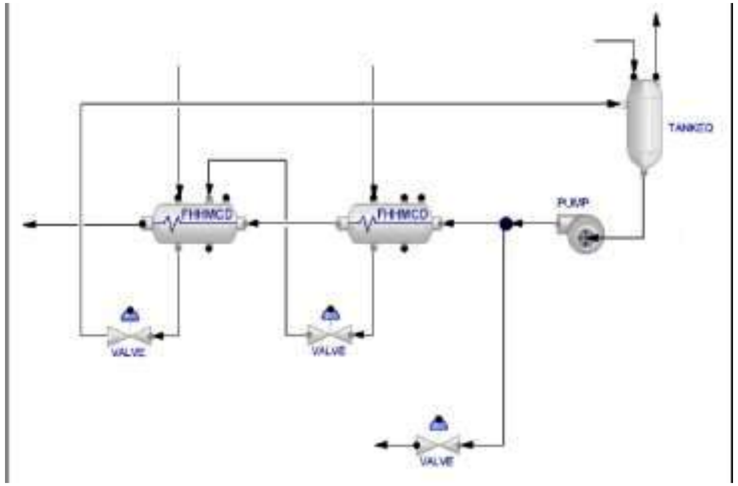


Component property window for parameterization



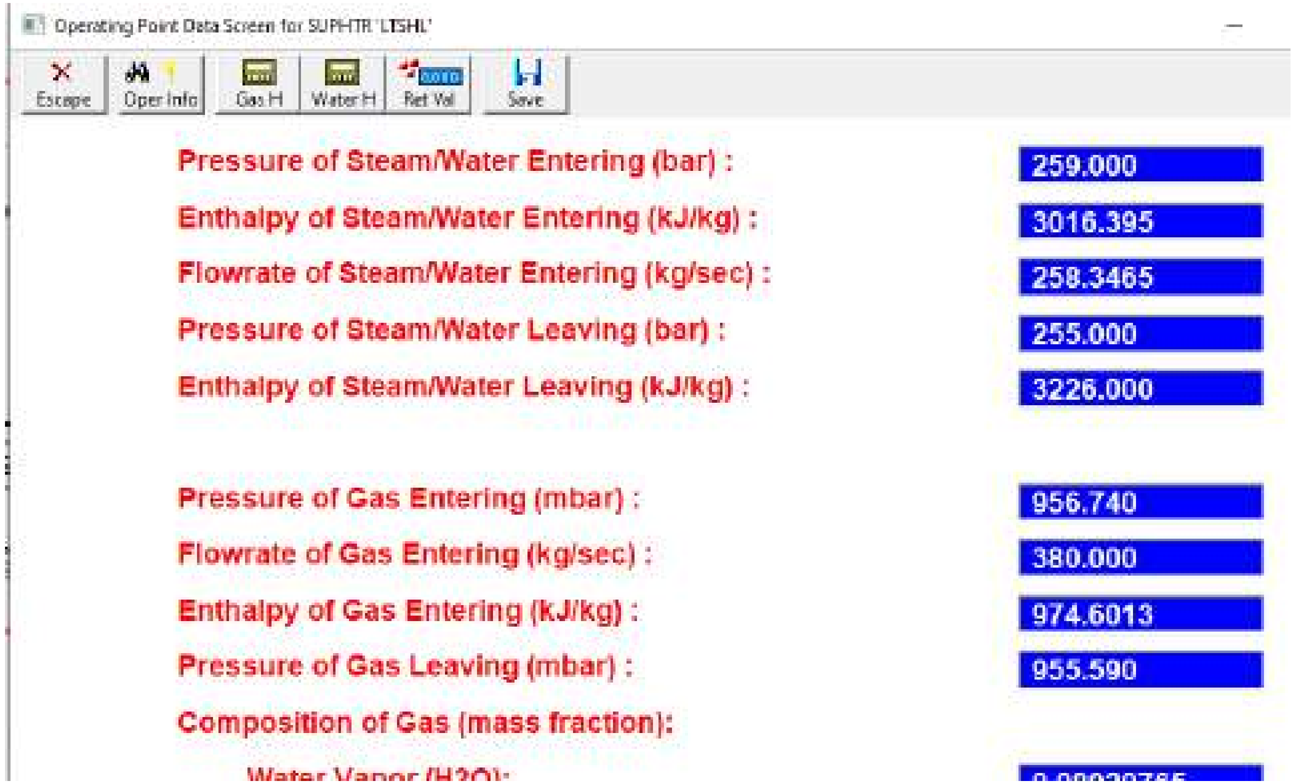
Physical data of the module

Operating data of the module

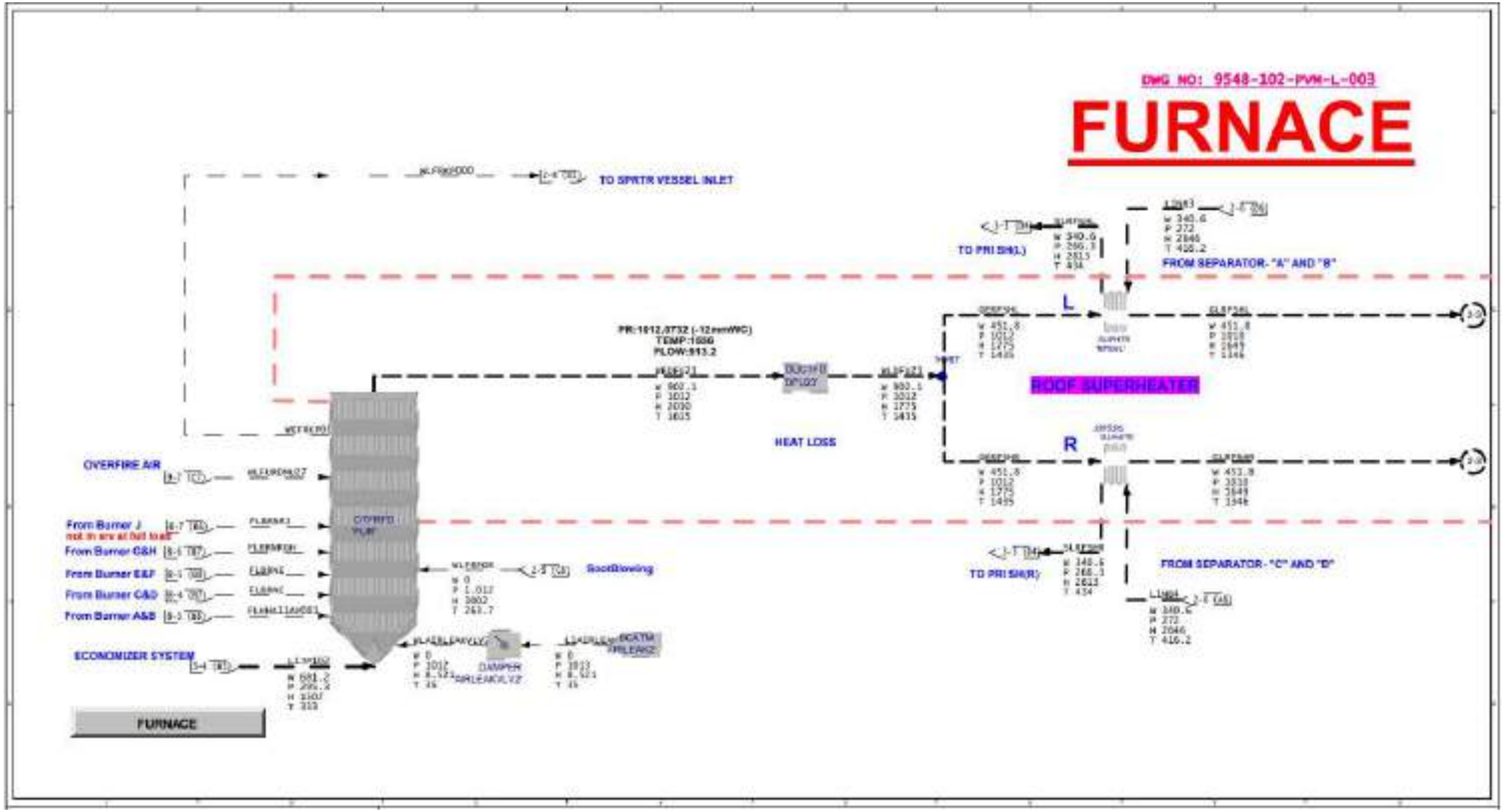


Sample model

Customization of Generic to plant Specific Module



Plant model schematic (Furnace screenshot)



Plant model schematic (Superheater screenshot)

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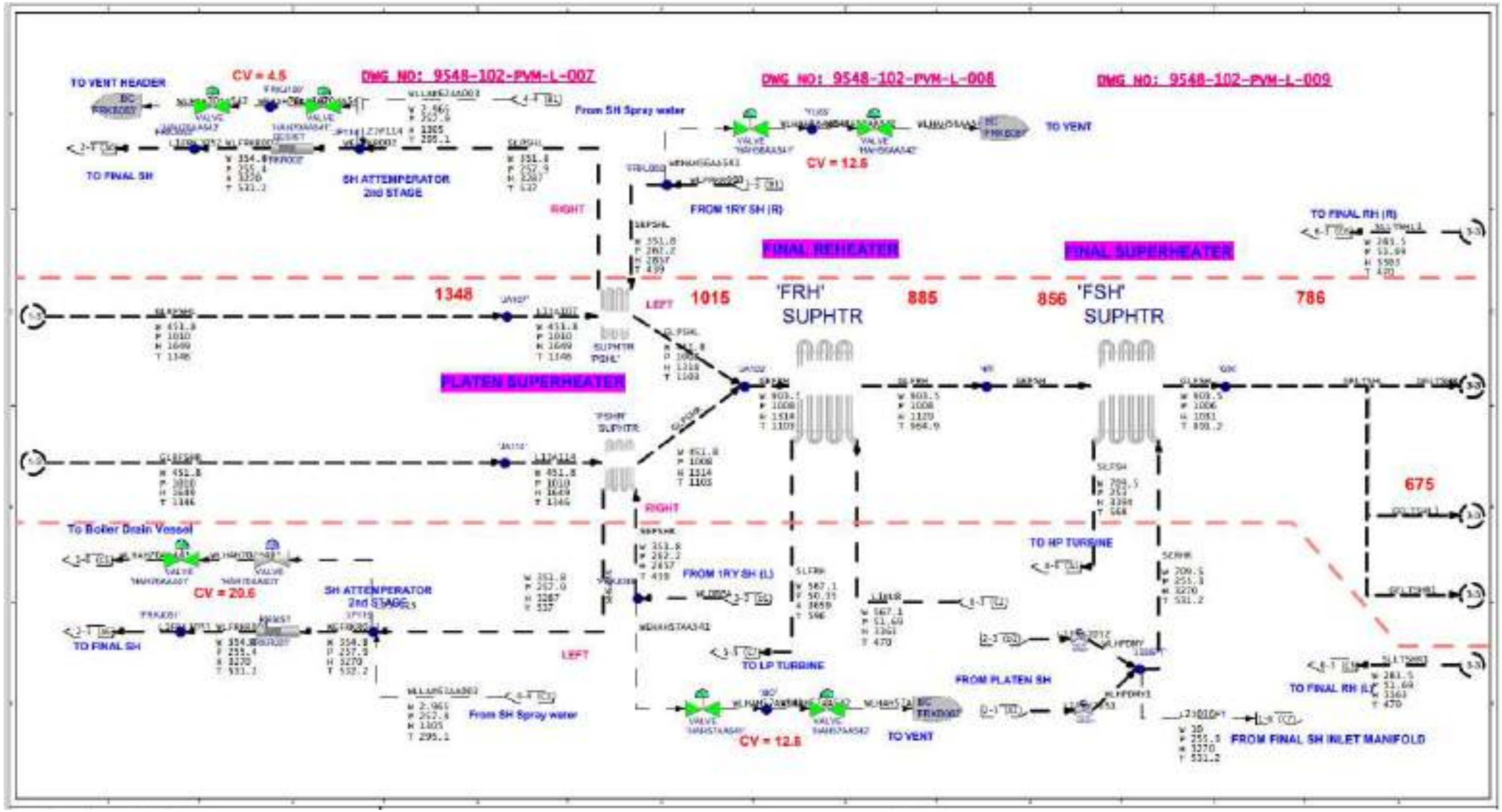


OTS Supplied by STEAG

RAWEC, Saudi Arabia

RAWEC SAUDI ARABIA Captive Power plant
Simulation for 815 MW, Oil Fired

(1) 13 Boilers,
(2) 7 Turbine
(3) 5 Limestone FGDs
(4) 24 Sea water reverse osmosis Desalination plant

NTPC Solapur RLI Training Centre

NTPC SOLAPUR

Eleven simulator in two set of hardware.

(1) 800 MW simulators

- KUDGI 800
- DARLIPALLI 800
- LARA 800 MW
- GADARWARA 800 MW
- TELENGANA 800 MW

(2) 660 MW simulators

- SOLAPUR 660 MW
- MEJA 660 MW
- BARH-II 660 MW
- TANDA STAGE-II 660MW
- KHARGONE 660 MW
- BARH-I 660 MW

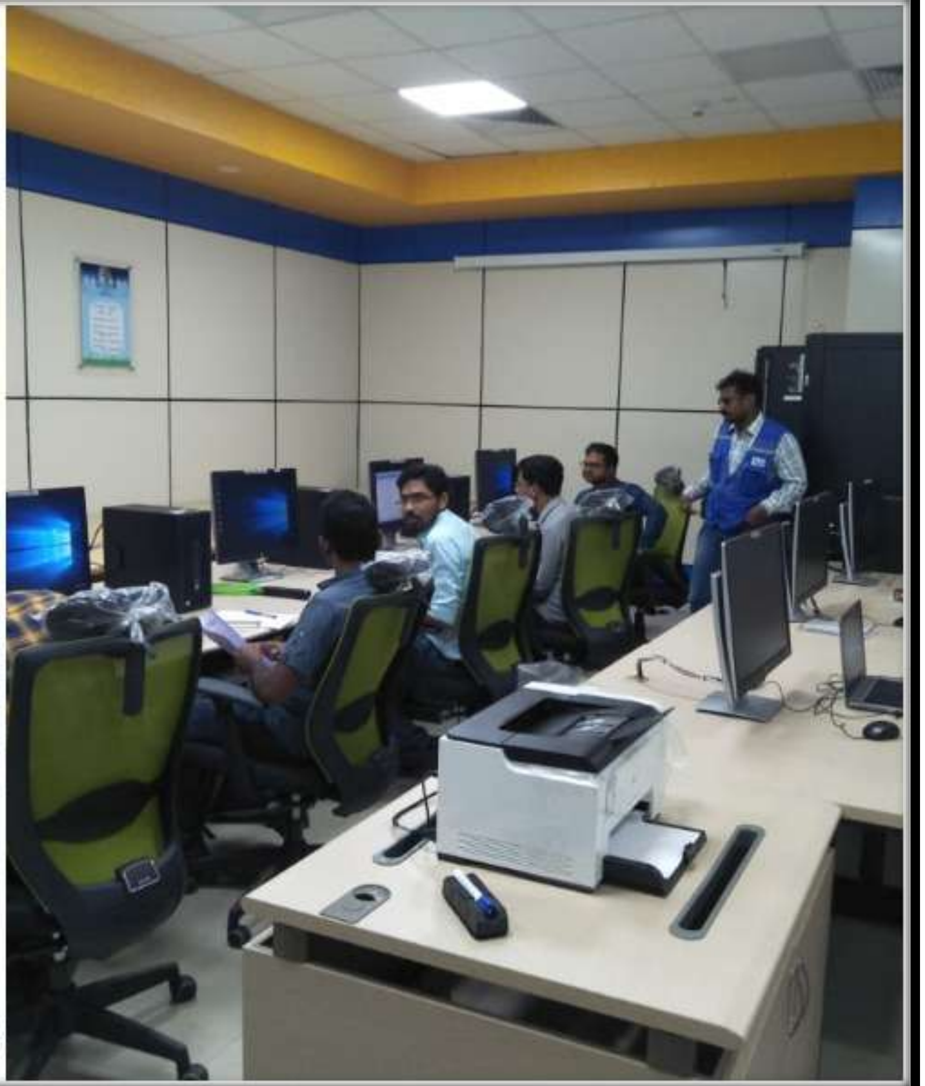
NPTI Nangal Hydro Simulator

Hydro Simulator , NPTI Nangal, 250 MW

Control System-ABB Advant

Turbine -Francis

NAPTIN Nigeria and NTPC Kudgi



LEFT PICTURE:

NAPTIN NIGERIA 440 MW CCGT SIMULATOR

HRSG-Siemens
ST-BHEL
GT-Siemens AG
V94.2 Combined Cycle
Fuel: HSD, Naphtha, Natural Gas

RIGHT PICTURE:

NTPC KUDGI 800 MW
SG-Siemens
TG-Toshiba,
BOP-Yokogawa

NAPTIN Nigeria

NAPTIN NIGERIA 440 MW CCGT SIMULATOR

HRSG-Siemens

ST-BHEL

GT-Siemens AG

V94.2 Combined Cycle

Fuel: HSD, Naphtha, Natural Gas

RRVUNL, KOTA

RRVUNAL KOTA THERMAL POWER PLANT 195/210 MW COAL FIRED

SG- MAXDNA
TG- MAXDNA
BOP-ABB

Flexibilization programs with GIZ, VGBE & EEC

Flexibilization programs with GIZ, VGBE & EEC

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Flexibilization Training – 500 MW Simulator

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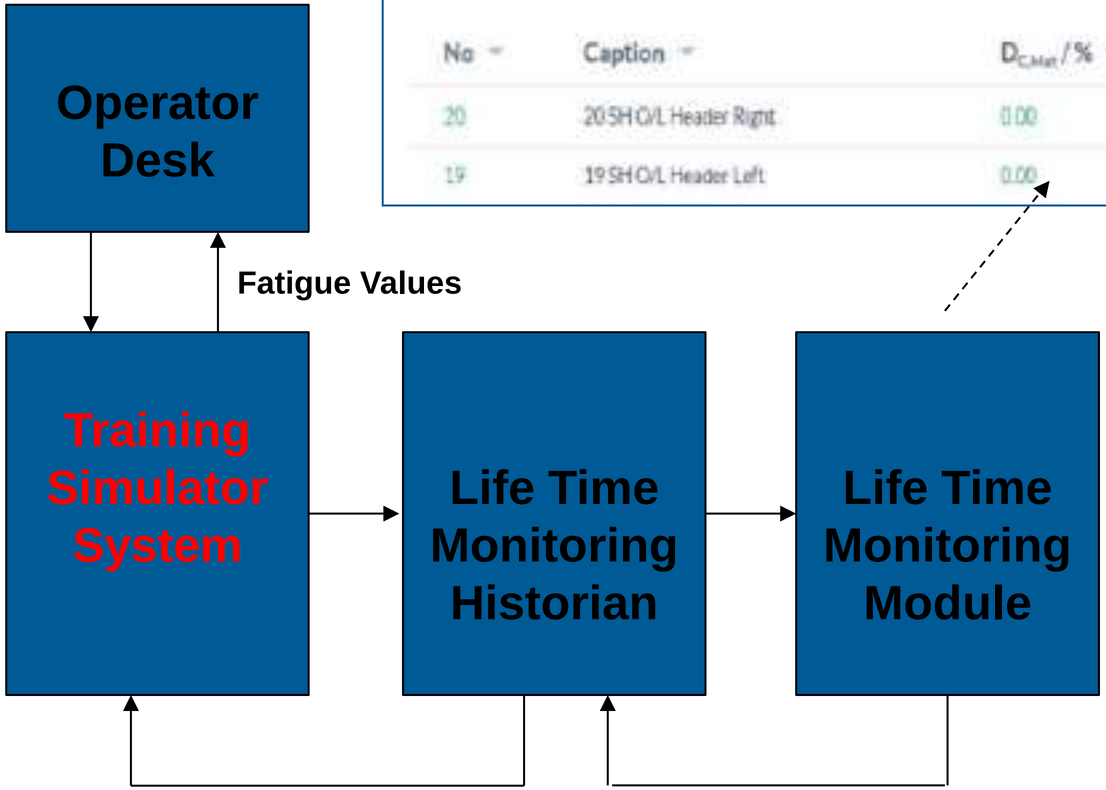
Flexibilization Training – 660 MW Simulator

Integration of Flexible Simulator with Life Time Monitoring SR1



1. Starting simulator with specific ramping and / or disturbances.
2. Date like temperatures, pressures, main steam mass flow goes to SRx Server
3. SR1 calculations start and transfer fatigue results to simulator historian

Advantage:

1. Increasing trainee's awareness of the impact of the boiler startup / shut down ramping on the wear of its thick-walled elements
2. Possibility of examining how different ramping values affect fatigue of thick-walled boiler elements and piping

Key Takeaways

Flexible thermal operation is essential for renewable integration

Flexibilization requires both technology and operator competency

Simulator-based learning enables safe operational preparedness

STEAG supports utilities through practical implementation experience

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Building Flexperts for a Reliable Energy Transition

Thank You

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