

Control Of Environmental Paramters through Process Optimization

Steag Energy Services

Head Quarters is in Essen, Germany

STEAG Energy Services GmbH Essen, Germany

STEAG Powitec GmbH Essen, Germany

OPUS Personaldienstleistungen GmbH
Essen, Germany

STEAG Energy Services
Schweiz GmbH Zurich,
Switzerland

STEAG Energy Services
Bangladesh

Constanta, Romania

STEAG Ensida Energy Services Ltd. Ankara, Turkey

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Mountain, USA

STEAG Energy Services
Solar Sevilla, Spain

STEAG Energy Services
(India) Pvt. Ltd.

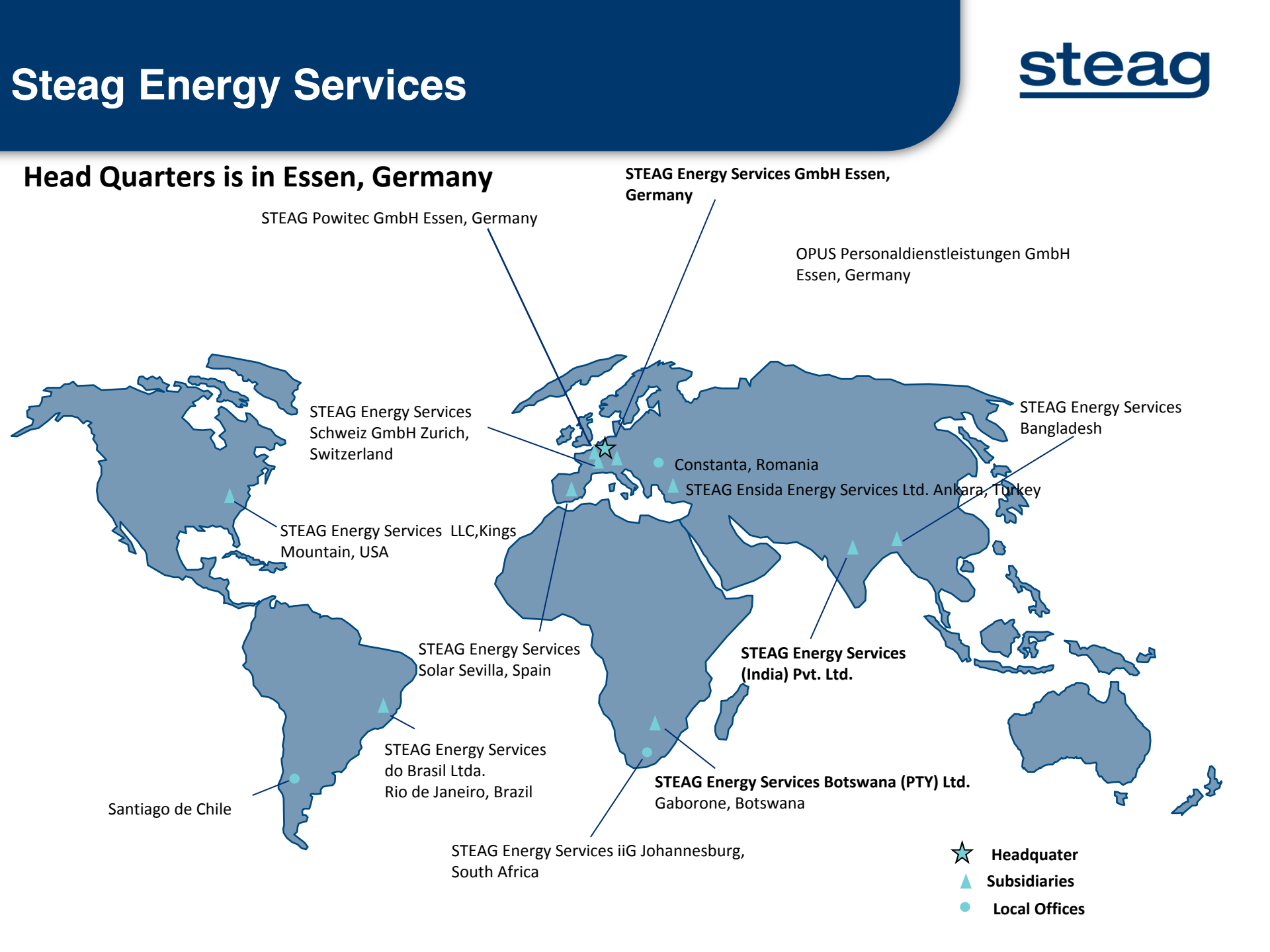
STEAG Energy Services
do Brasil Ltda.
Rio de Janeiro, Brazil

STEAG Energy Services Botswana (PTY) Ltd.
Gaborone, Botswana

Santiago de Chile

STEAG Energy Services iiG Johannesburg,
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- ★ Headquarter
- ▲ Subsidiaries
- Local Offices



Triad

GERMAN
ENGINEERING

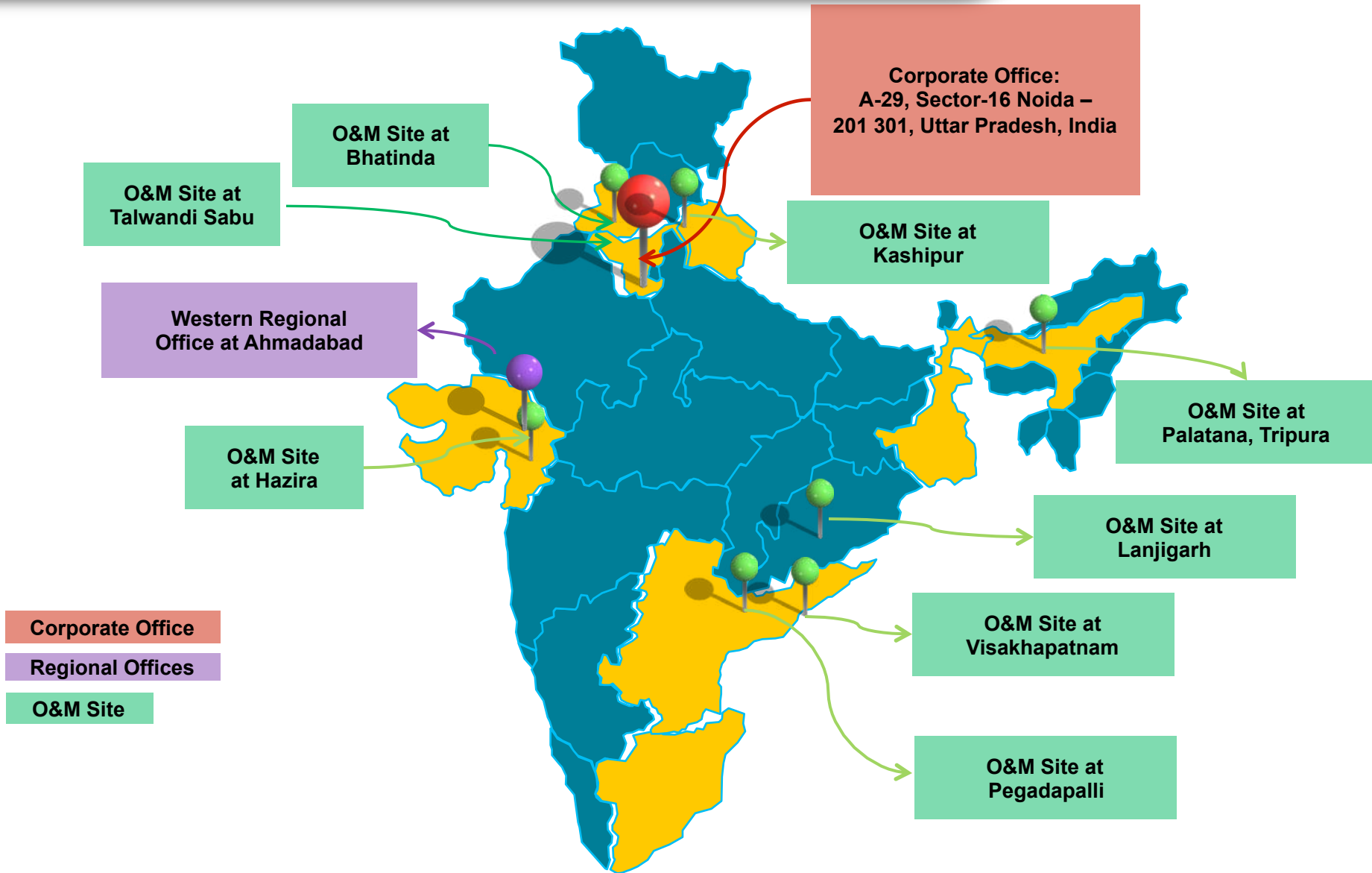
100,000 MW
across all
technologies

O&M
PRACTICES

>6,500 MW
full scope O&M for
third parties

O&M management
support for
further 3,500 MW

STEAG Energy Services India operations



O & M Services



Plant	SIZE (MW)	Location	Owner	Contract From	To	Fuel	Scope
HINDUJA	2X525	VISAKHAPAT	HNPCL/ SES	2012	Ongoing	Coal	Comprehensive O&M
SINAGRENI	2X600	TELANGANA	SINGARENI	2016	Ongoing	Coal	Comprehensive O&M
TSPL	3X660	PUNJAB	VEDANTA	2017	Ongoing	Coal	Comprehensive O&M
STERLITE	4X600	JHARSGUDA	VEDANTA	2010	2015	Coal	Comprehensive O&M
HMEL	165	PUNJAB	HPCL-Mittal Energy Limited	2010	Ongoing	Gas	Comprehensive O&M
GSEG	530	SURAT	GSEG	2001	Ongoing	Gas	Comprehensive O&M
HALDIA	165	W.BENGAL	Haldia Petrochemicals	2006	2014	Refiner residue.	Comprehensive O&M
LANJIGARH	3x30	ORISSA	Vedanta	2017	ongoing	Coal based	Field O&M
BARAUNI	7X110+ 2X250	BARAUNI	NTPC	2018	Ongoing	Coal	Control room support
GAMA	2X108	UTTARKAND	RLG Groups	2015	Ongoing	Gas	Comprehensive O&M
OTPCL	2X365	TRIPURA	ONGC &TRIPURA.	2016	Ongoing	Gas	Comprehensive O&M

SI No	Product	Description
1	PADO	Performance Analysis Diagnostic and Optimization (over 120 units supplied)
2	Ebsilon	Energy and Mass flow balances of thermodynamic process(over 74 units supplied)
3	OTS	Operator Training Simulator(over 22 Simulators) supplied for various configuration of Coal, Gas and Solar systems)
4	CO	Combustion Optimization
5	SI/ PAM	Computerized Maintenance Management System (CMMS)
6	iRENYSIS	Management Dashboard (MIS)
7	PowerFactory	Distribution and Transmission Simulator
8	Fleet Monitoring	Fleet wide monitoring of performance and fault prediction
9	MOR	Merit Order Rating
10	Perf	Performance Calculation

Control of Environmental Parameters through Process Optimisation

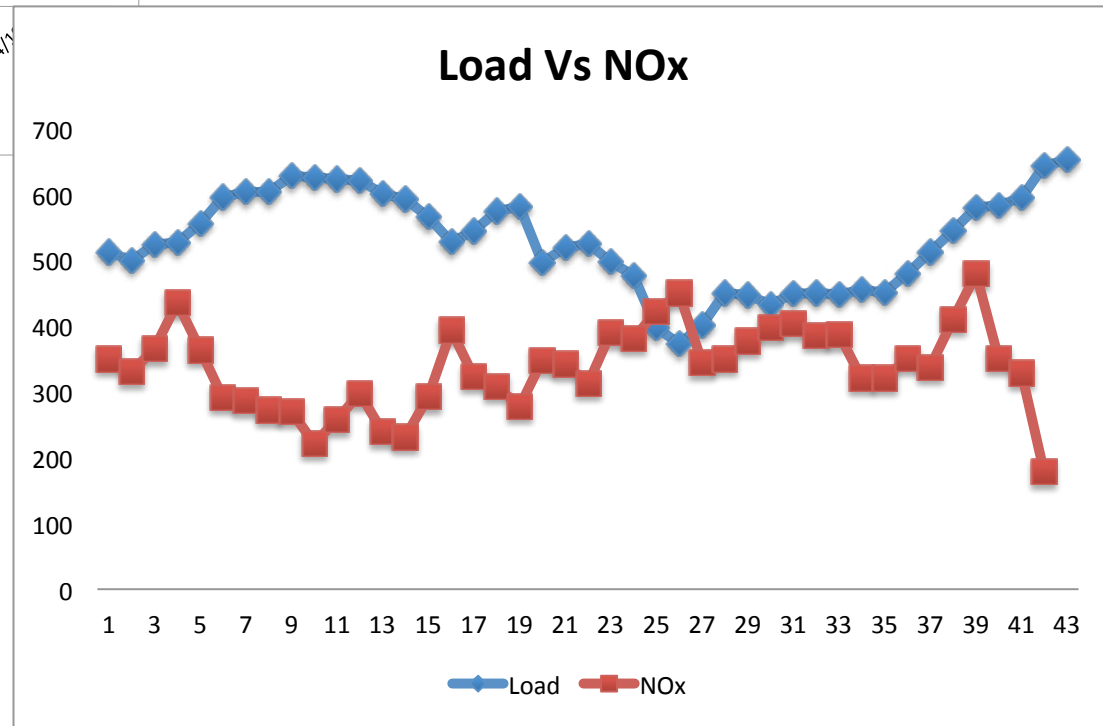
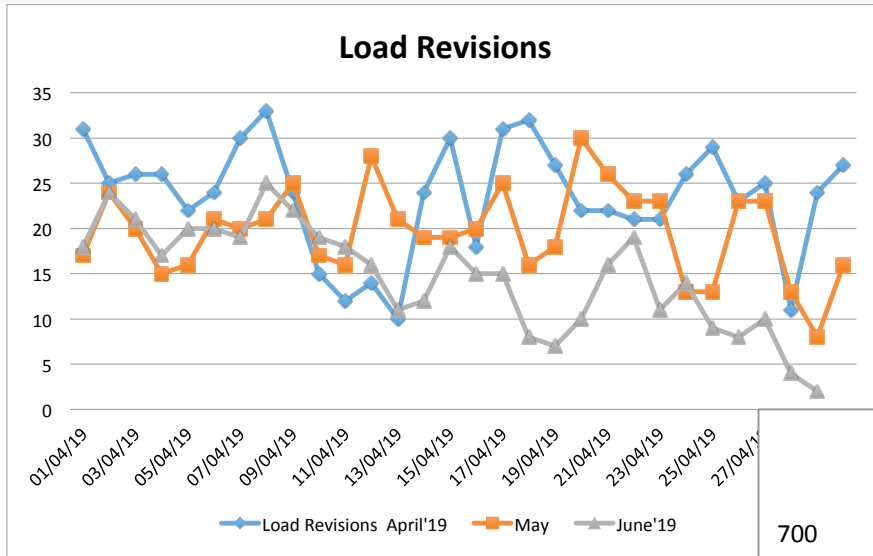
NOx Controls

Combustion Controls
Lower Flame temperature
Create Fuel Rich condition
Lower residence time of oxidation condition
Post Combustion
Converting Nox to Nitrogen gas

Introducing reagents into flue gas	Controls	Expected NOX reduction	Cost intensive
	Low Nox burners	40-60%	
	Overfired air	30-50%	
	Reburn/Gas recirculation	40-50%	
	Water Steam injection	20-25%	
	Trims		Cheaper options
	Burner out of Service	10-15%	
	Fuel biasing	10-20%	
	Low Excess air	5-15%	

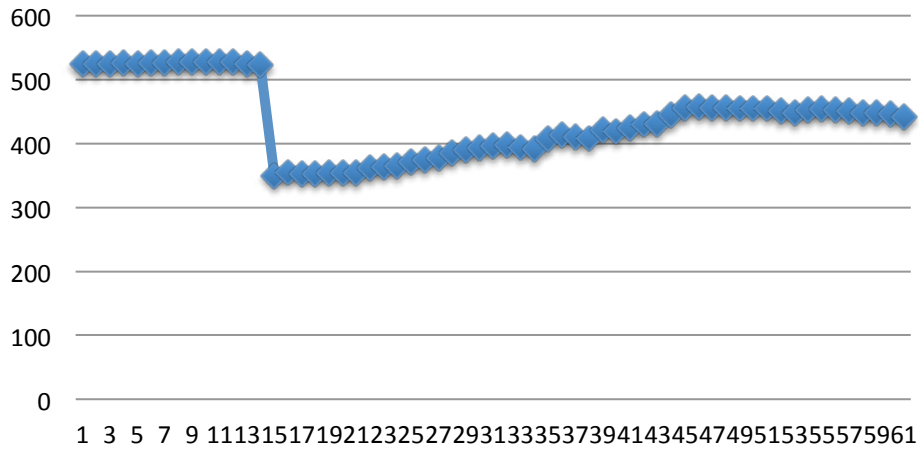
Ref:Ron D. Bell, P.E., MPR Associates, Inc.

Load fluctuation-Impact on Environmet

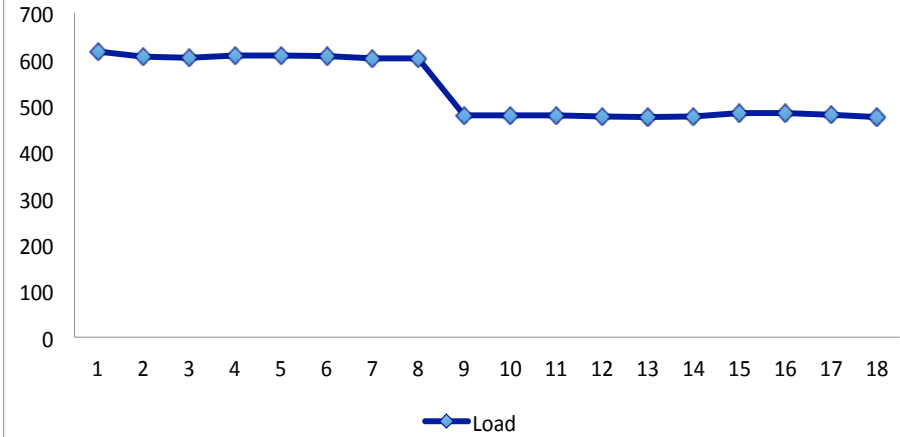


Variation of Nox with load at sub critical units

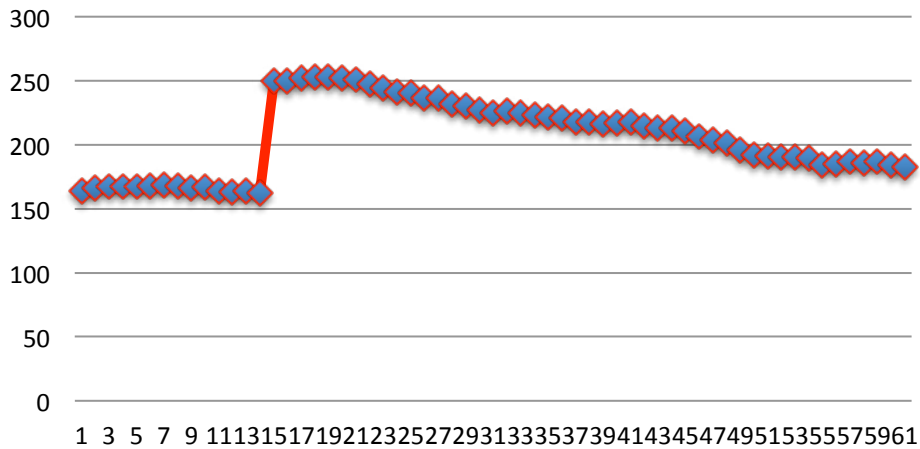
LOAD



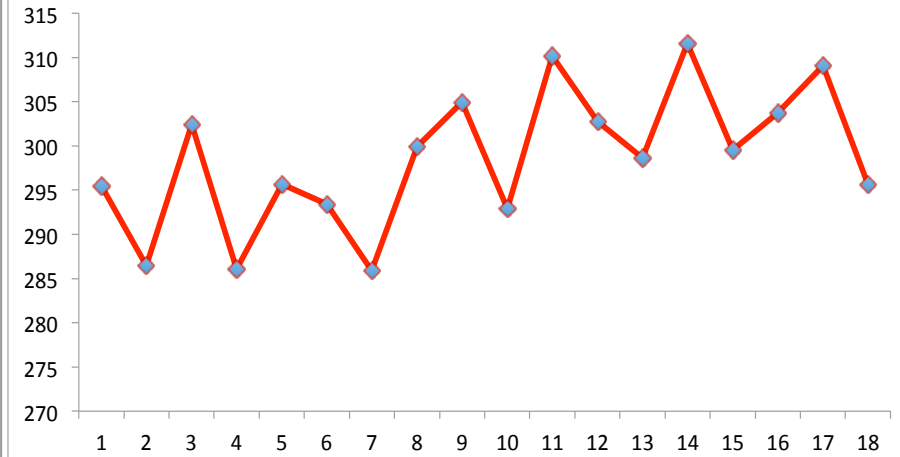
Load



NOx

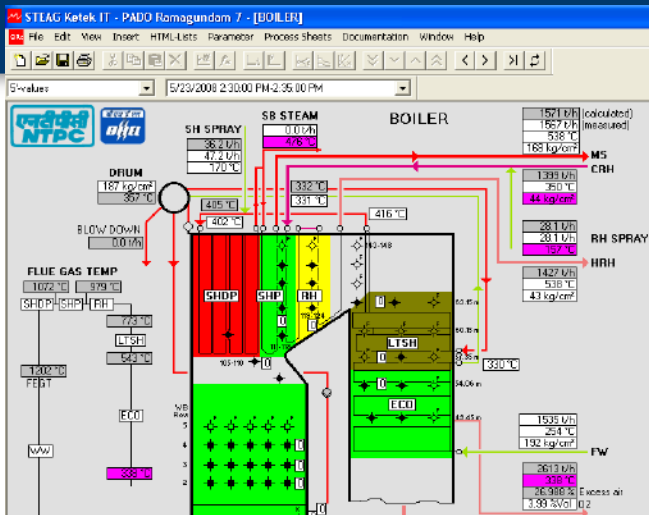


NOx



Process Optimisation

Digitalized diagnostics and efficiency enhancement

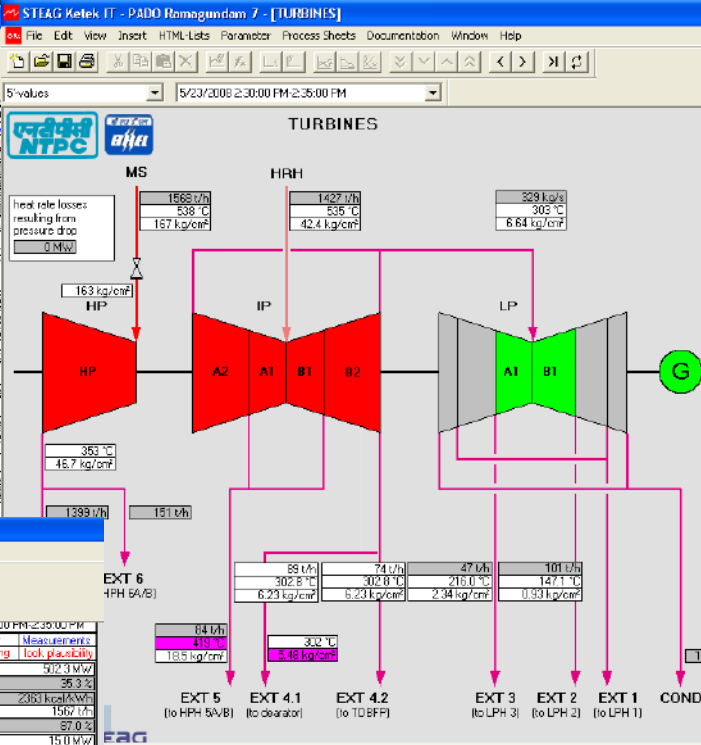


Ramagundam 7 5/23/2008 2:30:00 PM-2:35:00 PM

Status	Unit	Boiler	Measurements
ready	standby	operating	lock, pla
Generator el. output power gross: 502.3 MW			
Unit efficiency net: 35.3 %			
Unit heat rate gross: 2363 kcal/kWh			
Boiler Load Index: 156.7 t/h			
Boiler efficiency: 87.0 %			
Station load: 15.0 MW			

Heating Surface	Efficiencies	Level/ SB No.	Sootbl
Furnace/AVW	91.7 / 80.0	Row 1-5	SB no.
SH Division Pan	88.0 / 85.0	105-110	Comp.
SH Platen	93.2 / 85.0	111-118	SB no.
Reheater	78.0 / 78.0	119-124	Na2
Low Temp SH	108.2 / 85.0	83-15 m	Surge
Economizer	97.0 / 85.0	94-06 m	Surge

	Act	Ref	MonetL
O2 at Eco outlet	3.99 %vol	3.16 %vol	0.0
Runner tilt	11	4	

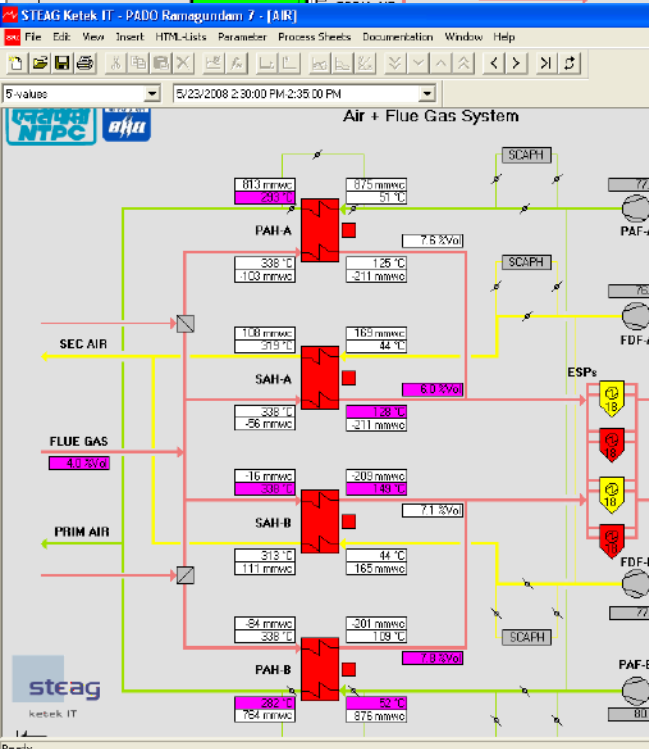


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Actual	Reference	Monetary losses
Frequency: 49.03 Hz	50.00 Hz	35.30 %
Efficiency: 88.60 %	88.60 %	0.00 %
Power: 502.3 MW	501.0 MW	1.30 %
PH2: 3.50 kg/cm ²		
Cost difference:		*** Bz/h

Reference stage efficiency	Actual stage efficiency	Monetary losses
HP: 91.41 %	88.13 %	1860.6 Bz/h
IP_A1: 92.71 %	88.18 %	3024.8 Bz/h
IP_A2: 94.72 %	84.07 %	5217.6 Bz/h
IP_B1: 92.71 %	88.18 %	3024.8 Bz/h
IP_B2: 97.82 %	84.07 %	11438.0 Bz/h
IP: 94.07 %	87.51 %	12841.6 Bz/h
LP_A1: 81.73 %	85.51 %	2233.0 Bz/h
LP_B1: 85.16 %	92.78 %	###



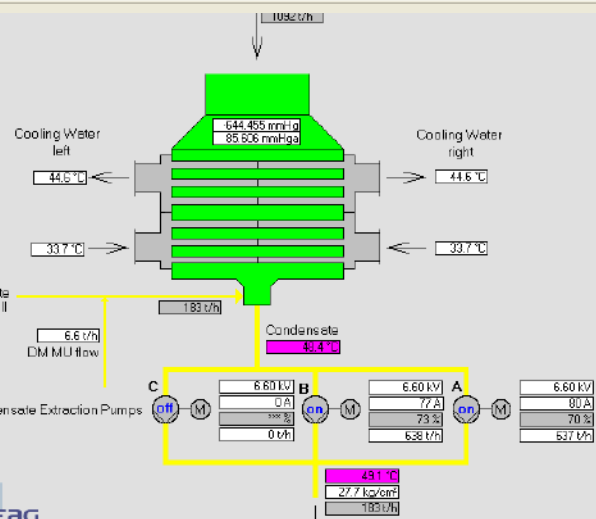
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	Monetary losses due to	leak-age
PAH-A	1021.3 Bz/h	436.0 Bz/h
SAH-A	1699.4 Bz/h	464.2 Bz/h
SAH-B	1782.4 Bz/h	721.0 Bz/h
PAH-B	1416.3 Bz/h	445.2 Bz/h

	Actual	Threshold	Calculated
CO	1564 ppm	100 ppm	
NOx	288 ppm	70 ppm	
SO2	599 ppm	800 ppm	1032 ppm
O2	4.5 %		16.34 %
opacity	46 mg/Nm ³	200 mg/Nm ³	

	actual opacity	ref opacity	collection eff. (Act/Ref ratio)
ESP-A	38 g/Nm ³	47 mg/Nm ³	80.8 %
ESP-B	35 g/Nm ³	80 mg/Nm ³	38.7 %
ESP-C	38 g/Nm ³	48 mg/Nm ³	79.2 %



Station load	Reference	Actual
condense vacuum	85.633 mmHg(a)	85.606 mmHg(a)
condensing temp. efficiency	85.0 %	100.0 %
TTD	3.8 °C	3.8 °C

	pass - I	Pass - II
heat rate deviation	-0 kcal/kWh	-0 kcal/kWh
heat rate deviation at ingress	-0 kcal/kWh	-0 kcal/kWh
heat rate deviation fouling	-0 kcal/kWh	-0 kcal/kWh
monetary loss	0 Bz/h	0 Bz/h

	pass - I	Pass - II
condensate	183 t/h	183 t/h
DM MU flow	6.6 t/h	6.6 t/h
vacuum due to cw inlet temp.	81.1 mmHg(a)	81.1 mmHg(a)
loss of vac. due to cw inlet temp.	5.1 mmHg(a)	5.1 mmHg(a)
loss of vac./excess heat duty tube/air ingress	2.0 mmHg(a)	2.0 mmHg(a)
total loss of vacuum	11.6 mmHg(a)	11.6 mmHg(a)

Process Optimization

Parameter Set point sets those critical parameters which the operator can pre-set, and obtain the Optimal values which the operator can try to achieve through suitable actions for optimizing efficiency.

Process inputs

Coal Quality

PA flow

SA flow

Burner tilts

Furnace O₂

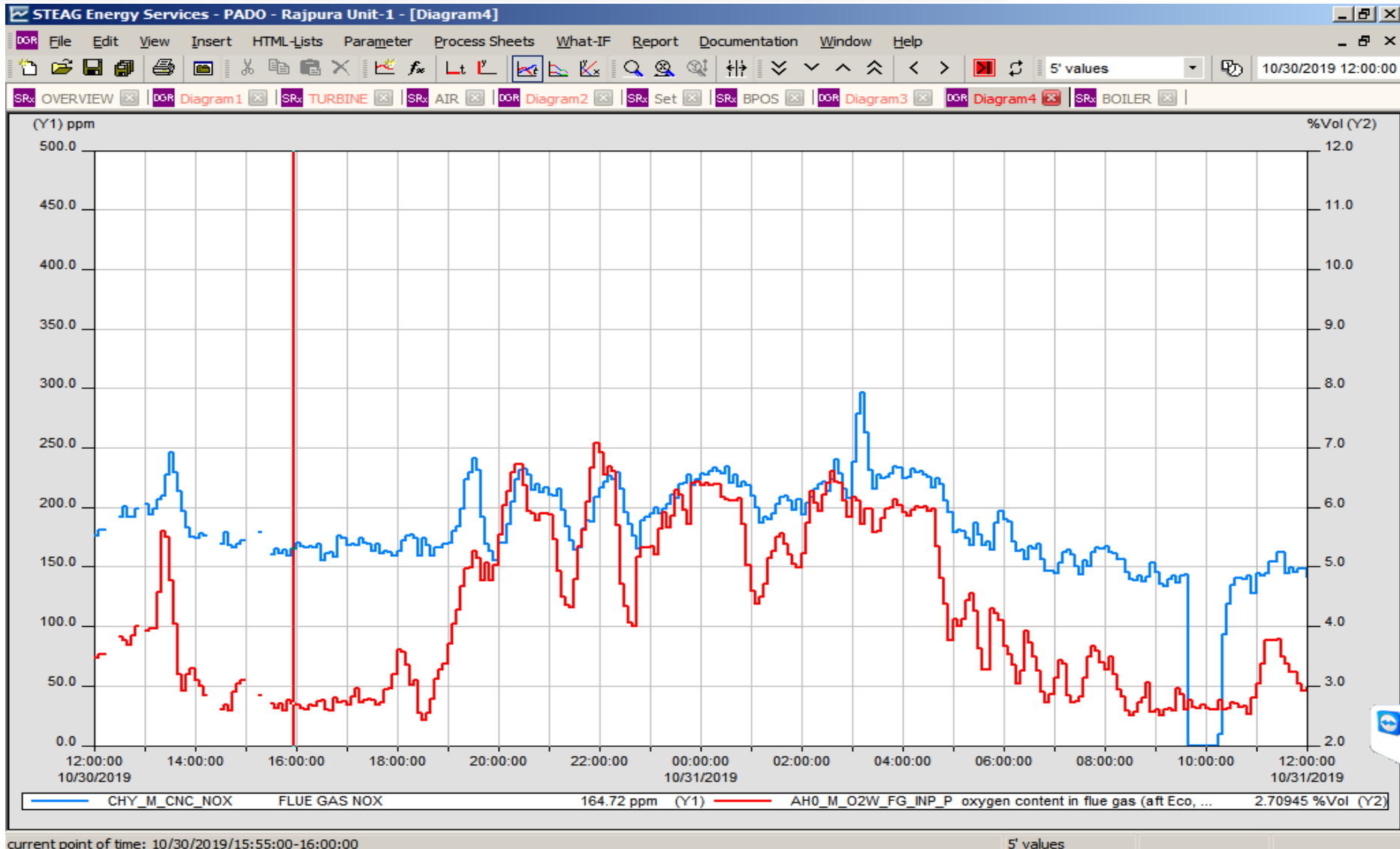
Over Fire Air Damper positions

Process Out put

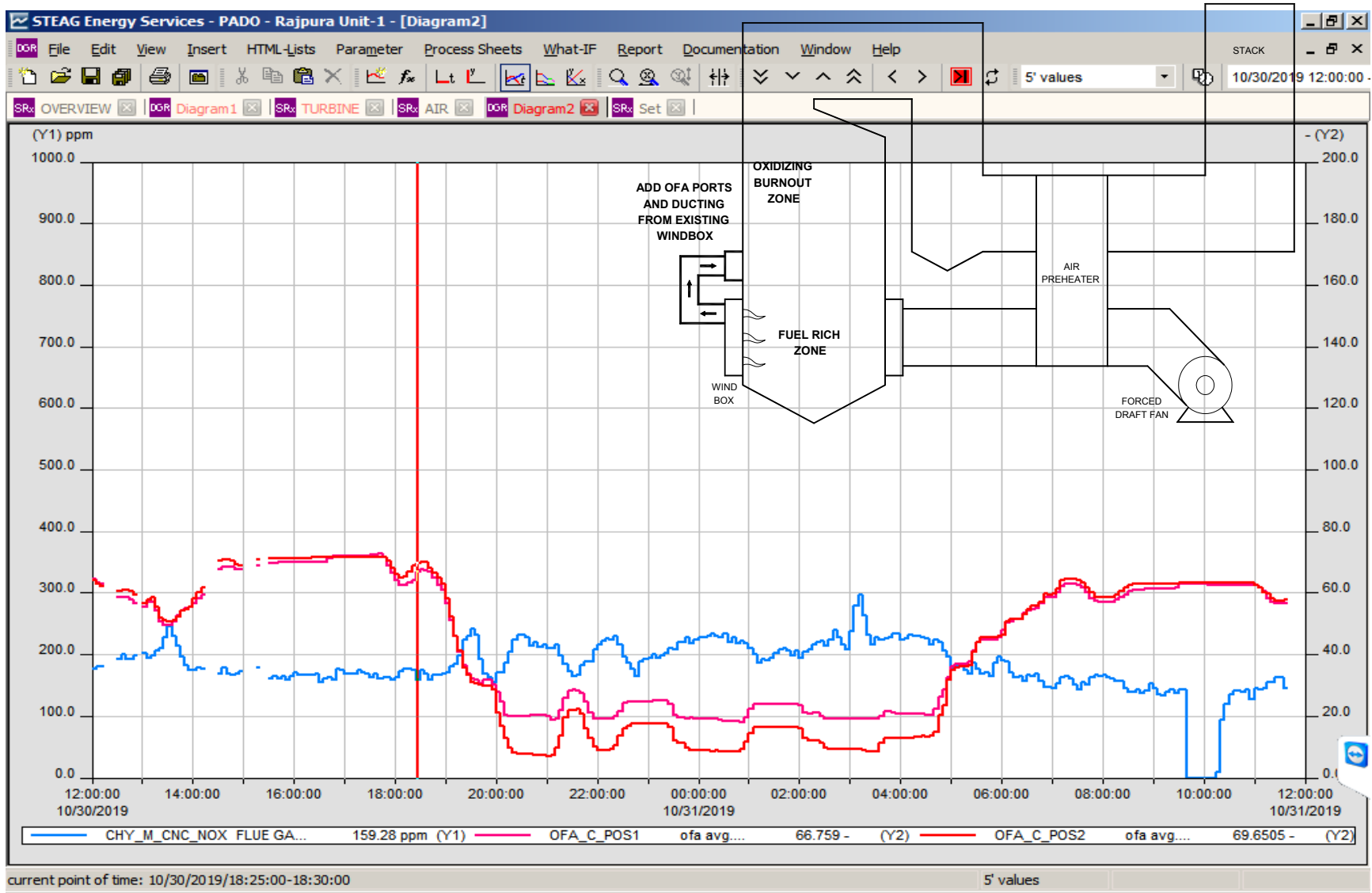
Optimised Efficiency

& NO_x

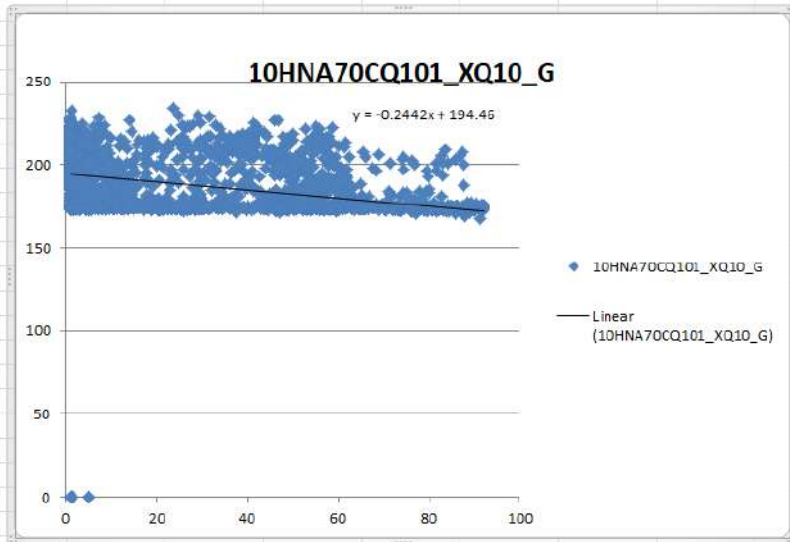
Variation of Nox with Furnace Oxygen



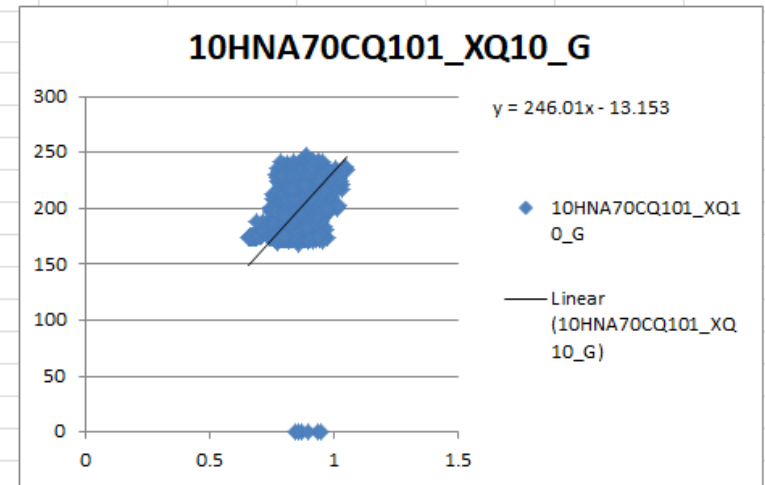
OFA damper regulation



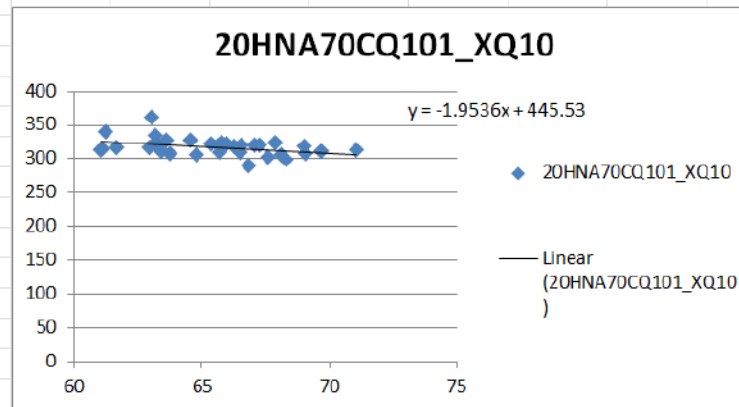
Parameter trending and training



Burner tilt variation

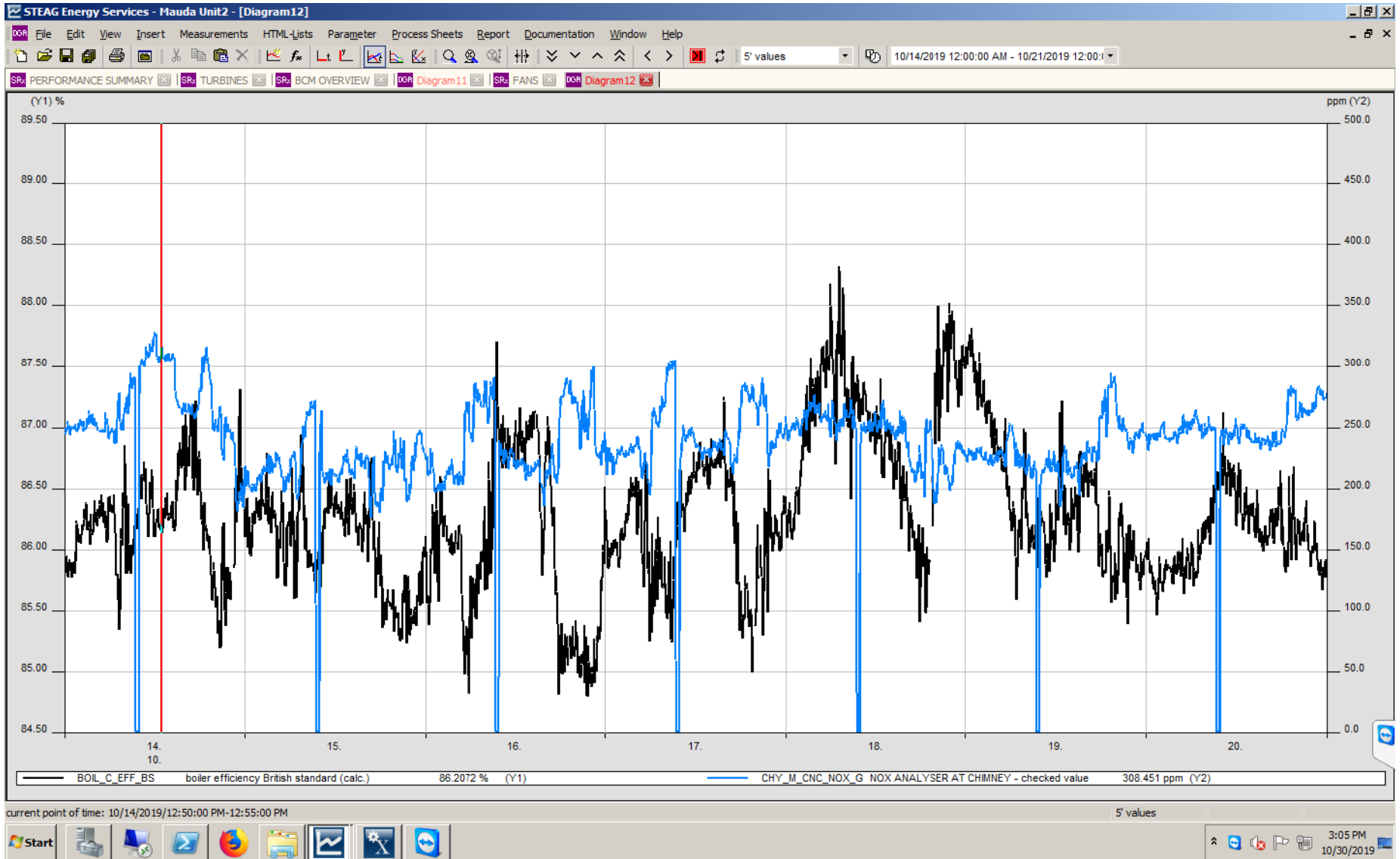


PA/SA ratio variation



$$\text{Nox} = -1.9536 \times \text{OFD_UPPER} + 445.53$$

Variation of Boiler efficiency with NOx





Thank you



K.bhanuprakash@steag.in
9717298317