



# Output Loss Analysis Capacity Loss Analyzer for a CCGT power station

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OSIsoft.

# REGIONAL SEMINARS

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**I N D I A**

**August 22 - 23, 2013  
Mumbai, India**

# AGENDA

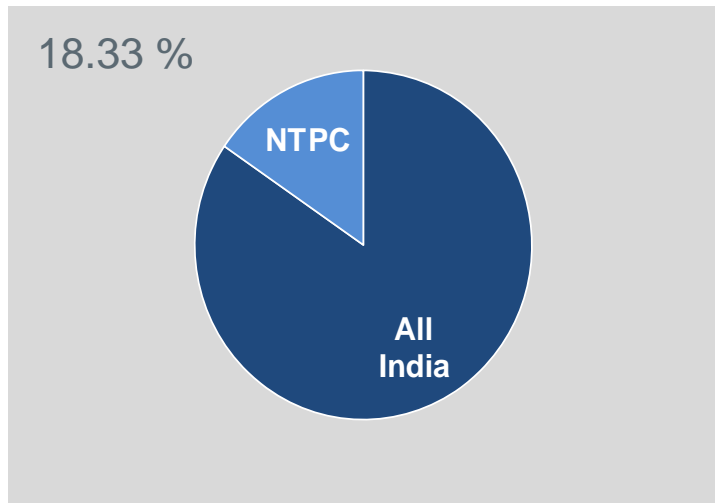
- About NTPC
- PI System implementation in NTPC
- Business Challenge
- Solution - OLA (Output Loss Analysis)
- OLA – Configuration, Process Flow & displays
- OSIsoft Products employed
- OLA – Results / Benefits
- Future Roadmap
- Summary
- Conclusion



# About NTPC

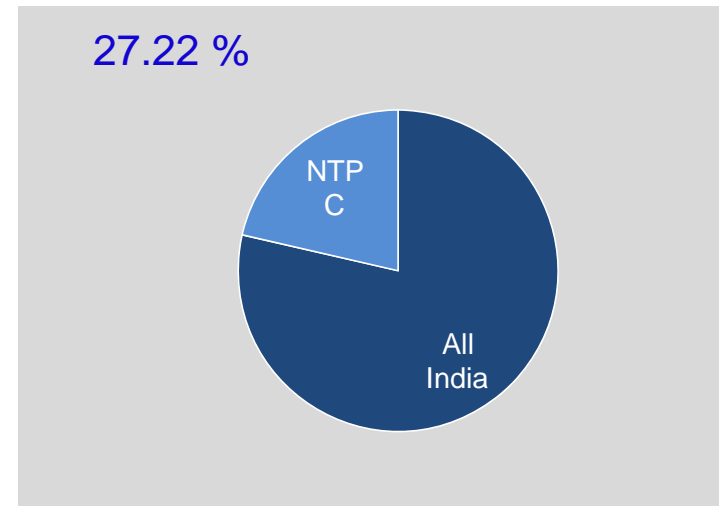
Total Capacity\*

41,184 MW



Generation\*

246.99 BU



**NTPC Contributes More Than One-fourth of India's Total Power Generation with Less Than One-fifth Capacity**

- Set up in 1975 with 100% ownership by government of India
- The largest power generation company in India, with comprehensive in-house capabilities in building and operating power projects
  - Target of 1,28,000 MW capacity by 2032
- 3820 MW of new commercial capacity addition in 2012-13

*\* Including Joint Ventures*

# *About NTPC*

## Stature

- Awarded “Maharatna” status in May 2010
- No.1 Independent Power Producer globally in 2012 as reported by Platts in its top 250 Global Energy Company Rankings
- 3<sup>rd</sup> overall in ‘India’s best companies to work for 2012’, a study by The Great Places to work Institute India & The Economic Times.
- The most respected company in Power Sector for the year 2011 by Businessworld.
- Ranked 348th largest company in the world as per Annual Ranking of top 2000 companies in the world by Forbes in 2011



# *About NTPC*

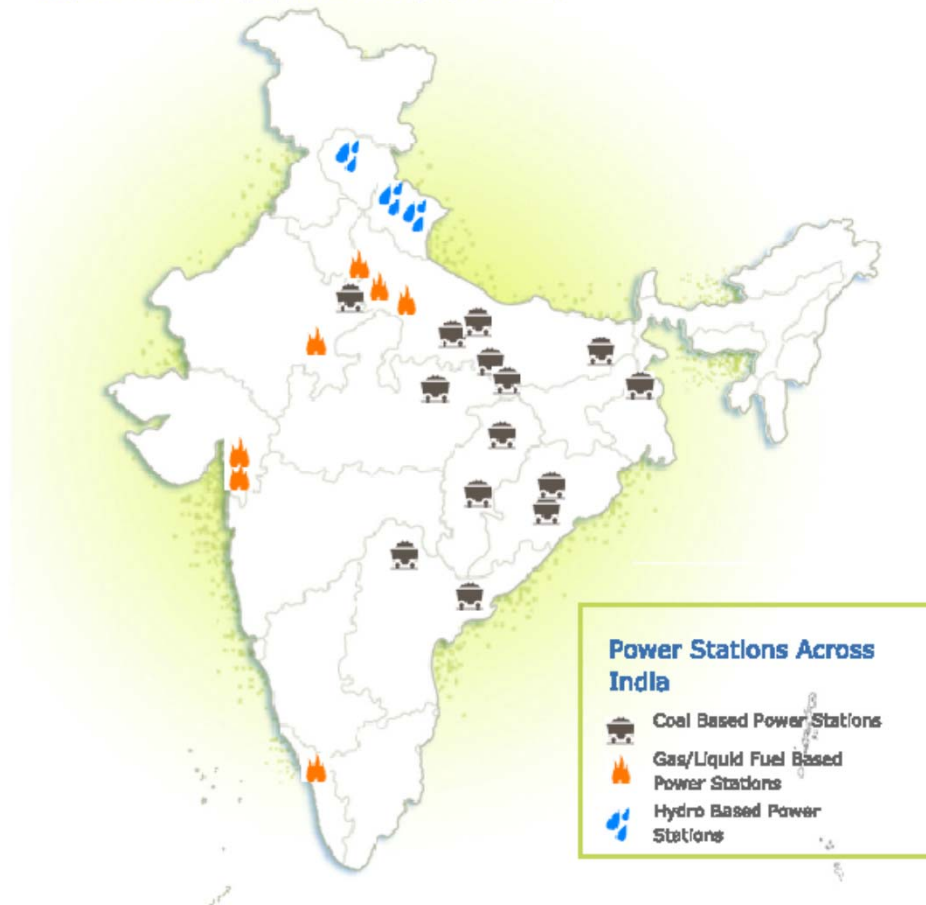
## Performance 2012-13

- NTPC has achieved a generation of **232.028** BU against a generation of **222.068** BU in 2011-12, a growth of **4.49** %.
- **Three** NTPC coal stations are amongst the **top five** stations of the country in terms of PLF.
- NTPC coal PLF is **83.08** % against all India PLF (incl. NTPC) of **69.93** %.
- NTPC coal stations have achieved Availability of **90.20** % against GOI-MOU target of **90.00** %.



# NTPC – Presence in India

All | Coal Based | Gas/Liquid Fuel Based | Hydro Based |



Type of Plant	No.
Coal based	16 (31855MW)
Gas / Liquid Fuel based	07 (3955 MW)
Renewables	02 (10 MW)
JV's (Coal & Gas)	07 (5364MW)

# PI System implementation

PI System implemented in NTPC at

- 16 Coal stations
- 7 Gas stations
- Corporate office





# *Business Challenge*

- The problem of output loss with time is a inherent feature of gas turbines.
- A part of this loss could be irrecoverable owing to mechanical reasons, but rest is possible to recover.
- The recoverable loss area wise breakup is not available in the conventional DCS systems, hence difficult to identify & optimize.

## *Solution - OLA (Output Loss Analysis)*

- Output Loss Analysis (OLA) is a tool to identify the CCGT station output (MW) losses plant area wise in real time enabling timely corrective actions to optimize them .

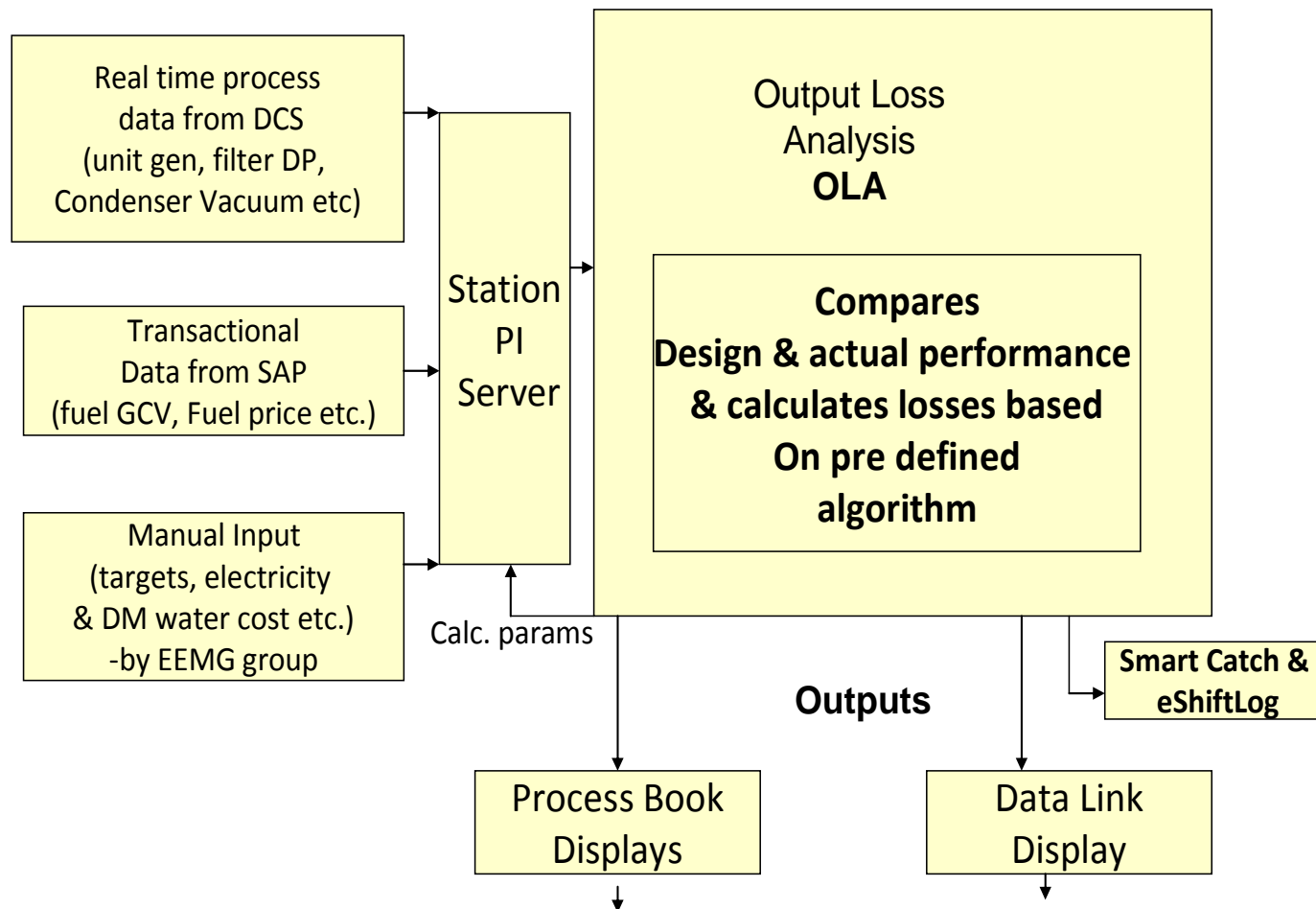
*Granted Copyright by Govt. Of India*

- The losses are displayed in monetary terms as well to have the desired impact on the operator.

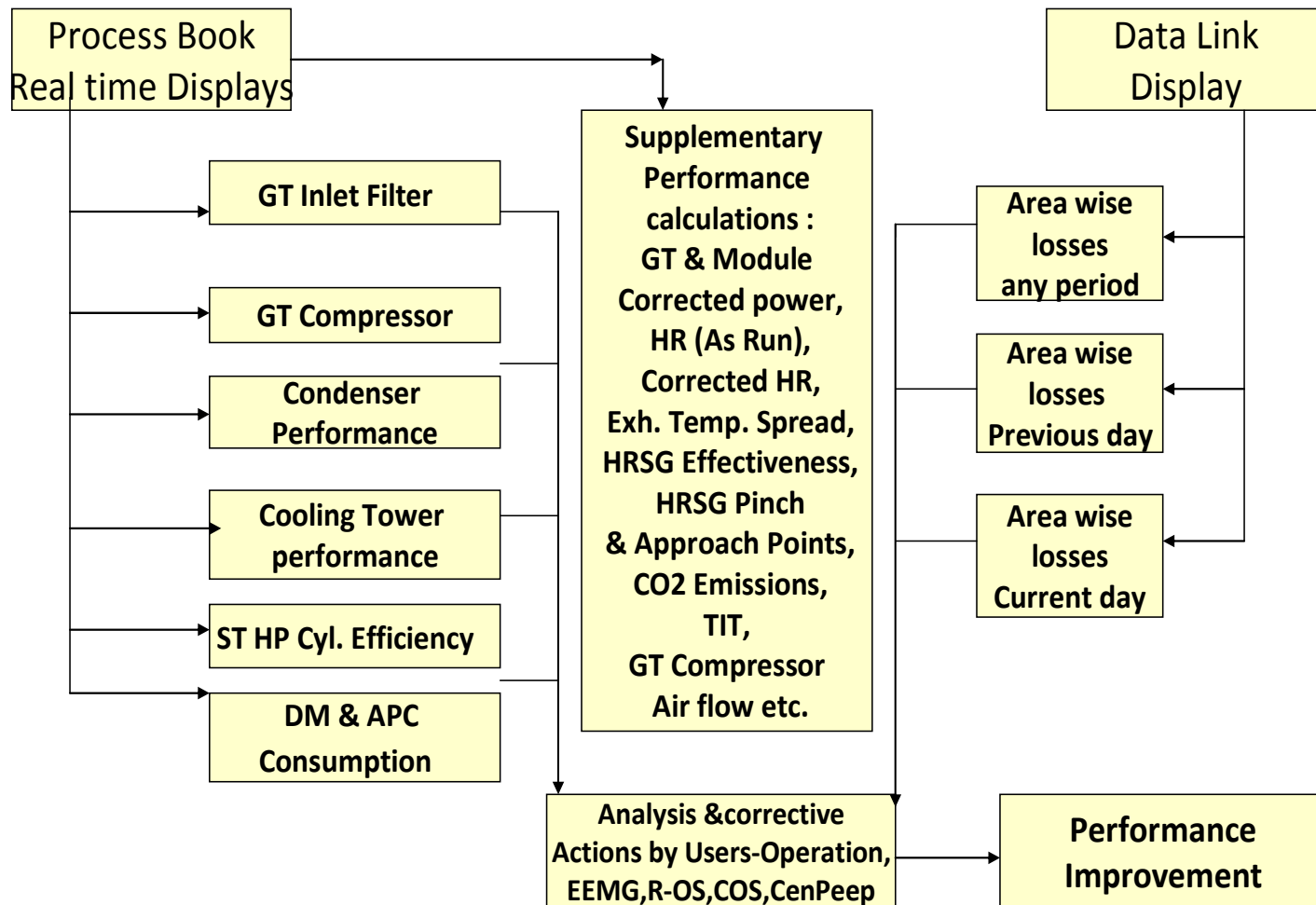
# *OLA – Configuration*

- The OLA is developed using PI-ACE & PI MDB on .Net platform displaying its output in PI Process Book.
- The application works on the base data derived from
  - Station PI server
  - Registered data specific to the station (e.g. targets etc.)
  - Transaction data from SAP (e.g. fuel GCV.....)

# OLA-Process Flow



# OLA-Process Flow



# OLA – Displays

## Uncontrollable losses

Ambient temperature, pressure, RH & frequency

## Major Controllable losses

- Higher GT Inlet Air filter DP
- GT compressor efficiency deviation
- Condenser Back Pressure deviation
- Aux power consumption deviation



## Supplementary Features

- GT & Module actual/corrected KPI's
- Loss Reports for a period
- OLA Help



# *OSIsoft Products Used*

- PI Server
- PI-ACE
- PI Module Database
- PI Process Book
- PI Data Link

## *OLA Results / Benefits*

- Improved operator awareness of critical plant performance KPI's
- Allows operators to make critical cost effective decisions based on evaluated plant conditions
- Output loss quantification helps in prioritizing resource allocation to increase productivity
- Integration of process data with transaction data for MIS & other applications
- Maintenance effort is quantifiable based on pre & post work cost of losses

\*Activities such as condenser water box cleaning, GT compressor washing, auxiliaries changeover at site are being done as per OLA recommendation.



## *OLA Future Roadmap*

- Advice for GT Inlet air filter replacement based on filter replacement cost & output loss due to high filter DP.
- Indicators for GT Inlet temperature & mass flow in GT Performance
- Alerts for GT compressor wash based on GT compressor performance
- Completing OLA roll out at all NTPC CCGT stations

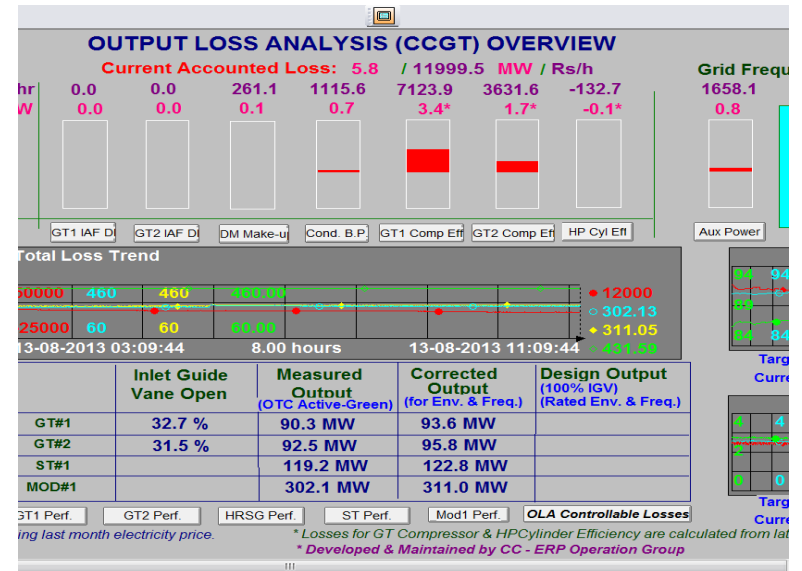
# *Conclusion*

- Implementation of Performance enhancing applications has given a new dimension to the level & quality of information available within the plant as well as outside it.
- Using these applications, the operator have an advisory tool with them to optimize station performance with quantified support to validate & justify his actions.
- The demand for more applications of such nature & addition of new features in existing applications is increasing by the day.

# Summary

## OLA – Output Loss Analysis

- Implementation of OLA has given a new dimension to the level & quality of information and an advisory tool for the operator to optimize station performance with quantified support to validate & justify his actions.



### Business Challenge

- To identify area wise output loss for a CCGT Module & guide the operator to take necessary corrective action for loss optimization

### Solution

Output Loss Analysis (OLA) is a tool to identify the CCGT station output losses plant area wise in MW as well as in monetary terms.

### Results and Benefits

- Critical cost effective decisions based on evaluated plant conditions
- Prioritizing resource allocation to increase productivity

# Contact Information

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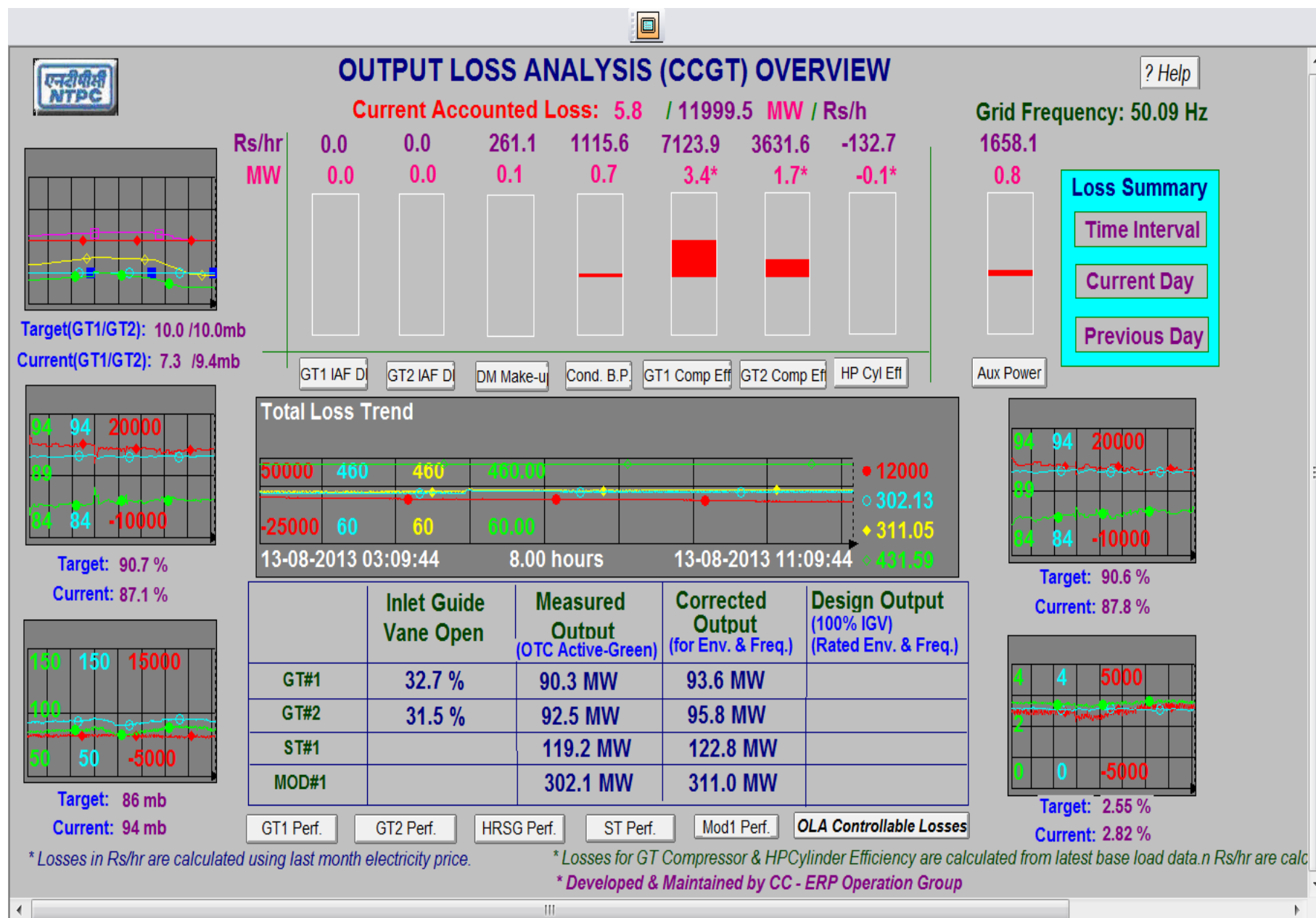


# THANK

# YOU

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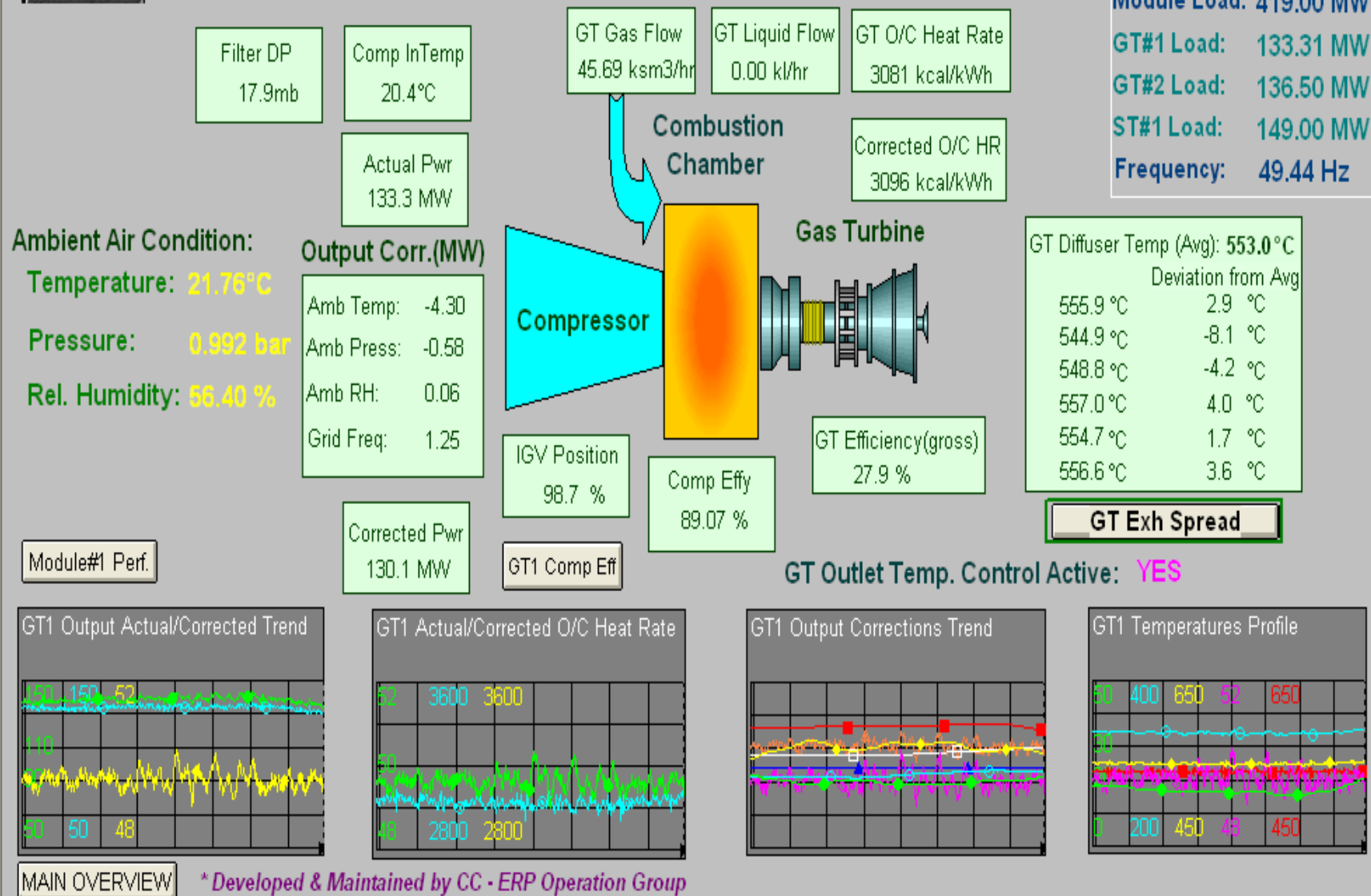




\* The data displayed in the screenshot is typical, only for demonstration purpose.



## GT#1 PERFORMANCE

[? Help](#)

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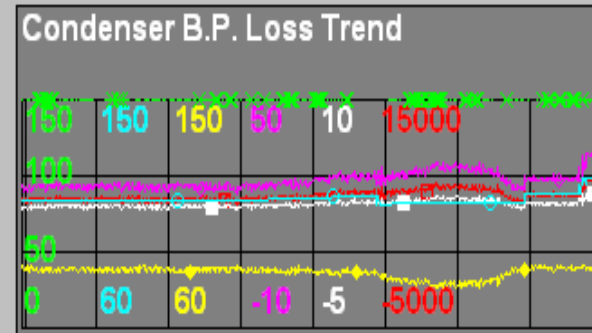


## CONDENSER B.P. DEVIATION OUTPUT LOSS

? Help

Module Load: 418.52 MW  
GT#1 Load: 133.02 MW  
GT#2 Load: 137.21 MW  
ST#1 Load: 149.00 MW  
Grid Frequency: 49.55 Hz

Condenser Expected Pressure: 83.82 mb  
Condenser Actual Pressure: 119.49 mb  
Condenser Press. Deviation: 35.67 mb




Condenser B.P. Deviation (Air Ingress/dirty tubes/others): 33.20 mb  
Condenser B.P. Deviation (Heat Load/CW Flow): 3.02 mb

Cond.B.P. Deviation Loss: 3.83 MW  
Cost of Cond.B.P. MW Loss: 8094.55 Rs/h

CW In Temp  
28.5°C

Condensate Temp  
43.2°C  
43.2°C

LP Sat. Temp: 49.4°C

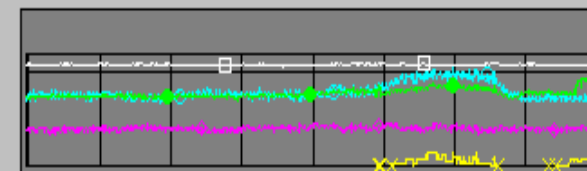


Temp Depr.(L): 6.24°C  
Temp Depr.(R): 6.17°C

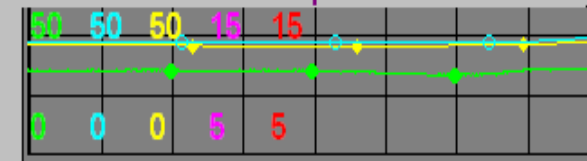
CW TTD(L): 10.1°C  
CW TTD(R): 11.3°C  
CW Out Temp(L): 39.3°C  
CW Out Temp(R): 38.1°C  
CW Temp Rise(L): 10.7°C  
CW Temp Rise(R): 9.5°C  
CW LMTD(L): 14.8°C  
CW LMTD(R): 15.6°C

MAIN OVERVIEW

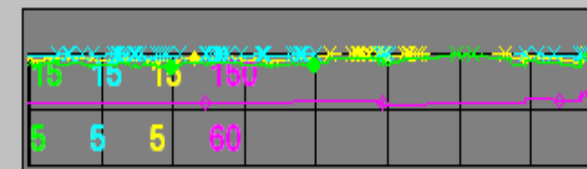
Condenser B.P. Deviations Trend



Condenser Pass Temperature Rise Trend



Condenser Pass LMTD Trend



\* Developed & Maintained by CC - ERP Operation Group

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1	Interval Start Time 06/12/11 08:58 06/12/11 09:58 Interval End Time					
2	Time Interval Loss Monitor					
3	* The monitor gives <b>true representation of losses for base load operation</b> of the station. At part loading also,					
4	trending of losses can be done to monitor degradations.*Other losses include <b>partial losses due to grid,fuel &amp;</b>					
5	<b>planned restrictions</b> also.					
6	S.N.	Parameter Description	Time Interval Loss (MW)			
7			GT#1	GT#2	ST#1	Station
8	1	Uncontrollable Parameters				
9		Output Loss due to:				
10	1.1.1	Ambient Temperature	-4.876	-5.032	-1.964	-11.872
11	1.1.2	Ambient Pressure	-0.608	-0.593	-0.714	-1.915
12	1.1.3	Ambient RH	0.057	0.053	-0.057	0.053
13	1.1	Environment Total	-5.427	-5.572	-2.734	-13.734
14	1.2	Grid Frequency	1.144	1.124	0.917	3.184
15		Sub Total Uncontrollable	-4.284	-4.448	-1.818	-10.550
16	2	Controllable Parameters				
17		Output Loss due to:				
18	2.1	GT High Inlet Air Filter DP	1.798	1.390	1.811	4.999
19	2.2	GT Poor Comp Efficiency	2.839	3.004	3.277	9.119
20	2.3	Deviation in Aux Power Cons				-0.947
21	2.4	Deviation in DM Make up Cons				-0.349
22	2.5	Condenser Pressure			3.358	3.358
23	2.6	ST HP Cyl Efficiency Deviation			-0.832	-0.832
24		Sub Total Controllable	4.637	4.394	7.614	15.349
25		Average Gross Gen	136.205	139.471	149.955	425.631
26		Installed Capacity	137.758	137.758	156.070	431.586
27		Total Gap	1.553	-1.713	6.115	5.955
28		Total Accounted Loss	0.353	-0.054	5.796	4.799
29		Other Losses	1.200	-1.659	0.319	1.156
30		Corrected Heat Rate	3063.5	2907.7	2849.5	1927.3
31		OTC Control Active Time (hrs)	1.00	0.92		
32						
33						

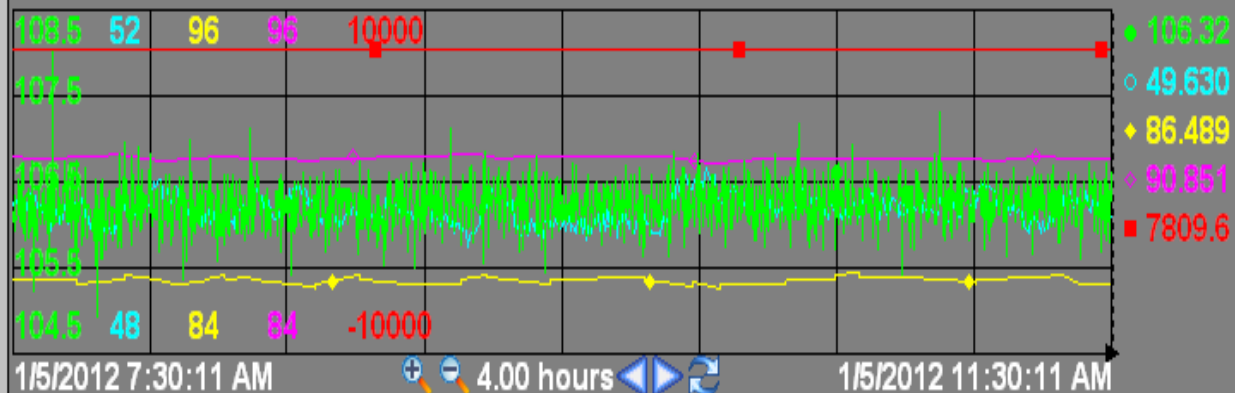
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## GT#1 COMPRESSOR EFFICIENCY OUTPUT LOSS

? Help

GT#1 Comp Efficiency Deviation Loss Trend



Module Load: 349.26 MW  
GT#1 Load: 106.32 MW  
GT#2 Load: 112.82 MW  
ST#1 Load: 129.70 MW  
Grid Frequency: 49.66 Hz

Temperature: 12.1 deg C    Comp. Inlet    305.6 deg C    Comp. Outlet    GT#1 Frequency: 49.63 Hz  
Pressure(abs): 0.972 bar    9.283 bar    GT#1 Output: 106.3 MW

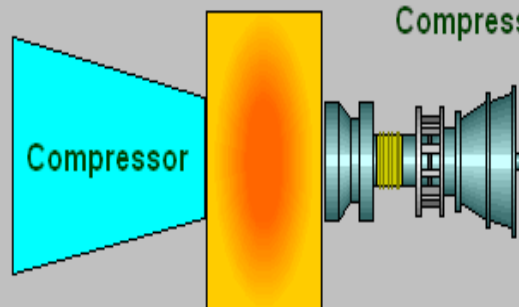
Ambient Air Condition:

Temperature: 14.59°C

Pressure: 0.995 bar

Rel. Humidity: 90.44 %

Compressor Pr. Ratio: 9.551



GT Comp Eff Loss  
(Base Load)  
**3.72 MW**

MAIN OVERVIEW

**GT Compressor Efficiency**

Actual: 86.49 %

Target: 90.85 %

Efficiency Deviations from Tgt

Current: 4.3 %

Recent Base Load: 2.5 %

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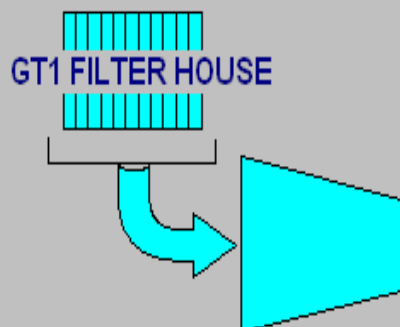
## GT INLET AIR FILTER DP DEVIATION OUTPUT LOSS

? Help

Inlet Air Filter House DP: 20.700 mbar

IA Filter DP Output Loss: 1.7 MW

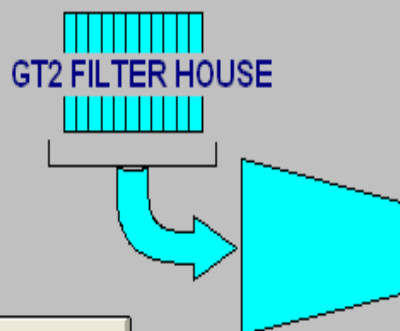
Cost of Filter DP Output Loss: 3565.3 Rs/h



Inlet Air Filter House DP: 20.048 mbar

IA Filter DP Output Loss: 1.7 MW

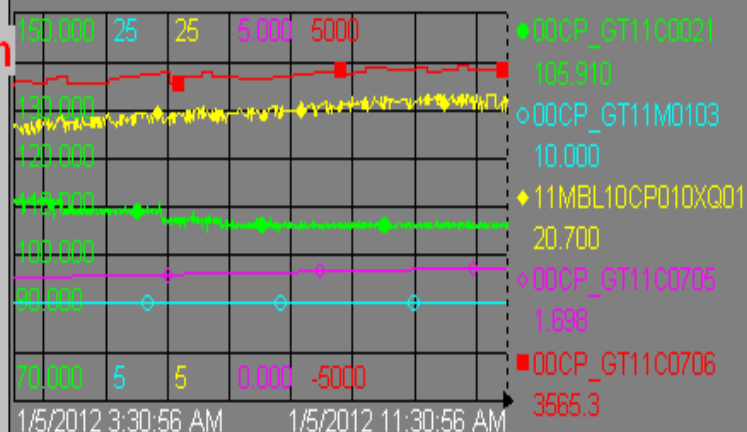
Cost of Filter DP Output Loss: 3673.9 Rs/h



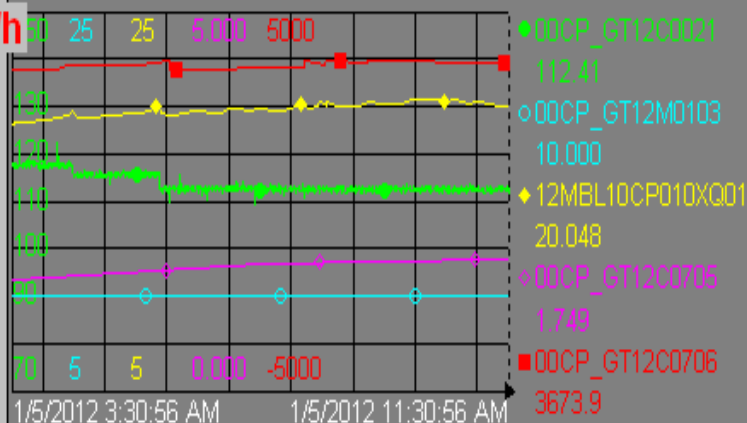
MAIN OVERVIEW

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GT#1 IA Filter DP Deviation Trend



GT#2 IA Filter DP Deviation Trend



Module Load: 348.73 MW

GT#1 Load: 105.91 MW

GT#2 Load: 112.41 MW

ST#1 Load: 129.70 MW

Frequency: 49.64 Hz

Ambient Air Condition:

Temperature: 14.59°C

Pressure: 0.995 bar

Rel. Humidity: 90.44 %

\* The data displayed in the screenshot is typical, only for demonstration purpose.



## Output Loss Analysis (OLA) Help

Choose from menu below to view relevant area:

### Gas Turbines

[Loss due to GT Inlet Air filter DP](#)

[Loss due to GT Compressor](#)

[Loss due to GT partial loading](#)

[Loss due to higher \(than design\) Ambient Temperature](#)

[Loss due to higher \(than design\) Ambient Humidity](#)

[Loss due to higher \(than design\) Ambient Pressure](#)

[Loss due to lower \(than design\) grid frequency](#)

[Loss due to GT Exhaust Temperature deviation](#)

### Waste Heat Recovery Boiler (WHRB)

[WHRB Outlet Temperature](#)

[Boiler Tube Leakages](#)

### Steam Turbine

Done

My Computer

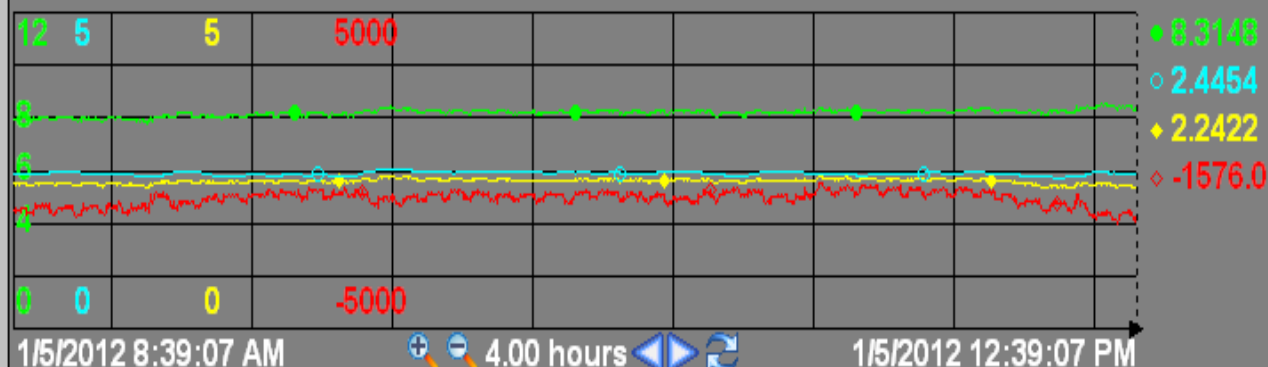
100%



## AUX POWER DEVIATION OUTPUT LOSS

? Help

Aux Power Consumption (APC) Deviation Loss Trend



Module Load: 370.84 MW

GT#1 Load: 112.54 MW

GT#2 Load: 123.00 MW

ST#1 Load: 135.60 MW

Frequency: 49.86 Hz

Output Loss due to APC Deviation: **-0.71 MW**

Cost of APC Deviation Output Loss: **-1576.05 Rs/h**

UAT1 Power: **3.93 MW**

UAT2 Power: **4.39 MW**

Total Aux Power Consumption: **8.31 MW**

Expected APC for Current Output: **2.45 %**

Current APC:  
(% of Current Output) **2.24 %**

APC Deviation: **-0.196 %**

### Status of Critical Auxiliaries:

#### CW Pumps

A CWP

B CWP

C CWP

#### Extraction Pumps

CEP A

CEP B

#### HP/LP Feed Pumps

LPBFP A

LPBFP B

LPBFP C

#### Vacuum Pumps

VAC PUMP A

VAC PUMP B

HPBFP A

HPBFP B

HPBFP C

#### Key

Not In Service

In Service

MAIN OVERVIEW

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