एनटीपीसी NTPC Transforming lives
A Maharatna Company

OSIsoft®

USERS CONFERENCE 2011

Turning **insight** into **action**.

SMART Catch: An Early Warning System - *Excelled through PI System*

Presented by **Sachin Agarwal & ANS Suryanarayana**

Outline

- NTPC-A Snapshot
- Organizational Challenges
- SMART Catch
- Our Enablers
- Approach-Fish Bone Diagram
- Case Studies
- Future Roadmap

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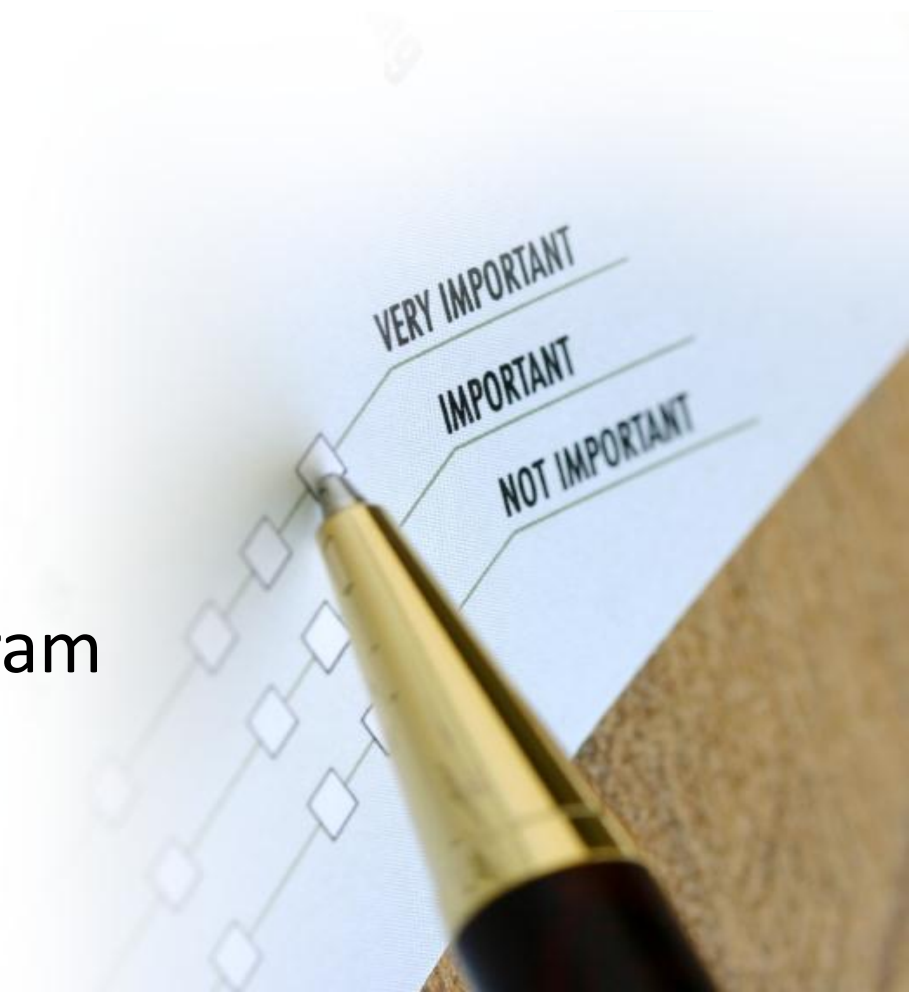


Who We Are…

NTPC Ltd

- One of the Best in Capacity Utilization in the World
- One of the largest in the World in Energy Generation
- Significant presence in the entire value chain of Power Generation Business
- 15 Coal and 7 Gas station with generating capacity of 33194 MW
- 03 Subsidiaries and 20 JVs
- Plan of becoming 128 GW Company by 2032

NTPC Vision

To be the World's Largest and Best Power Producer, Powering India's Growth

NTPC...As on Date

[illegible]	[illegible]	CAPACITY (MW)
[illegible]		
Coa[illegible]	[illegible]	[illegible]
Gas/Liquid Fuel	[illegible]	[illegible]
Total	[illegible]22	29,830
Owned By JVs		
Coal & Gas	6	3,364
Total	28	33,194

A 33000+ MW Company with 126 units and still growing.

- 85 Coal Units
- 28 Gas Turbines
- 13 Steam Turbines/WHRB

A Fleet with average age of 18+ yrs, having disparate designs

Units operating at challenging targets of >92% PLF

REGION	COAL	GAS	TOTAL
Northern	8,015	2,312	10,327
[illegible]stern	6,860	1,293	8,153
[illegible]	[illegible]	350	3,950
[illegible]	[illegible]	[illegible]	[illegible]00
JVs	[illegible]	[illegible]	[illegible]
Total	27,2[illegible]	5,[illegible]	33,194

NTPC-Diversified Growth


Hydro Power


Renewable Energy


Nuclear Power


Coal Mining

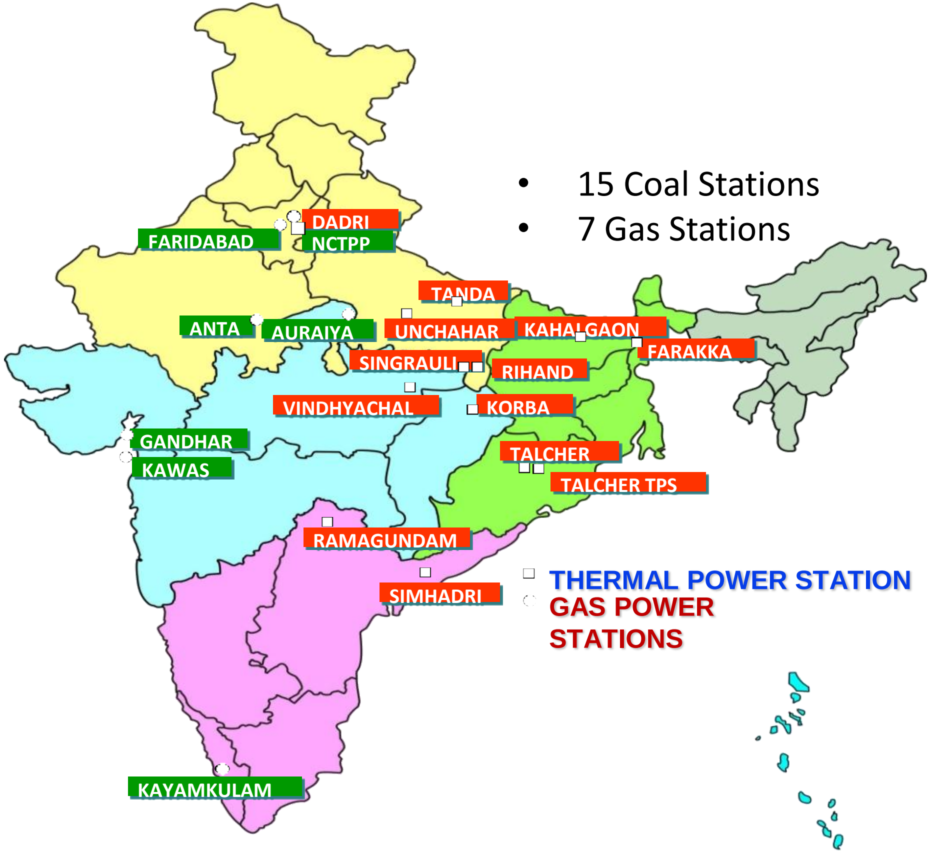
Power Trading


Ash Business


Power Distribution


Equipment Manufacturing

Spread



- 15 Coal Stations
- 7 Gas Stations

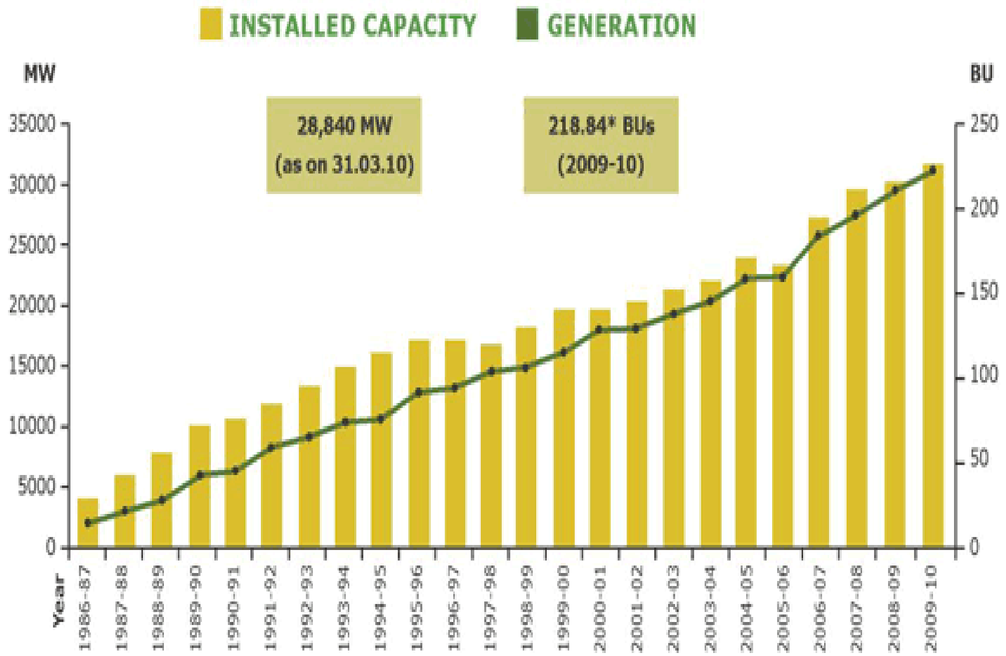
Subsidiaries

- NTPC Electric Supply Company Ltd. (NESCL)
- NTPC Vidyut Vyapar Nigam Ltd. (NVVN)
- NTPC Hydro Ltd. (NHL)

Joint Ventures

- NTPC -ALSTOM POWER SERVICES PVT. LTD. (NASL)
- NTPC – SCCL GLOBAL VENTURES PRIVATE LTD
- INTERNATIONAL COAL VENTURES PVT. LIMITED (ICVL)
- NTPC-BHEL POWER PROJECTS PVT.LTD
- NTPC-SAIL POWER COMPANY (PVT) LTD (NSPCL)

Growth of NTPC



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Organizational Challenges

Ageing fleet

Reduction in O&M cost

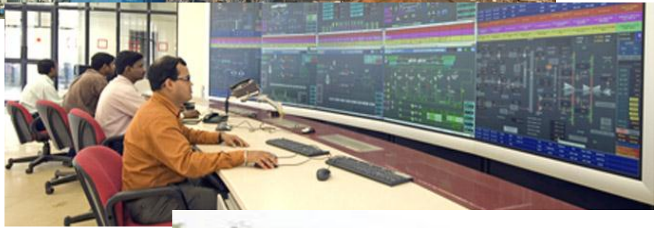
Optimization of plant processes

Limited experts in specific areas

Expected reduction in GHG emissions

De-regulation and Global competition

Rapid growth in capacity, across the country



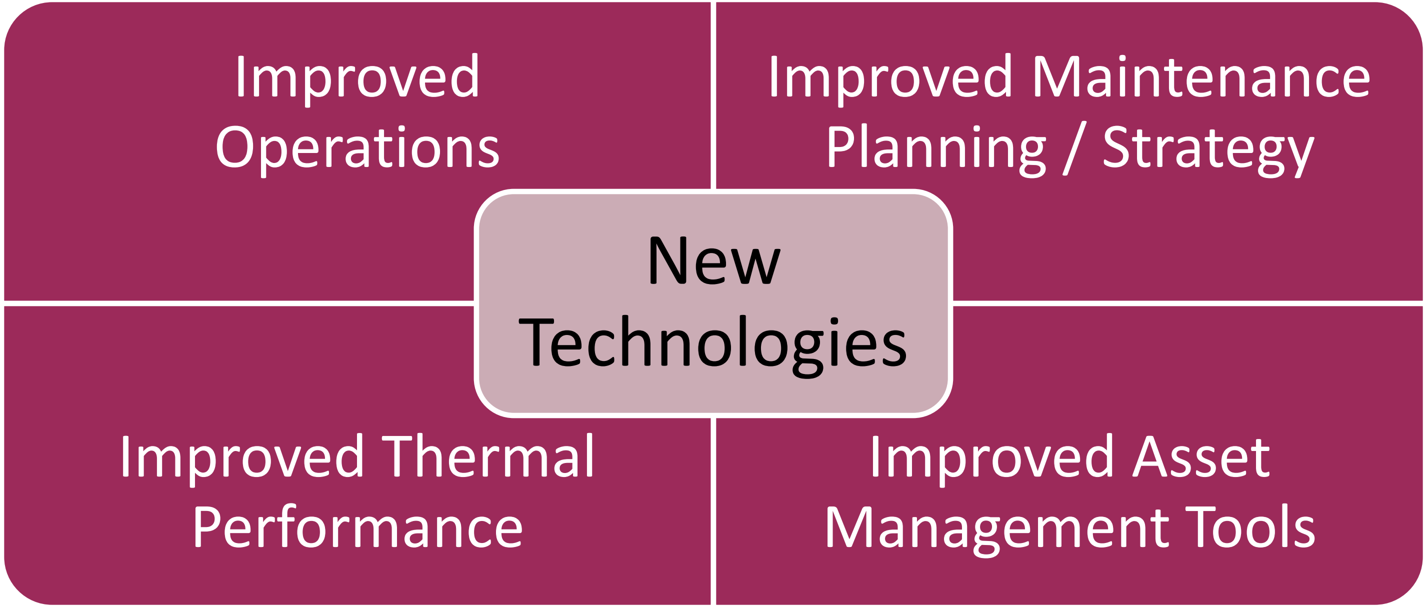
Business Drivers for using PI System

- Earlier, data input was manual and that too in non-standardized form
- PI System came along with ERP system to automate the MIS
- Real time data retrieval through PI System brought it on uniform platform
- Added no extra cost to present system
- Provide "Fleet wide" Plant Monitoring Capabilities

Fleet-Wide Monitoring (FWM)

- A Centralized Resource to manage Generating Assets
- Implementation of applications for monitoring, maintaining and optimizing business assets from a centralized location
- Primary focus is to develop an integrated approach based on all available information and advanced monitoring capabilities:
  - Equipment, plant, and fleet health status
  - Maintenance schedules and outage planning
  - Thermal Performance
  - Vibration Monitoring

FWM-Drivers



An Offshoot is SMART Catch

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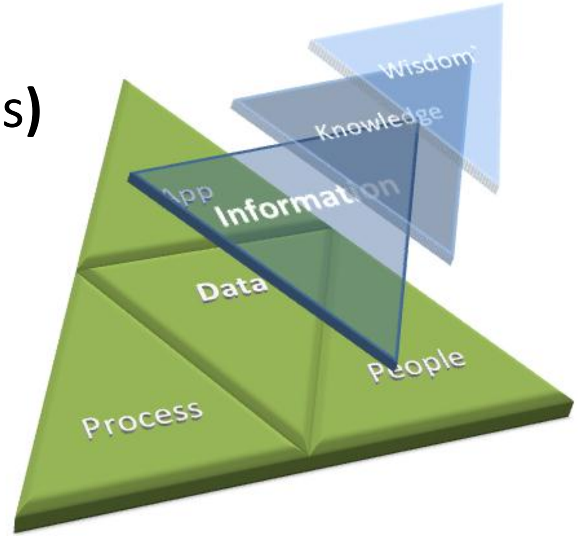
SMART Catch

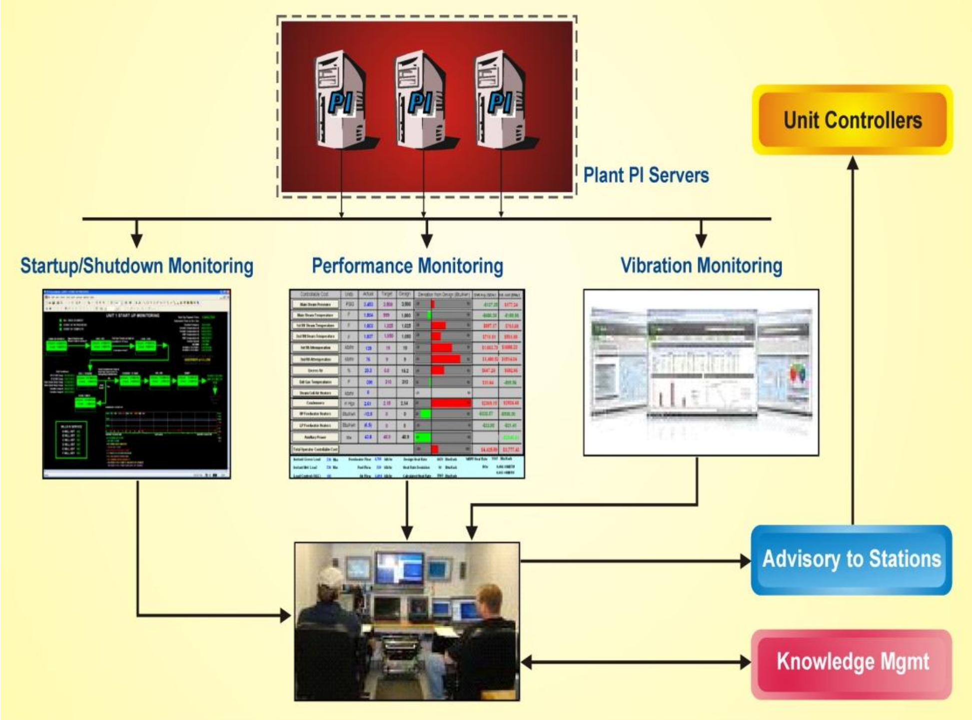
(**S**trategic **M**onitoring **&** **A**ssistance **R**emote **T**erminus)



- An additional watchful eye
- Automation of thought process
- In-depth analysis of real time data
- Early detection of impending problems
- Innovative approach for providing solutions
- Pool of experts operating from a centralized location
- Making knowledge available where it matters, reducing knowledge gap

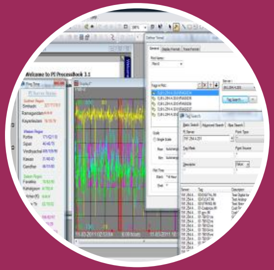
Objectives

- To bring the real time data to Regional set up & Corporate Centre
- 24x7 Access to Specialized Domain Knowledge
- Deployment of State-of-the-art Software & Diagnostic Tools
- Advisories to Plant personnel
- Creation of "Knowledge Repositories."
- Move Data, Not People



Evolution

Capturing the Experience



Providing Real time measures

Identifying key elements for current and historical analysis

Providing alerts and advisories to plants

Establishing Knowledge Repository

Automating the Thought Process

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Our Enablers

PI System at most of the plants

- Along with a Corporate PI Server

Vibrations analysis system for Turbine

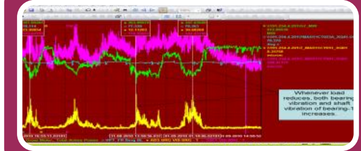
SMART Catch Software

- In-house development
- Using PI SDK, PI ProcessBook, PI DataLink

Deliverables using Existing Enablers

Tracking of Unit Startup and Shutdowns

Performance & Loss Monitoring



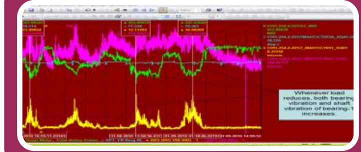
Monitoring of Turbine Vibration
(With the addition of client Software)

Keeping track of critical parameters
(Available in PI Servers from DCS)

Deliverables using Existing Enablers

Tracking of Unit Startup and Shutdowns

Performance & Loss Monitoring



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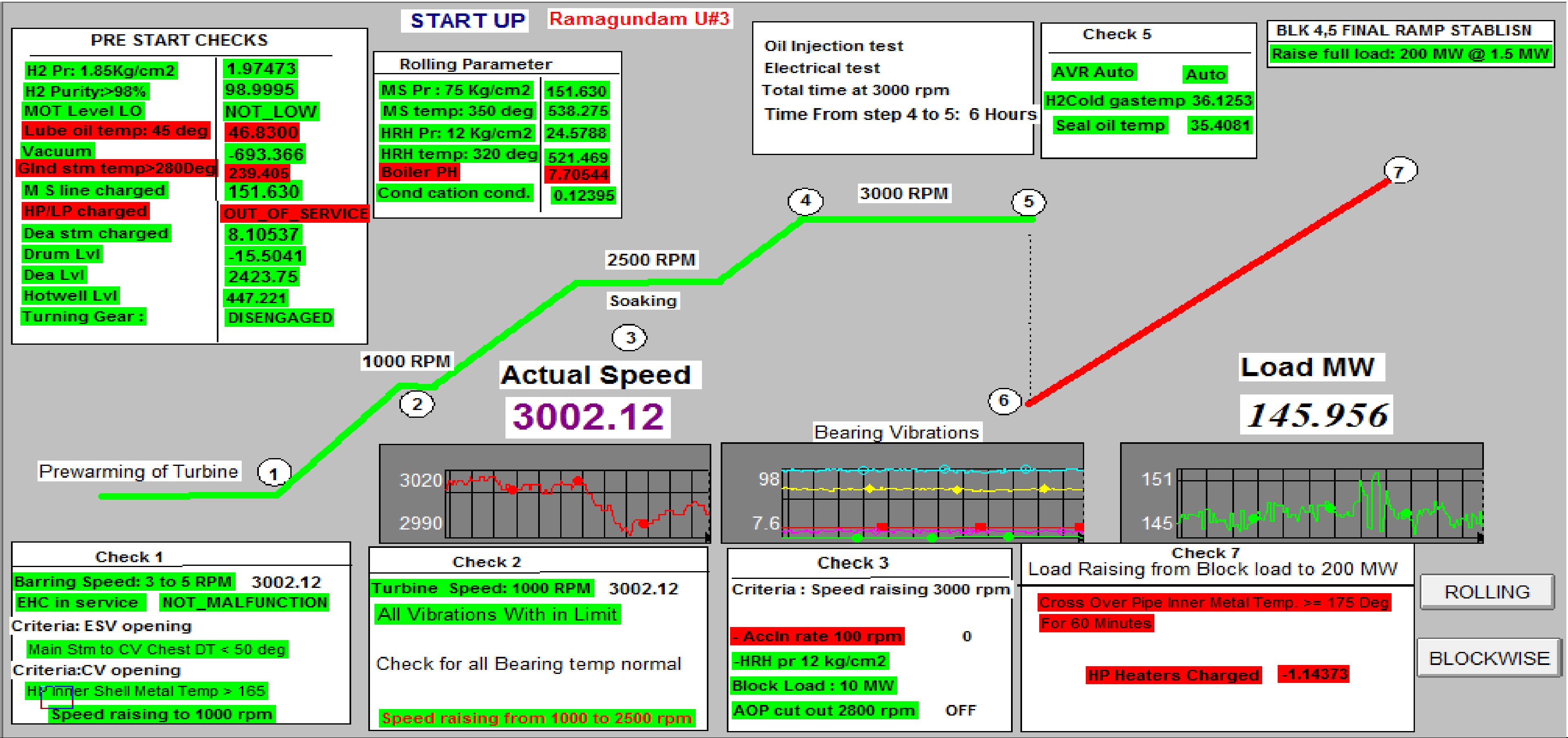
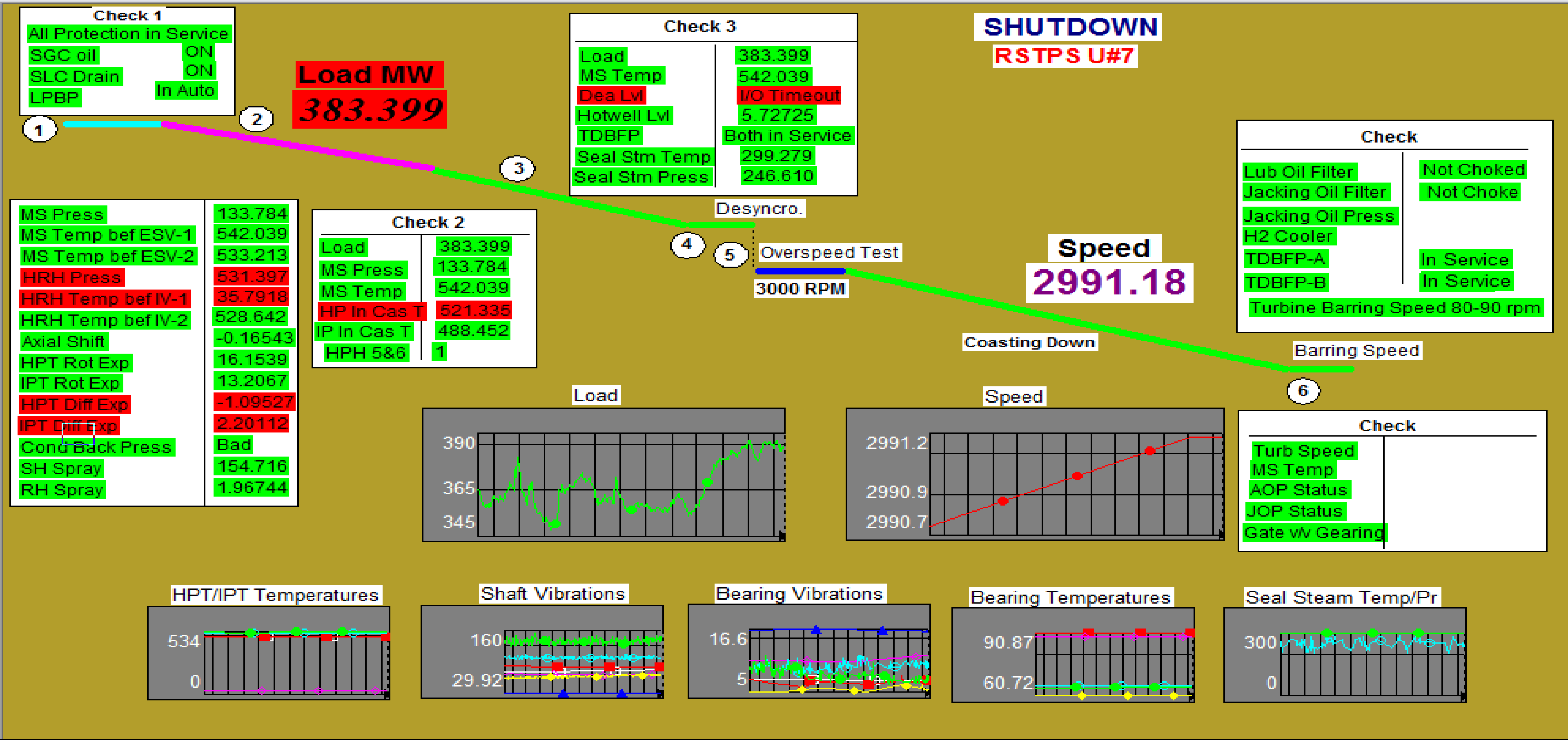
Non-routine Operations : Start-Up



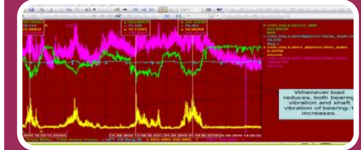
Non-routine Operations : Shut-Down



Deliverables using Existing Enablers

Tracking of Unit Startup and Shutdowns

Performance & Loss Monitoring



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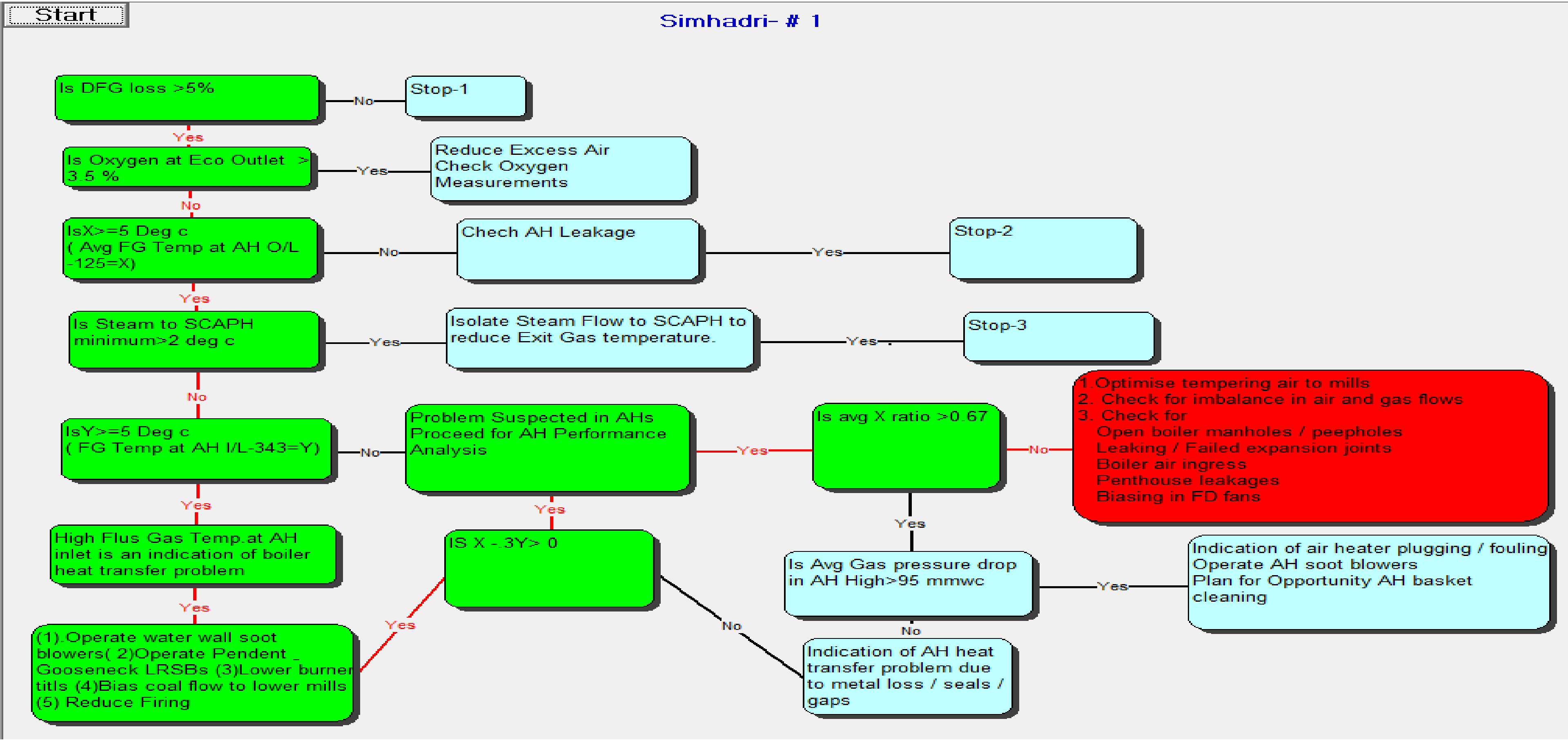
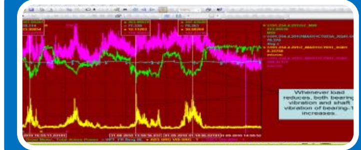
Decision Tree



Deliverables using Existing Enablers

Tracking of Unit Startup and Shutdowns

Performance & Loss Monitoring



Monitoring of Turbine Vibration
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Vibration Monitoring

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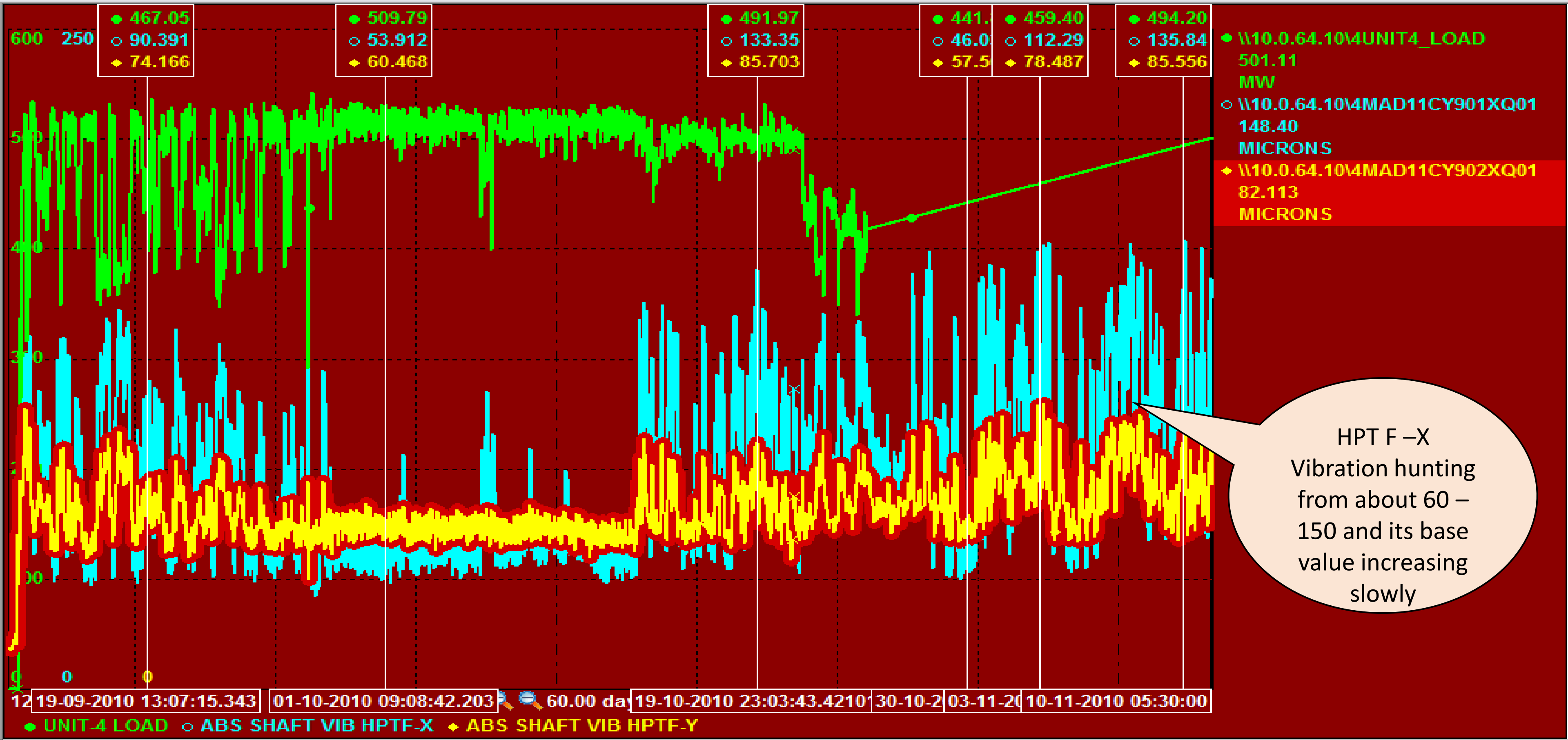
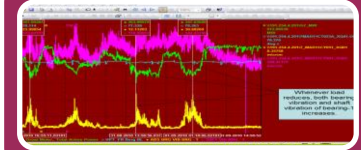


Deliverables using Existing Enablers

Tracking of Unit Startup and Shutdowns

Performance & Loss Monitoring



Monitoring of Turbine Vibration
(With the addition of client Software)

Keeping track of critical parameters
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Monitoring of Critical Parameters

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Simhadri Super Thermal Power Station Unit # 1

10-01-2011 14:59 | UNIT OVERVIEW | Press 'F9' to Refresh Data

S No.	Parameter	Current Value	Avg Value of Last 02 Hour	Deviation from Average	S No.	Parameter	Current Value	Avg Value of Last 02 Hour	Deviation from Average
	BOILER					**TURBINE**			
1	Load	524.70	525.62	Normal	1	Turbine Speed	2979.97	2978.12	Normal
2	Total Coal Flow	376.07	377.45	Normal	2	Throttle Press	170.56	171.78	Alert
3	Total Air Flow	1725.69	1743.93	Normal	3	First Stage Press	166.04	166.04	Normal
4	Drum Pressure	192.15	192.95	Normal	4	Max Shaft Vibration (SHAFT VIB HPTR-X)	155.18	154.26	Normal
5	MS Temp Left	530.33	530.12	Normal					
6	MS Temp Right	530.33	529.47	Normal	5	Max Brg Vibration (BRG VIB EXCT-X)	56.02	57.27	Normal
7	HRH Temp Left	534.85	531.92	Normal					
8	HRH Temp Right	515.33	521.87	Normal	6	Max Brg Temp (BRG-3 REAR BOT RGT)	95.65	95.01	Normal
9	Max SH Metal Temp	559.25	560.02	Normal					
10	Max RH Metal Temp	566.08	566.02	Normal	7	Trip Oil Pressure	10.16	10.12	Normal
11	Total SH Spray	55.28	55.68	Normal	8	Turbine Lub Oil Temp	46.12	45.11	Normal
12	Total RH Spray	21.01	20.70	Normal	9	Condenser Vacuum	-0.93	-0.93	Normal
13	APH Exit Gas Temp	139.20	139.75	Normal	10	CW Inlet temp	29.65	29.70	Normal
15	Hot Sec Air Temp	352.21	352.76	Normal	11	Condensate DO	6.78	6.63	Normal
16	Hot Pri Air Temp	306.46	306.41	Normal	12	Condensate ACC	0.13	0.13	Normal
17	Any Fan Not I/S	All In Service		Normal	13	DM Make-up*(08Hr/01Day)	11.96	10.93	Alert
18	Seal Stm Hdr Temp	287.92	287.19	Normal	14	Seal Steam Pressure	358.60	346.94	Normal
	GENERATOR								
1	Primary Water Cond	2.47	2.47	Normal	4	Excitor Hot Air Temp	49.53	49.33	Normal
2	H2 Pressure	3.52	3.52	Normal	5	Seal Oil DP H2S (TE)	2.30	2.28	Normal
3	Seal Oil Temp	31.72	31.68	Normal	6	Seal Oil DP H2S (EE)	2.43	2.42	Normal

SMART Catch SACS

Operations Monitoring | Performance Monitoring | Unit Startup/Shutdown | OffSite | Safety | Environment | Chemistry | View Fishbone

एनटीपीसी NTPC

SMART Catch

Special Analytics & Computing Services

SMART Catch A&E Client

SMART Catch

Special Analytics & Computing Services

Operations Monitoring

24-02-2011 11:23:09

Station	Freq	Unit-1	Unit-2	Unit-3	Unit-4	Unit-5	Unit-6	Unit-7
NR	49.604							
Rihand		0 / 0 525	0 / 0 526	7 / 9 522	7 / 10 521			
Singrauli		0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
Unchahar		5 / 17 Unit S/D	4 / 5 217	0 / 0 220	0 / 0 221	0 / 0 223		
Tanda		0 / 0	0 / 0	0 / 0	0 / 0			
SR	49.57							
Kayamkulam		0 / 0	0 / 0	0 / 0				
Simhadri		3 / 7 526	8 / 11 526					
Ramagundam		14 / 12 193	16 / 20 198	18 / 24 195	12 / 23 497	10 / 14 513	8 / 11 517	9 / 14 523

SMART Catch A&E Client

SMART Catch

Special Analytics & Computing Services

Operations Monitoring

Simhadri Unit-1

Fishbones Hit (3)

1.TURBINE DIFFERENTIAL EXPANSION PROBLEM
2.HPH PERFORMANCE POOR
3.POSSIBILITY OF APH TROUBLE

View Fishbone | Exceptions Trend | SMS | E-mail

View All Alarms | Apply Filter

Alarms less than 1 Days old | Sort by Alarm Time | Filter by Alarm Type All | Multi-Trends | Ack Alarm | Bad Tags

Alarms (7)

DESCRIPTION	Ack	TY...	VALUE	TIMESTAMP	ALM TIME	DE...	LO	HI	RAMP
IP casing overall expansion	N	HI	10.699	24-02-2011 10:42...	24-02-2011 10:42...	8	5	10.5	0/0
FG TEMP BEF SAH-B AVG	N	HI	380.518	24-02-2011 10:42...	23-02-2011 21:15:...	330	285	380	0/0
FG TEMP BEF SAH-A AVG	N	HI	385.398	24-02-2011 10:42...	23-02-2011 11:01:...	330	285	380	0/0
HPH 6B TTD	N	HI	3.645	24-02-2011 10:42...	23-02-2011 10:51:...	-0.3	-2	2	1.8/M
PRESS DROP ACROSS HPH5A	N	HI	4.148	24-02-2011 10:41...	23-02-2011 10:08:...	0.25	-2	3	0.2/M
HPH 5A TTD	N	HI	2.272	24-02-2011 10:42...	22-02-2011 23:09:...	-0.3	-2	2	2/M
HPT differential expansion	N	LO	-5.111	24-02-2011 10:42...	20-02-2011 09:50:...	-4.4	-4.8	2	0/0

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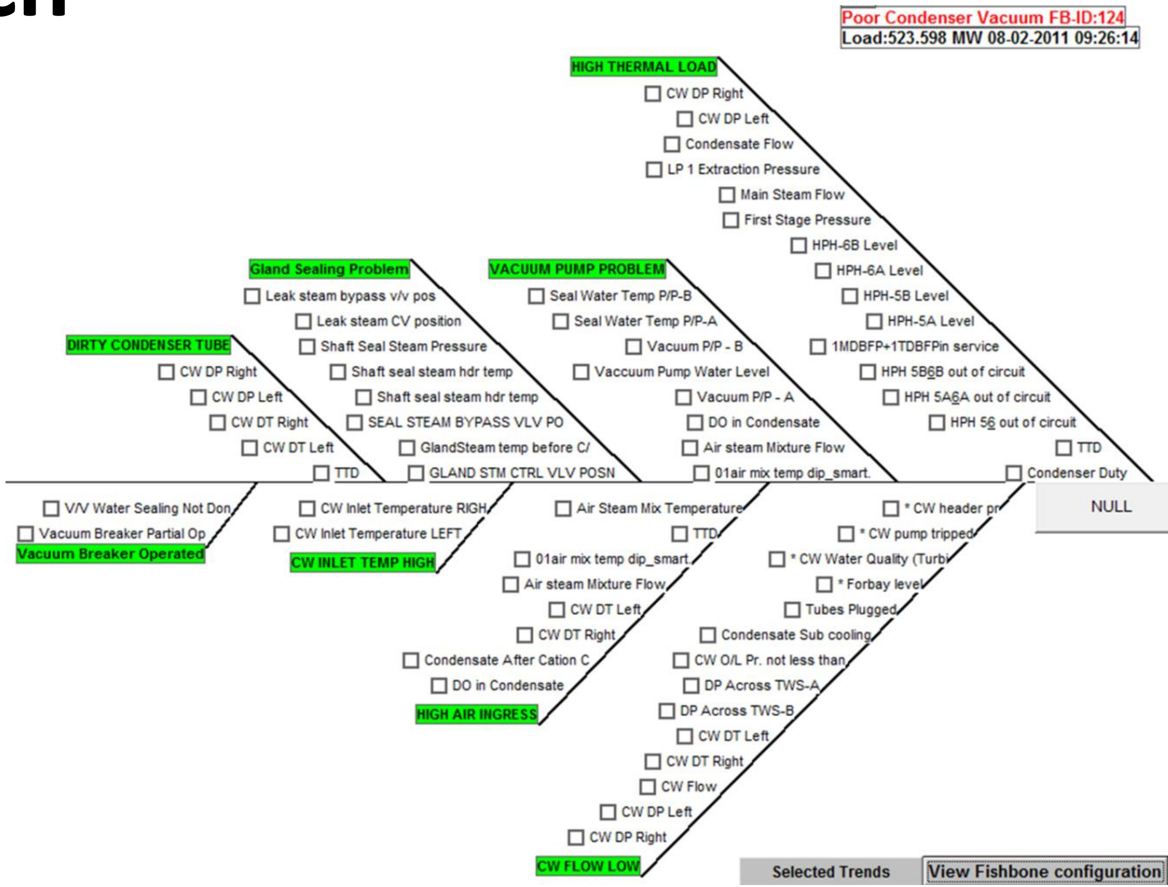
Fishbone Approach

- The fishbone diagram identifies many possible causes for an effect or problem
- It can be used to structure a brainstorming session
- It immediately sorts ideas into useful categories
- The same approach has been used for SMART Catch system



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- Condenser Tube Leakage by monitoring chemical parameters through SMART Catch
- Reduction of HP Heater Drain Temperature
- Condenser Vacuum improvement by arresting air ingress
- Instrumentation Failure Catch
- High Turbine Bearing vibrations after Overhaul
- High Cooling Water system Differential Pressure (DP) due to Debris Filter damage

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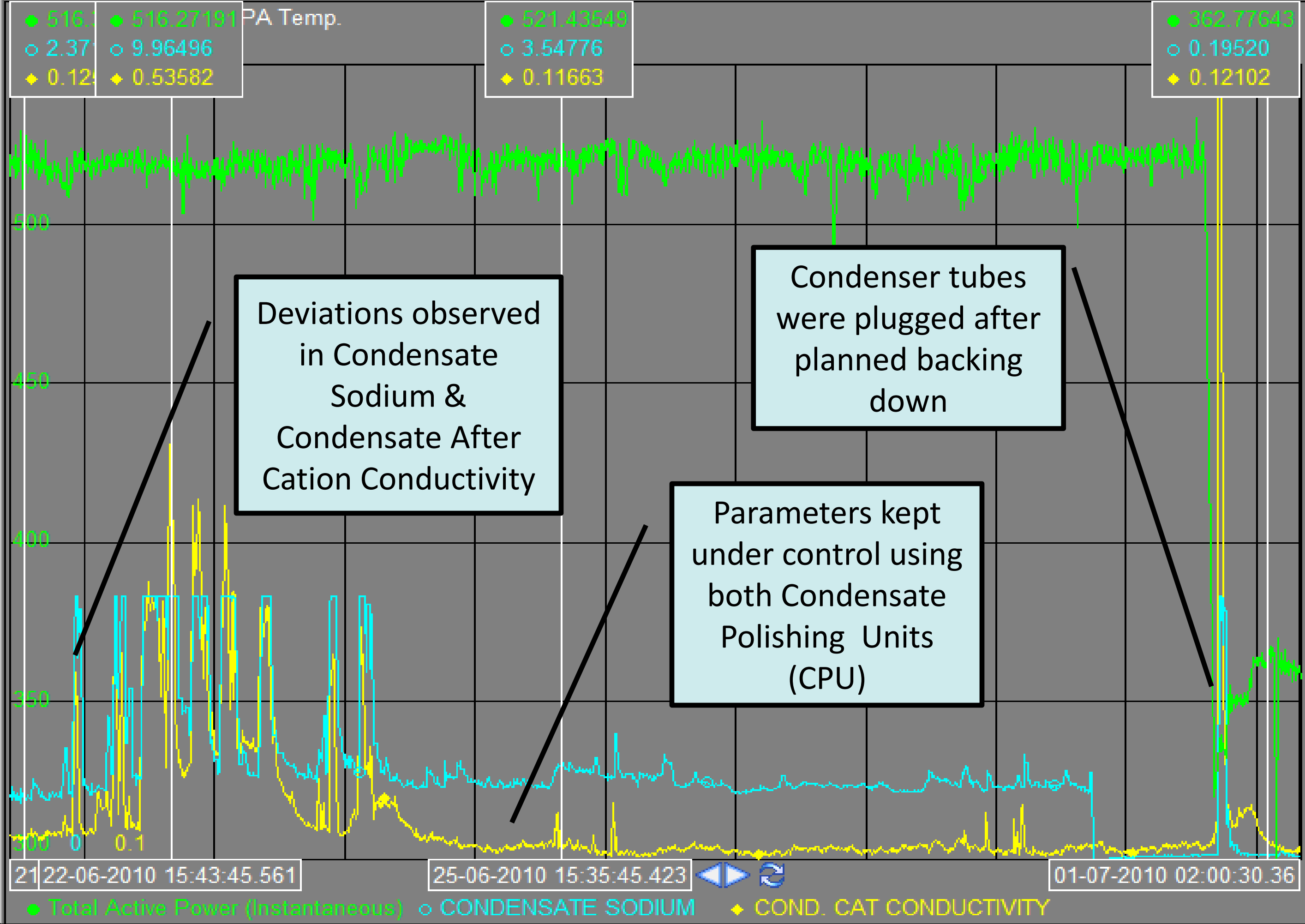

Fishbones triggered:

- Poor Condenser Vacuum
- Boiler Tube Leakage

Case Studies

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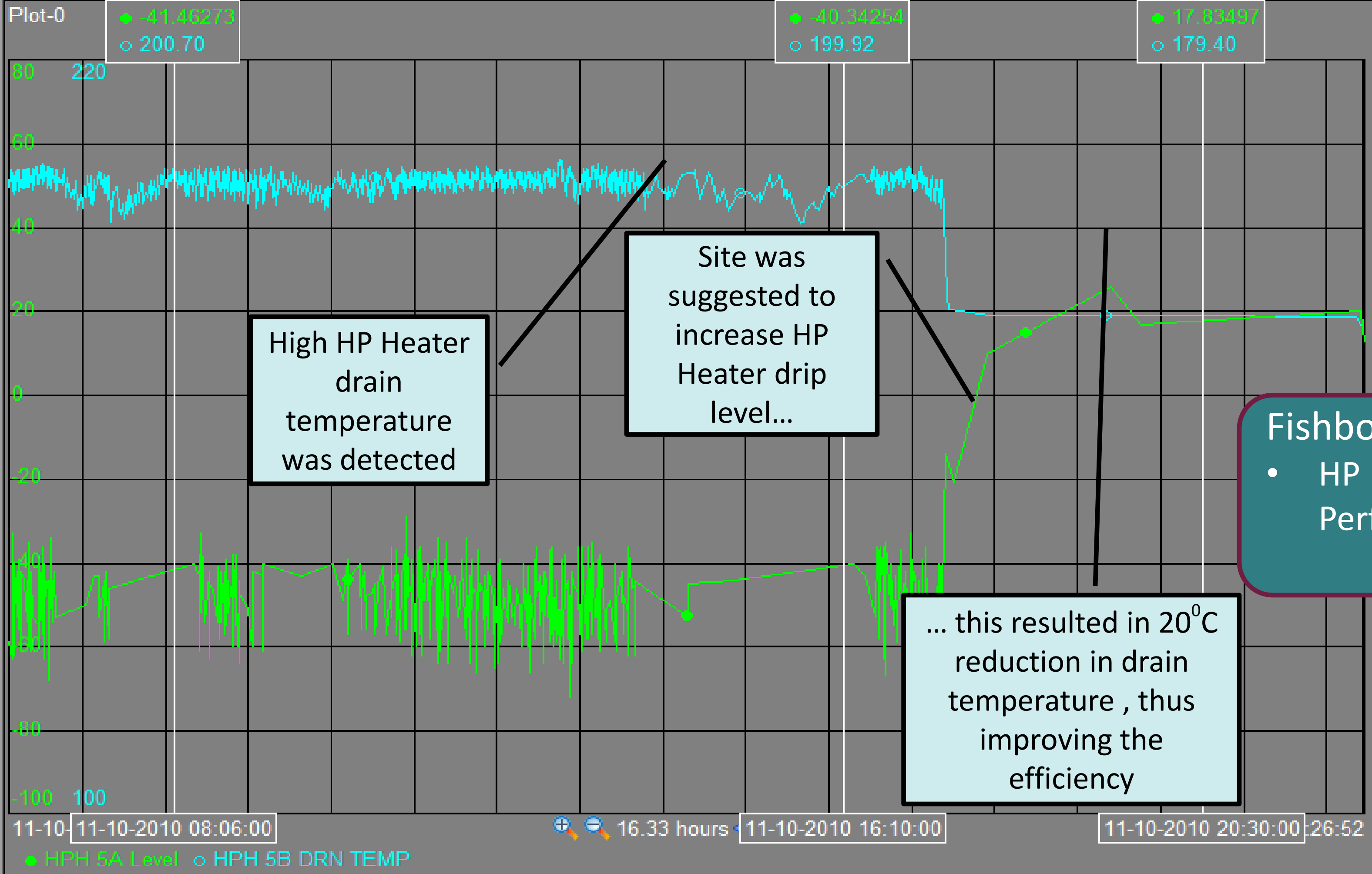

Fishbones triggered:

- HP Heater Performance Poor

Case Studies

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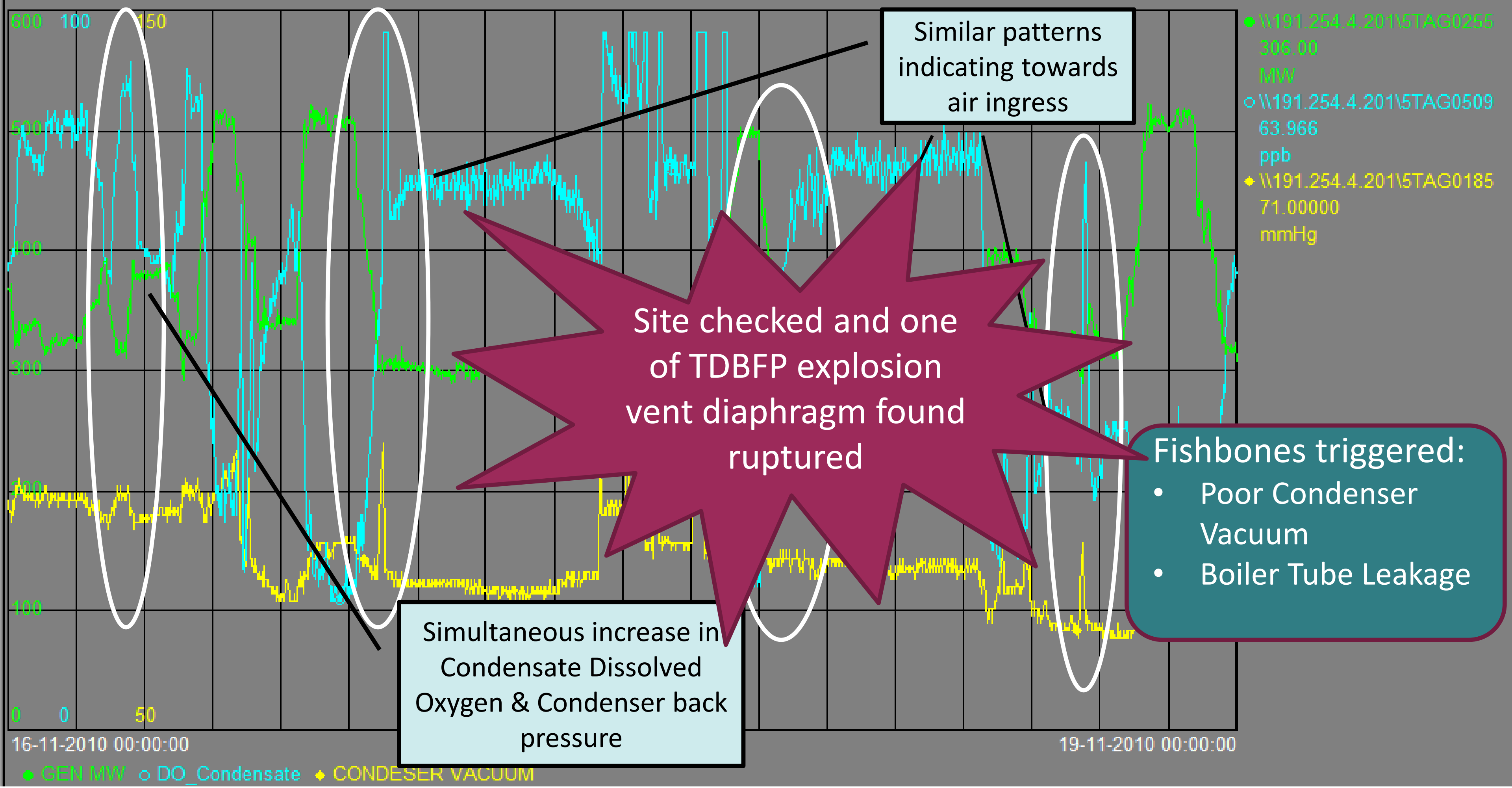

600 100 150
500
400
300
200
100
0 0 50
16-11-2010 00:00:00
19-11-2010 00:00:00
GEN MW
DO_Condensate
CONDESER VACUUM
\\191.254.4.201\5TAG0255
306.00
MW
\\191.254.4.201\5TAG0509
63.966
ppb
\\191.254.4.201\5TAG0185
71.00000
mmHg
Similar patterns indicating towards air ingress
Site checked and one of TDBFP explosion vent diaphragm found ruptured
Simultaneous increase in Condensate Dissolved Oxygen & Condenser back pressure
Fishbones triggered:
• Poor Condenser Vacuum
• Boiler Tube Leakage

Case Studies

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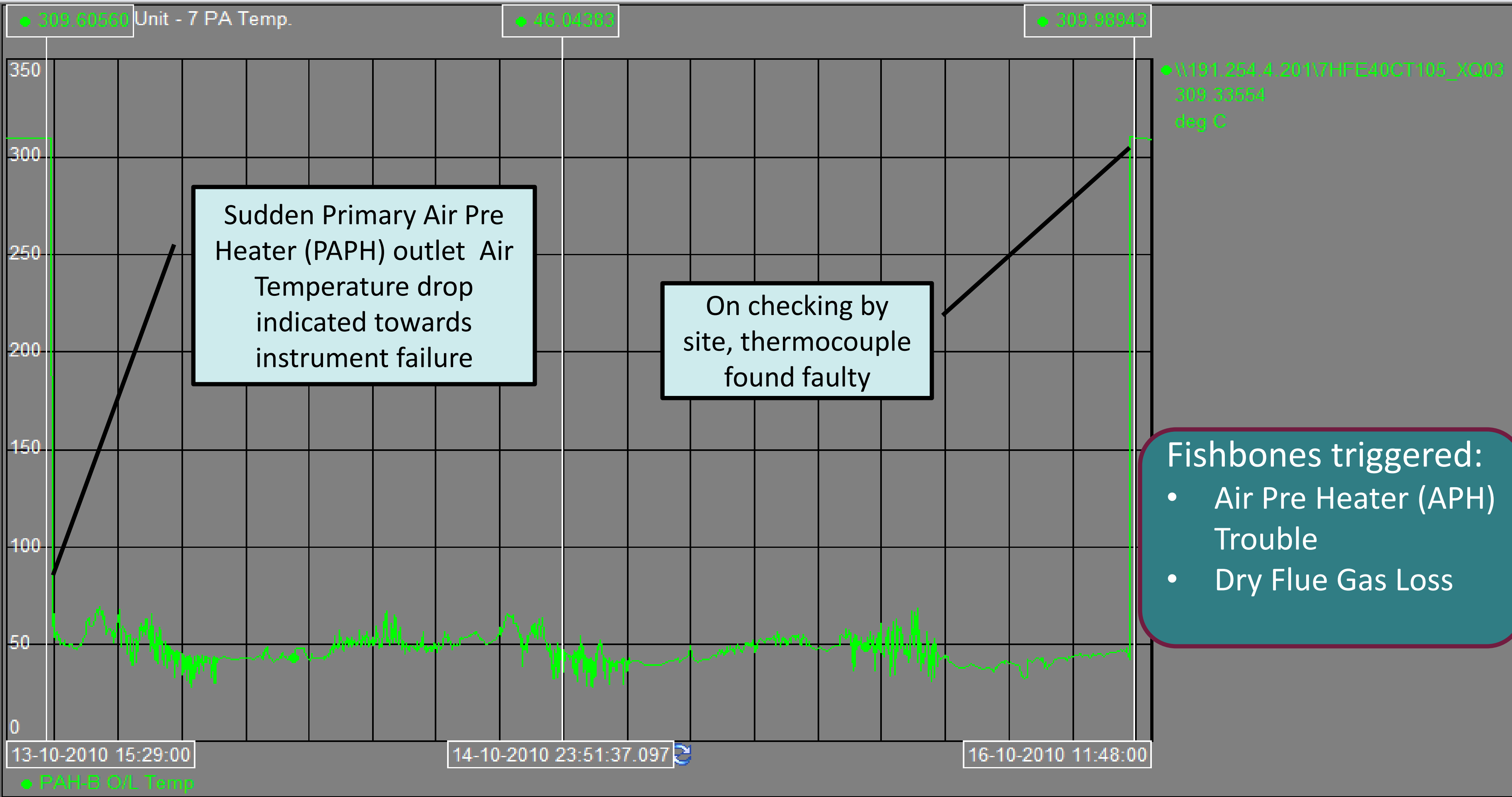

Fishbones triggered:

- Air Pre Heater (APH) Trouble
- Dry Flue Gas Loss

Case Studies

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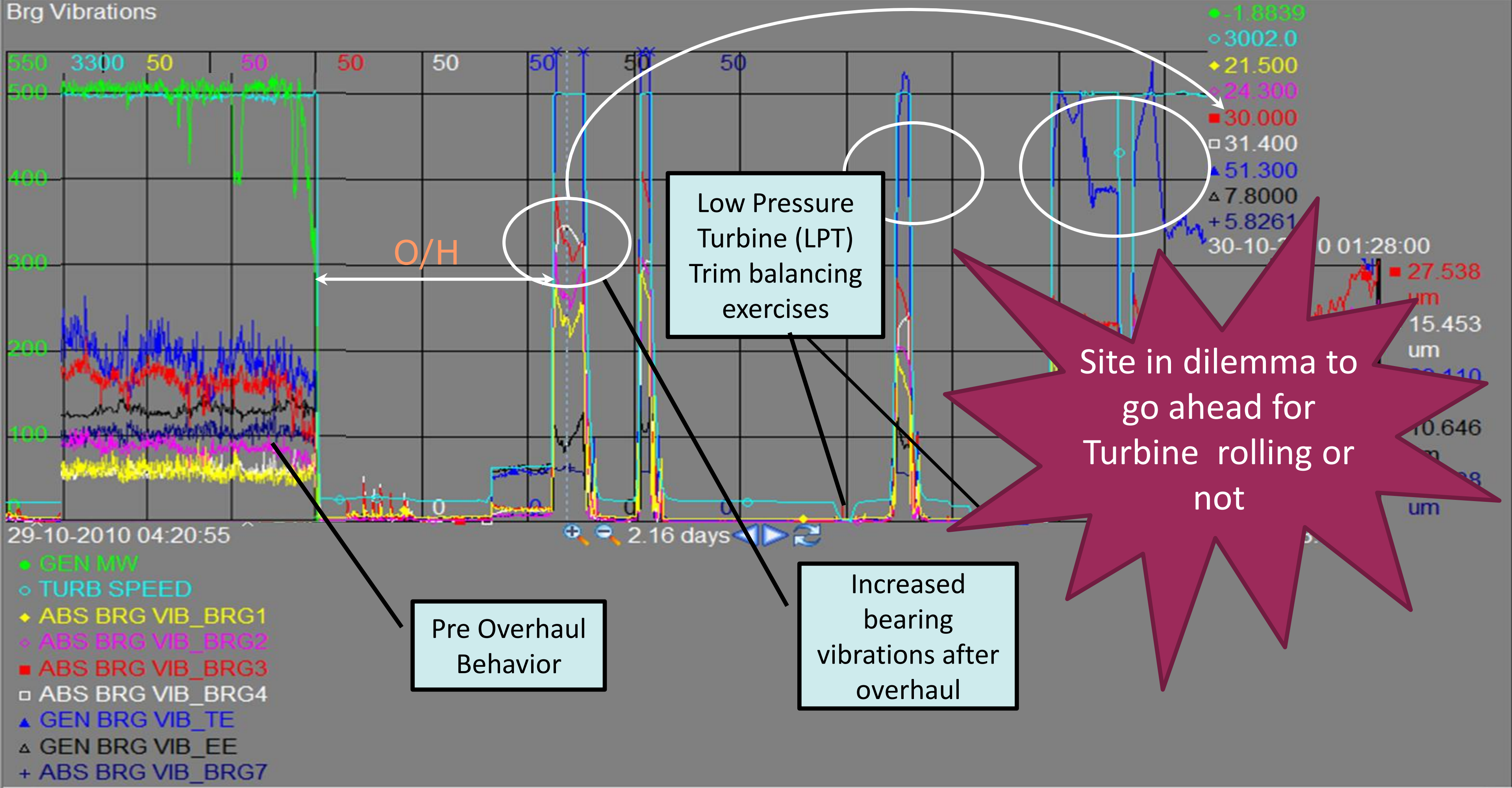

Brg Vibrations
550
3300
50
500
400
300
200
100
0
O/H
-1.8839
3002.0
21.500
24.300
30.000
31.400
51.300
7.8000
5.8261
0 01:28:00
27.538
um
15.453
um
10.646
um
29-10-2010 04:20:55
2.16 days
GEN MW
TURB SPEED
ABS BRG VIB_BRG1
ABS BRG VIB_BRG2
ABS BRG VIB_BRG3
ABS BRG VIB_BRG4
GEN BRG VIB_TE
GEN BRG VIB_EE
ABS BRG VIB_BRG7
Low Pressure Turbine (LPT) Trim balancing exercises
Site in dilemma to go ahead for Turbine rolling or not
Pre Overhaul Behavior
Increased bearing vibrations after overhaul

Sl No.	Parameters	30/09/2010 Pre O/H	Current Value (1755hrs)	30/10/2010 After First Rolling (0105-0205hrs)	30/10/2010 After Second Rolling (0415-0437hrs)	30/10/2010 After First Balancing and Third Rolling (1352-1422hrs)	30/10/2010 After Second Balancing & Fourth Rolling (1944-2215hrs)	30-31/10/2010 After Fifth Rolling (2249-0505hrs)	01-11-2010 AT Full Load (1125 hrs)	01/11/2010 During Over speed Test (1617hrs)
1	GEN MW	[illegible]	[illegible]	0	0	0	0	0-10	500	0
2	TURB SPEED	[illegible]	[illegible]	3000	3000	3000	3000	3000	2982	3383 (PI)
3	BRG VIB_BRG1	4.8	0.40	23 - 23	26	17 - 14	18.6 - 17	16.8 - 18.6	25.5	26.1
4	BRG VIB_BRG2	7.6	0.00	25 - 26	28	18 - 17	20.3 - 19	18.8 - 20.5	22	6.2
5	BRG VIB_BRG3	14.5	0.00	33 [illegible]	36 [illegible]	[illegible] 22	23.7 - 21	21.7 - 23	24.4	14
6	BRG VIB_BRG4	5	-0.10	30 - 29	[illegible]	[illegible]	18 - 15	18.1 - 14.8	17.2	24.7
7	GEN BRG VIB_TE	16.6	0.10	30 [illegible]	[illegible]	[illegible]	[illegible] 35	48.3 - 32	22.7	11.7
8	GEN BRG VIB_EE	11.5	-0.10	8.7 - 10	[illegible]	[illegible]	[illegible] Oct	7.2 - 9.1	15.6	10
9	BRG VIB_BRG7	9.6	0.30	5.5 - 5.3	[illegible]	[illegible]	5.5 - 5.3	5.9 - 5.6	5.2	7.8
10	SHFT VIB_ BRG_1	42.2	2.80	112 - 145	112 - [illegible]	[illegible] - 101	108 - 104	108 - 110	70.9	101
11	SHFT VIB_ BRG_2	56.1	3.00	107 - 121	107 - 116	85 - 94	87 - 89	90 - 80	65.9	58
12	SHFT VIB_ BRG_3	13.1	5.60	94 - 86	94 - 95	61 - 63	63 - 57	63 - 54	71.9	80.7
13	SHFT VIB_ BRG_4	28.3	9.40	65 - 70	67 - 65	53 - 48	43 - 35	40 - 33	71.9	57.7
14	SHFT VIB_ BRG_7	58.3	1.30	49 - 35	44 - 40	39 - 41	42 - 37	42 - 37	45	40.3

Decreasing trend in bearing vibrations

Interactive Problem Solving

Case Studies

- Condenser Tube Leakage by monitoring chemical parameters through SMART Catch
- Reduction of HP Heater Drain Temperature
- Condenser Vacuum improvement by arresting air ingress
- Instrumentation Failure Catch
- High Turbine Bearing vibrations after Overhaul
- High Cooling Water system Differential Pressure (DP) due to Debris Filter damage

Tangible Benefits

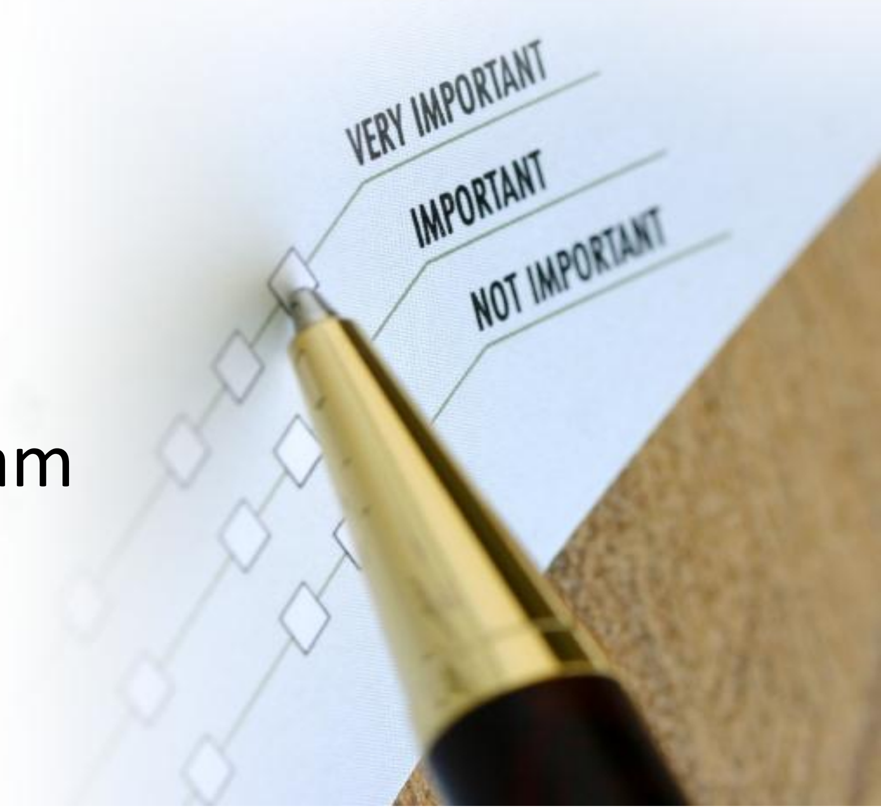
- Proactive notification
- Reduces unexpected downtime
- Return on Investment by catching failures before they happen
- Avoid costs –labour, parts, replacing things that don’t need to be
- Performance & Reliability Improvements
- One unit trip avoided is less than remote monitoring service cost annually
- Economic benefit calculated considering the penalty for unplanned loss of generation and one day outage comes to around 16 million ($ 340,000).

Intangible Benefits

- Sense of control
- Reliable information
- Prevent unnecessary labour & maintenance
- Awareness of asset health versus time-based maintenance
- Impact on performance improvement means additional revenues
- No additional investment is required

Outline

- NTPC-A Snapshot
- Organizational Challenges
- SMART Catch
- Our Enablers
- Approach-Fish Bone Diagram
- Case Studies
- Future Roadmap



Future Roadmap

- Coverage of Total NTPC fleet
- Enhancement of Knowledge Repository
- Data validation and reconciliation through PI System
  - Sigmafine
- Integrate critical business applications and data to new shared environment
- Looking to leverage some of the web-based technologies at offer
  - PI WebParts
  - PI ActiveView
- Further automation, other engineering tools utilizing PI System
  - PI Notifications
- Integration of advanced technology tools

Thank you

Turning **insight** into **action**.