



## **Quality based operation & maintenance practices for smooth functioning of coal handling plant of coal based power plant**

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### **Abstract**

The Material/(Coal) handling system is the backbone of the any thermal Power generation Industry to generate or produce the Power / Electricity. The crucial way of power generation starts with the Fuel Management System. If coal handling plant is not properly managed and the availability of coal handling system is not taken care adequately, the plant performance will be deteriorated. The function of Coal handling is to receive, transport and transfer the coal from one Transfer point to another transfer point. CHP-O&M is very wide subject which consist all types of operations and maintenance of coal handling system. There are several systems, Coal unloading system, Coal transferring /conveying system, Coal stacking /reclaiming system, Coal crushing & bunker feeding system. Dust controlling system Ventilation system & other facility system. The conveying system consist many operations processes. Here, I am focusing in paper the best possible O&M practices to be adapted to optimizing the Operation & maintenance activities at CHP. Our Technical paper presents the efforts to venture for the O&M best practices are to be done to save the fuel as well time, money, energy and to increase the optimization of the thermal power plants in CHP O&M processes by utilization of available resources at site in units of 600/660 MW. To increase the efficiency of the CHP as well as max. Availability of all equipment's by adopting all the best practices and make availability 100% of the CHP. The Top management focus is on the CHP because total power plant cost about 70% revenue is involved in the CHP. If CHP performance is not enhanced adequately then PLF will be deteriorated. Our focus by adopting there should be no single KWH losses by CHP only by managing the losses & processes management in CHP. Maintenance enhanced the reliability so I have focused on it, in this Paper.

**Keywords:** coal, power/electricity, CHP

### **Introduction**

About the Power plant 4620 MW Capacity & Technical Operational details, Awards, Recognitions & Achievements Highlights: of our Organization - Adani Power Limited (APL) entered in the power sector with its first SUPER CRITICAL plant in Mundra in 2006. Mundra has a total installed capacity of 4620 MW. Adani Power is committed to Nation Building.

- APL-Mundra is the world's largest single location coal based private power plant.
- Mundra power plant also holds the distinction of introducing supercritical power generation technology in India. APL has three thermal power projects under various stages of implementation totaling to 9240 MW, which is operational. Our commitment keeps us on-course to achieve our vision of 25000 MW by 2025.

We strive to not only deliver the targeted performance but also to raise the bar and set new industry benchmarks. Adani is committed to achieve excellence in Occupational Health & Safety (OHS) by maintaining safe, healthy conditions and adopting safe operating practices. The quality management system at Adani has ISO: 9001-2008 certification from TUV Nord. The participation of all employees in OHS management systems through OHSAS: 18001-2007 ensures a holistic, Inclusive approach to safety, quality, and health.

Adani Power Training and Research Institute (APTRI) was launched to provide intensive training support to functions

like projects, generation, transmission, distribution, business development, techno-commercial, Finance, human resource and other services.

APTRI is a center of excellence and knowledge built on the deep, rich and diverse experience of senior experts from top national and international organizations.

The institute has established industry tie ups with several reputed training providers to train employees on power generation, transmission and other related areas. To take the institute to the next level, the Central Electricity Authority (CEA) accreditation is in process.

APTRI is a permanent member of Indian Society for Training and Development (ISTD) and is actively associated with activities and events at International Association for Continuous Education and Training (IACET), Institution of Electrical and Electronic Engineering (IEEE), Society for HR Management (SHRM), and Conference International des Grandes Reseaux Electriques France (CIGRE). Empowering our assets.

Awards and recognitions-industry recognizes the Adani excellence. Most Admired Developer in Power Sector by KPMG.

1. Infrastructure Today's Infrastructure Excellence Award 2011 by CNBC TV18
2. Best Corporate in Power Sector by Infra' 2011
3. Golden Peacock Award for occupational safety
4. National Energy Conservation Award 2011

5. National Energy Conservation Award 2012

**Adani-power high voltage direct current (HVDC) transmission**

Integrating innovation and efficiency HVDC is a firewall against cascading disturbances and it improves transmission efficiency. HVDC system also requires fewer towers thereby reducing the number of right of way issues when compared to an equivalent AC system. HVDC also enables Controlled Power Exchange (125MW to 2500MW) and aids in power transmission and stabilization between asynchronous AC Distribution systems. Overall, HVDC improves the (inter-region) grid stability.

**Key achievements of our power plant**

- First private company in India to build HVDC system over 1000 kms. With maximum capacity of 2500MW
- Second longest line in India after Talcher - Kolar
- Longest earth electrode line of approximately 187 kms. at Mohindergarh
- First steel structure pre-fabricated valve hall in India
- First converter transformer from Siemens India, Kalwa factory, Mumbai (11 out of 14)
- Fastest Open Converter test conducted within 26 months of project inception
- India's fastest executed HVDC transmission line / terminals
- In-house design, engineering, testing, and inspection
- Designed special tower for river crossing with a height of 90m
- Executed typical π (Pi) shape tower @ Sami s/s with 6 phases Quad Moose strung on same beam

APL-BENCH MARKS –Highlights--Largest Thermal power station in India among private sectors at single location. First super critical unit in India.

First & only one private sector having HVDC in India. 500 KV Bipolar HVDC from Mundra to Mahindragarh (1000 MW power transmission capacity per pole).

1<sup>st</sup> Company in the world, who has developed methodology and got it approved for High Voltage Direct Current power transmission for CDM with UNFCCC.

Mundra 4620MW power plant consists of (4X330 & 5X660MW) units have been installed

**Data Collection Summary: -CHP-O&M**

1. Overall chp- availability -target 98% --achieved 99%
2. System reliability - 89% - achievement 90%
3. Mtbfc-crusher - 03 months - 04 months
4. Mtrr - crusher. - 40 hrs - 36hrs,
5. To achieve average maint. Cost of coal handling per mt 8.5 /-tons. - 8.9/-mt
6. To achieve auxiliary power consumption up to 1.10 kwh/mt - 0.99kwh/mt
7. Belt loading factorPH-1,2 & 3-4 - 60%-70% achieved - 65-75%
8. To achieve & sustain coal feeding of 100% to all apl

bunkers in conformance with plant requirement as well as to have a coal stock of 2, 50,000 mt in apl coal piles. - 95%

9. To achieve & maintain the availability of all chp critical equipments above 95%--achieved 98%

10. 100% compliance of all chp notifications-100%-99-100%

**Table 1:** Availability of Equipment's

Equipment	PH-I	PH-II	PH-III	PH-IV
Crusher	96.10	-	98.92	98.92
Stacker Reclaimer	-	90.46	98.92	97.22
Belt conv.	99.05	98.86	98.71	98.90
Vibro-Feeder	-	98.92	100.00	100.00
Coal Sampler Unit	Avl		Avl	Avl

**Table 2:** Fire Fighting Equipment's Availability Status

Particulars		PH-I	PH-II	PH-III	PH-IV
DV System	Installed	12	55	27	46
	Available	12	55	27	46
	Not Available	00	00	00	00
Hydrant System	-	Avl	Avl	Avl	Avl

**Other maint practices also covered**

- FMEA, DISHA, RCA-
- PREVENTIVE MAINT
- CONDITION BASE MAINT.
- CORRECTIVE MAINT.
- OPERATION COAL YARD PILE MGMT
- 5S MANAGEMENT
- QUALITY CIRCLE
- INVENTORY MGMT

**Table 3**

FY 2014-15	Opening Stock	Receipt	Consumption	Closing Stock
	MT	MT	MT	MT
Apr-2014	302687	1455044	1489420	268311
May-2014	268311	1543490	1634761	177040
Jun-2014	177040	1589844	1560540	206344
Jul-2014	206344	1496807	1375375	327776
Aug-2014	327776	1296758	1218892	405642
Sep-2014	405642	637004	669347	373299
Oct-2014	373299	1651246	1610135	414410
Nov-2014	414410	1500998	1484180	431228
Dec-2014	431228	1504467	1513760	421935
Jan-2015	421935	1503898	1383006	542827
Feb-2015	542827	1274008	1183455	633380
Mar-2015	633380	1108863	1030625	711618

SAP. PO & SO MGMT.

ISO 14001

ISO-18001 ISO9002

ISO-50001

ENERGY CONSRVATION AWARD

5S CERTIFICATION

BEST MAINT PRACTICES ADAPTED

**Coal Receipt, Consumption, Closing Stock Status 2014-15****Table 4:** Belt Utilization factor (BUF) MONTHLY

Coal Feeding (MT)	104121	125186	203313	635753
Belt Running Hours	367	307	264	471
Loading factor % (Target)	>60	>60	>60	>60
Loading factor % (actual)	69	68	61	67
Remarks:-	Considering the idle running hrs of the system			

**Table 5:** Compliance of SAP Notifications MONTHLY

Notifications	Dept.	Total orders	Comp. work order	Pending order	% completion
Preventive	C&i	62	62	0	100%
Maint.	Electrical	112	112	0	100%
Order	Mechanical	116	116	0	100%
	Total	290	290	0	100%
	C&i	62	62	0	100%
	Electrical	55	55	0	100%
	Mechanical	70	69	1	99%
	Total	187	186	1	99.66%

**Table 6:** CHP-Oil Consumption Monthly

Sl. No.	Type	Ph-1,2	Ph-3,4	Veh
	Installed Quantity 25920LTRS.	3588	8480	13852
1	SERVO 68	-	40	
2	ISO VG 100	30		
3	ISO VG 320	10	2	
4	X <sup>m</sup> MER OIL	15		
5	Transmission Oil			42
6	Engine Oil			270
7	Hydraulic Oil 68&10W			246
8	Ger Oil EP 90&140			67
Total Oil Consumed in Month		722 liters		
Total Oil Credited to Store		1800 liters		

**Methodology used**

5S is an integrated concept for efficient work place management. In fact, it is the gateway for introducing TQM in any organization.

An orderly mind alone can create a sound and well-ordered surroundings. Conversely, an orderly environment promotes an orderly mind.

The 5S is like a mirror reflecting the attitudes and behavioral patterns. Many of the day to day problems that we encounter would be cleared up if only we give more attention to 5S activities.

**Best practices at coal handling plant Mundra**

- Regular use of dust extraction system for the controlling the dust during coal feeding to create friendly environmental for operation as well as concerned maintenance work force.
- Regular use of sprinkler system at coal yard to avoid dust generation during stacking reclaiming & storage.
- Installation of centralized vacuum clearing system at

transfer towers for quick and automation for clearing fine coal dust at CHP-Phase 1/2 bunker floor /TT7&6 of ph-2.

- Hammer replacement of crusher statically balanced hammers used set of hammers weighted before installation for proper balancing.
- Condition monitoring and condition based preventive maintenance on all conveyors and crushers.
- Numbering of conveyor idler frames on conveyor gallery for quick identification.
- All the scrapes are categorized based on metallic, plastic paper & cotton waste and collected separately.
- Regular use of dust extraction & dust suppression system for controlling the dust during coal feeding to create friendly environmental for operation as well as concerned maintenance workforce.
- Oil changing of coupling hydraulic system gear boxes filtration of oil done and oil related parameters like viscosity, moisture impurities are checked at chemistry labs. Oil is changed on the basis of lab quality report.
- Lubrication is done on the basis of running hours of crushers and not on the monthly basis.
- New auto mode lincon make centralized lubrication system installed with SS piping and with lubrication failure feedback features in stacker reclaimer#2.
- The conveyor take up weight boxes are sealed to avoid ingress of coal dust & possibility of fire hazard conditions. Cleaning of take up areas also became easier.

**Best practices at coal handling plant Mundra**

- Collection & return of used/scrap oil from equipment to store for further processing.
- During replacement of conveyor belts the joints are planned in such manner that only final joint needs to be done at position on conveyor gallery.
- The other multiple joints from different belt rolls which requires long for preparation are done on the ground before actual replacement work.
- The set up time of belt is saved and equipment down time reduced.
- Actual weight of the gravity take up box is displayed at take up weight box of all conveyors in order to ensure the use of right capacity chin block and slings by workmen during take up lifting for maintenance works.

**Uses of O&M SAP Module**

- 100% monitor PM/CM/BDM/CBM/RCA/FMEA etc. Through SAP O&M tools.
- Monitor Equipment availability
- Spare management
- Material Procurements
- Contracts works management
- work orders management for PM/CM/BDM
- Inventory management

**FMEA for Equipment's**

Philosophy of working: classified all equipment's based on criticality like impact on generation loss, Health, safety & environment

**Classification all equipment based on criticality.**

- 1-generation loss Category -1:100% generation loss Category 2: Partial load, Category -3 No generation loss.
- Category 1: Major environmental impact on the community major fire /potential fatality.
- Category 2: Medical treatment /minor fire /environmental impact on the entire plant.
- Category 3: First Aid /minor environmental impact
- Category 4: No HSE Impact.

**Target setting**

1. Enhance the belt loading factor
2. To achieve & sustain coal feeding of 100% to all APL bunkers in conformance with plant requirement as well as to have a coal stock of 200000 MT at APL Stock pile.
3. To achieve axillary power consumption.
4. To maintain equipment availability of critical equipment's.
5. Compliance of all CHP equipment's PM notification 100% & 95% corrective notifications.
6. To achieve average maintenance cost of coal handling plant per MT of coal handled.

**In house inventions**

- Conventional diamond pattern lagging at head pulley of conveyors have been replaced by ceramic lagging strips for long life of lagging.
- Frequently jamming flow divider are replaced with in house fabricated flap gates with 3 positions arrangement.
- In plant ph-3 capacity of belt 2000TPH before the gate utilized to maximum extent now due to possibility of dual stream operation after the gate.  
Ph-4 screen discharge in house chute inclination angle changed and problem of frequent jamming and tripping resolved.  
Stacker /reclaimer long travel right side end bogie wheel bearing cover, shaft and seal fund damaged. New shaft bearing cover fabricated at APL work shop & replaced same.
- Frequent failure of communication due to control cable fault between S/R #1, 2, 3 & control room. CCRD Cable was replaced with wireless communication system.
- At ph-1 & 2 PMC S/R there was only one option of either stacking or direct feeding. 50% limit switch provided at center position and option of 50% stacking & 50% direct feeding provided.
- At ph-2 only single stream was available for feeding at time as per logic. Logic modified for parallel operation and provision was made to operate (R2, R4, CR2 R5&VF4) SCADA. \*TTTR5A&5B used over travelled frequently. Replaced simplex chain by duplex. & additional weights provided. benefits over travelling problem solved.
- Provision of additional air cleaner to prolong engine life of fork lifts used in ash handling.
- To reduce jerk & shock, replacement of solid rubber wheel with pneumatic wheel in forklift make Godrej used in handling of ash.
- Currently the capacity of tech pro system conveyor at ph-1 is 900 TPH and on av. 7000-900 TPH feeding taken

place. The unit 1-4 total consumption requirement about 660TPH which is just neck to neck of feeding capacity. This gives tight schedule time for maintenance of stand by stream. It is proposed to enhance capacity to 1000TPH like the PMC System by increasing the size of the pulley. with capacity enhancement the bunker feeding criticality and equipment running hour duration reduces in future.

To produce defect free product, it is a prerequisite to have well-ordered work place. 5S is a simple, systematic method of creating working environment in such a way it leads to improved productivity and quality, reduction in wastage of materials and inventories, enhanced safety and ultimately motivated and enthusiastic human force. Although the 5S movement obviously results in major improvements in 5S areas, it creates a lasting impact in changing the way people approach their work, and using what they learn in every aspect of work environment.

**Results and discussions**

**Cost benefit analysis**

Saving may be realized: by adopting the only two best practices following benefit realization.

**Table 7**

Sl.no.	Benefit description	Owner dept.	Start	End	Impact in terms of rupees
1	Crusher rotor refurbishment	CHP	1.2.2015	20.3.2015	Rs.429997
2	During the year BUF and APC targeted there by reduced apc by 1,017 to 0.973 ie 4.12%	CHP	APR 2014	MAR2015	Saving is @RS. 27 Lakhs Considering 3/-Per kwh.

- 1- Cost of one rotor replacement is more than 4800000/- and repairing cost comes only 5.0 lakhs so about 0.43 Crore may be saved.
- 2- BUF increased and APC - Reduced also saved the auxiliary power saving and saving about 0.27 Cr.

**Conclusion & Future Scope of work**

**Conclusions**

By only applying the Best practices we save a lot of resources and we can reduce drastically the budget of dept. which will reduce the cost of generation and we can survive in power industry. On the basis of best practices the availability may be reached to 100% of each equipment by adapting the checklist and best methodology and keep equipment's updating on regular basis. By only hard facing of rotor rotor new cost may be saved. of about 0.48cr. By adopting the best practices 0.27 cr electricity saved. By adapting best practices we save oil consumption in HEME equipment's. By practicing housekeeping we can save the environment. By practicing the good ISO 9002-2008, 14001, 18001, 50001 We can do the IMS - integrated mgmt. system.

**It will be the bench mark for any coal handling plant in thermal plant for any unit in India and abroad.**

- **Future scope of work:** This technical paper gives them a general study of best practices to be adapted to all the thermal power plants coal handling plants in India and abroad. This is the practical tested method in world best power plant in operation currently. Many Power plants are not functioning only due to CHP so this paper will give them the boon to restart their coal handling plant and give profit to them. This paper is giving the platform to concerned CHP people about best Operation & Maintenance practice may be adapted to enhance the reliability of their systems.

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