

# O&M

# BEST PRACTICES



FEBRUARY 2018



COMPILED BY OPERATION SERVICES & NTPC PMI



# BEST PRACTICES IN O&M AREA

COMPILED BY

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CC  
&  
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INSTITUTE

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# INTRODUCTION

A best practice is a method, technique or system that has been generally accepted as superior to any alternatives because it produces results that are superior to those achieved by other means. Best practices emerge when professionals strive to achieve superior results, look for alternatives, benchmark with other successful efforts and find out best methods which suit a particular situation.

Creating and compiling the best practices ensures that a company's performance is sustained and the employees across the organisation get a platform to document, disseminate, learn and adopt new and better practices.

After its inception in 1975 with an aim to accelerate power development in India, NTPC has now grown into the biggest power company in India receiving the coveted mahartana status from the Govt of India. Over the past years, the company has not only evolved as a widely respected and professionally run company having presence across entire value chain of the power generation, it has also created several benchmarks in various spheres of power sector viz power plant engineering, development, O&M and HR practices. From the fossil fuel based plants portfolio it has forayed into hydro and renewable energy sources. The company has ambitious green energy plans and its capacity will have a much diversified fuel mix with non-fossil fuel based generation capacity making up nearly 30% of NTPC's portfolio by 2032.

NTPC has been adjudged one of the most efficient utilities in terms of capacity utilization in the world and has created several benchmarks in Operation and Maintenance (O&M) of coal based thermal power plants and combined cycle gas plants. The company has been operating its plants at high efficiency levels. Today, with 17.73% share of the total national installed capacity, it contributes about 24% of total power generation due to its focus on high efficiency. This achievement is the result of the Best Practices followed by the NTPC in its O&M Areas. However, with changing business scenario, the capability of Indian power companies to deliver will heavily depend on how efficiently and how flexibly the capacities are operated and maintained. The experience of NTPC in operating and maintaining the power plants will be of great help in handling the challenges of future.

## BEST PRACTICES

# INTRODUCTION

This manual is a compilation of the best practices evolved from operating wide variety of Power plants across the company. It aims to share experiences and knowledge enabling our power professionals to operate the plants efficiently, reliably, flexibly and safely.

To create this manual ; NTPC stations, Corporate Operation Services and the NTPC Power Management Institute (PMI) have worked together by selecting, deliberating, elaborating and compiling the O&M best practices followed in its various power plants and related departments in NTPC. NTPC PMI envisages to bring out similar compilations for other domains by working closely with other departments.

This manual comprises specific sections focused on the Operation, Performance monitoring and Maintenance of various plant components. The aspects related to safety, reliability, availability and efficiency of generating units are also addressed.

The manual aims at sharing of the best practices that our professionals have evolved, honed and practiced.

This will also work as catalyst for a substantiating NTPC's culture of remaining a learning organisation where practices not only get established but they do evolve continuously and renew themselves.

# OPERATION



# TO RUN EQUIPMENT AS PER SPECIFIC ENERGY CONSUMPTION

## Background

Electrically operated drives consume electrical power as per their electrical/ mechanical loadings. When same type of drives are operated in parallel they consume different electrical power for the same loading. It happens because of the internal behaviour of the machine which it possesses. Specific energy consumption of a particular equipment is energy consumed per unit generation.

## Practice

Specific energy consumption of each and every equipment is recorded and running and loading preference is given to equipment with less specific energy consumption. Root cause analysis is done for the equipments consuming power more than desired and accordingly preventive/ predictive maintenance is planned for rectification of the defect.

## Benefits

1. Substantial savings in Auxiliary Power Consumption.
2. Prevention of equipment from major breakdown.
3. Maximum capacity utilisation of the equipment with lower specific energy consumption.

## Contact for further information

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# RUNNING OF UNITS AS PER MERIT ORDER RATING

## Background

In economic load dispatch the unit with lowest heat rate and variable cost is given top priority to meet the increased/decreased load demand by increasing/ decreasing its generation. Such units are already identified at every generating station.

## Practice

Whenever load schedule is changed, more generation biasing is provided to most efficient unit in terms of response time, ramp rate, heat rate and variable cost to meet the changed schedule and rest load is taken care by other units in merit order.

## Benefits

1. Quicker participation in load – frequency control.
2. Overall heat rate improvement of the generating station.
3. Stations having low variable cost get maximum schedule and their profitability increases.

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# OPPORTUNITY BASED CONDENSER TUBE CLEANING & APH WATER WASHING

## Background

Due to fouling and scaling inside the condenser tube, heat transfer capability of the condenser reduces drastically and in turn condenser vacuum deteriorates significantly. In poor condenser vacuum, turbine heat rate deteriorates which increases per unit generation cost. APH basket choking impedes the heat transfer between flue gas and cold air which results in reduced hot air temperature and increased flue gas exit temperature. Increased flue gas temperature decreases boiler efficiency.

## Practice

Condenser tube cleaning is carried out by high pressure jet or by congo ball cleaning or by back washing. On load tube cleaning system is also envisaged which is run on daily basis.

APH water washing is carried out in APH hot condition. Normally low pressure washing is in practice. If differential pressure across APH is quite high, high pressure washing is carried out.

## Benefits

1. Improvement in condenser vacuum
2. Improvement in turbine efficiency
3. Improvement in unit heat rate
4. Improvement in unit generation

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# EMPOWERMENT OF SHIFT OPERATION EXECUTIVES

## Background

Delayed action by shift operation executive in odd hours resulted equipment damage on many occasions. It happened mainly due to lack of confidence in prompt decision making by personnel on desk or by shift charge engineer. It was observed that involvement of others officials in decision making resulted advertent delay.

## Practice

Full authority to shift operation executive has been given to take decisions during emergencies in the overall interest of station upholding safety of man and machines as supreme. Shift operation personnel are taking their own decision in case of emergent condition.

## Benefits

1. Safety of machine
2. It prevents further damages

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# AVAILABILITY OF IMPORTANT & CRITICAL INCIDENTS/ACTIVITIES WITH ANALYSIS ON LAN

## Background

There is a prevailing practice in NTPC to analyse the any critical happening after the incidents to prevent the reoccurrence. Analysis data was not well documented for easy reference.

## Practice

The details of important and critical incidents are being uploaded on LAN for wide circulation and easy reference.

## Benefits

1. Easy to search
2. Knowledge enhancement

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# HARD WIRED START/STOP PUSH BUTTON OF DC DRIVES

## Background

In DDCMIS HMI has been provided in soft form to start/stop any drive. In case of failure of DCS, no other options were available to start DC drives actually required to handle emergency at that point of time.

## Practice

Hard wired start/stop push button is provided for DC drives of main turbine like EOP, SOP, JOP etc.

## Benefits

1. Independent from DCS power source.
2. Start/stop is independent of any logic.

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# LOCAL MANAGEMENT INSTRUCTION (LMI) FOR CRITICAL ACTIVITIES

## Background

To pass on structured instruction for any important/critical activities to be carried out safely and in totality was the genesis of LMI.

## Practice

Job instructions for important/critical activities are covered in well structured document called LMI. LMI is prepared on the basis of Operation Directive/ Operation Guide Notes and it is station specific. LMI is being followed in totality.

## Benefits

1. Decision making as per LMI
2. Chances of mistakes during job execution is almost nil
3. Overall System improvement

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# PERIODIC MOCK DRILLING FOR EMERGENCY CONDITIONS

## Background

To check the readiness of personnel and the system to handle the emergency situations inside and outside the plant periphery.

## Practice

Mock drill of emergency is to be carried out once in three months or as per the frequency specified by the station department whichever is earlier.

## Benefits

1. It develops structured practice of emergency handling
2. It rectifies any slackness in emergency handling

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# DISPLAY OF SAFETY VIDEO AT PLANT CANTEEN DURING CANTEEN HOURS

## Background

To inculcate safety culture amongst the employees and workers of the plant, many majors are taken. Introduction of safety awareness program in real time to make it impactful.

## Practice

Safety awareness program is being conducted through display of safety videos at plant canteen during canteen hours.

## Benefits

1. It has increased safety awareness amongst the personnel
2. People report immediately if any safety lapses are seen
3. A wise step towards accident reduction

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# CONDUCTANCE OF TECHNICAL AUDIT AND IMPLEMENTATION OF ITS RECOMMENDATIONS

## Background

Safe and reliable power generation depends on the reliability of the equipments and system in place. Any deficiency in the system causes loss of generation and sometimes unsafe condition.

## Practice

To highlight the system deficiency of a particular unit/plant, technical audit is conducted once in every year. System deficiencies are brought into the knowledge of senior officials and a resolution plan is made to resolve the issues.

## Benefits

1. Improvement in reliability of the system
2. Reliable and uninterrupted power generation
3. Enhancement in safety of man and material

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# MODIFIED SLIDING PRESSURE OPERATION

## Background

Constant pressure implies stable pressure of the steam generator and main steam line over a wide range of load. Meanwhile, the basic nature of a simple rotating turbine is to require less pressure as load is reduced, and if the main steam pressure is limited to only that required for each load, this mode is referred to as modified sliding pressure. This mode has a limited amount of pressure throttling to provide a modest amount of fast-response load reserve.

## Practice

All super critical fleets of NTPC are running in modified sliding pressure. Some of our subcritical units (500 MW) are running in modified sliding pressure and in rest of the fleets of 500 MW we are in the process of putting turbine in modified sliding pressure after few modification in the control system.

## Benefits

1. Minimal temp. variation for first stage turbine shell under varying load condition
2. Lower thermal stress during start-up
3. Reduced Pr. Level at lower loads to prolong cycle component life span
4. Improved overall power plant heat rate
5. Extended control range of MS and RH temp.

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# USE OF PI FOR REMOTE MONITORING

## Background

Desk operator is fully involved in maintaining the scheduled generation trying to keep all important parameters within design limits. On few occasions particularly during unit start up activities some parameters' deviations are not brought into the notice. It was felt that remote monitoring and analysis in such condition will really help a lot.

## Practice

Through PI all important parameters are getting captured and desk operators are informed immediately if any deviation is observed. Root cause analysis is being done from remote through captured PI data.

## Benefits

1. Online analysis of parameter deviations
2. Post trip analysis
3. Unit heat rate improvement by providing inputs from remote
4. Data archiving

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# MONITORING OF UNIT START UP

## Background

Unit start up is most critical activity of power plant as it requires to monitor critical parameters like temp, pr, level, flow etc. with respect to OEM guidelines. Various auxiliaries equipments are started in such a way that safe and cost effective start up is achieved. It needs integrated start up procedure and monitoring mechanism to avoid any delay in start up.

## Practice

Integrated startup procedure is developed and followed for safe & smooth startup of units. Detailed start up procedure of individual equipment is also prepared for ready reference. Dynamic start up curve is developed & followed for taking timely action. Startup curve is compared with designed curve and deviation is analysed for improvements. Turbine rolling is done through ATRS keeping desired TSE margin.

## Benefits

Comparison of unit start-up with the time period given by the manufacturer curve will help in improving startup practices and will help in start up cost optimization and increased generation

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# MONITORING OF FURNACE TEMPERATURE

## Background

Boiler steam temperature / metal temperature excursion and clinker formation/ ash build up are major concern of boiler due to coal from different sources. One of major reason of above problems are high flue gas temperature in boiler.

## Practice

Furnace temperature are measured by using Infrared thermometer/ optical pyrometer/ HVTC for optimization of boiler combustion & efficiency.

## Benefits

By maintaining design furnace temperature, problems like clinker formation & ash build up will be minimize by taking timely action and ultimately unit forced outage will be avoided.

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# ONLINE TUBE LEAKAGE DETECTION SYSTEM

## Background

Boiler tube leakage is major forced outage of boiler. Delay in leakage detection leads to severe secondary damage and generation loss.

## Practice

Online tube leak detection system are installed in boiler at various location that helps in detecting boiler tube leakage at earliest. It sends sound signal in unit control room that is confirmed by unit operating personnel.

## Benefits

Unit will be stopped at earliest to avoid secondary damage and generation loss

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# OPERATING INSTRUCTION OF EQUIPMENTS AT LOCATIONS

## Background

Rotation of manpower and posting of new manpower requires written instruction for safe start up of equipment. To avoid unsafe operation and failure of equipment due to change of personnel, important instruction are displayed at location for ease of operation.

## Practice

Emergency instructions are displayed in location for operations Like H2 purging, TG lube oil filter changing, ATT of TG, startup line up of equipments etc. For quick & ready reference & Illuminated with DC lighting to take care of total power failure.

## Benefits

It will help in safe and reliable operation of equipment. It will also help in confidence building of local operations.

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# MEASUREMENTS OF HIGH ENERGY DRAIN LINE TEMPERATURE

## Background

Heat rate is very critical parameter of power plants that directly reflects company profitability. High energy drain valve passing leads to heat rate deterioration. So non-contact type sensor are installed for monitoring of high energy drain valve passing.

## Practice

Use of non-contact type temperature sensor are installed in high energy drains valve to detect passing through valves and values are displayed in control room for taking action plan for any deviation in temperature.

## Benefits

It will help in early detection of valve passing and prevent erosion of valve seat. Early action will lead to improvement in heat rate.

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# ONLINE MONITORING OF CHEMICAL PARAMETERS

## Background

Chemical parameter plays vital role in smooth and efficient operation of power plant for a longer period. Boiler tube leakage, condenser performance, deposition on turbine blades and boiler tubes were major concerns so thrust was given to monitor chemical parameter online & offline for safe & continuous running of plants.

## Practice

Well established laboratory & instruments are installed for monitoring online chemical parameters through SWAS in control room and offline test are also being done for healthiness of equipment. Chemistry clearance are recorded in control room before rolling of turbine.

## Benefits

Reduction in boiler tube leakage as well as Prevent deposits in turbine and boiler components and improved performance of condenser. Better monitoring and maintaining chemical parameters will lead to long operation of plants.

## Contact for further information

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# STEAM DUMPING DURING START UP

## Background

Turbine rolling was earlier getting delayed due to delay in achieving chemical parameter and many times load was not getting raised due to high silica in boiler. This practice of steam dumping reduces unit start up & loading time.

## Practice

Steam dumping are done during unit startup to achieve quick chemical parameters for turbine rolling and subsequently load raising by maintaining low silica level in boiler water.

## Benefits

This practice helps in maintaining parameter quickly for turbine rolling and quick unit loading during unit startup.

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# MECHANISED HOUSEKEEPING OF PLANT

## Background

Housekeeping is very important for safe and reliable operation of power plant. Easy movement and dust free atmosphere is necessary for better monitoring of plant. Manual housekeeping was taking more time and not able to maintain desired level of housekeeping, so mechanised system was used for quick and better housekeeping.

## Practice

Mechanised system is in practice for proper housekeeping.

## Benefits

It helps in maintaining better housekeeping and plant safe for easy operation.

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## Background

At part load operation, APH outlet flue gas temperature drops leading to cold end corrosion as per atmospheric conditions. Boiler lit up is also getting delayed due to cold secondary air flow. Steam coil air pre heat system was used for taking care of above issues.

## Practice

SCAPH was charged during unit start up (cold & warm) for raising secondary air temperature and raising flue gas exit temperature at part load above dew point of flue gas.

## Benefits

SCAPH operation helps in quick start up & maintaining flue gas exit temperature to avoid cold end corrosion of APH and flue gas duct.

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# MONITORING OF COAL PIPE TEMPERATURE

## Background

Coal pipe choking is common issue in power plant and affect mill and boiler performance. Delay in choking detection and if choking gets released that may lead to sudden rise in various parameter of boiler like furnace pressure, drum pressure, MS/HRH temperatures even may lead to boiler explosion. So, coal pipe temperature monitoring was started.

## Practice

Periodical monitoring of coal pipe temperatures is being done for early detection of coal pipe choking.

## Benefits

Monitoring of coal pipe temperature will help in early detecting coal pipe choking and avoid problems in boiler due to sudden release of choked coal in boiler.

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## Background

Due to reduction in manpower and leave of existing location manpower, it was difficult to monitor all critical location by control room staff, so use of CCTV was started for remote monitoring.

## Practice

CCTV was extensively used for round the clock monitoring of critical locations like bottom ash hopper, HFO pump house, CW pump house, ash slurry pump house etc. for early detection of problems.

## Benefits

Use of CCTV camera will help in minimizing damage of equipment & improve safety of equipment. Man/MW ratio will also be optimized as per norms.

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# CONDUCTANCE OF OPERATION MEET

## Background

Operation Meet was started to share amongst the operation executive the best practices and technological up gradation in power sector.

## Practice

Desk engineers meet is conducted twice in a year whereas Shift Charge Engineer meet and Head of Operation meet is conducted once in year. Senior officials share latest power sector information and they also communicate regarding company's expectation from them.

## Benefits

All best practices of all stations were shared during meet and making people aware of the incident, good practices of other projects that helps better understanding of system related issue.

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# ONLINE MONITORING OF HEAT RATE & APC

## Background

Low merit order ratings leads to low scheduling of many NTPC stations which necessitates monitoring and improvement of HR & APC.

## Practice

HR & APC are calculated and displayed online in control room through packages like TLA, PADO and PI server application for continuous monitoring and improvement.

Low

## Benefits

Improvement in HR & APC will help in improving merit order rating and also earning carbon credits that can be traded.

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# FST HEATING DURING UNIT START UP

## Background

To keep magnetite layer of boiler intact it was experienced that boiler is to be filled with deaerated water only. For the said purpose FST heating was required with the help of auxiliary steam.

## Practice

FST heating is done with 1.5 KSC of auxiliary steam for cold start up and with 3.5 KSC of auxiliary steam for warm and hot start up. Feed water temperature is to be maintained around 105 Deg C for cold start up and it can go upto 120 Deg C for warm and hot start up.

## Benefits

1. Preservation of magnetite layer in feed water circuit.
2. Start up time reduction
3. Specific oil consumption reduction

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# LOAD TESTING OF LIFE SUPPORT EQUIPMENTS OF PLANT

## Background

Failure of life support equipment may lead to major outage of units. It will lead to huge loss of generation and cost to the company.

## Practice

DG set healthiness checking is done on daily basis. Battery healthiness checking is done on weekly basis. Battery load test and DG set load test is done during annual overhauling for ensuring their design capacity.

## Benefits

DG set & Battery back up will ensure safety of major equipment during station/ grid failure.reduction

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# BOILER MAINTENANCE



# PEP TALK AT START OF WORK DURING OVERHAUL

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## Background

During boiler overhaul lot of manpower joins from different parts of the country on daily basis as the work progresses. All this workforce is not conversant with plant safety practices therefore general safety induction training is given to all workers before entering the plant. However, area specific DO, s and Don't for safety compliance needs to be reminded on daily basis.

## Practice

Before start of work in each area the workforce is assembled area wise at identified locations and Dos and Don't are communicated by the safety supervisor and area engineer. Safety observations and any near miss is shared with all.

## Benefits

1. Improves safety compliance.
2. Improves safety awareness.
3. Improves works productivity.

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# USE OF CUPLOCK SCAFFOLDING, SAFETY NET AND SCAFFOLDING INSPECTION PROTOCOL

z

## Background

Parallel work at many elevations inside boiler needs to be carried out during overhaul. This requires safe approach for cleaning, inspection and maintenance work. Structure needs to be of adequate strength to take load of manpower and material being moved on scaffolding inside boiler.

## Practice

NTPC stations have complete set of scaffolding material for each type of boiler either supplied with new boilers or procured separately.

Scaffolding is erected in each area inside boiler by manpower having experience of scaffolding erection. Erection of scaffolding and its integrity is supervised by a qualified supervisor. Complete blanking at least one level and Safety net at minimum two level is provided.

Scaffolding safety protocol is made by Scaffolding Supervisor, Safety, FQA and BMD

## Benefits

1. Ensures safety of work at height.
2. Improves works productivity.

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# MAINTENANCE AND INSPECTION OF SKY CLIMBER

z

## Background

Sky climber is being used inside boiler during small shut down for attending boiler tube leakages, inspection and any other maintenance work. They are quick to assemble but need adequate care to ensure its integrity and safe operation in view some accidents in the industry.

## Practice

Operating instructions note has been prepared by corporate operation services to be followed by all the stations. OIN says that sky climber to be checked annually by the OEM representative and persons to operate it are trained by OEM. OIN mentions all the Dos and Don'ts. Not more than 05 persons are carried on sky climber at a time and sky climber all parts and safety locks are trial tested before taking it up and while disassembling. All persons travelling on sky climber are also briefed of its operation, locations for standing, safety locks and emergencies.

## Benefits

1. Safe and faster approach to the location inside boiler.
2. Improves safety compliance.
3. Improves works productivity.

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# CHECKING OF ALL LIFTING TOOLS AND TACKLES

z

## Background

Hoists, Chain pulley blocks of different sizes, Hook Chuck, Slings, Eye bolts etc. are used during overhaul to lift and shift material outside and inside boiler. Their worthiness for purpose needs to be ensured before taking them in service.

## Practice

All lifting material is checked as per statutory requirement. However, irrespective of testing certificates from agency all the lifting material is rechecked before start of work. Defective material is destroyed to prevent its further usage. Checking records of NTPC tools and tackles are kept by the MTP department and of agency lifting tools and tackles by the concerned engineer in charge.

## Benefits

1. Improves safety compliance.
2. Improves safety awareness.
3. Improves works productivity.

## Contact for further information

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# INSPECTION OF LTRH, LTSH, ECONOMISER ETC. COILS BY INFLATABLE JACK

z

## Background

Coils were being lifted for full inspection and repair during maintenance after cutting normalisation joints. This was taking lot of time and increasing number of weld joints cut for coil lifting. Use of chain pulley block to lift and making gap was also causing damage to coil tubes. Only up to 30 % coils could be fully inspected during limited overhauling period. This was resulting in lot of area remaining uninspected during overhaul.

## Practice

Inflatable jacks are being used wherever possible to make gap between the coils. Prefab mechanical spacers Of 300-350 mm width are provided after making gap and inflatable jacks are subsequently removed. Scaffolding board of 250-300 mm is provided between coils for safe working. Tubes inspection and replacement is done insitu and after completion of work again inflatable jacks are provided to remove the mechanical spacers.

## Benefits

1. Ensures wider inspection coverage.
2. Reduces total number of weld joints.
3. Improves works productivity.
4. Eliminates damage to the coils during inspection and maintenance

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# HYDRO EJECTOR SYSTEM FOR ASH REMOVAL FROM PENT HOUSE

z

## Background

Ash accumulation inside pent house is observed in a varying degree in all units. For inspection and maintenance this ash is required to be removed at the earliest. There is practice of removing this ash after it cools down, manually by deploying workers. This process was slow and harmful for health of persons working in pent house area.

## Practice

Hydro ejectors using existing fire water connection are now being installed permanently or temporarily during overhaul to evacuate this ash while it is still hot. Specially insulated pipe are used to take out ash from pent house. Manual handling is avoided and process can be completed within first few days of boiler overhaul.

## Benefits

1. Reduction in time to complete the work.
2. Hygienic working environment.
3. Good practice from point of view of health of persons working in that area.
4. Improves safety at workplace by avoiding any contact with hot ash

## Contact for further information

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# COMPLETE CLEANING OF BOILER HEAT TRASFER SURFACE WITH HP JET PUMP FOR INSPECTION

z

## Background

Lot of area in the boiler which is not covered by soot blowers remains with a hard ash deposit even after fire water cleaning of whole of the boiler during start of boiler overhauling. This hard deposit was earlier cleaned by manual scrapping and buffing. This was not only resulting in time delay but lot of dust remained air borne in the boiler during cleaning and which was not good for manpower working inside boiler.

## Practice

High Pressure jet cleaning is deployed after completion of scaffolding work. Two nozzles are simultaneously operated by trained workmen. Limited covered light is deployed in the boiler from TOP and elephant door to save it from water. No person is allowed to enter boiler during jet cleaning. Process takes about 2-3 days for complete cleaning.

## Benefits

1. Ensures hygienic condition inside boiler.
2. Ensures complete cleaning of the boiler.
3. Saves time and increases productivity.

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# MAGNETIC PARTICLE INSPECTION OF HEADER STUB JOINTS, ATTACHMENTS AND BENDS IN BOILER

z

## Background

Header stub joints, attachments and bends were being checked by DPT during overhaul and unit RLA. Even after satisfactory DPT, lot of stubs, attachments and bend failures occurred. Cyclic loading has further increased probability of these failures. Testing of few samples by MPI showed better picture with surface and subsurface cracks.

## Practice

Now, instead of DPT, MPI is done for ferrous metallurgy tubes, attachments (including SS attachments to alloy steel tubes) and bends in areas vulnerable for cracking. Depth of Crack is assessed after grinding and accordingly tube is replaced or repaired. Now, during any failure and during overhaul extensive flour cent MPI is conducted in house or by external agency. All sites have been advised to keep MPI KIT as special Tools and tackles.

## Benefits

1. Better defect detection rate.
2. Improves reliability of the system.
3. Faster than DPT

## Contact for further information

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# RADIOGRAPHY OF ALL MAINTENANCE WELD JOINTS

z

## Background

There is shortage of reliable HP welders in the industry. Therefore even after all the testing of the welders before putting them on job there are incidences of weld joint failures. Inspection of all joints gives a message of zero tolerance on the quality of the weld joints.

## Practice

Radiography work is planned in such a way that all the time gaps of Lunch, Dinner and in night from 2AM till 6 to 7AM radiography is carried out after ensuring removal of all manpower from location. By 9 AM all the results are made available for further action. Any repair reshot is to be taken during Lunch or Dinner time. For each weld joint, welder is identified and in case of defect he is counselled and removed if performance does not improve.

## Benefits

1. Welder remains committed for their job.
2. Reliability of work
3. Reduced secondary damages

## Contact for further information

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# USING CERAMIC PADS INSTEAD OF LOOSE BEAD COATED WIRE FOR HEATING DURING STRESS RELIEVING

z

## Background

Applying wire around tubes/headers takes lot of time and there is always possibility of breakage of wire while applying or during heating. Restoration takes time and affects quality of job. There are no couplers to connect to main supply and simply wires are tied with each other. Whole process is looks unsafe and untidy.

## Practice

Ceramic flexible heating pads are now available in market. These pads are readily used on tubes and are provided with connection coupler. Many stations have got it with SR machine and others have procured it from market. These pads are also used for preheating thus avoiding preheating by LPG gas.

## Benefits

1. Process is very safe and looks tidy.
2. There is ease of working
3. Reliability of Quality SR improves as there are no chances of interruptions due to wire snapping.
4. Saves time
5. There is no requirement of LPG inside plant for preheating

## Contact for further information

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# USE OF METALLIC CAPS FOR COVERING TUBE ENDS TO PREVENT FALL OF ANY FOREIGN MATERIAL INSIDE TUBE

z

## Background

Boiler tube ends need to be capped to prevent ingress of any foreign material inside tubes. Failure due to chocking by foreign material is not uncommon in power plant. Tubes capped by plastic caps may get exposed either due to breakage of plastic caps or sometimes heated material goes thru/ along with plastic cap inside tubes.

## Practice

Prefab metallic caps with slot at sides (to accommodate WW fin) of different sizes are procured. Caps are issued to agency before start of work and agency has to necessarily ensure capping of all tubes to prevent ingress of any foreign material.

Tubes kept in stores are also to be capped by metallic caps as plastic cap of tubes supplied by vendor gets brittle over the period of time.

## Benefits

1. Ensure fool proof safety from any foreign material ingress in the tubes.
2. Do not get damaged by heat or with time.
3. Are returnable and reused during next overhaul.

## Contact for further information

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# AVAILABILITY OF PRESSURISED AIR GRID AT ECONOMISER, RH, LTSH AND WATER WALL AREA

z

## Background

Air is required to operate all the pneumatic tools. Non availability of air in the vicinity becomes a reason to avoid usage of pneumatic tools inside boiler.

## Practice

Provision of air grid at specified locations in boiler is already included in new project specification. However in old stations special efforts have been made to provide air grid. During annual scope of work every station availability of pneumatic tools is checked and recoded. Minimum pneumatic tools to be maintained at stations are specified by the corporate OS. These tools are also given to overhauling agency on returnable basis.

## Benefits

1. Safety at workplace improves.
2. Pneumatic tools are lighter and easier to operate.
3. There is no chance of overloading due to continuous running.

## Contact for further information

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# INSPECTION OF BOILER TUBE MATERIAL BY ALLOY ANALYSER

z

## Background

There are number of incidences when lower grade material gets used in the boiler during maintenance or during manufacturing at vendors work. These tubes subsequently fails due to overheating. Therefore insitu checking of material is essential.

## Practice

All the sites have procured minimum one metal alloy analyser. This alloy analyser is used during inspection of new material and identification of existing material. This is also being used for positive identification of SS grades to ensure supply of right material.

## Benefits

1. Reliable supply of material.
2. Use of correct material during maintenance.
3. Cross check of old material in boiler to take advance action for replacement.

## Contact for further information

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# SPONGE BALL TEST OF COILS AND REHEATER AIR PRESSURISATION TEST

z

## Background

Failure of boiler tubes due to foreign material inside coils has been experienced at all stations and projects. Further detection of reheater leakages by vacuum pulling sometimes causes ingress of ash in the coils from failed opening of the tubes.

## Practice

Sponge ball/sponge pieces bigger than tube dia in sufficient quantity, a portable air compressor, nylon wire braded 1" PVC pipe of length approx. 20-30 m suitable for air pressure upto 10 ksc, with suitable holding arrangement for pipe and rubber gasket to prevent air leak are arranged in advance. Sponge ball test is being carried out in all the new coils before installation and in maintenance coils before making final weld joint in the loop. In units having T91 in antlers, and where many loops are to be tested by sponge ball then test is also being done thru headers to avoid T91 tube cutting and subsequent SR. Sponge coming in the header is sucked thru vacuum pipe.

Air pressurisation test in reheater is conducted to find out small leakages and cracks. Air pressurisation is started from reheater vent lines and takes around 6-8 hours. Therefore, it is immediately started after shut down in case of reheater tube leakage detection and during overhaul after finishing all the reheater work.

## Benefits

1. Loops thruiness is ensured.
2. Leakages due to foreign material are avoided.
3. Loops get cleaned of any loose scale and dirt which reduces time to achieve steam purity.
4. Reheater air pressurisation identifies even small cracks.

## Contact for further information

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# REMOVING OF WATER WALL ORIFICES IN 500MW UNITS DURING OVERHAUL BEFORE HYDRO TEST

## Background

Orifices provided in the water wall tubes at the bottom ring header sometimes get clogged by chemical deposits or foreign material getting accumulated during draining after hydro. This results in failure of water wall tubes due to overheating.

## Practice

After unit shut down when boiler is drained, bottom ring header manholes are opened and Water wall tube orifices are removed in a sequence and stacked in the same sequence so that there is no chance of any interchange of orifices. Orifices are checked for any deposit. Orifices are placed back after hydro test of the boiler.

## Benefits

1. Any foreign material in the tubes is removed.
2. Failure due to partial flow or choking is avoided.
3. Orifice condition is checked which reflects water chemistry of the unit.

## Contact for further information

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# COVERING BURNER LEVEL TOP/BOTTOM BENDS; SECOND PASS MANHOLE & LRSB BENDS AND BOTTOM C-HEADER WITH PLASTIC REFRACTORY

z

## Background

Boiler tube failures play a major chunk of total forced outages in coal fired units. Improvement in operation and maintenance practices play a big role in achieving the ultimate goal of zero tube failures by design. Indian coals are generally having 35 to 40 % of Ash. The tendency of erosion of the pressure parts components of the Boiler is high with such type of coal.

## Practice

Secondary air required for combustion enters the furnace through Secondary air control dampers in all the four corners of furnace. However the hot secondary air from Secondary APH is laden with some ash particles. This ash laden Secondary air when enters the boiler causes the erosion of the boiler tubes in the burner bottom and top bends leading to boiler tube failure.

Also the erosion of Boiler Pressure Parts components due to flue gas in the second pass is the major cause of concern.

Hence the practice of covering burner level top / bottom bends; Second pass Manhole & LRSB Bends and Bottom C-header with a coating of plastic refractory on the pressure parts components will avoid the erosion.

## Benefits

1. Avoids erosion of Pressure Parts Components.
2. Prevention of Boiler tube failure on this account.
3. Reduction of Boiler tube failure leads to reduction of Forced outage and thereby increase of Unit availability & reliability.

## Contact for further information

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# USE OF CHICKEN WIRE MESH IN EXTREME COILS AND NEAR HANGERS TO AVOID FLUE GAS EROSION

z

## Background

Boiler tube failures play a major chunk of total forced outages in coal fired units. Improvement in operation and maintenance practices play a big role in achieving the ultimate goal of zero tube failures by design. Indian coals are generally having 35 to 40 % of Ash. The tendency of erosion of the pressure parts components of the Boiler is high with such type of coal.

## Practice

Flue Gas velocities in the second pass is different in various sections. The erosion pattern of pressure parts components in second pass, which are subjected to higher flue gas velocities, is severe sometimes. Hence the practice of covering the extreme coils and hangers with Chicken wire mesh will reduce the flue gas velocities. The reduction in flue gas velocities will avoid the erosion of extreme coils and hangers.

## Benefits

1. Avoids erosion of extreme coils and hangers.
2. Prevention of Boiler tube failure on this account.
3. Reduction of Boiler tube failure leads to reduction of Forced outage and thereby increase of Unit availability & reliability.

## Contact for further information

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# TEMPERATURE SURVEY OF THE BOILER AND USE OF CERAMIC FIBRE INSULATION IN HIGH TEMPERATURE BURNER ZONE

z

## Background

The Boiler operation and maintenance practices are adopted to ensure the running of the unit with nearer to design heat rate. A simple way of increasing the efficiency and performance of the Boiler is to ensure that it is properly insulated.

## Practice

The practice of temperature survey of the Boiler insulation before the overhaul and subsequent replacement of insulation based on survey during overhaul.

Higher ambient temperature due to furnace radiation in the burner zone is one of the reasons of poor reliability of instrumentation of SADC and Burner tilt mechanism. The application of ceramic insulation pads, which is better than the glass wool insulation, will reduce the ambient temperature in the burner zone area.

## Benefits

1. Proper insulation of Boiler Pressure Parts in first & second pass; Flue Gas ducts and Power Cycle Piping will keep thermal losses to the minimum.
2. Reduction in thermal losses will lead to reduction of fuel consumption.
3. By consuming less primary fuel, the plant contributes to reducing greenhouse gas emissions for the same level of Power Generation as well as reducing emission from its own processes.
4. Application of ceramic insulation pads in Burner zone will improve the reliability of SADC and Burner tilt mechanism

## Contact for further information

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# TREVI TESTING OF ALL THE SPRING LOADED SAFETY VALVES OF THE BOILER AFTER OVERHAUL

z

## Background

Safety valves on the Drum and Superheater main steam lines provide means of protection by assuring adequate flow through the Superheater, if the steam demand drop suddenly and unexpectedly. Reheater safety valves, located on the hot and cold reheat piping serve to protect the Reheater if steam flow through the Reheater is suddenly interrupted. Hence the availability and the healthiness of the Safety valves is must for all the Boilers. These Safety valves are serviced during overhaul and checking of the lifting pressure by floating the Safety valve after the overhaul is mandatory.

## Practice

All the spring loaded Safety Valves are serviced in the span of two Boiler overhauls. Before the Unit is synchronised after the annual overhaul, all the Spring Loaded Safety valves are checked by raising the Boiler pressure. This process of checking all the Safety Valves by actual floating (Lifting / resetting) takes considerable time leading to increased planned outage and oil consumption.

The practice of Trevi / Online safety valve testing is a win-win solution for the plant operator and the maintenance department. Trevi / online safety valve testing is carried out by a kit for which does not require to raise the actual parameters of Boiler to the lifting pressure of the safety valves

## Benefits

1. It sustains plant safety, reduces direct testing costs and shut down times, extending the shutdown interval (plant operation) at the same time.
2. Reduction in oil consumption.

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# ANALYSIS OF PULVERISED FUEL FINENESS THROUGH ISO-KINETIC SAMPLING

z

## Background

Maintaining Coal fineness is essential for proper combustion in pulverised fuel boilers. Normally the pulverised fuel fineness 70% through 200 mesh and 99% through 50 mesh is adequate for satisfactory combustion in boiler. While higher fineness will waste pulveriser capacity and mill power and less fineness will cause poor combustion and loss of efficiency due to higher unburnt carbon in the ash. Hence coal fineness is an important parameter to be maintained at correct values.

## Practice

Measuring the pulverised fuel fineness with iso-kinetic sampling method is based on ISO 9931 and it increases the test accuracy over the conventional method of collecting pulverised fuel sample. Measuring pulverised fuel fineness accurately will assist in properly maintaining the Mill.

## Benefits

1. Based on iso-kinetic sampling, adjustments in the settings of the mill can be carried out to obtain correct fineness.
2. Optimum fineness leads to reduction of unburnt carbon in ash.
3. Reduction in unburnt carbon leads to better boiler efficiency.

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# WEAR DEBRIS ANALYSIS OF LUB OIL OF APH SUPPORT, GUIDE BEARING; GEAR BOX OF APH & PULVERISERS AND BEARINGS OF DRAFT PLANT (ID, FD & PA FANS)

z

## Background

With the growth of technology and development, the size of machinery has increased manifolds. These plants are characterized by large capital investments and high fuel costs, creating a critical need for detecting, identifying and diagnosing machinery problems. Any breakdown in such type of plants means huge loss in terms of revenue and reliability which may be accompanied by safety hazards also. Unplanned downtime in a large power plant can be exceedingly expensive. Condition monitoring is a management technique that uses regular evaluation of the actual operating condition of plant equipment and systems with the objective of optimizing plant operation cost. Most problems can be minimized if they are detected and repaired early.

## Practice

Wear debris analysis of the oil samples of the major equipment's of Boiler such as ID, FD, PA, APH & Milling system is an important condition monitoring technique. Wear debris analysis on quarterly basis will depict the condition of the bearings and gear boxes which in many cases gives early indication of deterioration.

## Benefits

1. It increases the reliability and availability of equipment's thereby reducing forced outage.
2. It reduces the major equipment's secondary damage.
3. It sustains plant safety & reduces shut down times.

## Contact for further information

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# USE OF WIRE REINFORCED PLASTIC REFRACTORY AT BOTTOM OF GUIDE VANES AND HIGH EROSION PRONE LOCATIONS

z

## Background

The Auxiliary Power consumption (APC) of the Unit is electric power consumed in percentage by unit internal equipment's like draft fans, mills, pumps etc to generated power. The deterioration of Boiler Flue Gas ducts over a period of time increases the Draft power, thereby increasing APC. Indian coals are generally having 35 to 40 % of Ash. The tendency of erosion of the Flue Gas Ducts of the Boiler is high with such type of coal. Hence it is necessary to adopt new and innovative practices to reduce the erosion of Flue Gas Ducts.

## Practice

The Flue Gas ducts from Air Pre Heater out let to ESP inlet duct is most vulnerable area of erosion. The deterioration duct leads to air ingress in these areas, thereby increasing the volume of Flue Gas handled by ID Fans. This leads to increase in loading of ID Fans and Unit APC. Hence the practice of Use of Wire Reinforced Plastic Refractory at bottom of guide vanes and high erosion prone locations in Flue Gas Ducts helps in reducing the rate of erosion.

## Benefits

1. The rate of erosion Flue Gas Ducts is reduced considerably. This eliminates the major sources of air ingress in Flue Gas Ducts.
2. Reduction in air ingress in Flue Gas Ducts helps in APC reduction.

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# PREVENTION OF AIR PRE HEATER FIRES DURING BOILER LIGHT UP

z

## Background

In coal fired power plants, Air Pre Heaters perform a major role by improving the boiler efficiency, improving combustion and reducing pollution by lowering the exit gas temperature. During start-ups and shut-down and sometimes even in boxed up (boiler) conditions, if proper care is not taken, air heater fires can occur which in turn will cause severe damage to plant and equipment. The subsequent downtime for repair and loss of availability can be very high.

## Practice

Air heater fires are mainly caused by the deposition of unburnt fuel on the air heater heat exchange surfaces, where it can be subject to significant temperatures and be supplied with adequate air to support combustion. The following practices are strictly followed during Boiler Light up:-

1. The necessary protocols for the same have to be filled up before lighting up the boiler. This ensures proper cleanliness of the APH before light up.
2. Air heater dampers shall be commissioned and made available for operation.
3. Air heater oil carry over probes and inspection ports with lights shall be made available for operation.
4. Air heater soot blowers shall be commissioned and kept ready for operation. During commissioning, lance travel, coverage, steam pressure, valve operation, electrical operation, healthiness of pressure gauge etc are to be ensured.
5. All oil burner valves shall be checked for passing and any defective one should be rectified.
6. Air heater fire water shall be charged up to the individual valve.
7. Infra-red fire detection system or an alternative arrangement for detecting the fire at an early stage shall be available when the air heater is in service, particularly during start - up activities. **Contd....**

## Contact for further information

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# PREVENTION OF AIR PRE HEATER FIRES DURING BOILER LIGHT UP

z

## Practice

8. Air heater interlocks and the functioning of alarms shall be checked before taking the air heater into service.
9. Charge SCAPHs as soon as the fans are started and maintain the recommended temp (about 70°C)
10. Maintain proper atomizing medium pressure and oil pressure at the time of light up.
11. Maintain the recommended minimum oil temperature (about 100°C for HFO).
12. During light up, check for proper combustion by observing the flame at local, exit of the furnace section and the stack.
13. Air heater soot blowing shall be started immediately after boiler light up. Blowing should be done with steam at proper pressure and temperature continuously throughout the period when the oil guns are in service, (including the idle air heater).
14. Oil carry over probes shall be inspected regularly during oil firing. If oil carry over is observed then oil flame should be checked and oil guns having improper flame should be withdrawn immediately.
15. Air heaters shall be inspected locally through the inspection port regularly.

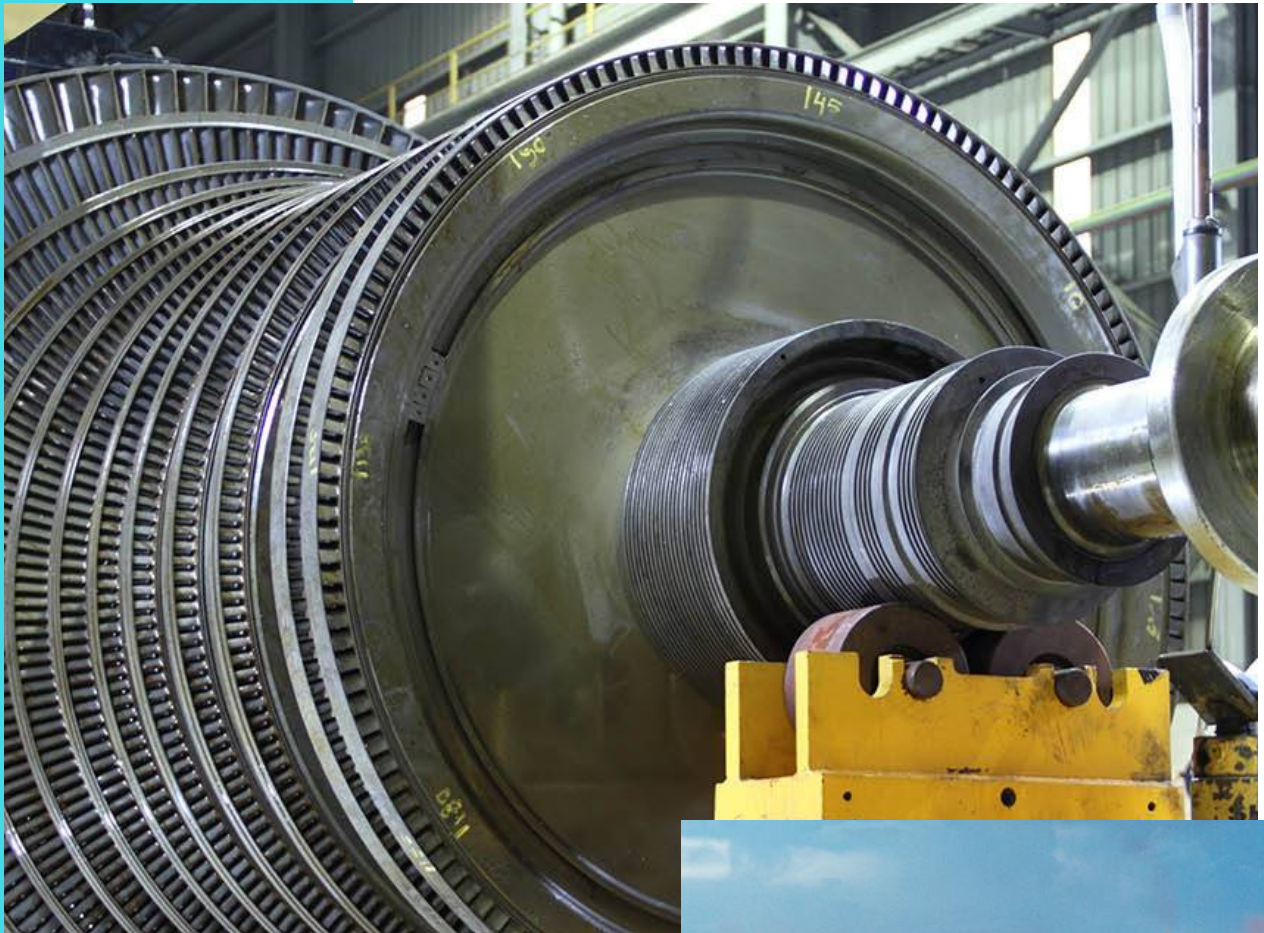
## Benefits

1. The adoption of the above practices avoids danger of serious fires in air preheaters.
2. Early detection of Air Pre Heater fires will help in reducing the damage and down time.

## Contact for further information

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# TURBINE MAINTENANCE



# IN-HOUSE CAPITAL OVERHAUL OF TURBINE

z

## Background

Previously Capital Overhaul of Main turbine was being done through OEM at a very high cost. Quality of Supervision and expertise during Overhaul was also not up to the mark, resulting in delay and post overhaul forced outage in some of the units.

## Practice

In-house capital overhaul of 500/210MW KWU, 210 MW LMZ, 110MW Skoda turbines through reputed vendors under direct supervision, guidance of CC-OS-ST/NTPC Engineers has been initiated and evolved, is now being regularly carried out in NTPC.

## Benefits

1. Post Overhaul Reliability
2. Increased confidence of Turbine engineers
3. Reduction in service cost
4. Optimised Outage Time

## Contact for further information

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# CERAMIC MATTRESS INSULATION ON THE HP/IP TURBINE CASING

z

## Background

Conventional Rock wool based spray insulation is highly polluting, hazardous. Due to the hazardous environment, surrounding work is required to be stopped during the removal as well as application, causing large down time.

## Practice

In lieu of conventional Spray type mineral/Rockwool insulation, Ceramic fibre based mattress/Quilted insulation was initiated, ahead of Leading OEM in India and is regularly used for application in Turbine cylinder and valves, for up to 500 MW Turbines.

## Benefits

1. Environment preservation during application and removal
2. Reduced Overhaul downtime and Availability improvement
3. Partly Usable.
4. Lower heat losses.
5. Easy to install and remove

## Contact for further information

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# MPI (MAGNETIC PARTICLE INSPECTION) TESTING OF FREE STANDING LPT BLADE OF KWU MACHINES BY COIL METHOD

## Background

For fool proof inspection of the Turbine blades, the conventional Yoke method fails to scan the whole area of the blades as section of the blade is magnetized locally in steps by an Operator manually and there is every chance that some area may be left unchecked ( Scanning/coverage of area entirely depends upon the skill of the person). Further the yoke method takes more time.

## Practice

The turbine blade is simply supported on its ends and is placed in a readymade electric coil carrying high current. After uniform magnetization all over the surface, the blades are checked for any cracks under UV lamp. The field is cross checked with Gauss meter. The Appx. Current required for MPI checking is calculated by following formula.

$$NI = 4500 / (L/D)$$

Where N= No of Turns of Coil

I= Current in Amperes

L= Length

D= Maximum Diameter/Width

## Benefits

There is no chance of any crack going undetected (Unlike Yoketype) as by this method it is ensured that whole surface of the blade is magnetized uniformly at a time and checked comprehensively.

## Contact for further information

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# CONTROLLED FAST COOLING OF STEAM TURBINE DURING PLANNED SHUTDOWN

z

## Background

Steam Turbines take very long time about 6 days (up to 500 MW), to cool down and cool enough to permit dismantling of the machine. This increased the Overhaul downtime requirements. Need for faster method of cooling was felt for optimising the down time.

## Practice

Faster cooling down method was studied and implemented and now regularly is in use, up to 500 MW turbines.

- Main steam temperature is reduced gradually along with reduction in unit load, gradually to appx. 450°C.
- Trip the machine.
- Allow natural cooling from 450 to 350°C.

After the temperature has reached 350°C, Start controlled fast cooling by vacuum pulling by keeping the drain of the HPCV open/flanges near HP turbines. Dry instrument air at atmospheric temperature is supplied through the flange/Drains and Turbine shaft, casing temperature, expansions are kept under close monitoring to ensure cooling at a controlled rate.

## Benefits

Reduction in Overhaul Outage duration.

## Contact for further information

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# REPLACEMENT OF ALL HP AND IP INNER CASING PARTING PLANE FASTENERS WITH NEW ONE AFTER EVERY 100000 HOURS OF OPERATION

z

## Background

Fasteners are normally designed for 1% strain. As per experience it is observed that due to ageing and creep/fatigue, the condition of 1% strain is found around 1 lakh operating hours and further invariably elongation based record/assessment of the fasteners is not reliable. Turbine cylinder is overhauled about after every 8 years. In some KWU designed units in NTPC, it has been observed that where they were not replaced and working hours had crossed one lakh hours, fasteners have failed in operation, leading to abnormal outages.

## Practice

In operation, due to permanent yielding of the fasteners and in view of the consequential damage, to parting plane, Turbine blades, Turbine casing parting plane fasteners are replaced after attaining operating life of 1 lakh running hours.

## Benefits

- 1.Helps in avoiding Turbine casing parting plane gap and leakages.
2. Helps in averting major breakdowns.
3. Helps in preventing casing distortion.

## Contact for further information

Operations Services

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# COUPLING FACE CONCAVITY AND CONVEXITY CHECKING AND COUPLING FACE CORRECTION

z

## Background

Some of the rotor coupling faces are observed to have Convexity, Concavity, Facial runout problem during Overhauls. This method is employed to eliminate high coupled run out/Swing value which gives rise to high vibration problem after overhaul.

## Practice

It is checked by placing a straight edge across the coupling face and then measurement of the gaps between the coupling face and straight edge. Gap mapping tells whether the coupling face surface is having concavity or convexity. Facial runout is measured on the rotor faces. Convexity of any value, concavity of more than 0.02 mm, high facial runout is corrected by means of manual scrapping of the Coupling face.

## Benefits

1. To prevent high coupled run out which ultimately leads to vibration.
2. Enhance Reliability/Availability between Two Overhauls.

## Contact for further information

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# ALUMINA GRIT BLASTING OF TURBINE COMPONENTS

z

## Background

Conventional Wet Sand blasting gives rise to rough surface condition of the blade profiles, leading to less efficiency due to increased friction. Also by wet method there is immediate formation of the rust on the exposed/pocketed surfaces which is undesirable, which subsequently gives difficulty in the DPT testing.

## Practice

All the Turbine components to be cleaned by Alumina Blasting only. Unlike wet method where Uncleansed/dirty water is used, it makes use of 5-8 Kg/cm<sup>2</sup> Plant Compressed air which carries alumina Grit particles (90 and 180 Grit size in the ratio of 40:60) along with it and passes through a nozzle and jet is directed manually on the Turbine components.

## Benefits

1. Alumina blasting gives better surface finish and increase inefficiency and does not affect the profile surface of the blades, shrouds, rivets etc.
2. Effect of the accumulated dirty water is also minimized as in the wet system there is chance of water accumulation around the blading attachment area which is an easy site for the corrosion.
3. Unlike Wet method, immediately after the alumina blasting the Turbine component is ready to undergo NDT testing.

## Contact for further information

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# DUST EVACUATION SYSTEM DURING ALUMINA GRIT BLASTING OF TURBINE COMPONENTS

## Background

z

During dry alumina cleaning of turbine assemblies, dusty environment exist, posing health risk to Craftpersons. Further due to poor visibility, cleaning effectiveness suffers.

## Practice

During dry alumina cleaning of turbine rotors/casings/diaphragms, sealed enclosure is made and inside the enclosure alumina cleaning is carried out. Air evacuation system using blowers is employed for exhaust air and in summer, in place of clean normal air for inhalation, air conditioned air is supplied. Before throwing dusty exhaust air outside, dust is extracted by wet means.

## Benefits

1. Environment preservation
2. Comfortable and better environment for Humans carrying out grit blasting.
3. Better effectiveness of cleaning process
4. Inspection during alumina grit blasting is easy.

## Contact for further information

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# AVAILABILITY OF PRE-MACHINED U-SEALRINGS FOR KWU TURBINES

z

## Background

KWU design turbines is having provision of number of U seal rings at various interfaces. Earlier practice was to stock Oversize U-seal ring blank (For HPT inner/outer casing, MS inlet, HP/IP stop valves) with margin of final tolerances. During overhaul, as per requirement, Blank was transported to BHEL-Hardwar fo sized machining and Use in the applicable turbine.

## Practice

Now additionally one number of pre-machined U –seal ring of each type (to drawing dimensions) is also kept as spare, so that if exceptional size requirements are not there then down time can be saved by using the already available finished one.

## Benefits

1. Immense saving in Overhaul downtime
2. Ease of process and Peace of Mind, as was a source of delay in Overhauling
3. Unnecessary dependence on OEM is reduced.

## Contact for further information

Operations Services

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# INSITU SPECTROSCOPY TO DETERMINE THE CHEMICAL COMPOSITION OF HIGH PRESSURE MAL DRAIN/WARM UP/ STEAM IMPULSE PIPES

z

## Background

Many of the units (Leading turbine OEM supplied) are found to have improper material used in High pressure, High temperature drain, Warmup lines, Impulse line piping, which fail within initial period of 1-3 years of operation or sometimes even after 5-6 years, leading to forced outage of the unit..

## Practice

During erection time before insulation application and during the first Overhaul, after insulation removal, the material composition of High energy drains, MAL drains, Warm-up and steam piping impulse lines is checked In-Situ by portable material analyzer. During the overhaul the insulation over the pipeline is required to be opened and all the sections of welded pieces from main line up to the first isolating valve is checked for the chemical composition.

This checking is required in units which have been recently erected/commissioned.

## Benefits

1. Helps in preventing controllable forced outages.
2. Helps in preventing any safety hazard to working staff as any leakage can cause catastrophic effect on the human life.

## Contact for further information

Operations Services

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# POST OVERHAUL STEAM BLOWING OF SUPER HEATER CIRCUIT

z

## Background

During boiler overhaul (500MW), lot of cutting, grinding, & welding works are carried out in boiler tubes & coils. At the time of unit start up, these entrapped slugs and metal chips get accumulated all around the main steam strainer mesh before turbine stop valves even after boiler hot draining/purging. Deposits of welding slugs and metal chips get fused/embedded with in the strainer element, in the long run, as it is subjected to very high temperature during continuous operation, resulting in permanent reduction of strainer effective area by 40 to 50 % which gives rise to steam flow path blockage and steam flow imbalance.

## Practice

To avoid this, steam blowing of main steam lines are carried out after every major boiler work in 500MW units (4 valve machine) before unit start up through dead end steam strainer i.e. no.1 (left side).

## Benefits

1. Prevents turbine from flow induced Vibration due to uneven steam flow from HP control valves.
2. Prevents damage of turbine Moving & guide blades from FOD &SPE.
3. Prevents choking & damage of Turbine inlet strainers.

## Contact for further information

Operations Services

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# OPTIMIZATION OF NO OF SHIMS IN THE BEARING PADS /TOROUS (MAX. 03 TO 04NOS.)

## Background

Too many shims in single location leads to spring action among the shims and hence fretting rubbing between them leading to damage of the shims and changes in alignment, which gave rise to high vibration in the turbine bearings. Number of shims should not be more than 3 at each location.

## Practice

To minimise such above occurrences , following should be ensured during any maintenance activity of the bearings.

1. Shims should be ready made or Pre fabricated.
2. Shims should be of SS 316 only. If SS 316 is not available then SS 304 can also be used.
3. No of shims in each location should not be more than THREE. The thicker one should be in the middle to avoid the spring action .
4. There should not be any kinks in the shims and edges should be perfectly smooth , otherwise it can lead to wrong adjustment in the bearings.For this ready made shims should be preferred.
5. There should be ample quantity of the shims of different sizes ( from 0.03 to 1.00 mm) so as to optimise the no of shims. In addition to shims ,suitable SS Plates of Different sizes ( From 1.00 mm to 3.00mm ) should also be made available.
6. It is better to check the shims with the magnet before application. As the shims are of SS , they should be non magnetic .
7. To prevent the use of other nonmagnetic material like Alumunium etc. by mistake. which looks like SS to naked eye ,the SS Shim/ Sheets should be properly labelled/marked by some suitable means.

## Benefits

Prevents damage to shims and high vibration in the turbine bearings

## Contact for further information

Operations Services

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# PROVISION OF CHAMFER'S IN SEALING STRIPS OF ALL TYPE OF OIL GUARDS

## Background

Scoring on rotor surface corresponding to oil guard portion of pedestal occurs due to touching /rubbing of rotors with brass/ aluminum fins of oil guards at high vibration/ eccentricity and due to improper clearances and further leading to subsequent oil leakage problem. At number of units, it is observed that chamfer/thinning in the fitted oil guard fins is not there.

## Practice

As per design, all type of seal fins should have chamfer/ thinning/Knife edge at the tip portion. During the event of rough running/ excessive vibration & eccentricity this thinner portion shall get worn/blunt easily and will not leave any scoring mark on the rotor.

## Benefits

1. Shall help in preventing deep Scoring on oil guard portion of turbo-generators rotors and subsequently preventing perennial leakage of oil through the space.
2. Helps in maintaining close clearance between shaft & strips.
3. Avoiding specialized machining on scored portion, which leads to extra outage time and cost.

## Contact for further information

Operations Services

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# LIFTING AND CLEANING OF PEDESTAL NO 2 IN THE LMZ/SKODA MACHINES

## Background

Older turbines are provided with sliding pedestals. Over a period of time LMZ/SKODA machines faced problems of HPT and IPT pedestal expansion, causing abnormal differential expansion. In some units during cold start up the unit was required to be tripped many times to control the differential expansion. This differential problem occurs due to lack of/poor sliding interface/ fouling of the pedestal bottom groove with the longitudinal key in the base plate.

## Practice

To overcome this problem the pedestal no 2 is lifted by means of EOT crane after decoupling it from the Turbine casings. It is lifted up to the extent that the groove does not come out of the key height.

After lifting, the surface beneath the pedestal and around Key area is cleaned mechanically /manually, lubricated properly and placed back in the position.

## Benefits

1. Smooth and friction less pedestal movements.
2. Safe operation due to Controlled Differential expansion and preventing vibration rise.
3. Smooth and short start up time.

## Contact for further information

Operations Services

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# REDISTRIBUTION OF THE CYLINDER LOADINGS TO DESIGN VALUE WITH THE HELP OF DYNAMOMETERS IN LMZ MACHINES

## Background

Over a period of the time due to foundation settlement and change in the loading of the pipe hangers, disturbance in the loadings of cylinder palm at corners of the pedestal is possible and hence causing problem of pedestal movement during start up. Thus the need for dynamometers, to check and resolve the problem.

## Practice

Two dial type dynamometers are screwed on the Left and Right side of casing( Female threads are already there) with their sensing arm touching on the pedestal. Then they are given equal tightening/Lifting force manually which is ensured by means of dial gauges placed on the casing .

The loading is given 3 or 4 times .The difference of the readings on the dynamometers scale directly gives the difference of the load (calculated by a calibration chart of the dynamometers) between both the side of casing and the sizes of the shims which are required to be placed/removed in the casing palms to get the cylinder loading as per design value.

## Benefits

1. Lowers vibration levels of bearings.
2. Improves pedestal and casing expansion

Applicability: LMZ design turbines.

## Contact for further information

Operations Services

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# CLEANING OF FRF TANK SYSTEM DURING OVERHAUL

z

## Background

Over a period of time, sludge with impurities settles down in the Control Oil (Fire resistant Fluid) tank of a running unit, necessitating proper and thorough cleaning of the tank in order to achieve and maintain the purity of the FRF of the desired quality.

## Practice

A separate tank prototype is fabricated of SS sheet which is placed outside the TG Hall.

With the help of a temporary transfer pump the FRF from main tank is transferred to the fabricated tank. After total cleaning of the Main tank and its system, the FRF is again transferred back from fabricated tank to the original Main Tank. Suggested frequency every 8 to 10 years.

## Benefits

1. For long term operation, FRF of good quality can be maintained.
2. Due to FRF quality issues, hunting of valves due to sticking / hunting is not expected.
3. Smooth start-up of the Unit.

## Contact for further information

Operations Services

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# MOBILE FILTRATION UNIT FOR CONTROL OIL/GOVERNING SYSTEM

z

## Background

When the FRF oil quality deteriorates the moving clearances of the sliding surfaces like liners and sleeves increase. This leads to mal operation of stop valves, pressure switches, injection valves etc. Hence the Control Oil/FRF (Fire resistant fluid) in the governing system should be of very high quality, with minimum particle count (NAS-5).

## Practice

For attaining FRF quality of the order of NAS-5 level, Trolley mounted Ultra fine filtration system is employed, which uses number of fine mesh filters. The system helps in bringing the oil quality in a very short interval. {In case the newly supplied Turbines have permanent systems, then this type of kit is not required}

## Benefits

1. Ensures reliable operation of Turbine stop/control valves.
2. Helps in maintaining NAS value of 5.

## Contact for further information

Operations Services

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# MPI (MAGNETIC PARTICLE INSPECTION) CHECKING OF THE BLADES

## Background

To ensure proper checking of the cracks in lacing wire holes in the Turbine blades where the lacing wire is brazed.

## Practice

In LMZ/SKODA/Ansaldo/GE turbines natural frequency of some stages are tuned and damped/set away from the operating frequency harmonics by means of grouping them ( Putting lacing wire and brazing of wire with blade). However over the period of time there is tendency of crack formation around the holes of the blade where the lacing wires are brazed.

Earlier the MPI checking of the blades were done without removing the Brazing which could not detect the cracks if any around the holes. To ensure total reliability of the blades new method was started in which the brazing was removed and area around the holes of the blades were cleaned for MPI Checking.

After checking the holes the new lacing wires are inserted and brazed

## Benefits

Ensures proper checking of the Blades for reliable operation.

## Contact for further information

Operations Services

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# INSITU /AT SITE REPAIR OF THE BLADES OF TURBINE DIAPHRAGMS AND NOZZLE BOXES (STATIONARY BLADES)

z

## Background

Damages, erosion to stationary vanes of diaphragms & nozzles of turbine occurs due to scales, welding slag from Main and Reheat Steam, which affects the efficiency of a Steam Turbine.

## Practice

During Overhauling, Diaphragm vanes and nozzles are repaired for dents, thinning, pitting, cuts, erosion, FOD in the profile;

- In-situ/at site welding by special Inconel TIG welding.
- No stress relieving is required.
- Polishing of the diaphragm blade profile is done after the repair.

## Benefits

1. Improvement in the Turbine Cylinder Efficiency.
2. Saving in Direct costs as new diaphragms are very costly.
3. Need for new diaphragms is minimised.
4. Less overhaul outage time as normally new diaphragms requires enormous machining activity for its fitment and getting desired steam flow path clearances.

## Contact for further information

Operations Services

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# EDDY CURRENT CHECKING OF THE CONDENSER TUBES

## Background

Condenser tubes fail due to thinning, in due course of time and cause deterioration in water/steam cycle purity. Timely detection of the thinned condenser tubes is extremely important, otherwise, it will cause fouling of steam path, boiler tube and Turbine blade failure due to corrosion.

## Practice

Eddy current transducers are employed after tube cleaning (twin or more in parallel, to save time) to detect thinning and cuts in the condenser tubes. Tube Thinning more than 40% is considered serious and rate of thinning is monitored at the regular intervals.

Procurement of tubes is started when Tube Plugging Status reaches 5%. Plan Replacement of Tubes is done when plugging status approaches 10 %/vacuum is affected. However if the thinning of the tubes is on the alarming side irrespective of the plugging status, procurement of the tubes is advanced.

Normative Frequency of testing:

Sea water : Check 100% tubing, once in initial 5 years and subsequently at every 1 lac hours.

All Other regime; Check 100 % tubing for every 1 lac operating hours (for SS tubing)

\* Depending upon Tube material, frequency of tube leakages and thinning pattern, timing of tube checking can be done earlier and frequency can be increased.

## Benefits

- 1.Helps in preventing tube leakages
- 2.Improvement in short term and long term unit reliability and availability
- 3.Supports for planning of procurement action.

## Contact for further information

Operations Services

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# SLOW SPEED BALANCING OF TURBINE ROTORS DURING CAPITAL OVERHAUL

z

## Background

Over a period of time due to operational reasons or rubbing, problem of Runout is observed in some of the rotors. This method has been found to be useful in lowering the base level of Vibrations.

## Practice

In case of run out, Unbalance or Reblading, Portable balancing machines are brought during capital overhauls and balancing is carried out at 200 – 250 RPM. Portable balancing machine also helps in meeting ON-Site machining requirement of the rotor.

## Benefits

- 1.Helps in bringing down the residual unbalance and base level of vibrations.
- 2.Helps in increasing Turbine reliability and Availability

## Contact for further information

Operations Services

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# PROVISION OF WORK STATION (DOG HOUSE) AT TG FLOOR WITH ALL FACILITIES DURING OVERHAULS

## Background

During Overhaul, continuous involvement of Turbine Maintenance professional is required in job supervision as well as Liaisoning/Smooth coordination with various agencies including departmental/interdepartmental manpower. However due to frequent movement between office and TG floor hampered the effectiveness.

## Practice

To improve the overall coordination during overhauls , a portable, closed, metallic container/Box having full fledged office set up is placed at TG floor, having all the following amenities

- Internet, intranet and telephone facilities
- A PC with printer.
- Related Drawings, protocols, history reports etc.
- Commissioning procedures.
- Good Seating arrangement and refreshment facilities.

## Benefits

1. Minimizes unnecessary movements of Staff.
2. Enhances the productivity
3. Faster decision making

## Contact for further information

Operations Services

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# PRESERVATION OF TURBINE CYLINDERS WHEN OUTAGE PERIOD IS MORE THAN 7 DAYS

z

## Background

During long shut down, corrosion rate to turbine components in wet environment is more and has potential to affect life seriously. Hence there is need to control the environment inside the turbine cylinders during long shut down.

## Practice

To enhance the life and reliability of the Turbine components, it is necessary to maintain dry conditions inside the turbine casing when the shutdown period is more than 14 days. Dry environment is maintained by supplying dehumidified air at controlled humidity with the help of a portable dry blower unit.

## Benefits

Helps in preventing the corrosion damage to the Turbine components, in particularly blading.

## Contact for further information

Operations Services

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# TIGHTENING AND LOOSENING OF HIGH TEMPERATURE PARTING PLANE FASTENERS OF HP AND IP CASING BY INDUCTION HEATING

## Background

z

Principle of loosening and tightening of all High Temperature fasteners (studs and capnuts) works on the differential expansion between the stud and the capnuts.

In conventional Electric-resistance heating, rod type heaters are used which heats appx the complete length of the stud. As rate of heating is slow the differential expansion between stud and capnuts is lesser whereby more time is consumed and chance of seizing of threads of stud and capnuts is also possible. Further it may require sledging hammers also during loosening.

But in Induction heating uniform and faster heating is done which is done only in the plain portion of the stud. As rate of heating is faster the differential expansion between stud and Nut is larger which minimizes the seizing of the stud threads with the cap nut threads. It also enhances the working life of the fasteners as lesser stresses are retained in the fasteners.

## Practice

It uses a portable Load transformer which generates High current at High Frequency. This high frequency current is fed to a Coil (Rod shaped) which is inserted into the hole of the stud which heats the plain portion of the stud only and does the Uniform heating at faster rate.

Contd...

## Contact for further information

Operations Services

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# TIGHTENING AND LOOSENING OF HIGH TEMPERATURE PARTING PLANE FASTENERS OF HP AND IP CASING BY INDUCTION HEATING

z

## Benefits

1. Increases working life of the Component as it generates less stress and strain into them.
2. It is faster and safer.
3. Rare Chance of the seizing of the studs in the Casing.
4. No sledge hammers are required.
5. Only shank portion is heated.

## Contact for further information

Operations Services

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# ELECTRICAL MAINTENANCE



# DISSOLVED GAS ANALYSIS OF TRANSFORMERS

z

## Background

Dissolved Gas Analysis is a worldwide accepted predictive maintenance tool for assessing transformer health. In NTPC, several failures of many transformers in the early 90s especially Generator Transformers and EHV class ICTs led to adoption of DGA analysis on certain frequency as standard method for analyzing transformer health , fault identification and finalizing repair strategy.

## Practice

Dissolved gas analysis to be done monthly at site of all transformers above 33 kV, critical transformers like UT, UAT & Reactors. DGA test of Generator Transformers to be done 3 monthly at NETRA and other transformers 6 monthly.

## Benefits

1. Useful predictive maintenance tool for assessing transformer health.
2. Identity and concentration of the gases being generated can be very useful information in fault identification and formulating subsequent maintenance action strategy.

## Contact for further information

Corporate Operations Services

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# INFRA-RED THERMOGRAPHY OF EHV CLASS TRANSFORMERS

z

## Background

To avoid failure of electrical equipments and forced shutdown /tripping of units due to excessive temperatures in transformer cooler MB, busducts, external connections etc and evaluation of temperature profile for maintenance requirement during planned outage / outage requirements.

## Practice

Temperature profile to be taken on quarterly basis for bushings, turrets, MBs, cooling systems and connected busduct of all critical transformers like GTs, UATs, UTs, ICTs etc by a thermovision camera. Temperature trending is to be done and necessary maintenance action to be taken as required.

## Benefits

1. Evaluation of temperature profile for maintenance requirement during planned shut down and to avoid failure due to excessive temperature
2. Techno economic evaluation based decision for run/repair/replacement
3. Proactive decisions for future repair
4. Provides excellent record/history of equipment condition for future reference

## Contact for further information

Corporate Operations Services

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# EHV CLASS TRANSFORMER INSULATION PROCESSING

## Background

Premature failure of transformer takes place due to accelerated ageing of paper insulation in presence of excessive moisture, oxygen and temperature. To prevent accelerated ageing of transformer, dryness of both oil and paper insulation is required to be ensured.

## Practice

Processing of transformer insulation as per guideline to ensure complete dryness of both paper and oil insulation separately as well as complete dryness of combination of both during any maintenance work carried out on transformer requiring draining of oil and exposure of paper insulation.

## Benefits

Avoiding accelerated ageing of insulation of the transformer

## Contact for further information

Corporate Operations Services

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# FREQUENCY DOMAIN SPECTROSCOPY (FDS) TESTING

z

## Background

Excellent condition monitoring tool for ascertaining dryness of solid insulation of Transformers , OIP bushings & EHV CTs without having to take out physical sample of insulation paper.

## Practice

Frequency Domain Spectroscopy (FDS) testing of transformers and EHV bushings during OH for ascertaining moisture in solid insulation of transformers, OIP bushings & EHV CTs.

## Benefits

It will give a fair idea of dryness in solid insulation of transformer and EHV bushing which may be correlated with health of insulation system and avoid sudden failure or accelerated aging related problems.

## Contact for further information

Corporate Operations Services

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# IMPROVEMENTS IN SPECIFICATION TRANSFORMER OIL FILTRATION MACHINE

z

## Background

Performance evaluation of oil filtration machine at machine end for achieving desired oil parameters. Precision in oil flow control from the machine which is require sometimes during insulation processing.

## Practice

Installation of VFD drives in inlet/ outlet/ main vacuum and roots pumps. Installation of online particle count and moisture in oil sensor. Use of oil water separator in filter machine vacuum pump oil circuit. Use of radiator in vacuum pump cooling circuit.

## Benefits

1. VFD installation, eliminates the need of manual valve operation, improve energy saving, promote fine operation of machine with improved performance in less time.
2. Online particle count measurements will give the instantaneous performance of coarse & fine filters and online moisture in oil sensor give shows the improvement of ppm value in each pass.
3. OWS reduce the oil consumption of vacuum pump.
4. Use of radiator reduces the water consumption and improves the cooling efficiency.

## Contact for further information

Corporate Operations Services  
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# USE OF REGENERATIVE TYPE MAINTENANCE FREE BREATHER

z

## Background

During its operation, the transformers breaths as it is exposed to temperature variation. The air that comes in contact with air cell or the oil surface in conservator should be dry. Any moisture carried with breathing air shall be absorbed by oil or shall damage the air cell. This shall impact the life expectancy of a transformer.

## Practice

Use of regenerative type maintenance free breather in place of conventional silica gel breather so that the dryness of the air into the transformer through breather is maintained.

## Benefits

Reduced moisture ingress in transformer and silica gel consumption.

## Contact for further information

Corporate Operations Services

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# RESIDUAL LIFE ANALYSIS (RLA) STUDIES OF EHV CLASS TRANSFORMERS

z

## Background

In the event of failure of a Generator transformer, the outage of a unit becomes very high in absence of a ready stand by. Hence, RLA helps in forecasting requirement of stand by transformer with time line which can be kept as immediate standby and the outage time of unit is minimized. For other transformers replacement planning is done to improve reliability of the system.

## Practice

RLA of EHV class transformers by several condition assessment technique as per Guideline that includes specific test methods, assessment criteria and the periodicity.

## Benefits

1. Reduction of unit outage time in the event of failure.
2. Reliability improvement of Electrical supply system.

## Contact for further information

Corporate Operations Services

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# NATURAL FREQUENCY TESTING OF GENERATOR STATOR OVERHANG WINDING

z

## Background

Failure of winding bars at overhang portion of stator winding in a turbo-generator was a general phenomena of winding failure in early 90s in the absence of a stator end winding vibration monitoring system. The failure is mainly attributed to resonance due to matching of natural frequency and the working frequency of vibration. Due 50Hz frequency, the working frequency of vibration is 100Hz. The natural frequency of vibration must be quite away ie,  $<95$  and  $>115$  Hz. For this Natural frequency test must be carried out.

## Practice

Natural frequency test of generator stator end winding at nose joint as well as at terminal connections is done at both vertical and tangential direction. Any corrective action required are taken such as strengthening of end winding support system.

## Benefits

Insulation deterioration / failure of stator bars at overhang portion is minimized.

## Contact for further information

Corporate Operations Services

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# MOTOR CURRENT SIGNATURE ANALYSIS WITH MOTOR EVALUATOR

z

## Background

Condition monitoring tool for identifying rotor bar cracks and incipient faults in rotor.

## Practice

Motor current signature analysis done of critical motors periodically to detect rotor bar cracks, to predict incipient faults in motor and to avoid loss of service of critical drives.

## Benefits

Reduction of motor failure rate. Improvement in availability of Motors.

## Contact for further information

Corporate Operations Services

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# LASER ALIGNMENT OF MOTORS

z

## Background

The alignment between the drive and driven equipment play the major role in performance of the system during its service. The degree of accuracy of alignments limits the vibration of the system.

## Practice

Alignment of motor with driven equipment by laser alignment kit.

## Benefits

1. To reduce alignment time.
2. Better accuracy in alignment leads to improvement in reliable operation of the system.
3. Low long term maintenance cost.

## Contact for further information

Corporate Operations Services

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# SURGE LOAD TESTING OF DC SYSTEM

z

## Background

For ensuring availability of DC drives during total black out, surge load testing of DC system was envisaged.

## Practice

All DC drives to started in charger off condition and run for 1 hour.  
Thermography of battery terminals to be done to check overheating during the test

## Benefits

Ensures reliable DC power circuit at the time of Emergency

## Contact for further information

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# CONDITION MONITORING OF SWITCHYARD EQUIPMENT

z

## Background

Various condition monitoring tools for ensuring healthiness and availability of switchyard equipment like CT, CVT, LA and Breakers have been adopted.

## Practice

1. Measurement of secondary voltage of EHV CVT to assess the health of CVT's.
2. Tan delta tip up test for EHV CTs.
3. DGA of CT's (Commissioning / 5years)
4. Third harmonic current monitoring (LCM) for LA's every 3 months
5. IR Thermography (monthly) and UV Corona monitoring (Commissioning/5 years).

## Benefits

1. To avoid destructive failure of CVT and unnecessary outage of line feeders and EHV bus due to CVT failure. Ensuring correctness of metering
2. To avoid premature failure of EHV CTs and subsequent outage of feeders and units. Initial warning signals before Failure.
3. Avoid catastrophic failures of CT's
4. Increased reliability of LA. Can predict majority failures beforehand
5. Planned interventions, reduced breakdowns and increased Reliability

## Contact for further information

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# PARTIAL DISCHARGE (PD) MEASUREMENT OF MV SWITCHGEARS

z

## Background

PD activity has lead to flashovers in many Stations.

## Practice

Partial discharge measurement for identifying incipient PD activity leading to inside the MV switchgear.

## Benefits

For identification of any PD activity caused by incipient fault & taking timely corrective action

## Contact for further information

Corporate Operations Services

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# IDENTIFICATION OF BACK PANELS OF MV/LV SWITCHGEARS

z

## Background

It has been observed that lot of untoward incidents have occurred due opening wrong panel backdoors in Stations.

## Practice

Identification of all back panel doors in coordination with front markings. Also numbering them sequentially and making a cross line by paint.

## Benefits

For identification of correct panel and ensuring human safety.

## Contact for further information

Corporate Operations Services

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# CONTROL & INSTRUMENTATION



# USE OF HEADLESS RTD FOR TRIP CIRCUIT OF FANS

Z

## Background

It has been experienced that spurious vibration signals from local instrumentation of ID/FD fans causes tripping of equipment / turbines. Therefore, modification of instruments appropriately would reduce the occurrence of faults and tripping. Also the operating staff would be enabled to take up timely corrective action avoiding disruptions.

## Practice

Use of headless RTD in tripping circuit of PA/FD fans has been done to prevent spurious tripping caused due to loose connections TB's caused by vibration. The use of headless RTD's ensures that TB connections are away from areas of high vibration.

## Benefits

Avoidance of spurious outages due to vibration induced failures  
Improvement in field condition.

## Contact for further information

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# RESISTANCE MAPPING OF CRITICAL SOLENOIDS

z

## Background

Coil burnout is the most common cause of solenoid failure. It's easy to spot. Variation of insulation resistance over a period of years, the effect of aging and dust accumulation is shown by decreasing values of coil resistance. Any sharp drop indicates an insulation failure.

## Practice

Resistance mapping of critical solenoids including cable during overhauls is being done. The readings are recorded and monitored to identify any deviations. In case of any noticeable change. The devices are checked in lab and replaced if found deteriorated.

## Benefits

Preventing failures due to ageing in critical trip related solenoids  
Improvement in field condition

## Contact for further information

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# PREVENTION OF MIXING OF CRITICAL VOLTAGES

z

## Background

High and low voltage conductors in the same junction box must be separated by a barrier. Bundling them together may be cost effective but prone to disturbance in signals due to which malfunctions result.

## Practice

Terminal blocks used for critical applications physically separated from other terminal blocks using separators. This done at field JBs and panel end to prevent inadvertent voltage mixing during any maintenance work.

## Benefits

Avoiding tripping due to shorting in times of maintenance work  
Improvement in field condition.

## Contact for further information

Operations Services  
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# IMPROVEMENT OF INSTRUMENT AIR QUALITY

z

## Background

Instrument Air used for operation and control of pneumatic controllers, valves, relays or gauges is required to be clean and dry. A small amount of moisture can cause malfunction of the instrument. Carryover of corrosion particles can plug valves, fittings, and instrument control lines. Clean and dry compressed air will result in lower operating costs.

## Practice

Elimination of the moisture by installation dryers and filters is already being practised. Additionally, Auto Drain Solenoid valves are being installed in instrument air lines to remove moisture from instrument air more effectively.

## Benefits

To ensure proper functioning of pneumatic instruments  
Improvement in field condition

## Contact for further information

Operations Services  
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# REPLACEMENT OF PRESSURE/TEMP. SWITCHES WITH TRANSMITTERS

## Background

Smart control philosophy aims at more efficient designs. Hence, for all critical control applications, transmitters are to be provided. Protection trip due to parameter deviations are to be derived from LVM of transmitter signal and not through switches.

## Practice

All trip related pressure/temp switches (Blind) are being replaced with Transmitters (With Electronic Display) and LVMs in DCS wherever possible.

## Benefits

1. Display of parameter at local.
2. Improvement of reliability of process parameter.
3. Reliability of protection circuit.
4. Improvement in field condition.

## Contact for further information

Operations Services  
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# MONITORING OF AIR/STEAM/WATER LEAKAGES

z

## Background

Periodic inspections of the systems will permit an immediate check of integrity and safety between preventive maintenance checks and operation.

## Practice

Periodical inspection of LIE/LIR/TRE for any air/steam/water leakages. Cleaning oil spills, condition monitoring, arresting minor leakages, filter cleaning, minor repairs wherever possible.

## Benefits

1. To ensure healthiness of process parameter.
2. Avoidance of any unsafe condition due to hot steam/water leakages.
3. Improvement in field condition.

## Contact for further information

Operations Services  
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# PROVIDING 2/3 PROTECTION FOR ALL UNIT PROTECTIONS

z

## Background

Globally accepted 2/3 architecture provides the most comprehensive protection against spurious alarm signals and thus ensures continuous operation. This concept incorporates the monitoring of each trip criterion and guarantees stable and continuous availability of the protection system.

## Practice

All unit protections are provided with 2/3 logic right from sensor to I/O cards to improve reliability. In case of failure of any one sensor, protections will change to 1/2 logic. Alarms are provided on actuation of 1/3 protection to alarm operator on actuation of any one sensor. These are done wherever it is feasible to have three sensors on the equipment.

## Benefits

1. Improving reliability of tripping circuits
2. Strengthening of protection philosophy

## Contact for further information

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# TRIPPING OF MAIN AUXILIARIES TO BE CONVERTED TO RTD/THERMOCOUPLE FROM TEMPERATURE GAUGE-CUM-SWITCH

## Background

z

Smart control philosophy aims at more efficient designs. Hence, for all critical control applications, transmitters are to be provided. Protection trip due to parameter deviations are to be derived from LVM of transmitter signal and not through switches.

## Practice

Tripping of major auxiliaries from field devices like Temperature gauge-cum-switch have been converted to RTD / Thermocouple with LVM or temperature switches. This has been done to avoid unreliability and drifting of set point associated with gauge cum switches.

## Benefits

- 1.Improving reliability of tripping circuits.
- 2.Strengthening of protection philosophy.

## Contact for further information

Operations Services  
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# HANDLING OF ELECTROSTATIC SENSITIVE DEVICES

z

## Background

Electrostatic discharge (ESD) is one of the leading causes of failure in power modules and integrated circuits. A strong ESD susceptibility can generate damage in the device that reduce its performance or destroy it. However sudden discharge of static electricity does not result in any harm to the human body.

## Practice

For handling of electrostatic sensitive devices (ESD) / electronic hardware, (devices which have a high probability of damage due to build up of static charge) electrostatic bags, wrist straps and other ESD handling devices are employed in control panels and lab. All cards/electronics are stored in electrostatic proof bags in stores and are transported between panels and lab in these bags only. All Laboratories are provided with ESD proof workstations.

## Benefits

- 1.Preventing build-up of static charge which can lead to card.
- 2.Failure Reliability of DCS.

## Contact for further information

Operations Services  
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# DISABLING OF USB PORTS TO PREVENT VIRUS /UNAUTHORISED ACCESS

z

## Background

The DDCMIS computers for plant operation has secured, sensitive and valuable contents. USB devices have become easy and possible reason for spread of virus / data theft across computers. To prevent unauthorized access to those files, protection by blocking USB port / storage devices provides a reliable system. Also, external intrusions can happen when working online without an effective antivirus program.

## Practice

All removable drives of servers and workstations are disabled. All USB ports are disabled to prevent inadvertent introduction of virus. Only authorized access is permitted for authorised personnel with proper password protection.

## Benefits

1. Providing protection against attack by viruses.
2. Reliability of DCS.

## Contact for further information

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# SOFTWARE BACK UP TO TAKE CARE OF EMERGENCIES

z

## Background

Policies, tools and procedures to enable the safe storage/retrieval of critical control system should be in place. Data backup and restoration of DCS information is essential for Power Stations. Stations should provide unique equipment and software for safe storage/retrieval so that at the time of disaster, it available and ready for use.

## Practice

Single source responsibility for software backup of DCS is ensured by identifying responsible person and back up is taken at predefined intervals and stored along with date/version of backup. Storage is done in fire proof cabinets located at two different locations at site to prevent damage and availability of back up.

## Benefits

- 1.Ensures availability of backup in case of system failure.
- 2.Reliability of DCS.

## Contact for further information

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# MAINTENANCE OF PASSWORD SECURITY

z

## Background

Computer systems face a number of user access security threats. Procedures by which authorized users access a computer system and unauthorized users are kept from doing so is critical to maintain the system integrity. The effectiveness of this line of defence by religiously practising procedures where a legitimate user is allowed and it is protected from unauthorised access. Strategies can be used to create and maintain secure passwords.

## Practice

A single source responsibility is fixed for the generation and maintenance of system passwords so as to maintain system security. The passwords are changed at regular intervals and are accessible only to authorised personnel.

## Benefits

- 1.Maintaining system integrity
- 2.Reliability of DCS

## Contact for further information

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# MEGGERING AND IDENTIFICATION OF WEAK CABLES

## Background

Understanding and measuring insulation resistance ensures the electrical system performance. Cable fault location, testing and diagnostics are the most demanding applications used for the purpose. It provides information about the overall insulation and / or reveal localised problems / weak spots in the insulation. High voltage cable tests are carried out to spot any potential failures before they occur and cause disruption of the services.

## Practice

All cables related to protection circuits are meggered during overhauls to identify weak cables which may fail in future. This is used as condition monitoring of cables and weak insulation cables are removed / rerouted to avoid forced outage.

## Benefits

- 1.Prevents failure due to ageing of cables
- 2.Reliability of DCS

## Contact for further information

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# MONITORING OF POWER SUPPLIES

z

## Background

Damage of power supply is a great danger. Reduced input voltage can cause excessive power supply heat dissipation, resulting in short equipment life. For every 10°C rise, MTBF cuts in half and conversely, for every 10°C lower, the MTBF is doubled.

## Practice

All power supply voltages are monitored with a fixed periodicity and it is ensured that they are maintained within +/- 10% of the rated value. This ensure healthiness and long life of all electronic equipment.

## Benefits

- 1.Ensures reliable and long life of electronic components
- 2.Reliability of DCS

## Contact for further information

Operations Services  
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# HEALTHINESS OF REDUNDANT POWER SUPPLIES

## Background

z

Redundant power supply offers high reliability to the control system. Redundancy is maintained only when diagnostics are in order and are predicting system health and required maintenance.

## Practice

Power supply changeover schemes checked for proper functioning by doing actual on load on load changeovers during any opportunity shutdown to ensure proper backup during any power supply failure.

## Benefits

- 1.Ensures availability of backup power supply
- 2.Reliability of DCS

## Contact for further information

Operations Services  
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# ENSURING HEALTHINESS OF POWER SUPPLY MODULES

## Background

z

Power supply has been a paramount requirement for process system continuity in power plants.

Testing it can save a lot of troubleshooting hassles.

## Practice

Load testing of power supplies in critical applications is done during overhauls to identify defects. In Power supplies with any defects replacement of power supply modules or electrolytic capacitor and power transistors used in the power supply is done if found deteriorated.

## Benefits

- 1.Ensuring reliability of power supplies
- 2.Reliability of DCS

## Contact for further information

Operations Services

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# ENSURING HEALTHINESS OF EARTHING SYSTEM

## Background

Effective earthing is a necessity for all electrical and electronic systems. It provides low resistance path for fault current, shield from external surges, maintains protection system, provides a path for dissipating energy from external source and ensures safety of life and property from hazards of electric shock and electric fires. Healthiness of earthing system is important and should be inspected periodically to ensure the effectiveness.

## Practice

To ensure healthiness earth voltages in control panels are monitored on a predetermined frequency and the values are recorded for trending. In case of any deviations (which are an indicator of problems in earthing), corrective measures like tightening of all connections or removal of any earth leakage is done.

## Benefits

1. Proper earthing is ensured which will take care of any faults in
2. System Reliability of DCS

## Contact for further information

Operations Services  
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# MAINTAIN AMBIENT CONDITIONS IN CER AND UCB

## Background

Maintaining Control Room environment with temperature and humidity criteria ensures that operating conditions for DDCMIS are met. It is critical as the equipments can tolerate a specific range of temperature and humidity, as described in the specifications, beyond which they tend to malfunction.

## Practice

To ensure healthiness of electronics temperature and humidity needs to be maintained within specified limits in CER and UCB. CER and UCB temperatures are monitored with on line monitors. These parameters are recorded in DCS and alarms are provided in LVS so that corrective action can be taken in case of any deviation.

## Benefits

- 1.Ensures reliable and long life of electronic components
- 2.Reliability of DCS

## Contact for further information

Operations Services  
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# ENSURING INTEGRITY OF ALL CONTROLLERS IN DCS

z

## Background

To ensure the DCS integrity maintained, procedures for safeguarding the system from unwanted changes and protect it is very much required. The assessment of the system needs to be done online and aberrations must be indicated through human interfaces by way of alarm systems which require timely action or assessment.

## Practice

Checking for the healthiness of all the DPUs and controllers is done in every shift. Standard mimics have been developed in all DCS to display status of all controllers and alarms are generated in case of any deviation so that necessary preventive action can be taken immediately.

## Benefits

Ensures availability of all controllers and their backup Reliability of DCS

## Contact for further information

Operations Services  
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# ENSURING HEALTHINESS OF PANEL COOLING SYSTEMS

z

## Background

Electronic assemblies and components inside panels are constantly exposed to the rigors of increasingly higher temperatures. In the event of component failure or malfunction, ultimately the generation suffers. For reliability of the running DCS, protection of equipment from heat is paramount. For ensuring the operational integrity from electronic heat overload, effective panel cooling systems are must.

## Practice

Distribution of cooling air inside panels is essential for ensuring healthiness of all cards and to preventing any local overheating Panel cooling fans checked periodically and replaced in case of any defects.

## Benefits

Ensures reliable and long life of electronic components Reliability of DCS

## Contact for further information

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# EARLY DETECTION OF CARD FAILURES

z

## Background

Issues of concern for semiconductor devices becomes important in the context of card failures which may be caused from various reasons. The early detection of card failure allows maintenance personnel to proactively work on equipment, preventing major breakdowns. Early detection of equipment malfunction saves repair costs and prevents downtime.

## Practice

Thermography of DDC Cards is done at periodic intervals using IR camera. This helps in identifying any localised overheating which is a early warning sign of incipient failure. In case of detection of any high temperatures cards are replaced.

## Benefits

Helps to identify incipient failures of electronics  
Reliability of DCS

## Contact for further information

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# IDENTIFICATION OF FIELD TRIP DEVICES

z

## Background

Field devices for tripping / protection are used for the safety of the process. Marking of the devices for protection identifies them and provides danger / caution for the passers by. Marking should be clearly visible across the instrument for safety. It also provides ease of identification for visual inspection of the instrument which should be performed to identify external damage or unusual conditions.

## Practice

Marking of trip related devices and Junction Boxes have been done with RED colour so that devices/junction boxes associated with tripping are clearly identifiable to prevent mistakes while working on field.

## Benefits

- Prevents wrong access of critical field devices
- Reduction of spurious outages

## Contact for further information

Operations Services  
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# WORK INSTRUCTIONS FOR WORKING ON RUNNING UNITS TO PREVENT HUMAN ERROR

z

## Background

Human error is a mistake made by a person that results in any unfavourable outcome. It is necessary to recognize our human limitations so that people can still do their work error-free. Workplace safety with reference to human error can be prevented by improving work instructions and job procedures. This necessitates the inclusion of error prevention and mistake proofing.

## Practice

Detailed work instruction are prepared and followed for working on all trip related devices in running units. Prior planning and discussion within the group is done within the working group before working in all critical areas. This will reduce forced outage on account of human errors.

## Benefits

Prevents human error when working on critical devices  
Reduction of spurious outages

## Contact for further information

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# ENSURING HEALTHINESS OF ALL SIGNALS USED IN PROTECTION

z

## Background

Deviations in parameter measurements are continuously checked against allowable levels to detect a deviation from normal. System provides trouble information with alarm annunciation by means of flashing either parameter values or on mimics, to alert levels corresponding to failure i.e. undesirable process deviations and equipment faults. Hence the monitoring of healthiness of the equipment to provide operator alerts are very much required to allow faster fault detection and diagnosis.

## Practice

All parameters used in protections and control loops are monitored and any deviation failure is annunciated. Mimics have been created for monitoring of these parameters and any deviations will be shown on these mimics which help in early fault diagnosis and rectification.

## Benefits

- Early warning of any failures in critical signals
- Reduction of spurious outages

## Contact for further information

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# ENSURING HEALTHINESS OF SWITCHES USED IN TRIPPING SCHEMES

z

## Background

The protection system should trip the equipment as per logic requirement for which the sensing elements (switches) should be reliable and unnecessary disconnection of healthy unit is avoided. Based on functionality & type of application, testing of switches' functionality is to be done at specified intervals. With the evolution of latest C&I instrumentation technology, monitoring / trending ensures that quality is ensured in process safety.

## Practice

Monitoring of pressure/level switches (all switches used in 2/3 logic) used in protection is done and any failure is logged. Mimic is created for monitoring and display of any failures.

## Benefits

Early warning of any failures in critical field switches  
Reduction of spurious outages

## Contact for further information

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# BOILER & TURBINE PROTECTION CHECKING DONE AFTER EVERY 3 MONTHS

z

## Background

The protection system monitors the parameters and ensures safety and reliability. It operates only when any of the control system set point parameters are exceeded, and equipment will be damaged if it continues to operate. To maintain the operating integrity of the protection system, checks should be routinely performed at every convenient shut-down opportunity.

## Practice

Boiler & Turbine protection checking is done after every 3 months on opportunity shutdown as per LMI.

## Benefits

Ensure healthiness of protection scheme and avoidance of spurious outage  
Reduction of spurious outages

## Contact for further information

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# PROTECTION CHECKING USING ACTUAL PROCESS VALUES

z

## Background

The protection checking intervals are defined by the OEM, consultants, industry organizations such as EPRI, plant personnel / process requirements, based on past experience. The frequencies and tasks specified for the system needs to be regularly tested by simulation and/or by actual testing of the complete system.

## Practice

Protection testing is done using actual process change without compromising equipment safety. Where this is not feasible, primary calibration devices are used to simulate process change from field end. Simulation is resorted to only as a last resort. This ensures checking of the entire protection scheme from sensors to control system.

## Benefits

- Ensures integrity of protection from field device to processor
- Reduction of spurious outages

## Contact for further information

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# STANDARDISING OF PROTECTION BYPASSING PROCEDURES

z

## Background

Whenever process plant, equipment or systems require to be taken out of service / bypassed for urgent maintenance, repair or modification, any potential hazardous condition is to be visualised and a safe method be adopted. A procedure to guide and standardize the protection bypassing process is to be taken to ensure equipment and human safety while in operation.

## Practice

Standard procedures laid down for bypassing and normalizing protections for various DCS systems to prevent human errors and outages. All simulations are getting recorded and normalized and procedures for the same followed as any mistake can compromise equipment safety.

## Benefits

- Avoids spurious trips due to wrong simulation
- Reduction of spurious outages

## Contact for further information

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# SHARING OF INFORMATION ON TRIPPING

z

## Background

NTPC has a widespread and diverse fleet of power stations with varied age profile. Statistically it is a well established fact that unforeseen unit trips are inevitable. Finalized trip reports are to be duly shared with all concerned stations and time-bound implementation to be reviewed in specific forums.

## Practice

All learnings from tripping's at stations are regularly reviewed and all relevant learnings are shared among all sites for taking preventing recurrence. These are also uploaded on OS website for easy access by all sites.

## Benefits

Sharing of learnings from stations across all NTPC units  
Knowledge sharing

## Contact for further information

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## Background

Significant technological advancement is observed in case of C&I systems which gets obsolete very fast. Stations therefore prefer to undertake complete replacement of C&I system. In order to effectively deliver the C&I R&M activities on time, it is important to assess the same and plan so as to minimize the actual downtime of the unit.

## Practice

Detailed guidelines for R&M activities were made based on past experiences. These guidelines include detailed activity schedule for pre shutdown activities and post shutdown activities. This has helped in reducing time taken for R&M and improving quality of work.

## Benefits

- Sharing of learnings from stations across all NTPC units
- Knowledge sharing

## Contact for further information

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# ROOT CAUSE ANALYSIS OF TRIPPINGS

z

## Background

Repetition of trips of similar nature is definitely avoidable. Every unit trip or near-miss invariably necessitates some change - design/system/process-oriented, procedure/policy/behavior-oriented or both. The correct way forward is comprehensive root cause analysis (RCA) of each incident, framing and circulating corrective action plan, implementing the plan with definite time frame and periodic review of expected result.

## Practice

Root cause analysis of all tripping is done and measures are initiated to prevent recurrence of the same in the concerned unit and all similar units across NTPC. Any changes which need to be implemented to prevent recurrence is implemented in other similar sites This knowledge is shared during C&I HOD meet and during technical/peer audits to create awareness.

## Benefits

Sharing of learnings from stations across all NTPC units  
Knowledge sharing

## Contact for further information

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# AMBIENT AIR QUALITY REALTIME MONITORING

## Background

Air quality management is an essential for healthy existence of mankind and its management requires an integrated approach to consolidate technical, economic, physical and ecological aspects of air pollution. Meteorological Stations also facilitate mathematical modelling to assess the impact of stack emission on ground level concentration around the power plants. Better understanding of local and regional pollution sources is of prime introducing new technologies for higher efficiency and environmental gains.

## Practice

Our stations are equipped with Ambient Air Quality Monitoring Stations (AAQMS) which conforms to the latest norms of MOEF. The data from these systems are directly fed to pollution control authority as well as pollution control boards. For on-line measurement of polluting gases in ambient air, three / four nos. of monitoring stations equipped with analyzers are located around the plant site. Meteorological parameters are also measured at one of the stations. Measuring instruments / analyzers installed are SO<sub>x</sub>, NO<sub>x</sub>, CO<sub>2</sub>, PM 2.5, PM 10 and for Meteorological parameters viz. Weather, Wind speed, Radiation, Rain, Wind direction, Temperature. All the remote stations are connected to the Central station through wireless network.

## Benefits

1. Minimising pollution by improvement in the Ambient Air Quality in and around the power plants
2. Meteorological Stations also facilitate better understanding of local and regional pollution sources
3. New technologies for higher efficiency and environmental gains

## Contact for further information

Operations Services

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# EFFLUENT QUALITY REALTIME MONITORING

## Background

As per the directions issued by CPCB to all SPCBs/ PCCs under Water Act and Air Act issued 05/02/2014, it was mandated to install online Effluent Quality Monitoring System (EQMS) at the outlet of effluent treatment plants of the industries and in ETPs for the measurement of the parameters like flow, pH, COD, BOD, TSS; not later than by 31/03/2015 and to connect and upload the online effluent monitoring data at SPCBs/PCCs and CPCB server.

## Practice

Our stations are equipped with EQMS which conforms to the latest norms of MOEF. The data from these systems are directly fed to state pollution control authority as well as pollution control boards. Measuring instruments / analyzers installed are pH, Conductivity, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Suspended Solid (TSS), Oil in Water (OIW) and Flowmeter. The communication between EQMS and CPCB server has been done by utilizing GPRS / Internet.

## Benefits

1. Minimising water pollution by improvement in the Effluent Quality in and around the power plants
2. New technologies for higher efficiency and environmental gains

## Contact for further information

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# CONTINUOUS EMISSION REALTIME MONITORING

## Background

As per the directions issued by CPCB to all SPCBs/ PCCs under Water Act and Air Act issued 05/02/2014, it was mandated to install online Continuous Emission Monitoring Systems (CEMS) in industries for the measurement of the parameters like SO<sub>x</sub>, NO<sub>x</sub>, CO, CO<sub>2</sub>; not later than by 31/03/2015 and to connect and upload the online effluent monitoring data at SPCBs/PCCs and CPCB server. The communication between CEMS and CPCB server has been done by utilizing GPRS / Internet.

## Practice

Our stations are equipped with CEMS which conforms to the latest norms of MOEF. The data from these systems are directly fed to state pollution control authority as well as pollution control boards. Measuring instruments / analyzers installed are Stack opacity, SO<sub>x</sub> (Oxides of Sulphur), NO<sub>x</sub> (Oxides of Nitrogen), CO (Carbon Monoxide), CO<sub>2</sub> (Carbon Dioxide). Data captured transmitted directly from the analyser from the site location to PCB server on realtime basis.

## Benefits

1. Minimising water pollution by improvement in the Continuous Emission Quality in and around the power plants
2. New technologies for higher efficiency and environmental gains

## Contact for further information

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# FUEL MANAGEMENT



# SAFETY PEP TALK AT START OF WORK

z

## Background

Lack of full awareness in usage of appropriate PPEs and decline in the commitment for compliance of safety rules during execution of work leading to unsafe acts and near misses.

## Practice

Safety pep talk is being conducted before start of work on daily basis as a refresher and reminder for the compliance of safety rules.

## Benefits

Increased productivity and confidence in teams due to better safety awareness and usage of regular and special PPEs such as fall arrestor, full body harness, lifeline, fluorescent jacket etc related to their work.

## Contact for further information

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# CONVEYOR BELT UTILIZATION AND POWER OPTIMIZATION

z

## Background

Under utilization of CHP equipment and conveyors during evacuation and bunkering of coal leading to more auxiliary power consumption.

## Practice

Monitoring of belt utilization factor, power consumption on daily basis and taking corrective action based on inputs from energy management system.

## Benefits

Improvement in belt utilization factor, Reduced running hours of the system, Reduce wear and tear and enhanced life of equipment, more time for maintenance and housekeeping

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# HEALTH MONITORING OF CONVEYORS BELTS

z

## Background

Frequent non availability of conveyors observed due to opening of belt patches, belt snaps due to thinning and wear out of belt at some areas leading to evacuation and bunkering problems and disturbance to regular maintenance planning and execution of works.

## Practice

Conveyor health monitoring by belt mapping on regular basis as per schedule (atleast once in 3 months) and taking corrective action thus minimizing unwanted conveyor outages.

## Benefits

Improvement in availability of conveyors and reduction in unwanted conveyor snapping's and outages especially during critical times in monsoon period. Also enhanced life of conveyor belts and its components due to timely repair of worn-out areas of belt.

## Contact for further information

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# HEALTH MONITORING OF IDLERS

z

## Background

Conveyor idler problem lead to wear out, lining out of belt resulting in coal spillage and belt through cuts requiring timely rectification. This also is causing more power consumption.

## Practice

Idler health monitoring is done on regular basis by idler mapping. It is done usually one day before taking the conveyor for preventive maintenance work.

## Benefits

Enhanced life of conveyor belt, Improvement in power consumption and improvement in housekeeping.

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# HEALTH MONITORING OF STACKER RECLAIMER

z

## Background

Stacker Reclaimer availability is very critical in stacking and reclaiming of coal from stackyard and frequent problems of stacker reclaimer affect evacuation and bunkering

## Practice

Health assessment of Stacker Reclaimer is done periodically through improved O&M practices such as regular protection and interlock checking, capacity test, ensuring healthiness of hydraulic system components, healthiness checking and auto greasing of slew bearing.

## Benefits

Improvement in machine availability, Pre information regarding deterioration of bearing and timely action plan for replacement, Life enhancement of bearing, Prevent premature failure of slew bearing, Improved maintenance practices of hydraulic system , Reduction in malfunctioning of hydraulic components.

## Contact for further information

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# HEALTH MONITORING OF WAGON TIPPLER

z

## Background

Wagon Tippler availability is critical for timely unloading of coal from railway wagons to minimize demurrage and ensure effective evacuation and bunkering of coal.

## Practice

Health assessment of Wagon Tippler is done periodically through improved O&M practices such as regular protection and interlock checking, ensuring healthiness of hydraulic system components, by ensuring hydraulic oil quality through online purification (NAS less than 7)

## Benefits

Improvement in machine availability, Improved maintenance practices of hydraulic system, Reduction in malfunctioning of hydraulic components, Reduction in malfunctioning/ failure of hydraulic components, Reduction in oil consumption

## Contact for further information

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## Background

Cast Hammers are seen to have average life of around 2-3 months leading to frequent hammer changes and reducing availability. Also many time hammers get broken by stones in coal leading to high vibration, unbalance of crusher rotor and outage of crushers.

## Practice

Forged hammers have better life and breakages of hammers is also negligible.

## Benefits

Life improvement of crusher hammer, Reduction in down time of crushers/ Improvement in availability, Almost no breakage of crusher hammers, Forged hammers being magnetic unlike cast hammers, thus can be sensed & picked by MS/ SM and hence no broken hammers in mills

## Contact for further information

Corporate Operations Services  
Sh Biswadip Roy - [broy@ntpc.co.in](mailto:broy@ntpc.co.in)

# INSPECTION OF CRUSHER SPRING DAMPER FOUNDATION

z

## Background

Crushers are subjected to high vibrations/ stresses due to presence of various foreign materials in coal from different sources. Healthiness of crusher foundation is important for dampening the vibrations/ non transfer of vibrations to the crusher components.

## Practice

Following checks are suggested to be carried out every 3 months departmentally in addition to the scheduled annual inspection by OEM:

- Spring Units: Nuts on the stud bolts should be in loose condition. A gap of 10mm (minimum) between nut and bottom base should be maintained during operation.
- Visco Damper Bolts/ Nuts to be checked for tightness.
- Visco Dampers Sleeves and Clamps to be checked for tightness and damages, if any.
- Spring units/Viscodampers to be cleaned by air blowing. Accumulation of coal dust around the spring units to be removed. Water washing is prohibited.
- Inspection of the spring units and viscodampers to be done for painting/ corrosion/damages.
- Crusher Foundation to be made free all around the deck slab to avoid any obstruction. A gap of 50 mm (minimum) between the deck and adjacent floors to be maintained. The gap should be free and covered with rubber sheet/ belt plies.
- In case of any major loads (machine parts more than 5 tons) to be removed from foundation, the bottom nuts of stud-bolts of spring units are to be hand tightened and later to be released to minimum gap, after placing the loads on to the foundation.

Contd...

# INSPECTION OF CRUSHER SPRING DAMPER FOUNDATION

z

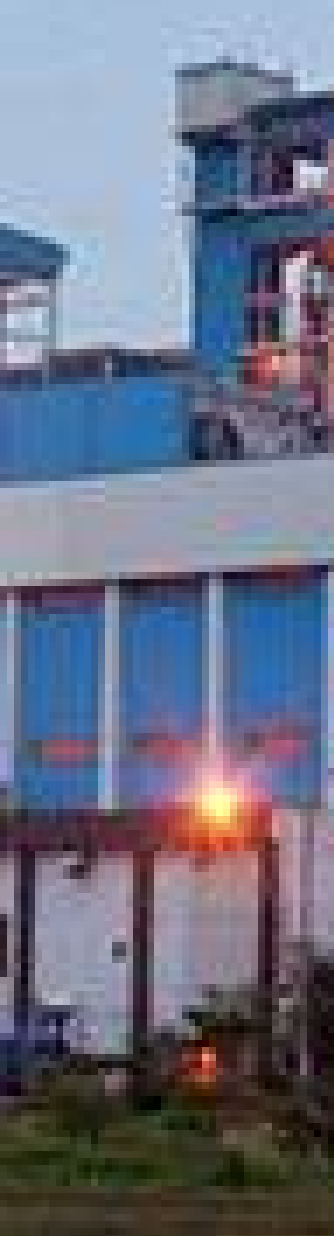
## Benefits

Improvement of structural stability of crusher foundation,  
dampening of vibrations

## Contact for further information

Corporate Operations Services

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# USE OF BOOM LIFT FOR HIGH RISE STRUCTURE INSPECTION, PAINTING, CONVEYOR GALLERY SHEET REPLACEMENT

z

## Background

Periodicals painting works are to be carried out for transfer points and crusher houses. Traditionally, these works are carried out by scaffolding/ hanging trolleys. These methods are time taking and unsafe at some times.

## Practice

Use of boom lift for high rise structure inspection, painting and conveyor gallery sheet replacement will save lot of time.

## Benefits

Non requirement of scaffolding, Less time consuming, More economical, More safe

## Contact for further information

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# INSTALLATION OF HDPE WIND FENCE TO CONTROL FUGITIVE EMISSIONS

z

## Background

In coal stockyard, fugitive dust emission is generated during stacking, dozing and high winds etc. This fugitive dust emission is not only harmful for the environment but also affects other power plant components such as cooling tower, primary air fans etc.

## Practice

Apart from traditional dust control techniques such as water spray, fog cannons, coal compacting, HDPE wind fence can be used to restrict the carryover of dust from stockyard to other areas. Wind fence can be provided around the periphery of stockyard

## Benefits

Pollution control, Improvement in CT performance if the dust is entering into CT

## Contact for further information

Corporate Operations Services  
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# USE OF MAGNETIC PLATES TO ATTEND CHUTE LEAKAGES ON TEMPORARY BASIS

## Background

In coal handling plant, chutes leakages are common phenomenon. Conveyor streams cannot be stopped for doing maintenance due to low bunker levels or evacuation of railway rakes. Also during night times, maintenance staff may not be available for attending the chute leakages. Running the conveyors with chute leakages creates dusty environment and housekeeping issues.

## Practice

As a stop gap arrangement magnetic plates are being used to temporarily arrest the chute leakages

## Benefits

Improved housekeeping, online application, No shutdown required

## Contact for further information

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# COVERING OF COAL STOCKYARD PILES WITH LDPE SHEETS DURING MONSOON

z

## Background

During monsoon there is less coal supply from mines and total dependency on running the units by reclaiming of stored coal at stockyard. Wet coal is difficult to transport and also causes chute blockage issues, bunker grill jamming, crusher jamming, feeder inlet pipe jamming etc.

## Practice

Covering of coal stored in stockyard with LDPE sheets for preventing water ingress inside the coal during monsoon. Further, LDPE sheets are held in position with coal filled bags. Also dedicated manpower is engaged for covering and lifting the LDPE sheets.

## Benefits

Availability of dry coal during monsoon exigencies, less equipment outages/ jamming, prevention of chute jams

## Contact for further information

Corporate Operations Services  
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# BUNKER CONVEYOR ALARM AND TRIPPING ON IDLE RUNNING OF CONVEYORS

z

## Background

In the efforts to maximize utilization factor of bunker conveyors, it is imperative to monitor and minimize the idle running of these conveyors. Consequently, an automated system to stop the conveyors need to be incorporated for improving utilization factor.

## Practice

Conveyor drive currents are indicative of the extent of load on the conveyor. So, whenever bunker conveyors are running with their drive current value below a set threshold value (no load current), an alarm will be generated, if the drive current value is below the set value continuously for x period of time.

In the event of its drive current continuously maintaining below the set value for a further period of x+y minutes the bunker conveyor will automatically trip.

## Benefits

Improves conveyor utilization factor, improves power consumption

## Contact for further information

Corporate Operations Services  
Sh Biswadip Roy - broy@ntpc.co.in

# DRONES FOR PRELIMINARY STRUCTURE INSPECTION

z

## Background

Periodical condition assessment of passive elements such as steel structures, concrete structures, buildings etc is done on regular basis. The process of condition assessment involves preliminary inspection to finalize the scope of work for detailed investigation. Preliminary inspection is primarily visual inspection. However, it becomes difficult to visually assess locations situated at considerable height having no access / high rise structures like Chimneys, Conveyor galleries, NDCTs etc.

## Practice

For assisting to examine such locations situated at considerable height having no access / high rise structures like Chimneys, Conveyor galleries, NDCTs etc conveniently, help of UAV / Drone can be taken.

## Benefits

Non requirement of scaffolding, less time consuming, more economical, safe

## Contact for further information

Corporate Operations Services  
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# USE OF ANTI-STICKING AGENT IN CHUTES DURING MONSOON

z

## Background

During monsoon, sticky and wet coal is received from the coal mines. It becomes difficult to handle such coal and often there is build-up of coal in the chutes requiring frequent poking and sometimes system shutdown

## Practice

Application of anti-sticking over surface of chutes before monsoon helps in smooth material flow. The anti-sticking agent fill the peaks and valleys on the surface of chutes thus allowing smooth material flow. Once the material starts building up again a reapplication has to be done. Time has to be monitored of the reapplication and followed.

## Benefits

Prevention of chute jams, less system down time

## Contact for further information

Corporate Operations Services  
Sh Biswadip Roy - broy@ntpc.co.in

# ASH HANDLING PLANT



# CHECKING OF VACUUM PUMPS SHUT OFF VACUUM 450MMHG ONCE IN A DAY

z

## Background

In Dry Ash Handling system, ESP & APH hoppers ash is evacuated pneumatically to Buffer Hoppers by vacuum pumps. Ash transportation media is air, differential pressure between hoppers & Buffer Hopper is vacuum. To get minimum pick up velocity of ash including its designed density, 100% air must enter through air intake valve/orifice located at the end of vacuum conveying line. Vacuum lines, ash intake-Ts, bends, branch valves, etc. are connected with many couplings and Buffer Hopper has many flange joints. These are leakage prone. More over ash is a very abrasive material and valves like MHV, Branch Segregating valves, ALV ash inlet/discharge/vent/Pressure Equalizing valves are eroded very fast. Then vacuum with air flow at ash pick-up zone reduced and as a result ash evacuation rate reduced.

## Practice

Checking of shut off vacuum 450mmHg (within the duration of 2 min) including Buffer Hopper & extraction line once in a day. Accordingly corrective actions are taken. It ensures capacity of vacuum pump (50m<sup>3</sup>/min-Dadri- II, Mouda-I, 65m<sup>3</sup>/min-Mouda-II, 56.5m<sup>3</sup>/min-Solapur) and minimum system leakages/passing. For vacuum extraction system, quantity of ash extraction depends on quantity of air entering through air intake valve and system DP (vacuum)

## Benefits

1. It ensures healthiness of the system
2. Leakages are detected easily by local checking at the time of testing
3. Every day checking & taking corrective actions, further deterioration stopped
4. Improved system reliability

## Contact for further information

OS BOP

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# OPERATION OF VACUUM EXTRACTION SYSTEM IN DESIGNED OPERATING RANGE

z

## Background

In Dry Ash Handling system, ESP & APH hoppers ash is evacuated pneumatically to Buffer Hoppers by vacuum pumps. Ash transportation media is air and vacuum pump is maintaining designed airflow with vacuum, differential pressure, between hoppers & Buffer Hopper. This air flow provides minimum pick-up velocity of ash in conveying line with designed ash-air mixture density. Ash-Air mixture density depends on operating vacuum. It is to be ensured without deviation. With decreasing of operating range, density reduced and ash conveying rate reduced. Normally, line vacuum-140mmHg, MHV closes at 350mmHg with max. ash flow, MHV opens at 300mmHg after partial purging, and hopper empties at 100mmHg. .

## Practice

To ensure smooth evacuation of ash from ESP, evacuation system is operated within operating vacuum range, which is 350-300 mmHg for Mauda & Kudgi and 300-200 mmHg for Dadri.

## Benefits

- 1.It ensures healthiness of the system
- 2.Efficient ash evacuation
- 3.By corrective actions, further deterioration stopped
- 4.Improved system reliability

## Contact for further information

OS BOP

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# STOPPING OF FA SYSTEM 1-2 HRS PER SHIFT

z

## Background

Dry Ash Handling system is designed with more than 25% higher capacity, removal of eight hours ash in six hours. One set of Buffer Hopper & Vacuum Pump evacuates 14 hoppers in 210MW Units, 18 to 22 nos. (for two branches /pass) or 36 to 42 nos. (for four branches/pass) in 500MW & above units, one by one. Total evacuation time of all hoppers of a pass once is called cycle time. When system runs efficiently, less ash content or partial load, cycle completes in one hour and pressure transport line runs with less than designed pressure. Less pressure operation increased line erosion and not energy efficient

## Practice

When ESP hoppers emptiness cycle time is less than one hour, system is made off for 1-2hrs per shift. It ensures healthiness of the system & energy conservation.

## Benefits

1. It ensures healthiness of the system
2. Efficient ash evacuation
3. Line & material erosion reduced
4. Improved system reliability

## Contact for further information

OS BOP

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# DRAW DOWN MODE BOTTOM ASH HOPPER DEASHING ONCE IN 24 HRS

z

## Background

In thermal power plants, ash is generated continuously after firing of coal. It is collected in boiler bottom ash hopper, Economizer hoppers, bottom ash generation. APH, Duct & ESP hoppers. Bottom ash generated in boiler furnace is either continuously removed by Scraper Chain Conveyor, Screw Feeder or stored in water impounded Bottom Ash Hopper. This water impounded hopper ash is removed in four/six hours interval depending upon the hopper capacity by means of jet pulsation pumps. Bottom Ash deashing is done either in maintain mode, water level maintained, or in draw down mode, make up water stopped and emptied completely. In 1st procedure, no harm to refractory and flame stable. 2nd procedure confirmed complete emptiness of hopper.

## Practice

In maintained mode evacuation, no harm to refractory and flame stable. Completion of removal of ash is confirmed by visual inspection of discharge quality & time duration. In pull down mode, complete hopper is emptied and flame through 5meter level peep hole is noticed. Draw down mode de ashing is done once in 24hrs especially during high ash content/clinkering regime.

## Benefits

1. It ensures healthiness of the system
2. It ensures no ash build-up inside the hopper
3. Improved system reliability
4. Reduced generation loss. Due to inadequate evacuation of Bottom Ash, if it is build-up above Boiler S-panel, unit have to taken under shut down and thus generation loss occurred.

## Contact for further information

OS BOP

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# INSTALLATION OF THERMOCOUPLES IN BOTTOM ASH HOPPER

z

## Background

Bottom ash hopper ash build up taking place either by chocking of gate due big size clinker formation or inadequate de ashing. Sometimes this build-up goes above S-panel, becomes uncontrolled and unit had to take shut down. if ash build-up detected at initial stage, it can be controlled and unit will be saved.

In few cases, sudden localized pressurization occurred by evolution of gas/vapor from the entrapped water in the falling heavy porous lumps of slag/clinkers while immersing in bottom ash hopper water bath. The undue unidirectional waves which are likely to generate under these circumstances, have exerted additional force on the pressure parts in S Panel and the structures of the bottom ash hopper and caused distortional damages to the above mentioned components. It is eliminated by ensuring proper arc quenching spray water header pressure.

## Practice

Bottom Ash Hopper temperature rises with build-up of ash inside BAH as well as inadequate arc quenching water spray. Thermocouples installed and its trend is continuously monitoring.

## Benefits

1. It ensures healthiness of the system
2. Improved system reliability
3. Reduced generation loss

## Contact for further information

OS BOP

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# MAINTAINING MAIN EQUIPMENT UNIT ASSEMBLY

z

## Background

Ash is a very abrasive material and ash handling equipment spares are eroded very fast. Life of main equipment spares like Ash Disposal pump impeller, Clinker Grinder roller, liner, bearings, Vacuum Pump spares, HP/LP/SW pumps spares, Aeration Blowers spares , etc. six months to one year. Some times above equipment breakdown is also occurred. Same spares are maintained. Attending the above equipment at side is time consuming and equipment outage occurred for several days.

## Practice

Ash Handling system main equipment unit assemblies are maintained to reduce maintenance outage time of the same. It is replaced immediately and refurbished at site workshop for next requirement

## Benefits

1. It reduces system outages
2. Easy & quality maintenance at workshop
3. Safe maintenance
4. Improved equipment reliability

## Contact for further information

OS BOP

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# USING OF TUNGSTEN CARBIDE SLEEVE FOR VACUUM PUMP AND ASH SLURRY PUMP

z

## Background

In Ash Handling System, Clinker Grinder is used to crash Bottom Ash clinkers during Bottom Ash Hopper evacuation and Ash Disposal Pump is used to transport ash in the form of slurry to Dyke or in Hydro-bin. Ash is a very abrasive material and it erodes Clinker Grinder & Ash Disposal Pump SS shaft sleeves. After erosion of sleeves, drive shafts are eroded, glands are damaged and ash leakage as well as bearing failure occurred.

## Practice

To reduce the wear of shaft sleeve and to avoid gland leakages, Tungsten carbide coated sleeves are used, which contributes to reduce the bearing failures due to continuous gland leakage.

## Benefits

1. Shaft sleeve failure reduced
2. Shaft failure, bearing failure & gland leakages reduced
3. Maintenance cost reduced
4. Equipment outage reduced
5. Improved equipment reliability

## Contact for further information

OS BOP

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# ASH SLURRY PIPELINE THICKNESS SURVEY & ROTATION

z

## Background

In Ash Handling System, ash is disposed in the form of slurry to Dyke or in Hydro-bin. Normally these pipelines are made of MSERW, ACI or Cast Basalt. Ash is a very abrasive material and it erodes the MSERW & ACI pipe lines. Normally, erosion starts from bottom portion of pipe line & high velocity zone according to flow profile (nearer to pumping station, bends and after bends). Due to this erosion, pipeline gets thinner & leakages arisen within few years.

## Practice

As per six months running hour basis, thickness survey is done & noted. According to previous report, regular thickness survey is carried out at high erosion zones. As per report, portion of pipeline, where thickness reduced to 3mm to 5mm, is rotated by 1200. Same procedure repeated for next rotation. Thus, increased the life of pipeline. Also this thickness survey indicates the tentative time of replacement of particular portion of particular line.

## Benefits

1. Ash Slurry pipe lines life increased
2. Leakage of line due to erosion reduced
3. Survey indicates right time & right portion of line rotation or replacement
4. Pipe line management improved
5. Budgeting for material & contracts improved & justified
6. Improved safety & environment protection.

## Contact for further information

OS BOP

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# BALANCE OF PLANT





# PROVISION OF BUCKET STRAINERS AT THE COOLING TOWER OUTLET CHANNEL

z

## Background

One of the reasons for the loss in unit condenser vacuum is due to choking of condenser tubes by the broken pieces of Cooling Towers internals viz. Fills, Nozzles and Drift Eliminators.

## Practice

Installation of two nos. SS Bucket Strainers in succession at the CT outlet has helped in arresting the dislodged fallen pieces of CT internals which Otherwise used to pass the trash rack at CW Pump suction and go to unit condensers and choke the condenser tubes.

Two consecutive strainers are required because, during cleaning of one strainers outside, other remains in place to arrest the fallen materials.

## Benefits

This has been installed at KhSTPP, TSTPP, VSTPP, RhSTPP and many other stations resulting in reduction of condenser tube choking by dislodged / fallen pieces of CT internals.

## Contact for further information

Corporate Operations Services  
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# COVERING OF OPEN APPROACH CHANNEL (OAC) OF CW SYSTEM WITH NYLON FISH NET

z

## Background

Dry leaves, plastic bags, flying objects, animals etc. fall in the OAC and choke the Trash rack and condenser tubes resulting in affecting the vacuum.

## Practice

To stop the ingress of these objects / materials to Open Approach Channel (OAC), covering OAC with Nylon Fish has been done at Unchahar TPP, KhSTPP, TSTPP, VSTPP, RhSTPP and many other stations.

## Benefits

This has been found very effective and being implemented in other NTPC stations also.

## Contact for further information

Corporate Operations Services  
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# 15 MTR. PAVEMENT ON THE TWO SIDES OF COOLING TOWERS

z

## Background

Free Air passage through Cooling towers is very important for best evaporative cooling thereby resulting in achieving the design CT outlet temperature.

This gets obstructed by the vegetation growth in the form of bushes, trees, grass etc. on the two sides of Cooling Towers.

## Practice

This vegetation growth should either be regularly pruned or best is to pave the areas on two sides which allow free air passage. CC-OS has recommended 30 mtr. pavement on both sides of the Cooling Tower to stop vegetation growth.

## Benefits

Since the area around the Cooling Tower becomes free from any obstruction, sufficient air is drawn to the Cooling Tower when all fans are running.

## Contact for further information

Corporate Operations Services  
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# 2 MTR. PAVEMENT OF BOTH SIDES OF OPEN APPROACH CHANNEL (OAC)

z

## Background

OAC length is quite long and become inaccessible due to heavy vegetation growth on the sides of Open Approach Channel.

## Practice

In order to stop this vegetation growth, 2 mtr. pavement on either side of OAC has been recommended.

## Benefits

This helps in stopping the vegetation growth and ease in inspecting the OAC for any seepage, wall breaks, ash ingress..

## Contact for further information

Corporate Operations Services  
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# USE OF SCISSOR LIFT FOR REPAIR / REPLACEMENT OF CT FILLS FOR NATURAL DRAFT COOLING TOWERS (NDCT)

z

## Background

Cooling Tower Fill replacement for NDCT is very time consuming due to inaccessible height.

It involves making of scaffoldings, shifting the same from one place to another and then removing the same from position.

## Practice

It has already been tried at Dadri-Th, Jhajjar STPP.

## Benefits

Scissor Lift has been found very useful in such cases which helps in safe and fast completion of jobs..

## Contact for further information

Corporate Operations Services  
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# JOINT CHECKING OF THE ELECTRICAL PROTECTIONS VIZ. LUB. OIL LEVEL LOW SWITCH, VIBRO SWITCHES, OIL TEMP SWITCHES FOR CT GEAR BOXES & MOTOR

z

## Background

Due to non-availability of these protections, damage of gear boxes has been observed at many stations due to high vibration, leakage of gear box oil and high temperature of gear box oil.

## Practice

Joint checking has been implemented at stations for these electrical protections viz. Lub. Oil Level Low Switch, Vibro Switches, Oil Temp Switches with Opn., EMD & MM & making a protocol on quarterly basis.

## Benefits

This helps in taking appropriate action at appropriate time which has resulted in reducing damage of gear boxes, drive shaft, fan blades, fills etc.

## Contact for further information

Corporate Operations Services  
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# RUNNING OF CT SLUDGE DISPOSAL PUMPS AT LEAST ONCE IN A DAY TO REMOVE THE SILT / MUD ETC. FROM CT BASIN

z

## Background

Accumulation of sludge in the CT basin needs to be removed on regular basis so that turbidity of circulating water does not increase.

## Practice

In order to control the turbidity, CT sludge disposal pumps should be run for 15-30 minutes a shift / day depending on the season and region..

## Benefits

This is helping in maintaining the turbidity as well as COC of the circulating water.

## Contact for further information

Corporate Operations Services  
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# CT CAPABILITY TEST ONCE IN A YEAR BY EEMG / THIRD PARTY TO CHECK THE PERFORMANCE OF THE TOWER

z

## Background

The CT capability of the Cooling Tower is a watch dog. The test is an elaborate arrangement for measuring the CW flow and correction of the parameters is also done so that we get the actual performance of the Cooling Tower.

## Practice

The test is being done on annual basis by station EEMG / third party to know the performance level of the tower so that corrective measures can be taken.

## Benefits

This has helped in making a rolling plan for replacement of the cooling towers fills, nozzles, drift eliminators etc. so that CT performance is improved.

## Contact for further information

Corporate Operations Services  
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# CT EFFECTIVENESS ON MONTHLY BASIS BY EEMG

z

## Background

CT Capability Test is an elaborate arrangement and takes longer time. Thus, many stations are not adhering to the schedule of CT Capability Test.

This way, one does not know the performance of the tower.

CT Effectiveness is a simple and hands on method of knowing the CT performance. The result is fairly good as far as performance of the tower is concerned.

## Practice

This effectiveness test is being done at many stations and they are able to suggest for remedial measures to the maintenance dept. for taking due action so that CT performance improves.

## Benefits

CT performance improved.

## Contact for further information

Corporate Operations Services  
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# MEASUREMENT OF WEIGHT OF CT FILM PACKS ON QUARTERLY BASIS TO MONITOR WEIGHT GAIN OF THE FILL PACK

z

## Background

Instances of collapse of CT film Fills has been reported from some stations due to abnormal weight gain of the pack. Weight gain is mainly due to deposition of scale & mud/silt in the flute of the fills.

It is therefore, essential to keep track of the weight gain of the CT Fill Packs.

## Practice

It has been recommended to check the CT Fill Pack weight gain on quarterly basis. Stations having Film Packs in Cooling Towers are following the same and accordingly they take cleaning / replacement action.

## Benefits

Timely action for cleaning / replacement of CT Fill Packs has helped in maintaining the cells available for performance.

## Contact for further information

Corporate Operations Services  
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# CW DUCT CLEANING AND PAINTING DURING STATION S/D

z

## Background

Corrosion / Thinning of CW duct is a normal phenomenon. Leakage in the CW duct due to peeling of the paint coating inside the duct leads to damage the outside duct too apart from loss of water.

## Practice

Inspection of the same during overhauling and applying protective paint coat is required to be done by all stations to protect the duct from puncture / leakage.

## Benefits

This will not only protect the duct from corrosion but also enhance the life of the duct.

## Contact for further information

Corporate Operations Services  
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# PROVISION OF AUTO DRAIN TRAPS IN AIR RECEIVERS, I/C AND A/C IN COMPRESSORS TO REMOVE MOISTURE.

z

## Background

Non-removal of moisture from Air Receivers, Intercooler and After Cooler in air compressors leads to carry over in the system and damage the temperature & pressure switches, actuators etc.

## Practice

Providing Auto Drain Traps would take care of removal of collected moistures from Air Receivers, Inter Cooler and After cooler and damage to C&I / Electrical appliances can be minimized.

## Benefits

Many stations have been benefitted by changing the manual auto drain traps by Auto Drain Traps. All stations have been advised to do it.

## Contact for further information

Corporate Operations Services  
Sh Binod Kumar - bkumar@ntpc.co.in

# INSPECTION & CHECKING OF RUBBER LINING OF TANKS & VESSELS OF DM PLANT ON ANNUAL BASIS

z

## Background

The Bulk Acid Tanks / DM Vessels have got internal rubber lining which if not inspected and tested on time, may lead to puncture of the tanks / vessel. It will create an emergency if acid leaks in the area. Hence, it is recommended to inspect the quality of rubber lining of tanks & vessel's internals periodically every year to take corrective measures.

## Practice

The rubber lining of tanks & vessels of DM Plant is inspected & checked on annual basis to take corrective measures such as repairing / replacement of rubber lining.

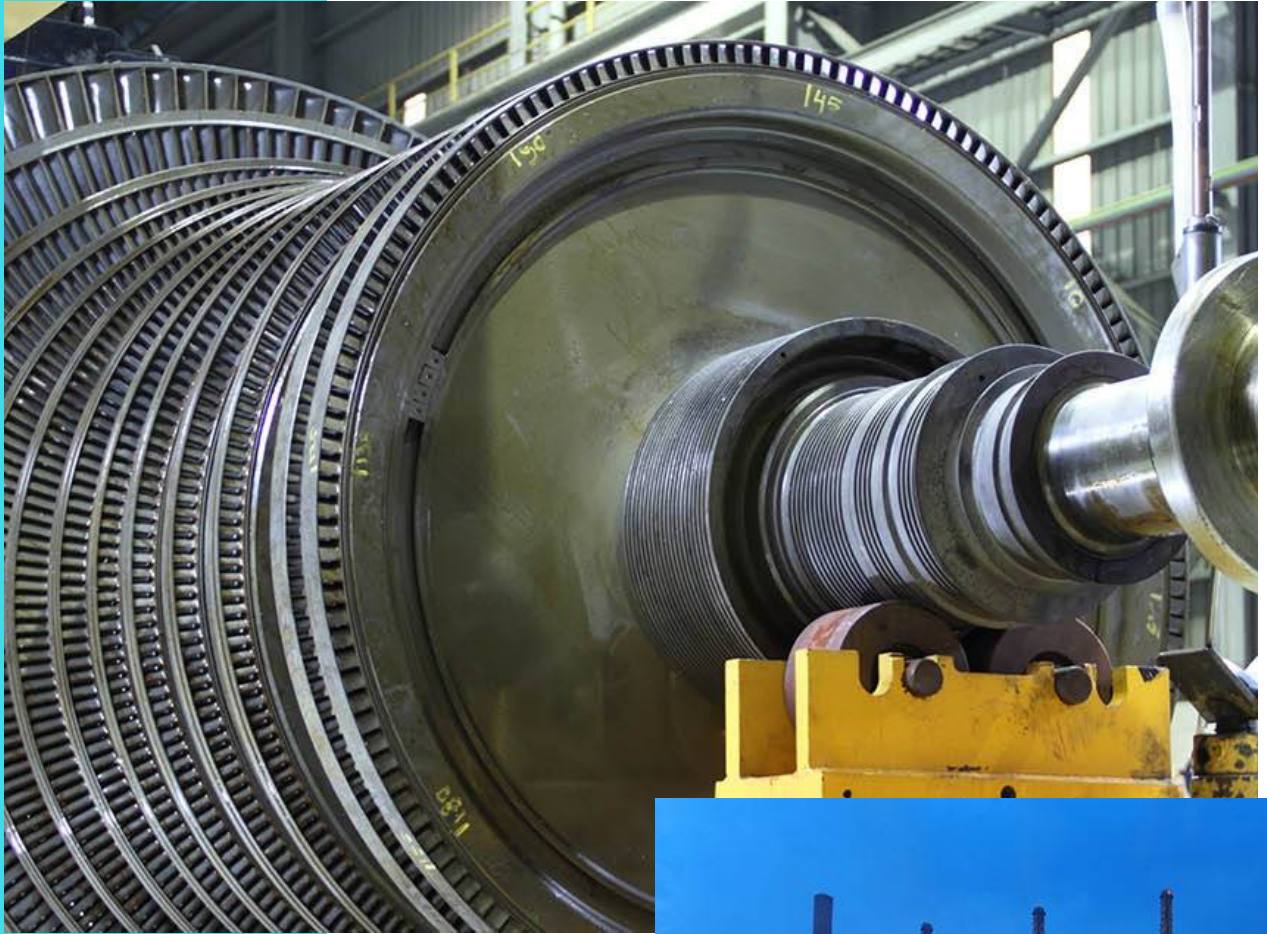
## Benefits

This practice has reduced leakage of tanks & vessels and increased reliability.

## Contact for further information

Corporate Operations Services  
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# EFFICIENCY MANAGEMENT



# BOILER EXCESS O<sub>2</sub> OPTIMISATION

z

## Background

Excess O<sub>2</sub> is required for proper combustion. Reduction in O<sub>2</sub> leads to incomplete combustion resulting in CO formation and increase in unburnt in bottom and fly ash. More O<sub>2</sub> than required reduces the boiler efficiency and further increases the draft power consumption. It also leads to high erosion of the boiler tubes and ducts.

## Practice

OEM suggest to operate boiler at O<sub>2</sub> of 3.5 % on dry basis which is around 3.2% on wet basis. Online measurement is on wet basis. Validation of online O<sub>2</sub> measurement is done by offline grid measurement of O<sub>2</sub>. Further, 2 additional zirconia O<sub>2</sub> probes at ECO outlet (one each at L and R ducts) have been installed for accurate O<sub>2</sub> measurement.

O<sub>2</sub> is reduced below 3.2% (upto 2.8%) by closely monitoring clinkering and slagging in the furnace and unburnt carbon. O<sub>2</sub> is further reduced till 2.5% by monitoring online CO.

## Benefits

1. Improved Boiler Efficiency
2. Reduced draft power consumption
3. Reduced erosion

## Contact for further information

Corporate Operation Services  
Ms Jhimli Dhar - [jhimlidhar@ntpc.co.in](mailto:jhimlidhar@ntpc.co.in)

## Background

Coal fineness is crucial for complete combustion inside the furnace. Pulveriser performance impacts the coal fineness. Tampering air to the mills needs to be minimised to improve the boiler efficiency. Mill loading and no of mills in service also has to be optimised for reducing the power consumption in milling system.

## Practice

Mill optimisation includes

- Periodic monitoring of PF fineness of all mills and taking corrective action
- Assessment of PF flow imbalance among coal pipes through dirty pitot test and taking corrective measures in case of imbalance
- Minimising tempering air by optimising mill outlet temperature and PA flow.
- PA header pressure optimization
- Optimisation of no of mills in service
- Monitoring of Sp power consumption of mills.

## Benefits

1. Savings in Auxiliary Power Consumption.
2. Reducing unburnt in bottom and fly ash
3. Improved boiler efficiency

## Contact for further information

Corporate Operation Services  
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## Background

Firing of poor quality coal and increasing the time between overhauls have increased the erosion in the ducts which increases air ingress and loads the ID fans. This reduces the ID fan margin and in some cases also results in capacity loss. So it is essential to know the extent of air ingress and probable areas in FG ducts from economiser to ID fan.

## Practice

O<sub>2</sub> measurement is carried out at various sections of FG duct from economiser outlet to ID fan ( Eco outlet, APH inlet and outlet, ID fan inlet ) using portable FG analyser. Grid measurement of O<sub>2</sub> is done at all these locations.

O<sub>2</sub> mapping is done every quarter and also before and after overhaul.

## Benefits

1. Information on condition of ducts, maintenance planning and repair/repl't work
2. Reduced Auxiliary power consumption
3. Improving boiler efficiency

## Contact for further information

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# CFD MODELLING OF FG DUCTS AND FLOW PATH MODIFICATIONS

## Background

FG flow inside the duct is not uniform especially at the corners and bends. This results in zones of high velocity, flow recirculation and vortex formation leading to ash deposition in low FG velocity areas and erosion where the velocity is high. CFD modelling of the ducts helps in pinpointing the high and low velocity zones and install suitable measures for flow smoothening.

## Practice

Units with high erosion in FG ducts are identified for CFD modelling. Duct layout and internal drawings are used for CFD modelling. During OH, FG duct inspection is carried out to understand the erosion pattern and identify the locations for fixing flow smootheners inside the ducts. After installation of FG smootheners, performance assessment is done to establish the benefits achieved.

## Benefits

1. Reduction in erosion of ducts and expansion joints
2. Reduction in draft power
3. Balanced ID fan loading

## Contact for further information

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# COOLING TOWER PERFORMANCE IMPROVEMENT

## Background

Turbine cycle performance (GTCHR) is adversely affected by increase in CW temp. Cooling tower performance and CW water quality plays an important role in maintaining the CW temp. CT performance is affected by L/G ratio (air flow) and CW water quality.

## Practice

Covering of CT Channel, installation of strainers at CT outlet and raising the height of parapet walls are carried out to avoid ingress of debris like tree leaves and twigs, plastics, soil, ash etc. This restricts the ingress of foreign material both in CT and condenser and thus improving the performance.

CT capability is assessed once a year during rainy season. Performance gap analysis is carried out and identified action plan is implemented during OH or by individual cell isolation.

CT Air flow assessment is carried out and airflow optimization is done by adjusting fan blade angle

## Benefits

1. CT performance improvement and sustenance
2. Condenser performance improvement
3. Planning maintenance work in CT

## Contact for further information

Corporate Operation Services  
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## Background

Condenser is one equipment which impacts the heat rate in a big way. Condenser performance deteriorates on many accounts, air ingress, dirty tubes, high heat load, tube leakages, high CW temp etc. However regular monitoring of condenser parameters can help in early detection of problems and loss areas which are attended during opportunity shutdown or overhauling.

## Practice

Condenser tube and water box cleaning at part load by isolating one pass and during short shutdown.

Assessment of air ingress in condenser through He leak test for its rectification during opportunity / overhaul.

Videoscopy of condenser tubes for assessing tube cleanliness

Acoustics and Thermography for air ingress detection in condenser and vacuum system

Ensuring effective operation of COLTCS by monitoring of Ball loss and CW DT

## Benefits

1. Condenser performance improvement
2. Unit HR and capability improvement
3. Planning for maintenance actions

## Contact for further information

Corporate Operation Services

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# AUXILIARY POWER CONSUMPTION REDUCTION

## Background

APC has direct bearing on station's profitability. Most of the HR improvement actions also improves APC.

## Practice

- Annual energy audit and Mandatory energy audit to identify the gap / potential areas and undertake improvement actions
- MDBFP running hours monitoring and its minimization
- Optimisation of FRS DP / Changing of DP mode to scoop mode operation for BFPs
- VFD installation in ID fans, CEPs, HFO pumps, gravimetric feeders
- Corro coating of CW pumps, raw water pumps, makeup water pumps
- Optimisation of CT fans, CW and ACW / ARCW pumps during winter and part load
- Replacement of old motors with Energy efficient motors
- ESP hopper Heater optimization
- Replacement of old compressors with Energy Efficient screw compressors
- Replacement of conventional light fittings with LED lighting in plant and township
- Replacement of CT blades with energy efficient FRP blades

## Benefits

1. Increase in marginal contribution (profit)
2. Capability improvement and hence higher DC

## Contact for further information

Corporate Operation Services

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# CHEMISTRY



# INSTALLATION OF GAS DISTRIBUTION SYSTEM FOR LABORATORY

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## Background

Over the period due to precision requirement in measurement various sophisticated instruments such as Atomic Absorption Spectrophotometer, Dissolved gas analyzers, Bomb calorimeters etc. have been installed in laboratories. These instruments require various gases for purging, carrier and support to ignition process. Mostly Nitrogen, Hydrogen, Acetylene, Argon, Oxygen and Air are used.

## Practice

At present these gas cylinders are kept in labs or beside labs and supply pipes are fed to the instrument. Gas distribution system provides proper feed and isolating valves with adequate monitoring gauges to safely handle the gases as per requirement of the instruments. Gas cylinders are kept at designated location away from lab and controlled operation is insured.

## Benefits

1. Safety of equipment, system and working personnel is ensured.
2. Better working practices.
3. Efficient and precise rate of gas supply for effective analysis

## Contact for further information

COS-CHEMISTRY

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# FLUE GAS BASED DESALINATION PLANT TO PRODUCE DM WATER FROM SEA WATER

z

## Background

Flue gas based sea water Desalination plant (FGSW Desalination) plant is an innovative low carbon intensive desalination system capable of producing quality DM water from sea water. It utilizes heat of waste flue gas to produce steam through Multi Effect Desalination (MED) which can be purified as DM water.

## Practice

The plant consist of two blocks. The low pressure steam block coverts water to low pressure steam by heating and flashing in flash chamber. This steam is fed to MED system through piping. Sea water is sprayed over this and combined effect to temperature and vacuum produces evaporation steam. The steps are repeated and finally condensed to water which is then purified by EDI mechanism to DM water.

## Benefits

1. Innovative way to utilize waste flue gas thermal energy.
2. Low carbon footprints.
3. Almost no chemical used to produce quality water.
4. Helps in ambient temperature control.

## Contact for further information

COS-CHEMISTRY

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# USE OF CHLORIDE FREE LEWATIT RESIN IN SPU SYSTEM

z

## Background

In Stator Polishing Units (SPU) mixed type resins are used for polishing some contamination in DM water being used for cooling of stators.

These resin base consists of polymeric structure which contains various groups attached to each other. The anion resin being used was in chloride form which was regenerated.

## Practice

Due to presence of chloride groups chances of chloride leakage from the resin may take place during operation. This will cause quality upset of the system and also affect resin performance. Thus the use of resin in hydroxide form is done. Use of chloride free resin in the SPU system will prevent such occurrence in the stator water system.

## Benefits

1. Quality of the stator water system is ensured.
2. Better performance of resins.
3. Cost effective and system safety.

## Contact for further information

COS-CHEMISTRY

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# USE OF GRADE-IV FERRIC ALUM FOR DRINKING WATER

Z

## Background

Water for drinking purpose require limiting values of various parameters in specified range. Earlier Ferric Alum grade-II was used for water clarification and same was used for drinking purpose. Introduction of Alum grade-IV will give better pretreatment and water suitable for drinking purpose.

## Practice

Alum Grade-IV has high content of Aluminum compound and low insoluble matter and Iron content. The permissible limits of lead & arsenic have been decreased and the limits of various heavy elements and organic impurities are also specified which is not done for grade I, II & III. Latest norms for drinking water as per IS & WHO have limited various impurities to very low levels. Owing to this Alum grade-IV is suitable for meeting the quality norms and providing better pretreatment suitable for drinking purpose.

## Benefits

1. Water quality meeting drinking water norms.
2. Better pretreatment.
3. Better material handling and storage.

## Contact for further information

COS-CHEMISTRY

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## Background

After Cation Conductivity (ACC) is most frequently used monitoring tool for assessing purity of the steam water system. With advent of high pressure and super critical systems the limits of ACC is very low and limited deviation allowed. Ingress of gaseous impurities may lead to erroneous reading of the system.

## Practice

Degassed cation conductivity (DCC) is a concept based on removing the dissolved gases before measuring cation conductivity. Thus DCC gives a better idea of the ionic impurities present and eliminates the chances of erroneous measurement due to presence of dissolved gases like CO<sub>2</sub> etc. DCC can be equal to or less than ACC. Based on this measurement corrective action can be taken.

## Benefits

1. Better measurement of ionic impurities in cycle water.
2. Reliable and actionable analytical parameter.
3. Helps in better operation and maintenance practices.
4. Better parameter monitoring during cyclic operation
5. Minimizes start up time.

## Contact for further information

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# CHLORIDE STRIPPING IN CPU REGENERATION

Z

## Background

Mixed type resins of Condensate Polisher Unit (CPU) are separated in regeneration system and regenerated separately as Cation and Anion resins. During separation some amount of exhausted anion resin may contaminate the cation resin and vice versa.

## Practice

To prevent leaching of chloride by anion resin during operation of the CPU system practice of chloride stripping is done during regeneration. The process is done after regeneration of cation resin with HCl. The chloride stripping of entrapped anion resin is done by sulphuric acid. This is followed by rest of the normal procedure.

## Benefits

- 1.Helps in preventing chloride slippage during operation.
- 2.Better CPU parameters are achieved.
- 3.Output (OBR) from CPU will be enhanced.

## Contact for further information

COS-CHEMISTRY

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# IN HOUSE TESTING OF PQ INDEX FOR LUBE OIL PARTICLE COUNTING

Z

## Background

Lube oil conditioning monitoring at stations is done for assessing contamination of oil during period of use. Precise and more sophisticated equipment require more precise and micro level monitoring to assess the condition of lube oil.

## Practice

The PQ Index is a relative measurement of the total Ferrous (Iron) metal content of oil regardless of the size or shape of the debris by means of detection by a magnetic field. The higher the PQ index reading in a sample the higher the total concentration of ferrous material generally associated with wear.

## Benefits

1. Precise and better analysis than MI.
2. Proactive condition assessment of lube oil.
3. Helpful in corrective operation and maintenance practices.

## Contact for further information

COS-CHEMISTRY

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# LOW LEVEL OFF LINE CHLORIDE MEASUREMENT FACILITY

Z

## Background

Chloride is one the most volatile contaminants in steam water system. Since due to its easy leaching and abundance presence in water bodies its contamination of system is easily monitored. Due to very low limit of chloride in cycle chemistry and difficulty in online measurement offline measurement low level measurement is done by Ion-Chromatograph.

## Practice

Cycle water and steam samples are taken at regular frequency and measured for chloride contamination by Ion-Chromatograph using chromatographic column. The value gives an idea of concentration of contamination present in the system. Measurement of chloride in steam water gives an idea about the ingress in system.

## Benefits

1. Precise measurement of chloride in cycle water.
2. Reliable and actionable analytical parameter.
3. Control of cycle chemistry for super critical and sub critical units.

## Contact for further information

COS-CHEMISTRY

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# 100% CPU IN SERVICE FOR SUB CRITICAL UNITS

Z

## Background

Condensate Polishing units (CPU) are provided in cycle water system of power plants for control of impurity ingress into the system. CPU is operated at desired flow rates to remove the impurities of condensate thus ensuring pure water flow to feed system.

## Practice

CPU consists of polisher system with mix bed resins. This removes both cationic and anionic impurities which may have contaminated the condensate either by condenser leak, contaminated DM water or chemicals. 100% CPU operation ensures all condensate passes through the polisher thus eliminating any chance of impurities passing to feed system.

## Benefits

1. Better control of ionic impurities in cycle water.
2. Minimizes deviation in cycle chemistry parameters.
3. Helps in better operation and maintenance practices.
4. Minimizes use of chemicals for parameter control
5. Minimizes start up time.

## Contact for further information

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# MMSD





# POOLED SPARES MOVEMENT

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## Background

pooled spares like Turbine rotors, casings, Gen rotors are highly capital intensive items and their refurbishment requires lots of time on account of various issues like high lead time for contracts, vendors paucity, highly technical nature job.

Availability of healthy pooled spares is essential to serve twin objective of meeting of any exigency or timely availability before start of overhaul to avoid delays or deferment of Overhauls.

## Practice

one to one mapping of pooled spares is already done and their requirement plan for overhauling is chalked out much earlier before start of overhauling. Close monitoring of the pooled spare since it is taken out from the unit during overhauling, is started in terms of repair plan preparation, contract preparation and award, transportation to party works and repair works status- all these things are kept under constant vigil and exceptions are triggered.

## Benefits

1. Timely availability of pooled spares
2. Avoidance of OH delays and deferments
3. Fulfilment of overhaul scope for better reliability and efficiency.

## Contact for further information

Corporate Operation Services  
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## Background

The concept of OPI has been devised as a tool to measure and monitor the degree of preparedness to carry out Overhauling of any unit in quantified terms and it helps in taking timely remedial actions

## Practice

Preparations for Overhaul start 24 months before O/H and assessment of resources for O/H and their procurement plan over 24 M period is prepared and punching of resources (material and services) into SAP for OPI matrix is done and on monthly basis, OPI is monitored, exceptions are identified and addressed and it is mandated to attain a OPI score of 100 before three months of start of OH. Annual OPI review is also conducted with regions and stations by C-OS.

## Benefits

1. It helps in avoiding delay i.e. timely start of OH (as per Schedule with full preparedness).
2. Ensuring availability of required resources at least 3 months before Overhaul so that in case of OH preponement, it ensures readiness.

## Contact for further information

Corporate Operation Services  
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## Background

overhauling is a systematic and planned intervention in the plan life cycle which fulfils simultaneously multifarious objectives such as liquidation of liabilities, enhancing reliability, Plant modification / R&M opportunity window, efficiency recovery etc. NTPC has big fleet of 106 Coal/32 GT & STs/04 hydro units of various makes and capacity so planning of units for overhauling itself is a big challenging task in view of weather dependent grid demand, uncertainty and unpredictability in renewable generation, uncertainty in coal supply & lean water period issues.

## Practice

The total capacity to be overhauled in the year is distributed month-wise in the reverse order of the projected demand i.e. during high demand period, capacity under overhaul is low and vice versa. Identification of priority for individual units to be overhauled in the above capacity is done on the basis of a checklist considering Unit statutory requirements, Unit conditions (Liability and efficiency) and Unit Specific Requirements.

## Benefits

1. OH planning is staggered and demand based. Monthly capacity to be overhauled rationalized on the basis of reverse demand order to ensure minimum capacity in overhauling during maximum demand.
2. Sufficient capacity is available to meet sudden spurts of demands and backing down owing to GRID restriction during low demand periods also become less.
3. Quarter to quarter variation in PO% is minimized.

## Contact for further information

Corporate Operation Services  
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## Background

Engineering declaration is a detailed document which encompasses particulars for all the works to be carried out during overhauling. It covers major equipment outages /performance history/ Root cause analysis and action plans for BTLs and trips in last five years. Previous KT exception/ actionable points through tech audit by OS/ NETRA recommendations and liability liquidation and reliability measures, all find place in the engg. Declaration.

## Practice

Engineering Declaration for O/H of each unit is prepared in the given format at least 24 months before the O/H due date and is revised every 6 months and frozen 12 Months before start of overhaul or completion of preceding overhaul, whichever is later. The quality and adequacy of engg. Declaration is first stepping stone in meeting the stated objectives of efficiency and reliability improvement through overhauling.

## Benefits

It becomes a complete dossier wrt to overhauling works scope/targeted improvements/resource requirement.  
Financial justification availability.

## Contact for further information

Corporate Operation Services  
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## Background

overhauling is a major event for any plant and its detailed documentation is very much essential so that becomes a reference point for future maintenance activities and it serves as a learning dossier also

## Practice

In OPI documents, detailed format is available to prepare the overhauling report and stations prepare OH report with in a time frame and same is uploaded onto intranet. All the maintenance protocols/ quality check list/ recommissioning checks are also attached in the overhauling report.

## Benefits

Overhauling history is maintained.  
Learnings are also mentioned so it may help in better planning for future overhauls.

## Contact for further information

Corporate Operation Services  
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# COMMISSIONING



## Background

Commissioning is an interface between Erection and O&M. It is a continuous and gradual process of building a unit from scratch to final state where the unit is declared commissioned and fit for commercial operation. Various milestone activities like Boiler hydraulic test, Boiler chemical cleaning, Steam blowing, Turbine lube oil & seal oil flushing, Synchronisation etc. require varying degree of system readiness. In order to stream line the process of commissioning and to make the unit ready gradually and reliably so that units can be declared commercial within shortest time after commissioning (preferably 02 months after commissioning), the need was felt to formulate:

- a. Checklist for milestone activities.
- b. Checklist for COD of new thermal units.
- c. Suggestive list of protocols

## Practice

In order to make all the systems ready gradually so that no system was left behind and project planning and execution could be aligned to declare units commercial within the stipulated norms, checklist for milestone activities and checklist of COD of new thermal units was formulated

The checklist enumerates the state of readiness of the plant required for that particular activity. Site makes itself ready for a particular mile stone activity based on the checklist. All protocols as suggested in the suggestive list are signed to take up a particular activity

## Benefits

1. Provides guidelines & improves preparedness of unit for various milestone activities
2. Improvement in Project planning and final preparedness of unit for COD.

## Contact for further information

Corporate Operations Services

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Sh Somnath Chattopadhyay - schattopadhyay03@ntpc.co.in

## Background

The commissioning involves huge quantity of paper work starting from preparation of commissioning documents, Check lists and networks, Issue of various commissioning certificates viz. SRCC, RIOG, ITOG etc, logging of commissioning data, preparation of protocols etc. Hence a need was felt to digitise the document control centre in Commissioning. During commissioning, system lacunae and shortcomings were also observed. In order to avoid any surprises in the end and to prepare the unit without any deficiency, need of commissioning audit at regular intervals, starting ORT immediately after first BLU and analysis of every boiler/ unit trip before COD of units was felt.

## Practice

Following practices were started to improve the system readiness and reliability:

1. Approval of Contingencies by COS & Engineering so that all contingencies are engineered & suitably sized
2. Commissioning audit at regular intervals & ORT from first light up
3. Pre COD trip Analysis & Consumptive figures analysis (Oil & DM water consumption, APC)

## Benefits

Following benefits emerged:

1. Digitalisation of Document control centre. Protocols, logsheets, procedures etc have become available online. Commissioning certificates can be generated online
2. Commissioning audit at regular intervals & ORT has helped in improving the preparedness of unit for capacity addition
3. Commissioning audit & ORT further improves the preparedness of Unit by bridging the gaps observed during analysis & ORT review
4. Consumptive figure analysis will help in optimising various commissioning processes

## Contact for further information

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# COMMISSIONING RESOURCE READINESS & O&M PREPAREDNESS

## Background

Commissioning activities start with the formation of commissioning group and arming them with all the required tools & tackles that would be required during commissioning. In this regard need was felt to formalise the list of equipment and facilities required

Similarly, after the commissioning of a unit, a smooth transfer of baton from Erection to O&M is very important for a trouble free and reliable operation of unit/equipment. To have a smooth transfer need was felt to formalise requirements of O&M departments in terms of Documentation, Contracts, Spares, Office space, Labs, Manpower required etc.

## Practice

In order to provide a ready guideline and to facilitate procurement of tools & tackles required for commissioning, Commissioning Resource Readiness Index was formulated. Commissioning group equips itself based on the list of equipment & facilities given in the index

In order to facilitate a smooth transfer from Erection to O&M phase, O&M Preparedness Index (OMPI) was created. Based on this index, O&M preparedness starts 21 months before the actual COD of the unit. The first part is the planning part (Part-A) and second part is the procurement or readiness part (Part-B)

## Benefits

1. Commissioning Resource Readiness Index has helped commissioning group to timely equip itself with necessary tools & tackles required for commissioning.
2. OMPI has improved the preparedness of O&M departments to take up regular O&M activities after units are declared commercial. The index has worked as an enabler to prepare/arrange the documents required for operation & maintenance, indent spares & award contracts, set up labs & workshop, plan for office space & furniture, create storage space, arrange mandatory spares etc.

## Contact for further information

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## Background

NTPC is a 50000 MW Plus company and plans to be a 130 GW company by Yr- 2032. More than 20000 MW is under construction involving suppliers both from India & abroad. Many more units are in pipeline. The commissioning of these units require approval of commissioning procedures. With increase in number of stations, difficulty was felt in monitoring the status of different commissioning procedures. Hence it was felt that a procedure monitoring system needs to be evolved.

## Practice

A commissioning procedure monitoring system was evolved to take care of the different procedures submitted by turbine or boiler suppliers. The process starts with a kick off meeting with the vendor who submits the submission schedule of procedures. The submitted procedures are allocated to commissioning group members who work on these procedure in collaboration with the suppliers representative. The progress of approval process is fed into the system till it is finally approved. The approved procedure is hoisted on COS website, once it is approved, so that it is visible across NTPC

## Benefits

1. Commissioning Procedure Monitoring System has helped in tracking the status of various commissioning procedures of different stations starting from submission to approval stage.
2. All approved procedures are hoisted on website for online visibility to all.

## Contact for further information

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# CORPORATE COMMISSIONING TEAM

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## Background

NTPC has moved from the era of subcritical units to super critical units. With increase in number of units under construction and that too with suppliers from across the globe supplying their own state of the art technology, it was felt that hand holding of site would be important for smooth commissioning and naturalisation of the super critical technology.

## Practice

A corporate Commissioning team comprising members from different specialist groups is formed. This group participates in all the important commissioning activities at site, conducts commissioning audit for improvement and also supports site O&M departments in O&M preparedness viz. spares identification, formulation of contracts & setting up of maintenance department etc.

## Benefits

1. Commissioning team has helped in hand holding and support during commissioning activities.
2. Specialist group members of the commissioning team have helped in improving the O&M preparedness index by providing timely guidance to their respective departments.

## Contact for further information

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# BOILER CHEMICAL CLEANING

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## Background

Boiler chemical cleaning is a process to remove the rust, dust, grease from water wall internals before the unit is put for regular operation. It involves, degreasing, acid cleaning & passivation of water wall internals. Once the acid is injected in the boiler at required concentration, it has to be circulated continuously for a predetermined time period to remove all the iron oxide from inside the tubes. This circulation of acid is achieved through either boiler circulating water pump or external Chemical circulation pumps. Any disruption in circulation of acid solution will upset the boiler chemistry and can be detrimental to boiler.

## Practice

If the circulation of acid is maintained through external chemical circulation pump, supply to one pump is sourced from emergency source or DG set to improve reliability

If the circulation is maintained through boiler circulating water pump, it is important that purge water of BCP motor cavity is maintained. In order to improve the reliability of pump during chemical cleaning, an additional pump with power source from emergency source is provided for BRP cavity supply in addition to the normal cavity filling line.

## Benefits

1. Uninterrupted Chemical cleaning process is ensured even in case of normal supply interruption after acid injection
2. Emergency cavity filling pump ensures continuous purging of cavity which is recommended to avoid any ingress of chemicals in motor cavity during Boiler chemical cleaning. Emergency cavity filling pump ensures an additional safety of BRP motor.

## Contact for further information

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# STEAM BLOWING OF BOILER & ASSOCIATED PIPELINES

z

## Background

- a. Steam supplied to turbine has to be ultra pure and should not contain any particle which can damage the turbine blades. In order to clean the boiler and its associated pipelines, pipelines are subjected to steam blowing where the drag force is higher than what is there in MCR conditions. The steam after cleaning the boiler & pipelines is exhausted to atmosphere through temporary pipelines. The cleanliness of the pipelines is checked through impingement on target plates due to foreign material. Since these target plates are placed in temporary pipelines, any rusted pipe used in temporary pipeline can mislead the blowing process by giving impingement due to material coming out from the temporary rusted or worn out pipelines.
- b. In addition, the completion criteria for steam blowing must conform to some international standard or practice acceptable to the turbine supplier. The clean flow ratio or the disturbance factor should be more than 1.4 to ensure adequate cleanliness of pipelines. Earlier vendors did not display the CFR online.
- c. In order to ensure a fail safe operation during steam blowing, an uninterrupted power supply requirement for EOTV (Electrically operated Temporary valve) was also felt

## Practice

- a. Use of old or rusted temporary pipe is not allowed during steam blowing. Instead, new pipes are being used for temporary piping to improve reliability of steam blowing process.
- b. Completion criteria is based on VGB or as recommended by the turbine manufacturer.
- c. Online display of CFR(disturbance factor) has been started
- d. Supply of EOTV is sourced from emergency supply to improve the reliability of valve operation

Contd...

## Contact for further information

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# STEAM BLOWING OF BOILER & ASSOCIATED PIPELINES

z

## Benefits

1. Rust carried over from rusted pipes use to mislead the steam blowing process due to extra impingement on target plates. With the use of new pipes this mis-representation could be avoided. No. of blows has reduced.
2. Cleanliness of permanent piping has improved.
3. Assessment of effectiveness of steam blowing has improved
4. Online display of CFR has helped in onsite adjustment of steam blowing parameters
5. Optimisation of fuel Oil and DM water can be done

## Contact for further information

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# AIR PREHEATER SOOT BLOWING

z

## Background

APH basket choking has been observed in many new units. On closer observation it revealed that pressure & temperature of blowing steam which is initially sourced from aux boiler/ Aux PRDS was not adequate. The condition worsens when soot blowers are operated simultaneously instead of one by one.

## Practice

Monitoring of steam temperature for soot blower has been started and proper insulation of steam pipe lines is being ensured. Operation of APH soot blowers is done one by one so that soot blowing pressure is maintained

## Benefits

Monitoring of steam parameters (pressure & Temperature) has resulted in optimisation of soot blowing process. Effectiveness of soot blowing has increased and choking of APH cold end basket has reduced.

## Contact for further information

Corporate Operations Services

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# INSPECTION OF SUPERHEATER & REHEATER HEADERS

z

## Background

Frequent tube leakages was observed in some new units resulting in forced outages. On further inspection after opening the hand hole of headers, some foreign material was observed left behind.

## Practice

Inspection of SH/ RH headers started

## Benefits

The practice has reduced forced outages due to boiler tube leakage. Lot of foreign material removed in various units which otherwise would have led to boiler tube leakage.

## Contact for further information

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# IMPROVEMENT IN TURBINE LUBE OIL FLUSHING PROCEDURE

z

## Background

1. Turbine bearing failure was observed on a few occasion due to foreign material in the turbine lube oil
2. Completion criteria for lube oil checking was based on Mechanical impurity checking, Moisture checking & Lube oil filter checking for presence of any hard particle. Hence need was felt to have a completion criteria which was internationally accepted.
3. There was no inspection of bearings & dead ends of lube oil pipe line during normalisation after completion of flushing process
4. The turbine lube oil flushing process & time required further optimisation

## Practice

1. In order to optimise the lube oil flushing process, Pre cleaning of Oil lines was started through card board bursting at 4-5 ksc air pressure
2. Completion criteria for turbine lube oil flushing was changed and was based on particle count (NAS/ISO 4406). The particle count in Lube oil is based on recommendation of turbine supplier
3. Borescopic inspection of dead ends & headers started after completion of oil flushing.

## Benefits

The improved flushing practices & change in completion criteria based on particle count has resulted in improved oil flushing & reduction in oil flushing time. No turbine bearing failure reported after adoption of these practices

## Contact for further information

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# GAS STATIONS



# OPERATION OF SINGLE CWP, CEP, HPBFP AND LPBFP IN CASE OF HALF MODULE OPERATION

z

## Background

With reduced availability of cheap gas, half module operation is increasing in NTPC Gas Based power Stations. Two CWP, CEP, HPBFP and LPBFP were run on part load to ensure reliability as per the design philosophy. This was resulting in very high Auxiliary power consumption (APC) much above the normative value.

## Practice

After ensuring reliability of these pumps, now only one CWP, CEP, HPBFP and LPBFP are run in case of half module operation.

## Benefits

1. Reduced APC
2. Reduced running hours of Pumps
3. Reduce wear and tear
4. Enhanced life of equipment

## Contact for further information

Corporate Operation Services

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# DURING UNIT SHUTDOWN, AIR CURTAINS (PLASTIC) ARE PROVIDED IN GAS TURBINE FILTER HOUSE

z

## Background

Due to non-availability of cheap gas, most of the Gas Turbines in NTPC Gas Based Power Stations remain under shutdown for long durations. Air Intake Filters are provided at the inlet of Gas turbines to remove the dust particles from the ambient air. There was dust ingress in this area even when Gas Turbines were not running and the filters were getting dirty.

## Practice

During the Gas Turbine shutdown, Air Curtains (Plastic) are provided at Air Intake filter house by fixing them inside of the bird screen. These protective curtains can be easily fixed and removed to save time .

## Benefits

1. Prevent dust ingress
2. Ensure higher life of Air Intake Filters
3. Less choking of filters
4. Reduced cost

## Contact for further information

Corporate Operation Services  
Sh Sandeep Gupta - sandeepgupta@ntpc.co.in

# HRSG HOT SPOT IDENTIFICATION AND RESULT ANALYSIS WITH INFRARED THERMOGRAPHY

z

## Background

Heat Recovery Steam Generators are now frequently put in service as per the Grid Demand. Due to cyclic loading, stresses are developed in the duct surrounding the HRSG. This leads to cracks in the plates and joints from where flue gas leakage starts resulting in loss of productive heat.

## Practice

Infrared Thermography is regularly carried when HRSG is in operation and all the leakage points mapped which have occurred to cracks in the plate or expansion bellows. These leakage points are attended in the next opportunity shutdown.

## Benefits

1. Timely identification of leakages
2. Reduced heat loss and better heat transfer inside HRSG
3. By timely welding/repairing of duct/bellows, major cracks can be prevented

## Contact for further information

Corporate Operation Services

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# R & M



# RETENTION OF EXISTING PANEL FRAMES AND IN- SITU REPLACEMENT OF PANEL INTERNALS

z

## Background

One of the major challenges in DDCMIS System R&M with old cable retention is replacement of panels with different configuration and shifting of the cables

## Practice

In cases where R&M is awarded to OEM and the basic configuration of the panel is similar, the existing panel frames can be retained as these are not subjected to much wear and tear

## Benefits

Reduced Shutdown Time

## Contact for further information

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# OFFLINE CHECKING OF CORRECTNESS OF LOGICS WITH MAXIMUM POSSIBLE SIMULATIONS

z

## Background

Based on the learnings and experience gained over the years, some minor adjustments in settings are incorporated. In case of units undergoing DDCMIS R&M, there are chances of these not getting migrated to the new system.

## Practice

Though the actual running conditions cannot be simulated in a plant under shutdown, simulations are done to realize situations closest possible.

## Benefits

Reduced Forced Outage on spurious trips

## Contact for further information

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# PRIOR CHECKING OF MOUNTING ARRANGEMENTS OF SPEED & VIBRATION PICKUPS

z

## Background

During R&M of Vibration Monitoring System, generally the new pickups do not match to the existing mounting arrangements.

## Practice

Prior checking and correction of such arrangements for matching to the new pickups are done well in advance.

## Benefits

Eliminates spurious trips of equipments.

## Contact for further information

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# SUB VENDOR COORDINATION TO MATCH SITE REQUIREMENT FOR INSTALLATION OF BOUGHT OUT ITEMS IN DDCMIS

z

## Background

Apart from the main system, sizeable quantities of items have to be bought out by the main vendor from sub vendors.

## Practice

A close monitoring and proper scheduling of these items is critical for the successful installation of any DDCMIS System

## Benefits

Reduced idle time and faster execution

## Contact for further information

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# PRIOR PHYSICAL MEASUREMENTS OF EXISTING DIMENSIONS AT SITE TO ENSURE MATCHING (E.G. DUCT SIZE ETC.)

z

## Background

In-situ measurement of existing duct dimensions and associated items are a must for quality and timely execution of ESP R&M works.

## Practice

Items with matching dimensions are made available prior to start of work that results in smooth execution of work & reduction in execution time .

## Benefits

Faster execution.

## Contact for further information

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Sh S K Grover - [skgrover@ntpc.co.in](mailto:skgrover@ntpc.co.in)

# DETAILING OF UNDERGROUND INSTALLATIONS E.G CABLE TRENCH/ WATER PIPES ETC

z

## Background

Damage may occur to cables , cable trenches , water pipe lines during execution of civil works of ESP. Such occurrences may lead to Unit trippings, challenge safety aspects of man & machine.

## Practice

Survey of underground trenches, cables and pipe lines are carried out before the start of the work . Based on the surveys, advance corrective actions like re-routing etc. are taken resulting in proper development of foundation drawings.

## Benefits

Helps to meet the targeted schedule of execution.

## Contact for further information

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Sh S K Grover - [skgrover@ntpc.co.in](mailto:skgrover@ntpc.co.in)

# PRIOR PLANNING FOR PLACEMENT/ MOVEMENT OF HEAVY LIFTING MACHINES ALONGWITH CONTINGENCY BACKUP

z

## Background

ESP R&M works involve large scale dismantling of bulky and heavy components and equipments. Further, handling of these items / equipments at height and restricted space needs utmost care.

## Practice

Planned deployment of heavy lifting machines like Tower Cranes and mobile cranes etc. are arranged for smooth and continuous work execution. Contingency arrangement of tools and tackles are also ensured.

## Benefits

Faster execution

## Contact for further information

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# OTHER COMMON PRACTICES



## Technical Audit/Peer Audit/Commissioning Audit of stations/projects

A systematic multi member team audit to find out, (through independent technical experts) the short comings, system deviations and suggest corrective action

## Local Management Instructions (LMI) and their audit

To create standard operating practices which are customised to the local station's specifications.

Auditing their use for ensuring Safe and efficient operation of Units

## Operation Review Team (ORT) Meetings

Comprehensive, periodic plant performance review wherein the station leadership, the station team and corporate experts together review the critical performance aspects through a well-designed domain by domain parameter review. This also acts as a link between station and corporate

## Regional Operational Performance Review (ROPR)

Comprehensive, periodic plant performance review (on regional basis) by the senior management through a structured meeting and

## Overhaul Preparedness Index (OPI) Review

To ascertain the readiness of unit to meet commercial and regular operation obligations and schedules

## Pooled Spare Movement

Monitoring of Pooled Spare for immediate availability and to optimise inventory

## SAP implementation for Preventive Maintenance module prior to one month of Commercial Operation Date in new plants

To ensure Safe operation and Maintenance of Machines and Individuals

## Business Excellence (BE) Model implementation

A specifically designed Business Excellence Model for NTPC wherein stations are assessed by certified assessors for performance on several lead and lag indicators in key domains like Leadership, HR, Strategy, Partnership and resource utilisation, Customer results, Sustainability etc.



## Safety Audit

To keep a watch and cultivate the culture of safety

## Third Party / Special Purpose Protection Audits

To review the current electrical protection philosophy in line with grid requirement

## Overhaul Reports with all protocols and expenditure details

Comprehensive details of OH work done specifying the work done and gains in performance parameters

## Monitoring of availability of Unit Assemblies for all major equipment

Minimises down time in case of breakdown

## Third party coal sampling

Transparency, authenticity of sampling and Reduction of ECR

# O&M



# BEST PRACTICES



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