



New Technologies & Best Practices of Reliance, DTPS, C & I Dept. for improvement in Reliability & Efficiency

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ABSTRACT: *This paper describes the strategies adopted in various C & I processes at DTPS in order to improve power plant performance in terms of Efficiency & Reliability of coal fired power plants, through system approach, innovative O & M practices, process optimization, regular updates, and periodic up gradation. The philosophy of “Think Bigger Think Better” is dealt in detail to improve the overall performance of plant whereby emphasis is given on reduction in equipment & unit tripping, auxiliary power consumption and improvement in reliability. The measures mentioned here are implemented rigorously in improving the plant performance and are enumerated in this paper.*

1.0 INTRODUCTION

Reliance Infrastructure Limited, a group company of the Reliance - Anil Dhirubhai Ambani Group, is a fully integrated utility engaged in the generation, transmission and distribution of electricity. The company operates a 500 MW (2x250 MW) coal based Thermal Power Plant at Dahanu (Maharashtra), commissioned in 1995. The plant is located around 120 km North of Mumbai on Mumbai-Ahmadabad rail line, situated between two creeks very close to the Arabian Sea.

DTPS is supplying electricity to its esteem consumers at India Financial capital i.e. Mumbai suburban area where there is high reliability & availability required. Therefore, it is essential to generate the power with highest level of efficiency and reliability at Dahanu Thermal Power Station (DTPS) is committed to generate power with energy efficiently & reliability. DTPS had taken up numerous initiatives in conserving the energy while generating the power economically.

The power plant was commissioned in 1995 and has been constantly upgraded to maintain its technological edge. It is the first generating utility in the country to be certified as **ISO 9001** and **ISO 14001** for its Quality Management System and Environmental Management system respectively. The health and safety of the employee is given utmost importance at DTPS and the plant is also certified as **OHSAS 18001** as well as **SA-8000** for Social Accountability. DTPS is also certified for information **security management system (ISMS) ISO 27001:2005**. The governing principle behind ISMS is that an organization should design, implement and maintain a Coherent set of policies, processes and systems to manage risks to its information assets, thus ensuring acceptable levels of information security risk. Chief objective of Information Security Management (**ISMS**) is to implement the appropriate measurements in order to eliminate or minimize the impact that various security related threats and vulnerabilities might have on an organization.

Reliance Infrastructure Ltd - Dahanu Thermal Power Station (DTPS) has become the first company in the world to be awarded **ISO 50001:2011** certificate for its energy management system.

Certification of **ISO 55001** Asset Management standards is in final stage.

Plant has established a comprehensive fuel management system. Keeping in view the logistics, economics, O&M challenges and environmental issues, DTPS has gone in for imported coal blending

with washed Indian coal. Various ecological and environmental factors have been given adequate care with round the clock measurement, monitoring & control systems. Regular preventive maintenance of all systems is done to keep them available & reliable through ERP_ SAP System. Plant maintains various environment related parameters well below the norms laid down by the statutory bodies. Some of the Environment Management Programs like Installation of Flue gas Desulphurization plant, effective utilization of fly ash are the unique for this coal based power plant.

DTPS has over the period developed competency in measurement, monitoring, evaluation and control of various parameters related to plant performance and also implemented numerous improvement programmes. The plant undertook Six Sigma initiative, which has directly resulted in considerable improvement in Key Performance indicators i.e. lowest Specific Oil consumption, lower auxiliary power consumption, Highest Plant load factor and plant availability along with improved Environmental performance. One of the key contributors to this is the continuously improving Operation & Maintenance practices. The present shape of operational practices has been evolved over a period of 15 years of striving towards excellence. This paper showcases the typical steps taken & implemented at DTPS for achieving excellence in C & I Systems in plant.

2.0 APPROCH FOR RELIABILITY IMPROVEMENT.

- Focused operation and maintenance practices.
- Maximum capacity utilization without violating the critical equipment parameters.
- System based approach.
- Enhanced monitoring and control.
- Regular energy and system audits.
- Use of new technologies.
- Use of break through quality tools.
- Knowledge sharing at national and international level forums.
- Most important factor is to create awareness regarding energy conservation.

3.0 INNOVATIVE PROJECTS & TECHNIQUES FOR RELIABILITY IMPROVEMENT.

- 3.1 In House Development of DDC Card, PLC, Elect. Actuator & Tank Level Control testing Kit.
- 3.2 Development of Mill Level control Logic Modification for Reliable auto operation in all seasons. (Air to Fuel Ratio)
- 3.3 Thermo-vision of DDC Cards at periodic intervals for finding any abnormality at early level
- 3.4 Segregation of tripping switches of various critical Auxiliaries from same cards.
- 3.5 Critical Plant data on Smartphone for immediate decision making.
- 3.6 Remote indication of various parameters of Mills, Fans & Flame scanners resulting in avoidance of Generation loss / trippings.

3.1 In House Development of DDC Card, PLC, Elect. Actuator & Tank Level Control testing Kit.

A) Development of DDC Card Testing Kit.

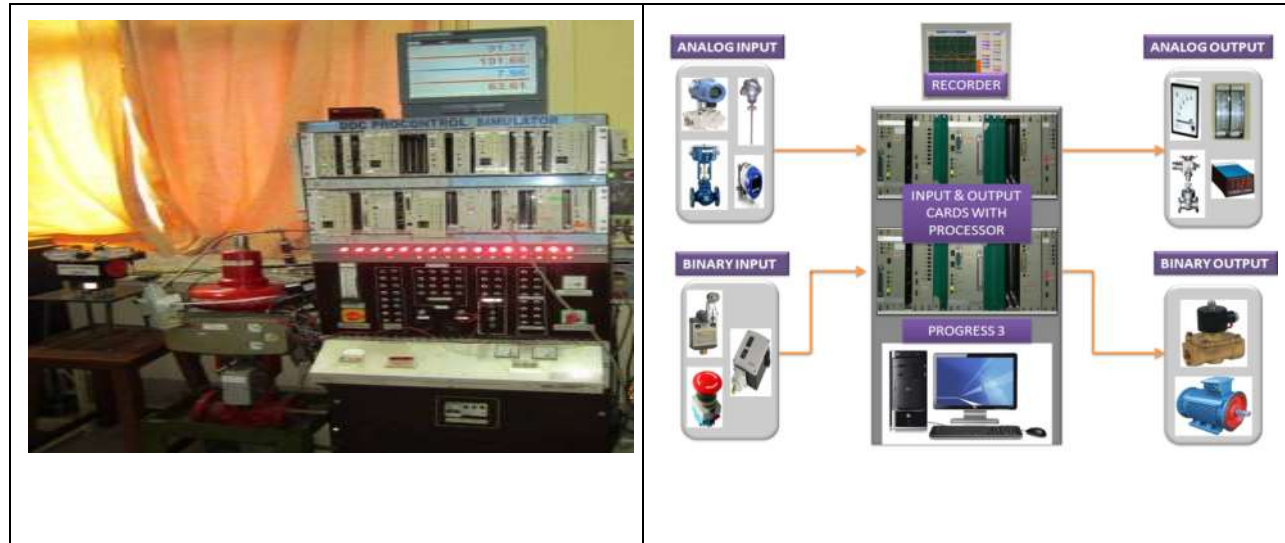
DTPS has ABB Pro-control P13 system as DDC for controlling the plant operations. DDC has total 6900 Nos. of Cards of various types supplied by BHEL in 1994 & in service since then.

It was observed that, healthiness checking of DDC cards in running unit is risky & also any new or repaired cards insertion in running unit was also risky. OEM doesn't have off line test kit facility.

So, C & I team in house developed the DDC Card testing kit. The developed Card test kit is utilized to test faulty cards, new cards, and repaired cards off line without affecting plant process.

Kit has integration of all input & output field instruments like Transmitters, thermocouples, RTD's, switches, indicators, electrical actuator & control valves, pushbuttons,

Data logger with trending facility helps to test cards for longer durations.



Features of Test Kit -

- A simulator type approach adopted so that testing can be carried out in actual operating environment.
- Provision is made to connect the Electrical & Pneumatic actuator to this kit in the laboratory to evaluate the response and study the problems before installing at site.
- Facility is provided to validate the effectiveness for logic changes before applying the changes directly to online system.
- Provision is made for testing of different type of repaired electronic hardware and keeping under observation along with new DCS cards for considerable period in the test kit before putting into service through data logger.
- Suspected faulty electronic cards from the system can be subjected to intensive diagnostic test in the test kit. Similarly with this facility in-house repairs of electronic cards are carried out & validated successfully.

BENEFITS ACCRUED:

- New / Repaired cards can be tested before putting in service
- The Device is useful in identifying problem in faulty cards
- The Device has enhanced reliability of unit on account of malfunctioning of card.
- Integrated Card testing possible along with field sensors to identify loading problems and response.
- Card testing can be carried out for long duration to find out passing faults.
- Defect details identified by the device helped BHEL in diagnosis of fault. This avoided repeated repairs.
- Utilized as training Simulator to train all executives, trainees, Vocational trainees.

B) Development of PLC Testing Kit.

- At DTSPS, two major service utilities viz. Compressor house (reciprocating compressor 5 Nos) and CWPH (4 pumps of 1.2 MW), were converted to PLC's from Relay Logic for reducing tripping & non availability & better diagnostic features.
- Both the Utilities CWPH and Compressor house are critical to Unit operations as one is supplying condenser cooling water and other is supplying compressed air for various critical applications.
- A system was required to facilitate online PLC testing, Interlocks & Protection testing, field instruments healthiness checking, without hampering plant operations to reduce down time & keep system & logics healthy always.

Solution Suggested and Implemented:

- To overcome the above issue, the suggestion for developing a kit came out from brainstorming that could cater to all the field requirements for PLC and logic testing.
- The kit facilitated us for exploring and testing of logics and fine tuning of PLC system.

Benefits:

- If the test kit was not there, shut down of equipments would have been required which would have cost us the generation loss of both the Units.
- Loss of both units is equivalent to generation loss of 5 hrs.
- The use of the kit avoids the repeated HT breaker operations during protections checking. This has resulted in enhancement of HT breaker life.
- The kit is very useful for training of new GETs as the training can be imparted to them without affecting the process.
- Since actual running equipment is not being disturbed, it increases the equipment availability and reliability.

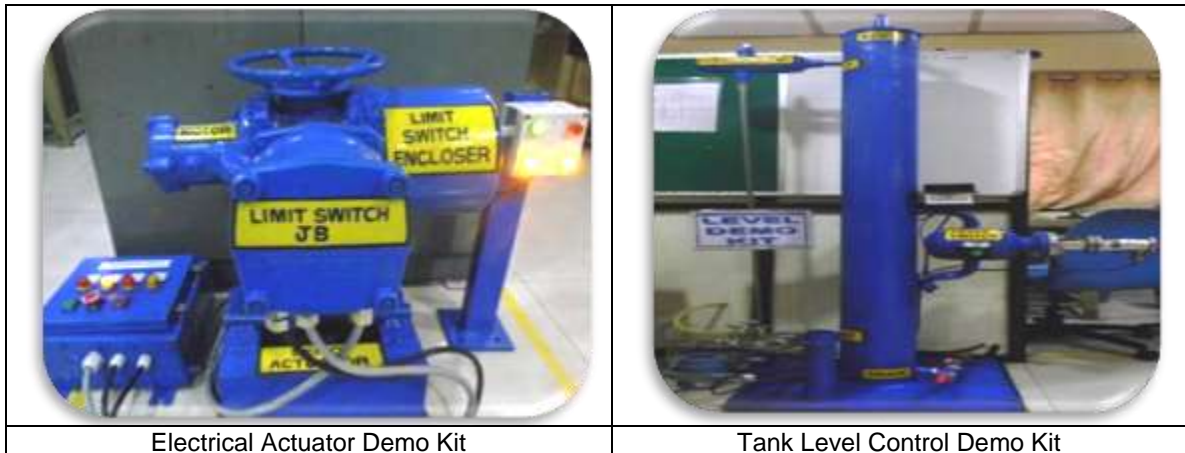


C) Electrical Actuator & Tank Level Control Kit & integration with DDC test kit.

- It was observed that integrated testing of Electrical actuator was not possible in running unit.
- Also, integrated tank Level control, tuning of loop, testing of program was not able to test in running unit in all conditions & faced many site issues.

Action taken:

- Developed in house Electrical Actuator & Tank Level Control Kit in C & I Lab & integrated with DDC test kit.
- Both the systems are tested in all respect in integration with DDC so exact problems are getting identified.
- With the help of these kits, it is getting possible to test & tune auto control loop.
- Test Kits are finding very helpful to give awareness training to the maintenance staff as well as new joinee's and college students with actual hot trials.



3.2 Coal Mill Level control Logic Modification for Reliable auto operation in all seasons. (Air to Fuel Ratio)

- Coal Feeders are controlled by Mill DP level for auto operation. But mil DP Level measurement was not working properly as shell is rotating & level was not getting accurate. In rainy season it was getting more difficult as DP level measurement is not working at all.
- Most of the time auto level control was not working & operation was facing lot of issues. Apart from this, aux. power consumption & other critical parameters was also getting hampered.
- There was a requirement from operation side to identified solution to control feeder on auto.

Action taken:

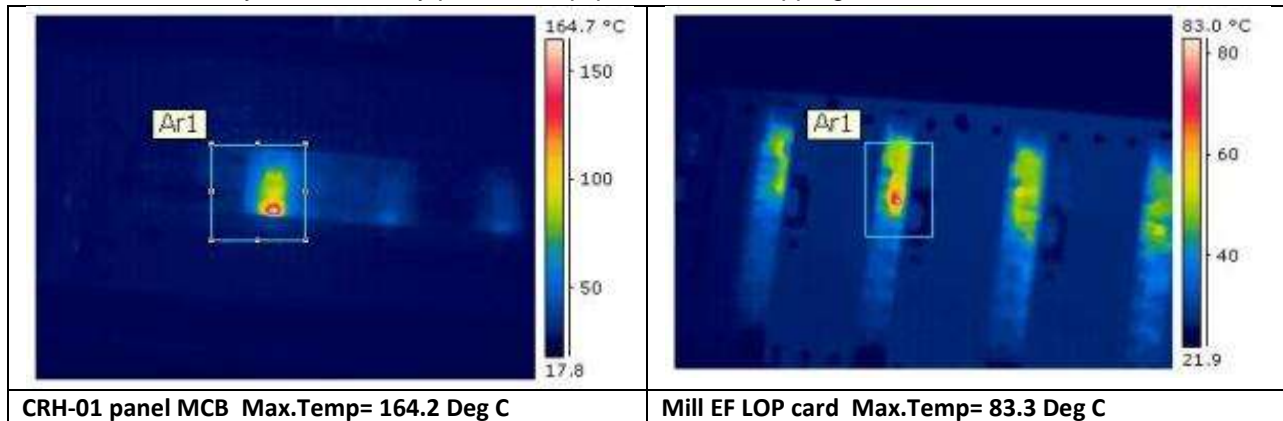
- After lot of brainstorming, Logic modification for consideration of Air to Fuel ratio was developed in coordination with operation team to keep coal mill feeders in Auto.
- Software modification was done as per requirement. Logic testing done.
- This modification carried out for all Mill AB/CD/EF.
- HMI programming done to monitor all related parameters.
- Logic tested & found working properly in all seasons.

Benefit:

- Air to fuel logic helped to control mill level control in auto & to maintain optimum Coal Mill Level, aux. power consumption, improvement in efficiency & heat rate.

3.3 Thermo-vision of DDC Cards at periodic intervals for finding any abnormality at early level.

- DDC is critical system for main plant. It is having total 6900 Nos. of electronic cards. Though DDC Room temperatures are kept at 21 degrees all the time through continuous monitoring, all cards are not getting equal cooling effect. Due to uneven heating of electronic components, card fails sometimes.
- Team C & I came out with innovative idea of – Thermo-vision Checking of DDC Card Temperature
- Actions Taken: Thermo-vision Checking of DDC Card Temperature started for each panel & each card once in a month.
- Found many observations like localized heating. Some attended by some temporary solutions like providing external fan. Some were attended permanently by replacement of cards in short shutdowns.
- This activity avoided many potential equipment or unit trippings due to card failures.



3.4 Segregation of tripping & critical signals & cards of various critical Auxiliaries.

Observation:

While caring out any maintenance for any drive or any Isolation for particular drive by removing or Resetting its Drive card its adjacent drive card may pull out because no space observed in between two cards and emergency may occurs.

Action taken:

Critical AS06 drive card location arranged in same panel and same station in such a way that any drive card can be pulled out easily due to sufficient space in between two cards and hence further Emergencies & trippings avoided.



B) CEP, BFP, ID, FD, Coal Mill Auxiliaries Critical Tripping signal segregation in different cards

Observation:

- It is observed that both CEP discharge Pressure very low signal for CEP Trippings were in same Card. If this card gets malfunction or faulty both CEP will Trip & unit may trip.
- In CRB04 & CRB05 panel also CEP-A & BFP-A i.e. stream A & stream B discharge pressure very low signal were in same card hence if any one card gets faulty that stream will not be available.

Action taken:

- In CRD panel as well as in CRB panel critical signal of discharge pressure v. low segregate such
- that if any card gets faulty or malfunction its standby CEP & BFP will not be affected and other Stream will be available.

3.5 Critical Plant data on Smartphone for immediate decision making.

- Real time Plant Critical data was not available other than plant control room. So it was difficult to take decisions in case of emergencies.
- Need came many time to have real time data while at site, office, tour, etc.

Action taken:

After lot of brainstorming, idea came to provide data of Tab or smart phones with the use of latest technology adoption at minimum expenditure.

- New software and data made available on RTAB for all Critical Parameters. This system is working as very effective tool to get the current value of the critical parameters of the plant even from remote location. Up to 256 parameters can be shown on RTAB at one time for both the units Status of main Equipments and auxiliaries are shown on real time basis.
- Important & critical parameters of all units compiled at one place & then same was connected with said software & hardware. Now data is available on Smart phones for quick decision making.



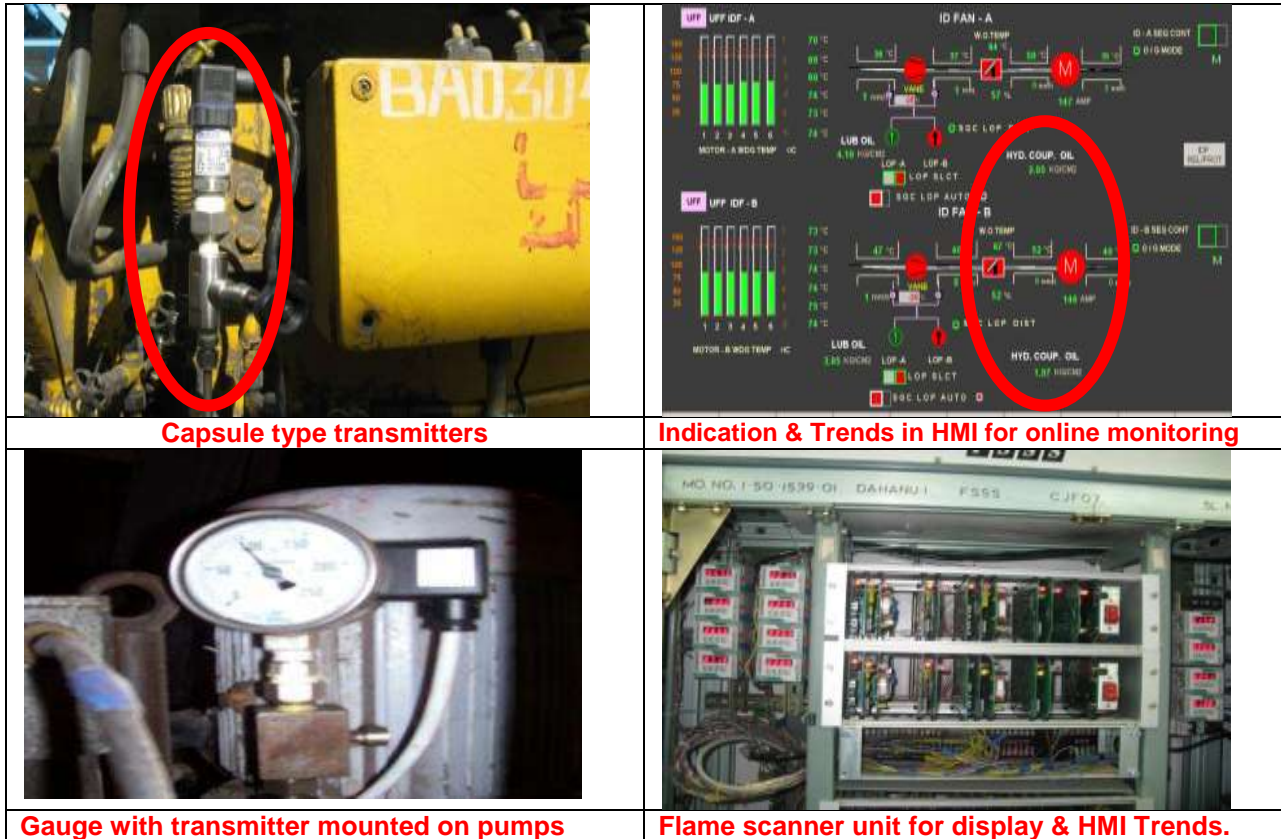
Hardware & software connectivity with HMI



Viewing of Plant data on TAB or Smartphone

3.6 Remote indication of various parameters of Mills, Fans & Flame scanners resulting in avoidance of Generation loss / trippings.

- Earlier only alarm & trip switches were provided in original plant design for HT Auxiliaries like ID, FD, PA fans, Coal Mills, HPBP System, Compressors, Pumps, Motors, Flame Scanners, etc.
- This resulted in Equipment or unit tripping because of lack of no continuous monitoring.
- Team C & I identified cost effective way by installing capsule type transmitters in parallel with Gauge. Spare cables & cards channel utilized & signal provided in HMI for continuous monitoring.
- These signals gave early indication of pressure drop & due to this Gen. Loss avoided.



4. BEST O&M PRACTICES OF C & I SYSTEMS FOR BETTER PERFORMANCE

Given below are the various Best Practices / initiatives undertaken by DTPS C & I for reduction in C & I

Defects, malfunctions thereby reduction in equipment or unit tripping, Aux. power consumption & improvement in energy efficiency through heat rate improvement as follows.

- 4.1 Logic Modification in Boiler & Turbine C & I System.
- 4.2 Relay Panel up gradation & Provision of Common Terminal of BOP PLC at Plant Control room for monitoring & control.
- 4.3 Daily Plant Report conversions in soft for close monitoring & improvement.
- 4.4 Digital Dairy on Smartphone for early tracing of signal location.
- 4.5 **Case study - 1** - Noise Level & Vibration measurement system for HT Auxiliaries.
- 4.6 **Case study - 2** - Installation of Proximity switches at critical locations for avoiding gen. loss.
- 4.7 **Case study - 3** - Provision of Extra Fans for DDC Panel Cooling to maintain cards temp.

4.1 Logic Modification in Boiler & Turbine C & I System.

- DTPS Dahanu Plant got commissioned in 1995 & working since then. Equipment & unit tripping occurred initially many times due to false reasons. Repetition of same false condition also observed.
- So DTPS Team decided to avoid similar false trippings in future.
- So detailed study & analysis carried out of each tripping & from that some logic modifications suggested by team from Operations, maintenance & efficiency Depts without compromising equipment safety.
- Same are implemented after lot of discussions in all directions & same process continued till date.
- More than 250 logic modifications done till date in boiler & turbine area & found working satisfactorily.
- This has avoided many false equipment or unit tripping. Also improvement in plant performance

4.2 Relay panel up gradation & Provision of Common Terminal of BOP PLC at Main Plant Control room for monitoring & control.

- All Balance of Plants (BOP) supplied at DTPS in 1994 were with relay control panels
- Fault finding was very difficult in that system as it was time & manpower consuming.
- Manpower requirement was also more in case of long distance BOP's
- Downtime of equipments or sometimes plant was also observed for critical BOP's like CWPH, Compressors.
- Hence it was decided to upgrade relay control panels with PLC Based systems in phased manner.
- In this way, CW Pump House, Air Compressors, DG Sets, are upgraded in phased manner in running units without affecting the plant performance.
- Additional features like mimics, permissive, interlocks, protections, SOE, Connectivity with plant control room through fiber optic network, remote operations from plant control rooms in case of emergencies, SCADA, are benefited to plant O & M Team.

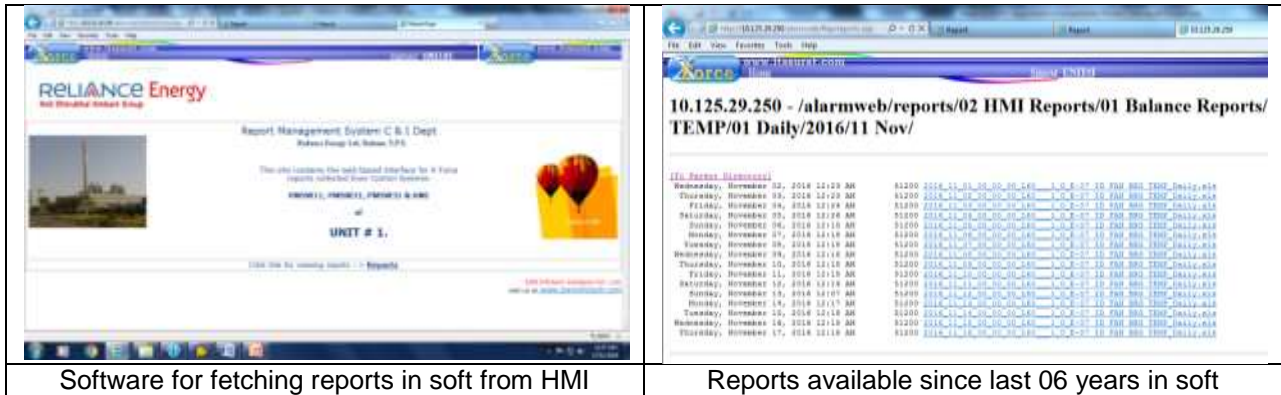


4.3 Daily Plant Report conversion in soft for close monitoring & improvement.

With BHEL Supplied system in 1994, all Daily Plant reports use to come in hard copy on every morning & all Depts. Like Operation, Efficiency, EMG, Central technical service to corporate office are taking hard copy of these reports & doing further activities like analysis, MIS, Records, etc. Keeping hard copy & preservation was also a big task.



- C & I Team done brainstorming on this & came out with innovative idea of providing reports in soft format for DTPS Users.
- Accordingly printer port of HMI / PMS used & data captured in soft & converted in excel sheet.
- Same made available to all for required data processing, MIS, Analysis & improvements.
- This also improved analysis of events, trending & trippings & resulted in improvements.
- Also considerable reduction in paper consumption thereby saving environment.
- Also issue to record keeping of paper type reports also resolved & manpower saving observed.



4.4 Digital Dairy on Smartphone for early tracing of signal location.

Being a power Plant the logics are complex and during any anomaly the time required for analysis and resolution is very critical. Resolution of any problem needs various drawing references and its flow path. There are 55 stations (Panels) in DTPS for one Unit and around 15000 signals. Since it is difficult to remember each and every signal and its reference manual it takes time to identify details of the signal in the system.

For finding details about any signal it takes on an average of 25 - 30 minutes for an experience engineer conversant with Pro-control P13 DDC System.

Some malfunction in the signal can falsely operate certain plant/ equipment tripping logics whose timing is less than 5 minute. Sometimes this delay in signal identification can lead to Unit Tripping as cause cannot be isolated on time.

Pro-control P13 being a old technology system does not support many diagnostic features what new systems available now a days in the market provide ,hence the problem resolution becomes more difficult.

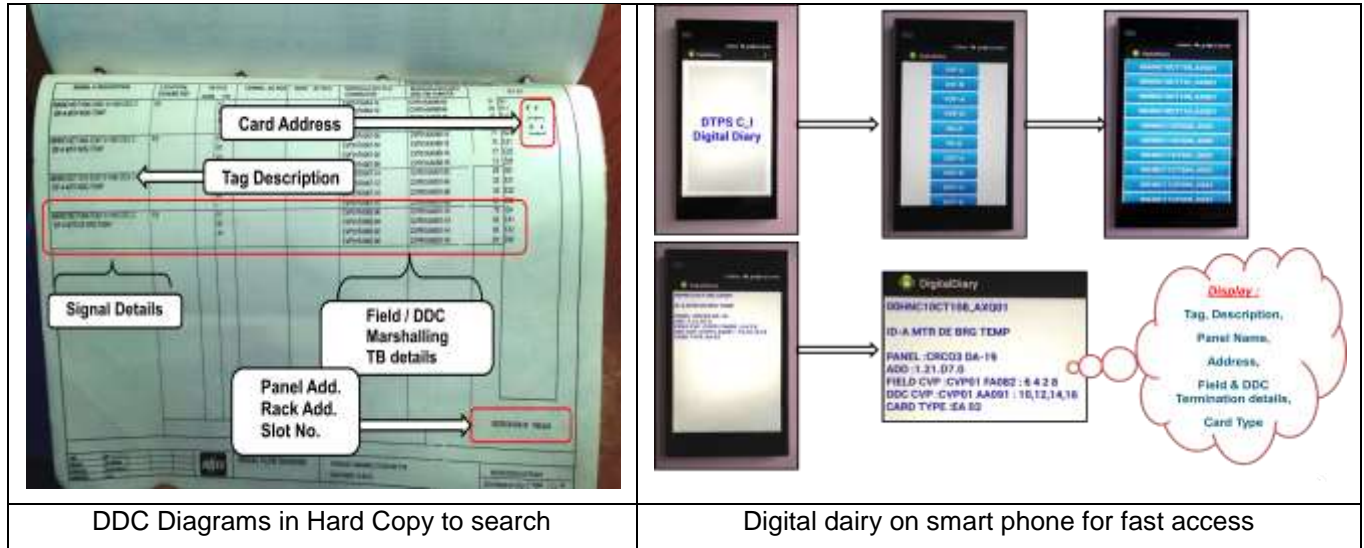
Innovation done –

Now a day's smart phones have become buzz of the day. An innovative idea came through brain storming for utilizing the smart phone computing for finding quick reference of critical signals, which can later be extended to other signals.



An Android app was developed in-house which can be loaded on any android based smart phones and can be utilized in case of disturbance in the process

Same application is now loaded as ready reference on mobiles of 15 to 20 C & I Engineers for faster response during potential plant emergencies. Out of that 6 to 8 are working in shift C & I to handle round the clock emergencies & this is benefitting a lot for quick isolation of fault or false emergencies.



Developed Application - Photo graph of Application installed on Smart Phone

4.5 Case Study – 1, Noise Level & Vibration measurement system for HT Auxiliaries from remote.

Availability of Critical HT Auxiliaries is very important for plant operations.

- Measurement of critical parameters like bearing & winding temperatures are in place but it felt that some more monitoring for early indication is essential to avoid failures.

Action taken:

- From Brainstorming, idea came of Noise level monitoring & vibration of Booster Fan Blades will be helpful.
- Noise level & vibration sensors system installed at one booster fan & Noise level signal connected to FGD HMI. Alarm is also configured for early indication.

Cost Benefit Analysis:

Any problems in booster fan blade will reflect in booster fan blade noise, which will give early indication to operator to take corrective actions.



Noise Level sensor mounting on Booster Fan



Data & trends in HMI

4.6 Case study – 2 - Installation of Proximity switches at critical locations for avoiding Gen. Loss.

- At DTPS, in CWP4 4 Nos. of Pumps supplying Sea water to condenser of both Units.
- Tripping of any pump may lead to tripping of one or both generating units on low vacuum.
- Opening & closing of Discharge Butterfly valves feedback is provided through Normal limit switches which plays vital role in valve operation & pump operation.
- Due to mechanical Seal leakages there are chances of heavy water leakages through valve body.
- In past year we faced problem of Heavy leakage at Pump No-1 Butterfly valve which was having Normal limit switches. Operator was very panic in such a situation of Starting & stopping pump in case of Emergencies as limit switch feedback consistency was not sure.
- It is realized that Normal switches will not further work in Sea water & we could not stop the pump to attend seal leakage because it will directly affect the Generation loss.
- Hence it is decided to search such limit switches which will work in sea water condition.



Solution Suggested and Implemented:

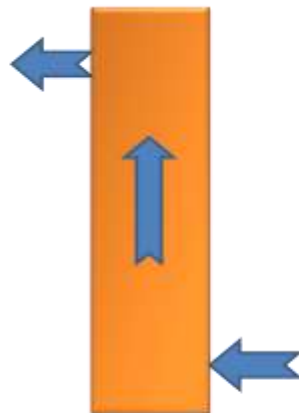
- Use of proximity switch idea was best suited in sea water climatic condition same first tested at C&I Lab by inserting charged Proximity switch in sea water for more than 2 days.
- Hence it is decided to replace existing switches with proximity switches & detail engineering with bracket mounting developed in house at DTPS work shop.
- 3 Nos. of Proximity switches per pump replaced & Trial taken and found ok.

Benefits:

- Generation loss avoided.
- Maintenance cost reduced as no wear & tear of moving parts.
- Reliability of System Improved.

4.7 Case Study – 3 Provision of Extra Fans for DDC Panel Cooling to maintain cards temp.

- The electronic hardware module failure rate at DTPS had been a very torturous pain for us, as the failure of electronic modules either leads to generation loss, or any equipment or Unit tripping Because of ageing of electronic modules, and unpredictable nature of the problem, it is very difficult to really sort out the problem, and also not possible to replace the electronic modules in a running unit. The solution required was on a general level, which could enhance the life of the electronic modules, thus reduce their failure rate.
- C & I Team came out with marvelous idea of increasing the cooling effects inside the panel by adding two high capacity flow fans on the panel doors to increase the air circulation inside the panel. The same idea was implemented in the pilot panels, where the observed failure rates were higher. To our surprise the card failure rate and malfunction reduced to remarkably low levels. The same idea after observing for 3 months has been implemented in both units in all the 88 panels, and overall results are very effective.



Suction Fan

5 Conclusion:

Above mentioned 4 corner initiatives helped to reduce C & I defects & improved plant performance.

All measures mentioned above are summarized under following practices -

- Adoption of System based approach through Various ISO Standards
- Six Sigma projects undertaken for critical issues to reduce repeated problems.
- Implementation of new O & M practices and technology through continual improvement

With above initiatives & other close monitoring & analysis of every event, C & I faults & malfunctions are reduced considerable & thereby unit or equipment trippings are reduced. This reduced stresses on machines & improved overall performance & unit heat rate.

Also apart from plant performance, Our 04 C & I Technicians got **Prime Minister Shram shree** award by Labor Ministry, 08 technicians got **Vishwakarma awards**, Interview on All India Radio, etc.

Copy right received for Air to Fuel Ratio

Patent is applied for DDC Card Testing kit & it is under process

----- **SAVE ENERGY & GENERATE ENERGY**-----

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