

## REMOTE MONITORING OF MULTIPLE BROWN FIELD CONSTRUCTION SITES IN A STEEL PLANT



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### ABSTRACT

Effective management of a construction site inter alia requires continuous monitoring of the complex set of activities involved. Such monitoring is only possible through real time and correct data collection and it's processing which lead to timely action. With the increasing stress on qualified supervisory resources to execute construction jobs the reliance on technology has become the need of the hour. State of the art technologies are being used for remote monitoring of construction sites which facilitates a smaller management team to maintain control on progress, quality and safety effectively from a single location. This article describes the implementation of remote monitoring carried out for a brown field project site where new plant facilities were being put up in the vicinity of existing operating plants. The successful implementation of remote monitoring resulted in safe and incident free execution within the project schedule.

### 1. INTRODUCTION

A typical construction project site comprises of a heterogeneous mix of resources comprising materials, machinery and humans performing multiple inter-related activities. The diverse activities comprising excavation, demolition, construction, erection, testing and commissioning may occur at the same place or at different places at the same time. The entire gamut of activities have both spatial and temporal variation and meticulous planning of activities at various levels along with the resource planning, quality assurance plan and safety plan are prepared to successfully execute the project. While the actual physical work goes on at site, a large amount of data collection, handling and processing is done at back end offices to coordinate the activities well so as to achieve the desired results in terms of safety, quality, schedule and cost.

In order to monitor project execution for all these aspects, the practice has been, and on many projects still is, to engage a team of supervisors and foremen who are physically present at site supervising the works and collecting data manually to measure and monitor progress, quality, safety, keep watch on pilferage of materials and generally ensure that workers were performing the designated tasks correctly, the construction equipment are functioning and doing their allocated task, etc. This system has two major drawbacks. On one hand it requires a large number of supervisory staff of different specializations to be physically present at site with associated high costs and more scope for human error. On the other hand where budget constraints restrict the deployment of required numbers of trained supervisory staff, the execution of works suffer; the most common victims are safety and quality since time and cost take priority in project monitoring. Further, with most companies trying to work across various geographic locations, this old practice in the fast track modern projects is now almost failing to produce acceptable results.

Many new technologies are now available for remote monitoring of many aspects of site construction. These technologies help the Project Managers, Project Owners and other stake holders to review data from various areas of the same site or even from various sites in a command control centre. They can receive data feed on real time updates, review

and analyze the data, monitor the situation and suggest action based on the requirement of the situation. Physical on-site monitoring promotes the sense of involvement of the management in the condition and progress of the work and the wellbeing of the workers. The use of the right technology can greatly enhance this feeling with much lower direct manpower effort from the managers.

## 2. DESCRIPTION OF THE PROJECT AND CONSTRUCTION SITE

The project taken up for execution was for a steel plant. The plant owner has an integrated steel manufacturing facility with coke ovens that employ wet system for quenching of hot coke from ovens. The wet quenching systems, for two Coke Oven Batteries (COB), were being changed to dry quenching system to meet environmental norms and also use the waste heat for power generation. The new Coke Dry Quenching (CDQ) plants were being installed inside the existing coke oven plant and in close vicinity to many existing and operating units. Due to space and time constraint, the construction activities become very critical in terms of achieving progress with limited accessibility to the work areas, extra care required to allow unhindered operation of existing plant and complete safety of not only the project execution team but also the operation and maintenance staff in the adjoining operating plants.



Fig.1: A PTZ camera at construction site

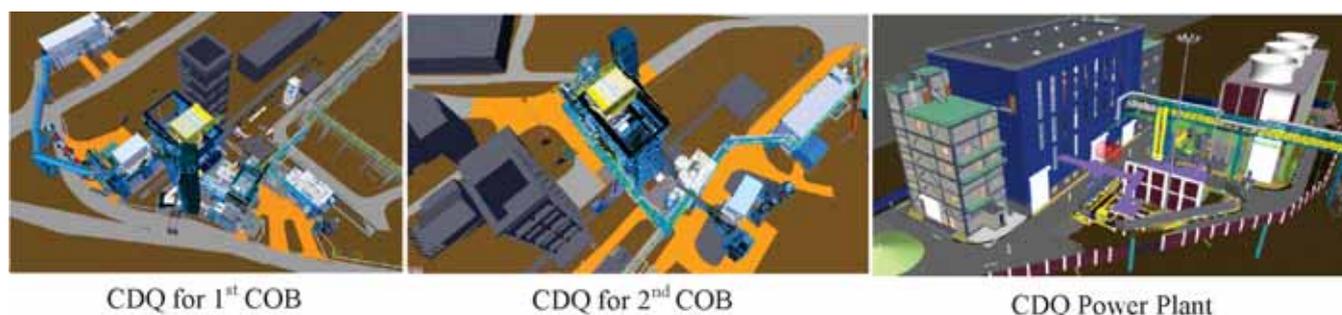


Fig.2: Coke Dry Quenching Facilities Layout

## 3. DESCRIPTION OF PROPOSED REMOTE MONITORING SYSTEM

The monitoring system proposed for the construction site was a CCTV surveillance system. Nine cameras were installed at various locations across the sites at the two CDQ plants and the CDQ Power Plant. There were nine fixed cameras and three Pan-Tilt-Zoom (PTZ) cameras all housed inside enclosures with IP67 rating to make them suitable for use in the dusty and humid conditions at site. The cameras were connected to a multi-channel TV unit located at the project site office through IP based wireless system. Point to point (PTP) wireless access point/ bridge capable of handling seamless video streaming from IP based cameras was used. The monitoring set used was a 32" screen. The equipment comprised a Network Video Recorder (NVR) processor unit, and STP cables for connections. Eight numbers of wireless radio communication sets were also installed with eight port switch for multichannel communication with the engineers on field. The locations of the fixed cameras across the site are shown in Figure-3.

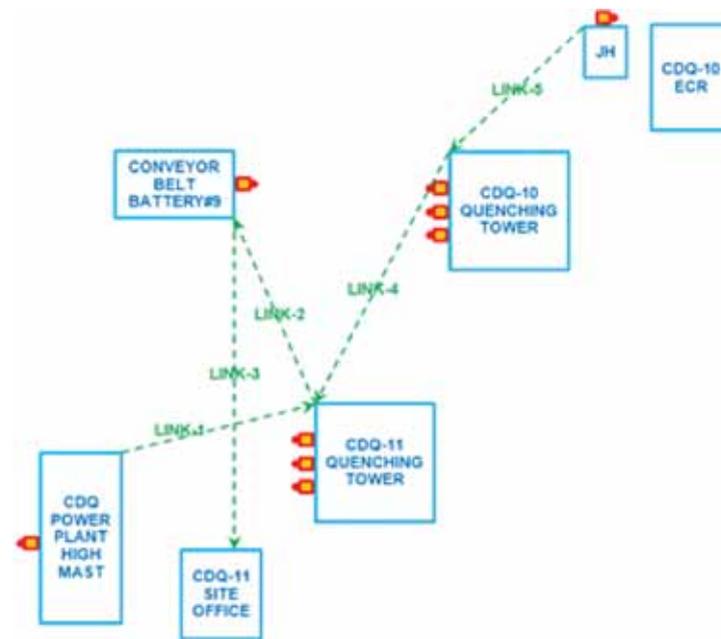


Fig.3: CCTV Camera Location at site

#### 4. MONITORING ACTIVITIES CARRIED OUT FROM COMMAND CENTRE

The project execution area was spatially demarcated into three distinct zones as can be seen from the site layout in Fig.-2. The Command Centre was established in the 2<sup>nd</sup> CDQ area which is almost midway between the two other sites – 1<sup>st</sup> CDQ and Power Plant. The site activities comprised work for demolition of old structures and their foundations, installing excavation protection system for deep excavations adjacent to existing structures and their foundations, earthwork for deep excavation, foundation construction, building construction, structure erection, mechanical and electrical equipment erection, piping and cabling works and various miscellaneous jobs. The monitoring work carried out from the command centre involved:

- a) Review of vehicle movement and logistics – cranes, dumpers, excavators, and concrete millers,
- b) Monitoring of cranes and other lifting equipment during structure and equipment erection,
- c) Note incidences of safety violation and take corrective and preventive action, including imposition of penalties, if necessary,
- d) Note incidences of attempted pilferage, misuse of materials and take corrective and penal action,
- e) Review implementation of safety practices; whether being properly adopted as per site HSE policy,
- f) Review work quality and detect lapses; also note good practices, appreciate and highlight such cases in mass meetings,
- g) Detect hazards due to multiple activities by various agencies happening at same time and place across the three sites, and
- h) Review progress of work and plan for the next activities based on real time feedback.

#### 5. BENEFITS ACCRUED FROM THE REMOTE MONITORING

For a complex project of this nature distributed over various discrete areas of an operating plant, reliance on only human supervision would have affected all aspects of the project vis-à-vis schedule, safety and quality. The remote monitoring system facilitated achieving the following for the site works:

- a) Major demolition of existing building in Power Plant site done safely.
- b) Enable to ensure that the Safety Tool Box was checked on daily basis without fail.
- c) Timely job commencement daily, in morning.
- d) Monitor major machine/ equipment deployment which helped in getting maximum efficiency of machine/ equipment usage time.
- e) Monitoring progress 24 x 7.
- f) Capture safety and quality violations in any area of the site.
- g) Monitor progress of work at height.
- h) Check actual resources available at site and help to calculate delay due to lack of resources.
- i) Ensure 100% supervision of work using lesser supervision staff.
- j) Ensure safety during night work at height with few supervisors from control centre.
- k) Capture real time progress with time to prepare exact current status report during review meetings.
- l) Security of material during no work or holidays which helps zero incident of theft.

An interesting case study to highlight the benefit of the remote monitoring system was during an incidence of cutting of existing live power cables during the excavation work. The incident occurred at night due to negligence of the contractor who was working without a valid work permit in that area. The contractor requested for work permit after the incident occurred and tried to put the blame on the supervising staff. However, the incident was recorded on camera with actual time of occurrence and when that was compared with the time of permit, the agency at fault was correctly detected and suitably cautioned.

## 6. CONCLUSION

The use of the remote monitoring system proved to be invaluable in handling such a difficult project with multiple constraints. The benefit of the system was highlighted by the fact that out of the total of 9 million man hours consumed at site there were no safety incidences recorded. There was only one case of Loss Time Incident (LTI) which happened in the bar bending yard located offsite and was thus not covered under the remote monitoring system. Hence the learning is to monitor even the off-site works.

## 7. ACKNOWLEDGEMENT

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## 8. SNAPSHOTS FROM PROJECT SITE



Fig.4: Control Centre with Display Monitor and Camera Feeds