Tata Iron & Steel Co. Ltd. (TISCO) have used Intelligent MCCs at their Coke Oven Plant #2. They have been supplied by L&T in 1997. Probably, this was the first material handling plant in India to use Intelligent MCC concept completely. The plant was commissioned in July 1998.

Sharing of experience has been an ongoing process at TISCO and L&T. Adopting the innovative concept of Intelligent MCCs with indigenous know-how and successful implementation of the concept on schedule was a real achievement for TISCO.

Mr. Sharat C. Kumar of TISCO was involved in the process all along. In this issue of L&T Current Trends, he shares his experience with the readers.

In the month of October 2000, Bureau Veritas Quality International (BVQI) has awarded ISO 9001 - 2000 certification (based on the FDIS) to L&T’s following divisions:-

- Electrical Standard Products
- Electrical Systems & Equipment
- Petrol Dispensing Units

The certification involves L&T - EBG’s Powai, Madh, Ahmednagar and Faridabad works.

So far, many Indian companies have been certified for ISO 9001 - 1994 standard.

The new standard, i.e. the 2000 version, focuses on customer interaction, customer satisfaction, etc.

With this certification, L&T is the first Indian company and one of the few worldwide to get certified for ISO 9001 - 2000 (FDIS).

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1. INTRODUCTION:

Tata Steel has set up state-of-the-art Coke Ovens for producing 1 million tons of Blast Furnace Coke and Nut Coke using Stamp Charge Technology. Coke plant # 2 consists of two batteries viz. Battery # 8 & 9. These two batteries consist of 70 ovens each. Battery # 8 was commissioned in July 1998 and it has already achieved its rated capacity of 0.5 million tonnes of Coke production in its first full year of operation i.e. 1999-2000. Battery # 9 was commissioned in August 2000.

In any typical Coke Oven in an integrated steel plant, there are three major processes:

❖ Coal handling plant.
❖ Battery proper with ovens machines
❖ Coke handling plant.

1.1 Coal Handling Plant:
Coal handling plant blends and crushes coal of various types and this processed coal is fed for use in Coke oven batteries using Stamp Charged technology. Coal is withdrawn from the blending bins as per the blend required through weigh feeders, taken through conveyors to primary crushers; then to secondary crushers and finally to coal towers for both Battery # 8 and 9. Each coal tower can store up to 2500 tonnes of blended and crushed coal. Coal is then fed in to the SCP machine hoppers from gates provided in the coal tower and finally charged as coal cake in to the battery oven.

1.2 Coke Handling Plant:
Coke Plant evacuates the coke produced from the Coke Oven batteries and transports to the Blast Furnaces or stockyard. Coke is evacuated from the wharf using plough extractor and sent to surge Hopper through conveyors. Using vibratory feeders and screens the Coke is separated into Nut, Pearl, Breeze, and BF Coke. BF Coke is ultimately sent to Blast Furnaces. Schematic of the process is shown in Fig.1.

1.3 Power Supply Arrangement:
Three 1600 KVA transformers feed power to the 415V PCC at Coal plant and an identical system exists for PCC at Coke plant. PCCs in turn feed power to Intelligent MCCs 2.1 & 2.2 for Coal plant and MCCs 3.1 & 3.2 for Coke plant. Each MCC has 2 incomers and several motor starters. All incomers use Feeder Vision relays (FVR) for protection, monitoring, measurement and control. All motor starters use Motor Vision relays (MVR) for protection, measurement, monitoring and control. Between Coal and Coke Plant Optical Fiber is used for data transfer.

We, at Coke Plant # 2 in Tata Steel, studied the option of using Intelligent MCCs in place of conventional MCCs. The offer was mainly from L&T (in collaboration with P&B Engineering, U.K. for Supervision series of Relays) and some other switchgear suppliers.

2. SELECTION OF INTELLIGENT MCCs: WHY?
It would be prudent to discuss the selection of Intelligent MCCs at this stage.
The advantages foreseen in using L&T’s Intelligent switchgear were obvious. Some of the benefits were:

- Additional hardware for O/L, E/F, U/V, O/V, current metering and associated wiring not required.
- Most of the protection, metering and control data could be transmitted on serial link to higher level system like PLC and thereafter to the MMI for indication and information feedback as graphical or text displays. Operators and engineers as per their requirement could subsequently use this information.
- Inputs for interlocking and safety could be wired directly to the intelligent device instead of wiring in the PLC. By doing so, the MVR could switch off on its own if any interlock fails and at the same time this data (interlock failure data) could be used by the PLC for back-up action (trip/alarm etc.).
- An MVR could be programmed/configured as per user’s requirement out of the several options available for motor starters.
- Configuration or parameterization was extremely user friendly.
- Very good diagnostic facilities were available for pre and post-fault conditions.
- Use of twisted pair cable instead of Optic Fiber for communication between devices and Xcell system lead to lower cost and simple connectivity.

Several other features were available which were convincing enough for us to decide in favour of Intelligent MCCs.

3. ELECTRICS :

Electrics for Coal and Coke plants were given as a turnkey project to Larsen & Toubro Limited (L&T), India. The following devices were used:

- Intelligent MCCs using Feeder Vision Relay (for feeders) and Motor Vision Relay (for Motors).
- Data Concentrator XCell - Communication between supervision Relays and PLCs
- Modicon PLC and remote I/Os
- IC2000 SCADA system running on Modbus Plus protocol
- Connectivity between Coal and Coke plant using fibre optic cable.
- Use of Remote I/Os at blending bins for easy interface between PLC and J&N Weightfeeders, Belt weighers and Bin level sensors.
- Use of twisted pair cable instead of Optic Fiber for communication between devices and Xcell system lead to lower cost and simple connectivity.

Several other features were available which were convincing enough for us to decide in favour of Intelligent MCCs.

4. OUR EXPERIENCE

After the Coal and Coke Plants were commissioned, several teething problems and shortcomings arose in the Intelligent system and its use. However, these were overcome with a joint effort by L&T and Tata Steel. The problems experienced and solutions arrived at are given below:

4.1 Problems encountered initially:
The initial problems during commissioning were due to power quality and voltage spikes. By incorporating surge suppressors, replacing dielectric capacitors with dry type capacitors the problems were brought under control.

4.2 Zero speed sensing and belt sway sensing:
Zero Speed Sensing (ZSS) and Belt Sway Sensing (BSS) feedback are used as protection for any conveyor system. These inputs were configured misbehaving since ZSS required a finite time part to get the final “healthy” condition and BSS had to remain faulty for a finite period to detect “unhealthy” condition. These External inputs were forced to run the plant but it became difficult to keep a record of inputs being forced (ZSS and BSS).

Subsequently, these two inputs were removed as interlocks by disabling them on the MVR for “trip”. At the same time, status of these inputs were being read by the PLC on serial link (through Xcell). These were additionally incorporated in the interlocks for the drive in the PLC ladder logic with a time delay, which is required for starting for ZSS and tripping due to BSS. Also these inputs became available for forcing OFF/ON during trailing of belts and motor trial and the forcings could be monitored. Hardware provided in the existing system for ZSS became redundant.

4.3 Serial Communication:
As time passed, one problem came up. “Serial time out trip” became a nuisance tripping @ 15-20 times per shift. Engineer from P&B visited the
Plant, discussed and studied the problem.

The start command given by the host PLC was a latched command. This led to the serial time outs. Start command was converted into a 4 seconds pulse to reduce the number of interrupt commands from PLC to XCell. This substantially reduced the serial time out. MVR ON command was also taken as an interlock bit.

4.4 Link between MV and XCell:
On some occasions, communication link between XCell and MVRs failed; some drives tripped and some drives remained ON leading to severe spillage of material. On further investigation, we found that if serial link fails, MVRs can stop the drive if serial time out trip was enabled in the MVRs. Similarly, XCell could recognize or read serial link failure with either one or all devices. This communication failure status was read in the PLC system and provided as interlock bit in the ladder logic. Display of link failure was made on the MMI using LC2000 system. Also a facility for serial fail reset from remote, which could be done on one click of the mouse, was disabled and reset enabled only through each MVR on the MCC. This was required as operators used to click the RESET icon on the MMI inadvertently as a common icon is made for all RESET. In some cases AUTO RESET of serial link failure of MVRs were enabled. In these cases as and when serial link is established fault resets automatically. The problem herein lies when any conveyor trips in the circuit. As long as all conveyors are running and if link fails and gets re-established within 120 seconds and resets on auto, then there is no problem as trip time were set at 120 seconds (programmable). But if a conveyor trips within these 120 sec, then spillage would take place. Therefore both AUTO and SERIAL RESET were disabled through REMOTE and allowed only through LOCAL mode.

4.5 Spillage in coke conveyors:
Suppose conveyor A discharges material into conveyor B. If the two conveyors are running and serial communication of conveyor B fails, conveyor A would trip on serial communication of conveyor B, the last status is conveyed to the PLC. The last status is ON when link has failed. This feedback is motor on for B into A. Thus conveyor A doesn't know that conveyor B has tripped. This resulted in spillage. To prevent this, status of conveyor B was put in the starting interlock of conveyor A.

4.6 Spillage between non-MVR and MVR conveyors:
In the coke plant CK - 01A (a non-MVR conveyor) discharged coke into CK - 03 (a MVR conveyor). A loose connection at the RS485 port of the XCell concentrator had caused this. Two things happened simultaneously :-

❖ The motor vision relays connected to the XCell tripped on serial timeout.
❖ The XMIT block, a loadable function block used for mapping the XCell addresses with those of the PLC, went into a fault state.

Thus with the failure of communication between PLC and XCell, the last status was retained by the PLC. Thus the current f/b, communication status, contactor A ON, remained high although CK - 03 had actually tripped. This led to spillage of coke from CK - 01A over CK - 03. To avoid this, an additional interlock "XMIT transmission error" was incorporated in the starting logic of CK - 01A.

4.7 Remote Input / Output head:
A Remote Input / Output (RIO) header card was used in the PLC for communication with all Input / Output modules on various racks. In Dec '99 this RIO card failed and we had no spare card available. Complete Coke Plant came to a halt as all ON commands were issued through RIO card for Non MVR drives and Remote/Local selection to the MVR control inputs. However, the serial link between the MVR and the PLC was still existing which was used for ON command directly. Switching ON the drives through this serial link with certain interlock modification was tried for one conveyor and then subsequently for all coke conveyors. Additional interlocks were provided for the whole system to work on serial link.

5. VISION FOR FUTURE:

❖ Eliminate ZSS by incorporating ZSS into MVR or through current measurement.
❖ Remove most I/Os from PLC and use only CPU for digitally receiving data through serial link.
❖ Eliminate unnecessary interface.
❖ Real time and history of data on a higher level system.
❖ Database for all data imported from MVRs.
❖ Parameterization of MVRs through serial link from XCell. Both online and off-line, from SCADA.
❖ Forcing of inputs serially.

6. CONCLUSION:

It can be certainly concluded that use of Intelligent MCCs has been successfully implemented and benefits have accrued to Tata Steel because of this. It has been a continuous learning process for both Tata Steel and L&T.