THE PRACTICES ON THE INTEGRATIVE SYSTEM WHICH INCLUDE AUTOMATIC CONTROL AND MES OF IRONMAKING IN BAOSTEEL[1]

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Abstract
By analyzing nowadays the theory of the information structure and production management mode ,it applies an integrated solution to upper ERP and middle MES and lower PCS, this paper presents the development and system architecture, the factual solution was presented and used in the iron-making plant of Baosteel Corporate Ltd. The result is good ,not only save the energy sources but also reduce the consumption, enhance the management level at the same time.
Key word: Ironmaking; Integrative System; Automatic control and MES; MES;ERP.

A PRATICA SOBRE SISTEMA INTEGRADO QUE INCLUI CONTROLE DA PRODUCAO DA REDUCAO DA BAOSTEEL

Resumo
Avaliando a teoria atual de estrura da informacao e gestao da producao, aplica-se uma solucao integrada em ERP, MES e PCS. Este trabalho apresenta o desenvolvimento e arquitetura de sistema, bem como a solucao apresentada e usada no controle da unidade de reducao da Baosteel. Os resultados mostraram-se bons, nao apenas pela economia em energia mas tambem pela reducao de consumo de redutores, melhorando o nivel de gestao ao mesmo tempo.
Palavras-chaves: Redução; Sistema integrativo; Autocontrole; MES; ERP

[1] *Technical contribution to the 3rd International Meeting on Ironmaking, September 22 – 26, 2008, São Luís City – Maranhão State – Brazil*
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1 PREFACE

It's necessary to carry out a real-time efficient production and management policy, meanwhile to assure agile and continuous and automated process if the steel enterprise want to win in the competion.

According to the ISO's technical report, the steel enterprise automated system have 6 levels structure, the control level include 3 grades, the first: check and drive, the second: equipment control, the third: process control, the management level include 3 grades too, the fourth: the online production management, the fifth: the management of the enterprise short production plan and business, the sixth: the long-term development planning. According to the above definition, with the use of integrated framework strategy, including the advanced computer technology, network technology, database technology, automated control technology, modern times enterprise management and so on, to build the integrate automation system which include the above six grades function, at the same time to integrate the internet technology, supply chain management, client relation management, electrical business, automation office technology, to integrate and optimize the information, the logistics and the capital flow, and in the end to realize the share of the resource and the enterprise process optimization, this is the integrative system which include Automatic Control and MES and ERP in steel enterprise[1].(ISAME for short)

Along with the economical development and the improvement of the steel enterprise information level, almost all the flow processes have the process control system (PCS) in their enterprise, and some have the enterprise resource planning system (ERP), but it's needed to build a new system to fill up the interspace between the management level and control level, to realize the ISAME, the MES (Manufacturing Execution System) is the bridge of the above, and it is a key technology[2], as figure 1 shows.

By the development of the Baosteel Corporate Ltd. more than 20 years, we have realized the target of ISAME, not only have the perfect PCS level, but also have the key MES level in each branch of the Baosteel Corporate Ltd., base on this, we build the ERP level in 2001 in Baosteel Corporate Ltd.. This innovation has been taken advance, for example, in the cost, quality, service, reaction speed and technical innovation etc.

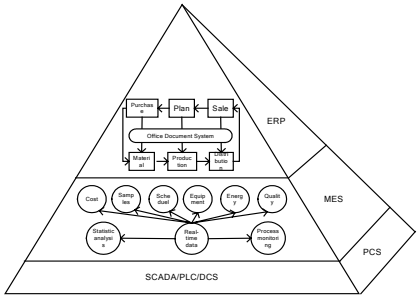

Figure 1. ISAME structure diagram

2 A BRIEF OF INTRODUCTION OF THE DEVELOPMENT OF ISAME USED IN THE IRON-MAKING PLANT OF BAOSTEEL CORPORATE LTD.

As the subset of the Baosteel Corporate information system, the ISAME used in the iron-making plant include two phase during its development, the main design

thought based on the MES system in the firs phase, because of the PCS system has been there, and in the second phase, the main objection based on the ERP system, supplied a gap for the Baosteel Corporate ERP system couldn't cover with the iron-making plant.

During the first phase before 2000, the each branch of the iron-making plant had the perfect PCS system, and corresponding Automatic Control center in the every craftwork section, but the MES system was absent in the iron-making plant, only used the paper document ,telephone and meeting to exchanging the information, the PCS's data couldn't be transmitted by network, to deal with those technical data need use Excel and other simple hand tools. We started to study this item and project establishment since 1998, it spend two yeas to build the MES system in the iron-making plant, it experienced several stages, such as technology negotiate, preliminary design, construction and installation, basic design, detailed design, individual commissioning of system equipment, system joint adjustment, trail operation, etc. The MES system include all of the Level 3 functions and partial Level 4 functions, communicated with more than 20 interfaces, reconstructed 9 PCS systems , which concerned the Blast furnace, the sinter plant, the coking plant, the raw material plant and the other departments and so on. The whole system include 3 parts, Production Monitoring and Managing System, Statistic Analysis System, Office Document System.

During the second innovation phase, from the project establishment in March 2004 to the fourth Blast Furnace blown-in in April 2005, it spend only one year because of the first phase item was very good, during this phase mainly increased the function to cover with the new no.4 BF, adjusted the function to adapt the new logistic model, 3 sinter plant and 3 coking plant to the four Blast Furnaces, and innovated the partial lower PCS systems, and added the function of the hot metal scheduling system, jointed the Level 3 of the iron-making plant and the Level 3 of the steel-making plant, and meanwhile we moved the statistic system and raw material management system from the MES system to the upper corporate ERP system, mainly further perfect the ERP system. we didn't add computer server, only update the hard system of the original server.

3 THE STRUCTURE OF THE ISAME

3.1 The Solution for the Host

The MES system used advanced computer and network technology, there are 2 servers separately used to the production and monitoring system, document system, which installed advanced and universal soft, high performance data base and develop tools. The application system adopted client/server structure, the upper ERP system include the Production and Marketing system, Data Warehouse system , which the servers located in the corporate Ltd. separately. It's the important comprehensive solution for the enterprise information.

3.1.1 Host configuration

The MES host adopted two COMPAQ company's AlphaServer GS60 servers, Due to the new system need high performance, we need to update the original sever host. We separately added 2 525 MHZ EV6 CPU ,4GB memory, and finally 4 CPU ,8GB memory were obtained in two host server, which online dual backup. In addition added two 9.1GB UltraSCSI harddisk. Between two servers used special high speed

cluster jumper, and shared a set disk raid, to ensure the high performance of the servers. Two servers switched automatically. The host operation system used the COMPAQ company's True64 Digital UNIX V4.0F, the data base is ORACLE 8.0.5 OPS, development soft is PB. The ERP host operation system is IBM AIX for Data Warehouse System which used SAS dataset to store data, the development soft is SAS and Lotus.

3.1.2 Storage equipment

Disk system: Outside disk raid RA7000 added 4 18.2G hard disk, to ensure the development environment.

Tape system: used HP company's TL891 enterprise, high performance, big capability DLT tape base, joined with two servers by SCSI, TL891 had two drivers, seven tape slots, the max storage capability were 6300GB.

3.2 Solution for the Network

3.2.1 Project introduction

According to the network condition, the design principle as follows:

1) Thick cable were changed to optical cable ;
2) Network equipment adopted CISCO's;
3) The special line node used ATM.
4)

3.2.2 Host connection

The MES system's two AlphaServer GS60 hosts access the corporate main network by using ATM network card and 155M speed, divided into multi LEC to communicate with every client in the main network of Baosteel corporate Ltd.

3.2.3 Network topology map

The ISAME of the iron-making plant communicated with the upper ERP system by the main network, the ISAME's network structure as Figure 2 shows.

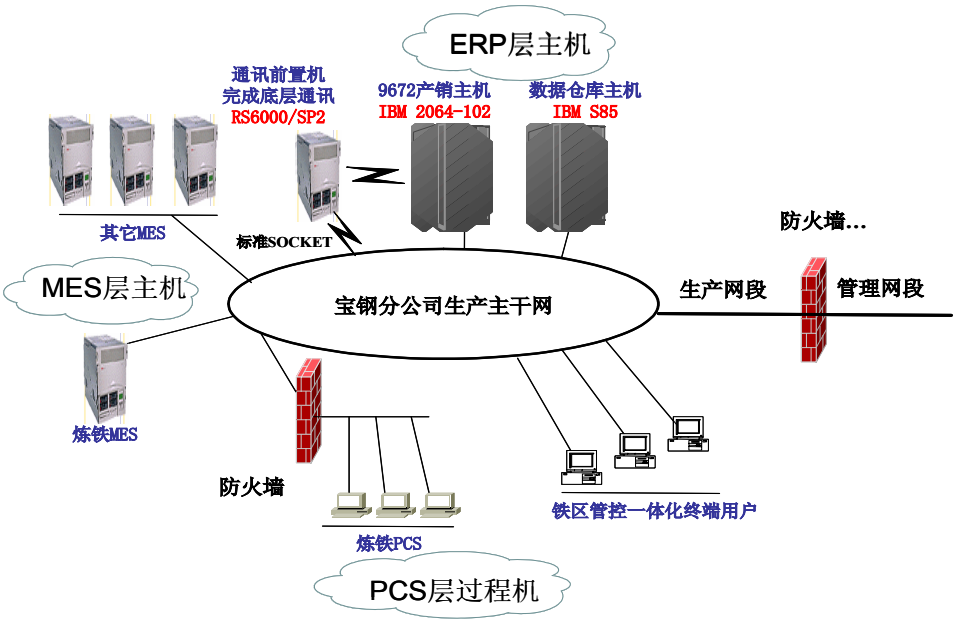

Figure 2. ISAM network structure of the iron-maikng plant of Baosteel Corporate Ltd.

4 SOFTWARE SYSTEM ARCHITECTURE

The ISAME of the iron-making plant function as flow Figure 3 shows, the iron-making plant's ERP function in the upper ERP level, mainly include the production plan management, raw and flux material management etc, the MES level is the key level, it mainly include the real-time monitoring system, production plan management etc, the lower PCS system had each branch's level 2 process control system and level 1 base PLC system.

Because of the lower PCS system function are perfect in every enterprise, so this paper mainly introduce the function of the ERP and MES.

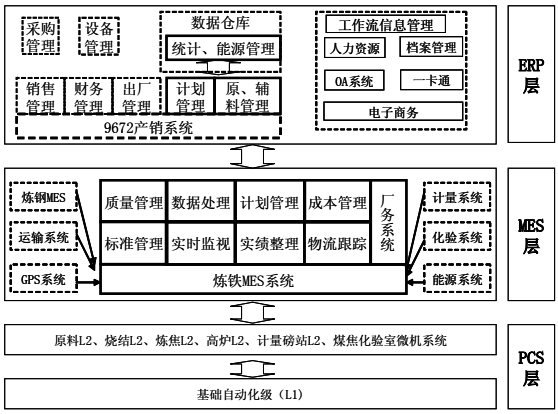

Figure 3. The ISAM diagram of the iron-making plant

4.1 ERP Level

As the subset of the ERP system of Baosteel Corporate Ltd., the ISAME of the iron-making plant's ERP system included the statistic analysis system, energy management, planned management, raw and flux management system.

4.1.1 Planned management

The ERP level's planned management belong to the Raw Material Center of the Manufacturing Management Department. The planned management included the production plan and burden plan, those plans could be transmitted by network. Through control the permission assignment as roles, we can control the burden plan and submit the plan to the PCS level directly, thus realized the communication two-way online transfer between the ERP and PCS system.

4.1.2 Statistic management

The statistic analysis function mainly include production management, cost management , process management, comprehensive reports etc, which concern with each unit in the iron-making plant. The others functions located in the Raw Material Center of the Manufacturing Management Department, for example, iron ore, coal and coke, limekiln, scrape's management and plan, quality management, storage balance etc. These result could be used to the technical analysis.

4.1.3 Energy management

We get the every unit's energy consumption by month report, and extract the data from the EMS system in the upper ERP system relate with iron-making plant by month.

4.1.4 Raw and flux material management

The raw and flux management included the iron ore, flux, coal and coke management. It was composed of entering the factory management, iron ore actual performance management, iron ore plan, coal and coke actual performance management etc. Because of there are some trade material in the raw material yard, so included the entering the factory management, storage balance and export management.

4.2 MES Level

The MES level is the bridge between the upper ERP level and the lower PCS level, so it is the key level of the ISAME.

4.2.1 Planned management

According to the production month plan from the ERP level, we can submit the date production plan to the very unit of the iron-making plant. The burden plan can be transferred to the lower PCS level and used to control the system after confirmed by the different grade users.

4.2.2 Real-time monitoring

The Real-Time Monitoring System is the important part of the MES system of the iron-making plant, it changed the reality that need to know the field data by the telephone, now we can know the field data anywhere and anytime. This system recombined and concentrated the important parameters of the flow process of each unit, to form the diagram that easy to understand, as Figure 4 shows.

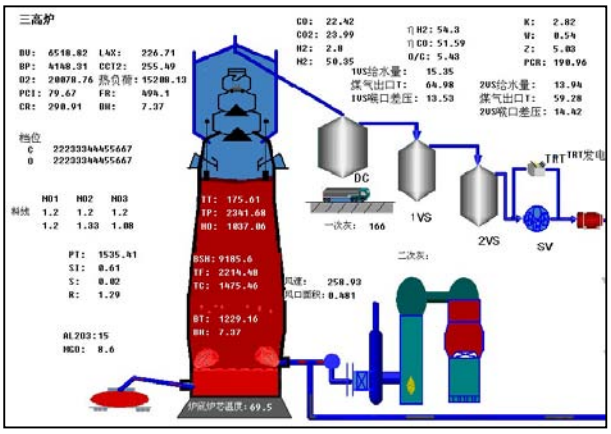

Figure 4. the real-time monitoring picture of the ISAME

4.2.3 Process actual performance management

The function include to collect the actual performance report of the shift and date, after confirmed by someone, these data are integrative and exact, we can use them in MES or ERP system. On the base of the collection and confirmation, we can

get the daily report, monthly report, and annual report, and then those report become the base for production, management, technical study, statistic analysis used in the upper ERP system.

4.2.4 Quality management

There are a lot of samples need to be analyzed in the iron-making plant, these samples located in deferent places, they need to be collected, checked, analyzed in time, with use this system to ensure reliable quality guarantee for the production operation and technical analysis.

4.2.5 Logistics tracking

The function of the hot metal scheduling system became more efficient to manage and track the TPC transportation, which from BF receiving iron to reladling, such as iron tapping exit, iron tapping line, desulfurizing workshop, torpedo car pouring workshop, front and back slagging-off workshop, slag-tipping workshop, electric furnace, ingot mould, pig machine, furnace kiln, TPC (torpedo car), locomotive and railway, etc. We can realize more function to manage and track the TPC transportation by means of collection the every station information with use the GPS Location System.

4.2.6 Cost management

We realized the cost track of the iron-making plant by using this system, it can calculate the cost of each unit by date, and can track and analyze the Input-Output. At the same time, we introduced the concept to control the raw material cost, from the annual plan to the least period, calculated each period cost, we can know the real cost during the phase of plan.

4.2.7 Standards management

This one include the code, standard cost price and hot metal standard management function, etc.

4.2.8 Data mining

We developed the different data mining tools for the ERP level and the MES level, realized the data download, increase the efficient of the data analysis.

4.2.9 The official document flow system

The official document flow system based on the system platform of the Lotus Notes and Web System which improve the work efficient.

5 CONCLUSION

（1）This system is an individual development of Baosteel to realize the function of the integration of management and controlling in the iron-making plant of Baosteel Corporate Ltd. It’s concluded that Baosteel has the ability to developing the large ISAME system individually.

（2）The factual solution was presented and used in the iron-making plant of Baosteel Corporate Ltd. The result was good ,not only saved the energy and reduced the consume but also had produced better benefit by practice , in the same time enhanced the manage level.

（3）Through combine the information technology and management technology, to improve the industrialization trough the information is the Only Way to the technology advancement and development of the enterprise.

（4）During improving the information of the enterprise, the improving of the PCS,MES and ERP, the three need to be improved at the same time, which is the only way to best integrate the information flow and the logistics and the capital flow, to improve the competition of the enterprise.

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