

ISO 50001 Energy Management System Case Study

2020

China

Sinopec Zhenhai Refining & Chemical Company (ZRCC)

*Sun Minjie. SEMS Integrated into ISO 50001
System to Improve Energy Efficiency*



ZRCC Panorama

Organization introduction and business case

Sinopec Zhenhai Refining & Chemical Company (hereinafter referred to as “ZRCC”) is the largest integrated refining and chemical enterprise in China. Currently, it has 23 million tons/year crude oil processing capacity, 1 million tons/year ethylene production capacity, 45 million tons/year marine terminal handling capacity, and more than 3.5 million cubic meters of tank storage capacity, which constitutes the industrial pattern of “large refining, large ethylene, large terminals and large storage” and represents the advanced level of China's refining and chemical industry. The performance evaluation report made by the internationally renowned Solomon Consulting Company shows that ZRCC's oil

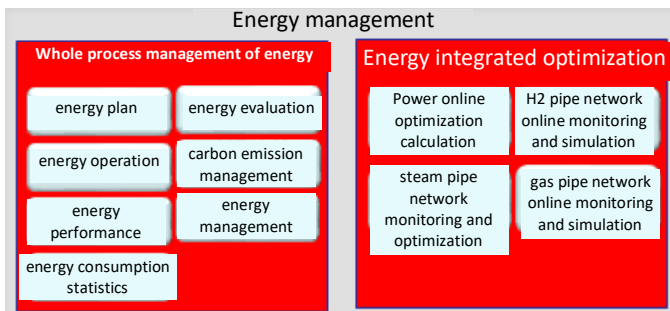
refining efficiency ranks the first quartile in the Asia-Pacific region; the performance of its ethylene plant ranked the first quartile in the global ethylene plants (naphtha) after it was completed and put into operation in 2010; the ethylene cracking unit has been awarded the honorary title of “Benchmarking Enterprise for Energy Efficiency Leader (Ethylene)” and the energy efficiency leader of the Ministry of Industry and Information Technology by the China Petroleum and Chemical Industry Federation for seven consecutive years.

ZRCC established the ISO 5001 energy management system and was certified by the third-party system in 2013, which promoted the improvement of its energy management. However, some problems were also found during the operation of the system, such as scattered visualization system of energy management, weak analysis and optimization function, lack of energy monitoring module, and inability to meet the needs of the construction of intelligent plants and the further improvement of the operation performance of ISO 5001 energy management system, and even more inadaptation to the broad environment of continuous information technology development. In 2015, ZRCC management decided to set up an Energy Management Information System (SMES) with the goal of “building a world-class energy and chemical company” and an intelligent plant and for the purpose of saving energy and reducing carbon. The SMES is organically integrated into the currently operated ISO 5001 management system to promote interactive innovation and continuous optimization of data, technology, business processes and organizational structure, fully tap the potential of resource allocation, continue to build a new energy

efficiency enhancement capability in the information environment; with the help of the ISO 5001 management system, SMES is operated to form a sustainable competitive advantage, realize the process of innovative development, intelligent development and green development, and achieve that energy can be "clearly stated", "well managed" and "saved", and achieve "maximum energy efficiency, visualization of energy flow and online optimization".

Main functions of SMES: collect, merge, count, analyze and optimize the values of data in the whole process of production, storage, conversion, transportation and consumption of various energy media in the enterprise through the construction of an energy plant model, so as to realize the integrated optimization of the whole process management and energy mainly including energy working media:

steam pipe network; built the energy consumption monitoring module by the core idea of real-time monitoring and real-time control; through SMES system, the energy consumption and energy utilization process of the enterprise was fully demonstrated. On the basis of SMES system data, ZRCC organized the annual energy review; first, the energy review was conducted with each production unit as the energy-using unit; second, the entire process energy review of the enterprise was conducted in combination with the unit review to determine key energy-using links, find out energy-saving potential, put forward plans for improving energy performance and performance targets, thus promoted the operation of the energy management system and finally improved the energy efficiency. and finally improved the energy efficiency through analyzing and finding the energy-saving potential and making improvement.



Through SMES integration into ISO 5001 energy management system, ZRCC has realized a two-level energy balance from the balance of physical pipe network to the balance of the whole plant's segments, and made statistics and monitoring of energy consumption data of refining and chemical plants in an online integrated manner; established the mechanism optimization model of anti-equilibrium efficiency to reduce the production cost of boiler and turbine; achieved the on-line monitoring and optimization of

Commercial benefits

Input and output analysis of energy management: the input cost of Smart Management of Energy System (SMES) is US\$922,700, and the annual total energy saving cost is US\$2.575 million.

1. Direct economic benefit

After SMES is integrated into the ISO 5001 energy management system, the operation efficiency of the ISO 5001 energy management system has been enhanced and the energy efficiency has been improved through the organic combination of SMES and the energy management system to realize the online statistics, analysis and control of energy consumption. Taking the ethylene plant as an example, the energy consumption of the ethylene plant in 2019 is 1.71% lower than that in 2015, which can save about 2.88 million yuan of energy cost per year, with a total energy saving of 422110GJ and 35,900 tons of CO₂; through thermoelectric optimization, the annual energy consumption cost is saved by about 14.76 million yuan, the total energy saving is 216420GJ, and the CO₂ saving volume is 184,500 tons.

2. Indirect economic benefit

Performance of power system optimization management. The combined modeling of steam power system, boiler water supply system and circulating water system is realized, the real-time calculation of thermoelectric indexes of each power station is realized, and an optimized adjustment scheme is provided for the comprehensive thermoelectric indexes of the power station. Through the implementation of this project, it can play a role in popularizing technology for managing the operators, improve the technical literacy of the

Summary of case study	
Industry	Petrochemical
Product/service	Gasoline, refining, diesel, polyolefin etc.
Location	China
Energy management system	ISO 50001
Energy performance improvement interval, in years	2015 ~ 2019
Annual increase ratio of energy performance (%)	0.43%
The whole improvement period (taking ethylene as an example)	
Total energy-saving cost	
The whole improvement period	
Implementation cost of energy management system	US\$ 922.7K
Total energy saved during the improvement period	2586310 GJ
Total CO ₂ emission reduction during the improvement period	220400 (Metric tons)

operators, fundamentally ensure the operation safety of the energy system, and help the planners to consider the whole steam-water power system globally and make a reasonable planning scheme.

Effectiveness of ZRCC’s steam pipe network improvement. The combined modeling and linkage simulation of the steam pipe network with various pressure grades and different media pipe networks are realized, and the online optimization and quantitative optimization are achieved.

Effectiveness of energy flow management. The data collection of the whole process of energy supply, production, transfer, transmission and consumption is completed, the on-line ten-day and monthly balance and

monthly settlement are realized, and the calculation and evaluation of comprehensive indexes of energy production and consumption are achieved. Data support is provided for enterprise ERP system, energy consumption statistics & analysis system of refining and chemical plants, enterprise energy statistics & analysis system, production scheduling system and production management system. In addition, the energy efficiency of the equipment is improved through on-line centralized monitoring of the energy consumption of key energy-using equipment.

3. Social benefits

Demonstrate and promote the two-oriented integration of chemical enterprise

The integration of SMES with enterprise ISO 5001 management system has effectively promoted the two-oriented integration of the enterprise, improved the management level of the enterprise, and promoted the Chinese refining and chemical enterprises to become world-class integrated and advanced enterprises, all of which have good demonstration effect.

Promote energy saving and emission reduction and fulfil social responsibility

The report of the 18th National Congress of the Communist Party of China puts forward the guiding ideology of “taking scientific development as the theme and taking the promotion of the change of the economic development mode as the main line”, taking the strategic adjustment of the economic structure as the main attack direction, and puts forward the requirements of "vigorously promoting the construction of ecological civilization, promoting the fundamental transformation

of the mode of resource utilization, strengthening the overall process of conservation management, greatly reducing the intensity of energy consumption, improving the utilization efficiency and benefit, and controlling the total amount of energy consumption". Through integration of SMES into the ISO 5001 management system of the enterprise, ZRCC has improved the efficiency of system operation, effectively reduced energy consumption and promoted the realization of the goal of "double control" of energy, helping to better fulfill the social responsibility of the enterprise.

Planning

The SMES project of ZRCC was started in early 2015. After preliminary research and scheme certification, the implementation scheme was formally determined and the implementation contract was signed in December 2015. The main functions of enterprise-level SMES cover the following four aspects: energy operation, energy optimization, energy statistics, evaluation & analysis.

SMES implementation schedule:

S/N	Name of Control Point	Completion Time	Deliverables
1	Implementation scheme	Dec. 2015	Submit the Implementation Scheme
2	Project initiating	Dec. 2015	Submit the Commencement Report
3	System design and modeling	May 2016	Model verification and test report
4	Online operation	Oct. 2016	Submit the Online Operation Initiating Report
5	System acceptance	Dec. 2017	Submit the Application for Acceptance

Main objectives for SMES implementation:

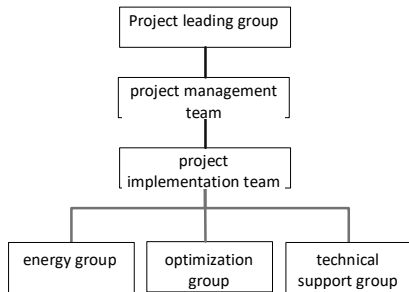
1. Make optimal management of the power system, and calculate the economic benefits according to the improvement of comprehensive thermoelectric economic indicators.

2. Complete the data collection of the whole process of energy supply, production, transfer, transmission and consumption, realize on-line ten-day

& monthly balance and monthly settlement, and realize the calculation and evaluation of comprehensive indexes of energy production and consumption, and calculate energy-saving benefits according to the improvement of energy performance.

Implementation, Inspection and Action

In order to ensure the smooth progress of the project, the organizational structure has been defined, and the leading group for energy management project has been set up; the company's intelligent plant leading group is determined as the leading group of energy management project. The enterprise project management team and the enterprise project implementation team have been established. The project implementation team consists of an energy flow group, an optimization group and a technical support group. The responsible units, responsible persons and corresponding responsibilities have been defined. SMES implementation organization framework is as follows:



Requirements for personnel and responsibilities of project leading group and implementation team.

Position	Requirements for Work Division	Work Plan and Responsibility
Energy management project leading group	The leading group of the company's intelligent plant is the energy management project leading group. Leader: company GM Zhang Yuming	1.Approval of project organization. Ensure the authority of the personnel composition of the project team in terms of business and management. 2.Decisions on other major issues related to the project.

Management team of Energy management project	The intelligent production & operation team of the company's intelligent plant is the management team of energy management project	1.Hold regular meetings in due course to solve various problems in the project construction, and control the project schedule. 2.The conclusion of the regular meeting of the management team forms official minutes of meeting, which is issued as an official document of the enterprise. 3.The management team is responsible for coordinating and managing the project schedule, personnel attendance and other important items of project construction.
energy flow group	As the competent department of energy, the Production Department coordinates all business units and is responsible for the demand and construction of energy evaluation modules. The Planning Department is responsible for energy operation, energy statistics module demand and construction. Leader: Sun Minjie	The energy flow group is responsible for the implementation of energy operation, energy statistics, evaluation and analysis of energy management projects.
optimization group	The Mobile Department is responsible for the demand and construction of energy optimization modules.	The optimization group is responsible for the implementation of the energy optimization module of the energy management project.
technical support group	The Information Center organizes PCITC and Donghai Lanfan to provide IT technical support.	Be responsible for project development and implementation, conduct the training of key users and end users properly, and timely transfer the knowledge to the system maintenance IT personnel of Donghai Lanfan.

The operation of ISO 5001 management system is required for management during the project implementation; the process control adopts the method of weekly meeting. During the implementation process, the personnel of the project implementation team communicate, coordinate and improve the schemes timely as required, and conduct training according to the progress to ensure the smooth progress of the project. Training methods:

Project Stage	Main Training Contents	Participants
Implementation preparation stage	Basic concept training	Leaders and key users
	System software training	Key users
Project design, system modeling, testing and training	Training of implementation module	Key users
	End user training	End user
	Training of operation and maintenance	System operation & maintenance personnel
Online and support	Consultant knowledge transfer	Key users

Target checking:

Evaluation methods of energy performance:

Through the implementation of the management plan, the energy performance has been generally improved, with the outstanding performance being the

improvement of energy efficiency of thermoelectric power system and ethylene cracking unit.

1.Improvement of energy efficiency of thermoelectric power system. The evaluation is based on the improvement of thermoelectric index, and the main index is the standard coal consumption of power supply. Compared with 2015, the power supply standard coal for thermoelectric power system in 2019 decreased by 27.65g standard coal/KWH, equivalent to a decrease of 2164200GJ.

2.Improvement of ethylene energy efficiency. The evaluation is based on the energy consumption per unit product of ethylene cracking unit. Taking ethylene cracking unit as an example, compared with 2015, the comprehensive energy consumption per unit product of ethylene in 2019 decreased by 8.74 kg standard oil/ton, equivalent to a decrease of 422110GJ.

Visual material

Successful experience

- A. The implementation of organizational structure, personnel and responsibilities is the guarantee for the success of implementation, and the efficient operation mechanism is the essential condition for the success of implementation.
- B. Keep pace with the times and adapt to the needs of rapid informatization. Build an energy plant model; through collection, merge and statistics of

the values of data in the whole process of production, storage, conversion, transmission and consumption of various energy media of the enterprise, adapt to the ever-increasing information needs, such as the management of carbon emissions, online monitoring of government energy, etc.

- C. The new system is adapted to the existing systems of the enterprise and the superior departments to ensure the integration and consolidation with the existing system of the enterprise. During the construction of SMES system, ZRCC has considered to realize the integration with Sinopec's chemical dispatching and command system and keep the data consistent; realize the integration with Sinopec's refining energy statistical analysis system and keep the data consistent; realize the integration with ERP system; realize real-time database integration; realize LIMS system integration, and realize the integration with weighing apparatus database to ensure the operation efficiency after the system is built up.
- D. The functions set up by SMES should be realistic, meet the needs of the enterprise itself and match the quality and ability of enterprise personnel. In the process of realizing on-line optimization of steam system, the chief engineers of ZRCC's departments participated in the whole process, revised and proposed the scheme, which ensured that in the process of project implementation, the operating state of boiler and turbine could be adjusted from the perspective of the whole system by calculating the actual cost of steam and electricity, thus improving the system efficiency and reducing the energy consumption of equipment; and in the current energy price market environment, optimize the energy structure configuration of the system,

Through the Energy Management Working Group (EMWG), government officials worldwide share best practices and leverage their collective knowledge and experience to create high-impact national programs that accelerate the use of energy management systems in industry and commercial buildings. The EMWG was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC).

For more information, please visit www.cleanenergyministerial.org/energymanagement.



reduce fuel costs; comprehensively consider the economy of purchased electricity and rationally adjust the cogeneration mode.