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IMPLEMENTATION OF ISO 50001 ENERGY MANAGEMENT SYSTEM WITH THE ADVANTAGE OF ARCHIVE VIEWER IN NSRRC

C. S. Chen†, W. S. Chan, Y. Y. Cheng, Y. F. Chiu, Y. C. Chung, K. C. Kuo, M. T. Lee, Y. C. Lin, C. Y. Liu, Z. D. Tsai, NSRRC, Hsinchu, Taiwan

Abstract

Due to the limited energy resources in Taiwan, energy conservation is always a big issue for everyone who lives in this country. According to the data from the related departments, nearly 98% of energy is imported from abroad for more than a decade. Despite the strong dependency on foreign fuel imports, the energy subsidy policy leads to a relatively low cost of energy for end users, while it is not reasonable. In order to resolve the energy resource shortage and pursue a more efficient energy use, the implementation of ISO 50001 energy management system (EnMS) is activated with the advantage of the Archive Viewer in NSRRC this year. The energy management system will build up an overall energy usage model and a certain number of energy performance indicators to help us achieve efficient energy usage.

INTRODUCTION

According to the data released from ISO in 2017, more than 22,870 enterprises have been certified to meet the requirements of ISO 50001 globally. Comparing 2017 to 2016, the increment of certificated enterprises is nearly 13%. There are 290 enterprises certified in 2018 in Taiwan. It shows the determination of Taiwan in energy conservation. Since 2011, the Taiwan Green Productivity Foundation has been entrusted to execute the consulting project in deployment of ISO 50001. This project has successfully assisted 125 enterprises in developing the energy management systems and earned the third-party certifications from 2011 to 2018 in Taiwan. This project sums up to carry out 1,131 energy conservation treatments and saves 120 million kWh of electrical energy in total over the past eight years.

Figure 1 shows the trends of power usage and gross domestic product per capita in Taiwan from 1995 to 2018. Taiwan's factories are an indispensable part of the global supply chain for high-tech industry. Over the last two decades, the total energy consumption grew up obviously along with the GDP in Taiwan except for the drop in 2009 due to the great earthquake of September 21. It is always a real dilemma when it comes to economic development and environmental protection together. Due to the limited natural resources in Taiwan, the development plan in this country must be sustainable and environment-friendly. It is the main intention to deploy the energy management system to NSRRC.

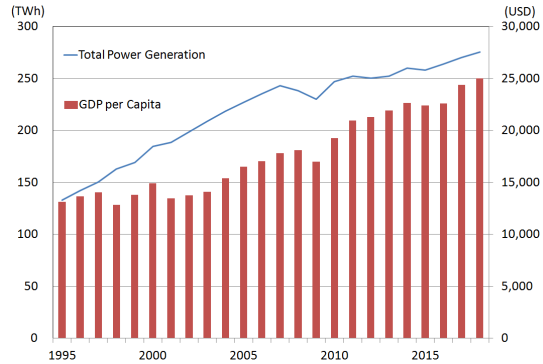

Figure 1: Total power generation and GDP in Taiwan from 1995 to 2018.

ISO 50001:2018

ISO 50001 is an international standard which integrate the energy performance system and the institutionalized system. It provides enterprises a completed energy management system to fulfil energy saving affairs. Its first edition was released by International Organization for Standards (ISO) in 2011, and revised to the latest version in 2018. It combines the viewpoint from stockholder and the concept of risk management to operate the PDCA management cycles, which stands for Plan-Do-Check-Action, a repetitive four-stage model for continuous improvements shown as Fig. 2.

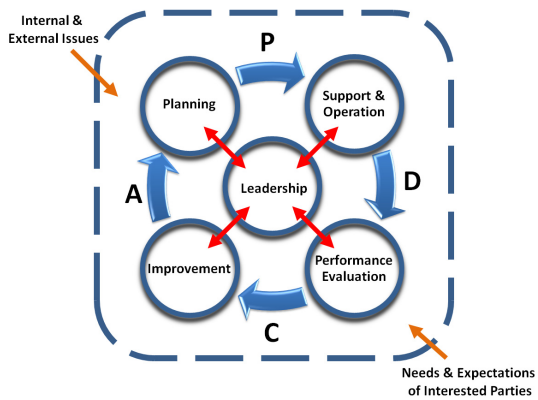

Figure 2: PDCA cycles in ISO 50001:2018 energy management system.

The latest version of standards labelled as ISO 50001:2018 are mostly the same with the former. The biggest difference between ISO 50001:2018 and the former version is laying a greater emphasis on the role of high level structure, which implies the stronger importance of leadership in the operation of PDCA cycles. Furthermore, the clarifications on the content of energy

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performance indicator (EnPI) and energy baseline (EnB) make it easier to understand these concepts.

ARCHIVE VIEWER SYSTEM

The Archive Viewer system in Taiwan Light Source (TLS), a highly complicated system with hybrid SCADA systems was proposed by Tsai et al. in 2007 [1]. It collects most of the instrumentation data in TLS, including the vacuum, magnet, RF, utility, cryogenic, power, safety, optic devices and so on. These data are collected in the central storage area network (SAN) via fibre network without latency to form a big data base. Most importantly, these big data could be extracted and arranged by different purposes and systems to satisfy all kinds of end users.

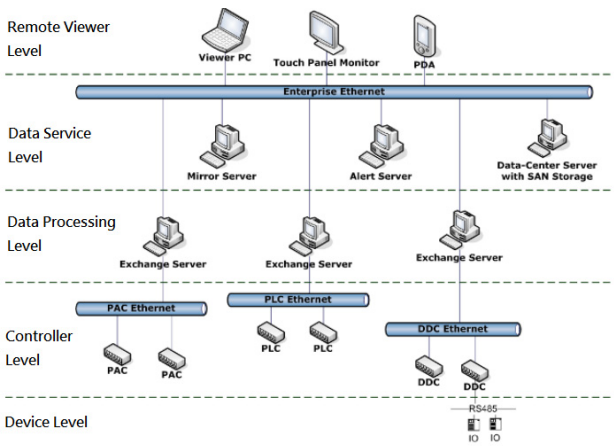

Figure 3: Network architecture of the Archive Viewer system.

Figure 3 shows the latest version of network architecture of the Archive Viewer system in NSRRC. The new Archiver Viewer system provides better protocol integration, such as dynamic data exchange (DDE), OLE process control (OPC), PSP, EPICS, Modbus etc. [2]. The data belong to different systems or different types of classifications are collected by respective data servers. For example, the data of de-ionized water systems and cooling systems are collected together in server TPS1 due to the higher importance of these data. The data collected through direct communication with devices or gateways are recorded and stored in server TPS4. On the other hand, the data of power system are channelled to the server TPS6 from the existing power SCADA system. All of the data mentioned above could be reviewed in real-time or historical form on the union platform by enterprise Ethernet. With the aids of the whole area coverage WiFi within NSRRC and the remote desktop apps on smart phones or remote devices, commanding on utility systems becomes very simple and easily accessible. After integrating the LINE Notify, the alarm server could send instantaneous warnings once the readings of the monitoring data exceed the thresholds. The big data base is very helpful to build up the energy tracking model and EnPIs, as well as to establish the long term EnB.

ISO 50001 IMPLEMENTATION

Some of the core concepts of ISO 50001 are presented below. Most important part of this implementation lies in the actions that top management takes to support the implementation and maintenance of an EnMS. The top management is important not only to demonstrate the determination on energy conservation, but also to coordinate with other related sectors. Once winning the support of leadership, a series of review work have to be done afterward.

Energy tracking could be easily accomplished by analyzing the big data base of Archive Viewer system. There are two electricity meters to record the electric consumptions of TLS and TPS separately. Each of them is composed of two high voltage feeders and different capacity contract. The contract capacity of TLS and TPS were 5,500 kW and 7,500 kW respectively before the modification this year. Tracking the electricity usage helps us to itemize the major equipment with significant energy consumption. An energy profile composed of the numerous data is a useful tool to allow management acquiring the energy consumption status of the organisation with more accuracy and details.

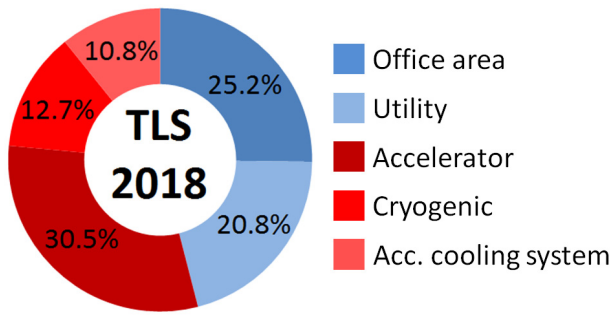

Figure 4: The energy profile of TLS in 2018.

Figure 4 shows the energy profile of TLS in 2018. The different shades of red portions in this graph represent the total energy consumption of the accelerator related facilities. This part is excluded from energy review items at the first stage due to its importance and immutability. Therefore, the action plans proposed to meet energy policy in this implementation are all confined within utility and office usage. Energy consumption can be obtained by reviewing electricity bills, calculating and estimating from the data of Archive Viewer system. The energy baseline is a reference for measurement of energy performance. In order to review energy performance, the performance indicators must be defined according to the conclusions of energy management team. Respective performance indicators could be proposed and adopted in their own fields as long as the indicators could describe the energy consumption well. The energy management team have to review these data periodically and take actions at once if any of these indicators show something wrong. All processes mentioned above must be written down as documentations and put into the P-D-C-A cycles to review energy performance regularly. Five action plans in this implementation are introduced as follows.

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FIVE ACTION PLANS

These five action plans have been discussed and approved by the energy management team in NSRRC.

Rationalization of Electric Contract Capacity

Total electricity consumptions of TLS and TPS from 2016 to May, 2019 are shown as Fig. 5. The values of electric power capacity in TLS and TPS were 5,500 kW and 7,500 kW respectively before the modification to 5,300 kW and 7,100 kW in July, 2019. In order to avoid breach of the contract, there is much buffer between real usage and contract. It will save 4,000 USD every month after the new agreement. Although it seems not a large amount of money, the resource could be used in energy conservation and make it a more efficient investment.

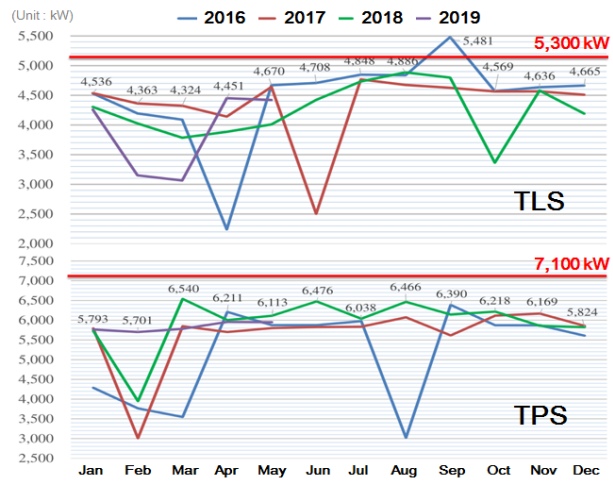

Figure 5: Total electricity consumptions of TLS and TPS from 2016 to 2019.

Photovoltaic System in NSRRC

Figure 6: The "Green Roofs" in NSRRC.

To respond to the "Green Roofs" policy held by the government, it cost more than two years to set up photovoltaic system on the available roofs in NSRRC as shown in Fig. 6. The photovoltaic system generates 1.15 billion kWh of electricity every year which is up to 20% of the total solar power generation in Hsinchu city. This solar power system is estimated to reduce over 600 tons of CO_2 exhaust every year, and furthermore, the shadow of solar panels lowers the temperature beneath. The temperature decrease in top level room is about 2°C, and saves more than 5% of air conditioning system energy in the specific building.

Adoption of EC Fan in AHU

An EC (Electronically Commutated) fan is a fan with a brushless, direct current and external rotor type of motor. The rotation speed of the EC fan is adjusted by changing input DC voltage. Therefore, the frequency invertor is not a necessary device to achieve accurate temperature control. Other advantages of EC fan include lower energy consumption and vibration, smaller than plug fan, and more reliable. For example, a 15,000 cfm plug fan could be replaced by a set of two 7,500 cfm EC fans or a set of four 3,750 cfm EC fans. The power of single plug fan is 10.55 kW, noise levels 86 dB(A). However, the double fan set operates with 7.73 kW and 76 dB(A), the quadruple fan set operates with 7.63 kW and 73 dB(A). Both reduce at least 25% of power consumption.

Replace Metal Halide Lamps with LED Lamps

384 metal halide lamps were replaced with LED lamps in TPS experiment hall. Each lamp power reduces from 400 W to 153 W and saves 700 USD every month.

Clean the Exchanger of TLS Cooling System

The exchange heat capacity of Cu de-ionized water system in TLS was limited because of tubes blocking. It caused the secondary pumps to operate with excess power and valves out of control. The situation returns to normal after the heat exchanger pipes got cleaned.

CONCLUSION

In this article, we describe the processes to get ISO 50001 certification in NSRRC. The energy efficiency in NSRRC will become better in the future.

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