Profitable Migration Planning of Production Control Systems by Master Planning

- An Application Example at the Moscow Refinery of JSC (Joint Stock Company) Gazprom Neft in Russia -

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The Moscow refinery of JSC (Joint Stock Company) Gazprom Neft in Russia decided to migrate its existing production control systems including safety instrumented systems, as a part of a large-scale modernization project. The refinery was operated from about 40 distributed control rooms of different sizes. Although consolidating these was expected to improve safety and efficiency, many problems were faced when creating a road map to the target. The Moscow refinery therefore decided to apply Yokogawa’s Master Planning to solve them and to conduct a preliminary study. After a five-month study, Yokogawa created a profitable migration plan for the production control systems, ensuring safety and feasibility throughout the course until the completion of consolidation. The improvements to production efficiency and work efficiency are expected to yield sufficient profits.

INTRODUCTION

Upgrading and renewal of plant facilities, including production control systems and safety instrumented systems, are essential for maintaining safe and efficient plant operation. Even though these activities are categorized as R&R, they require investment and customers are often required to evaluate the profitability for obtaining approval.

The Moscow refinery of the Joint Stock Company (JSC) Gazprom Neft was planning a large-scale modernization project of its facilities, including consolidation of the control rooms. As a part of the project, the refinery conducted a preliminary study on consolidation of the control rooms by using Yokogawa’s Master Planning. Through five months of study and analysis, Yokogawa prepared a safe and feasible migration plan for the production control systems to consolidate them from the distributed ones. The plan also showed that the migration was justified in terms of improving production and operation efficiency.

OUTLINE OF MASTER PLANNING

Yokogawa’s Master Planning creates a master plan for solving customers’ challenges for system migration.

- Outlines

Yokogawa has prepared many migration plans for production control systems and worked on migration projects. Based on these experiences, Yokogawa proposes profitable migration of a production control system, in which Yokogawa not only replaces the existing obsolete production control system with the latest system but also draws up a roadmap leading to the VigilantPlant while solving current problems. It is particularly important for a large-scale project to conduct a detailed feasibility study before implementing the project, since the consolidation of control rooms or modernization of facilities is not a simple replacement but affects even the production organization and procedures. The master plan established through the study includes the systems and facilities to be replaced, the investment, operational impacts (e.g., operation by fewer operators, yield improvement and energy saving), requirements for consolidated control rooms (number of rooms, location, size and functions), implementation steps and schedule, reengineering of the production organization, and training of operators.

- Study team members

A feasibility study is conducted by working closely with the customer to make maximum use of the customer’s...
requirements. Furthermore, the team consists of a user-oriented member who has experience of system consolidation/migration and expertise in state-of-the-art technology. This brings more benefits to both the customer and Yokogawa by investigating improvements with the customer than merely designing a new system configuration and estimating the investments.

Study procedure

The Master Planning is one of the VigilantPlant Services. The study is conducted under a standard procedure based on the DMAIC process of Six Sigma (Define, Measure, Analyze, Improve and Control).

BACKGROUND OF SERVICE INTRODUCTION TO THE MOSCOW REFINERY

Outline of the Plant

JSC Gazprom Neft, one of the leading Russian petroleum companies, has five refineries in Russia and Serbia. One of them, the Moscow refinery, is capable of processing 12 million tons of crude oil a year or about 230,000 barrels a day. The refinery produces 15 products of more than 40 specifications, such as LPG, gasoline, jet fuel, diesel, fuel oil and asphalt, which are mostly supplied to Moscow and its vicinity. The refinery plays an important role in meeting the demand in the capital of Russia. It is a complex refinery equipped with crude distillation units, vacuum distillation units, a fluid catalytic cracking unit, catalytic reforming units, hydro-desulfurization units and an asphalt production unit in addition to utility facilities, and receiving and shipping facilities.

Challenges

As a result of a long history of process expansions and obsolete production control systems, the Moscow refinery has approximately 40 separate control rooms of various sizes near individual units, with distributed operators stationing in those rooms. Aiming to be a safer and more efficient world-class petroleum refinery, the Moscow refinery launched a modernization project. As part of the project, they considered consolidating control rooms to operate a series of units in a centralized and coordinated manner. However, the Moscow refinery had never experienced large-scale consolidation of control rooms and was concerned about the following issues in proceeding with the project:

- Is it possible to migrate from the 40 control rooms to one consolidated control room in one step?
- Where is the best location for the consolidated control room? What functions should it have? What kind of personnel in charge should be stationed? How large does the room need to be?
- How far can the operators be stationed from the process equipment in terms of safety?
- How much investment is required and how much return can be expected?
- The minimum turnaround period for migration is desirable. What is a realistic schedule?

- How does the consolidation of the control rooms impact on the job assignment of the operators? What training will be necessary?

The new process equipment is scheduled to be constructed soon. To match the control room consolidation schedule with process modification, immediate master planning for the consolidation was requested. If control rooms were designed and constructed separately from new process equipment, it might prove to be a poor investment.

Solutions

To solve the challenges stated above, Yokogawa proposed a feasibility study to create a master plan for a consolidated control room and the Moscow refinery accepted. One of the key reasons for the acceptance was the fact that Yokogawa had conducted a similar feasibility study elsewhere in Russia.

MASTER PLAN FOR THE MOSCOW REFINERY

The Master Planning of control room consolidation for the Moscow refinery was implemented by the following procedure, which took five months including the preparation period.

- Field survey and information gathering
- Clarification of future vision of the refinery
- Creation of multiple migration scenarios
- Study on requirements and configuration of a new production control system
- Evaluation of return on investment based on the scenario of each case
- Selection of the best scenario from various perspectives including safety, feasibility during the transition process, and return on investment
- Establishment of the project schedule considering migration procedures
- Reengineering of the operation organization and job assignment

Define

Normally, Yokogawa conducts a field study called a preliminary site survey before proposing a study on control room consolidation. This process is useful for defining the study items and details that vary depending on the customer’s situation and requirements. Meanwhile, for the customer this is a good opportunity to obtain an overall picture of the project in advance, such as the purpose of the study, its output, project team structure for the study and Yokogawa’s expertise. Through the site survey, the customer and Yokogawa can share ideas.

During the study, the Moscow refinery and Yokogawa shared a vision: The consolidated control room will become a production management center (PMC) which, by not only consolidating process control rooms but also consolidating production functions and accelerating cooperation between functions, can execute the Plan-Do-Check-Act (PDCA) production cycle surely and promptly.
addition, we included proposals on the production management system, asset management system and training system of operators upon request.

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<th>Table 1 Study items and details</th>
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<td><strong>Item</strong></td>
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<td>APC *2</td>
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<td>OMS &amp; Blending *3</td>
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*1 Studies on upgrading the production control system and reengineering the organization for operation are also included.
*2 Advanced Process Control
*3 Oil Movement System & Blending
*4 Operator Training Simulator

Yokogawa lays down the principle that proposals should follow in the study of control room consolidation. Important conditions are:

- Not to increase the workload of operators
- To improve the plant operation stability
- To provide a more comfortable operation environment
- Not to lead to layoffs

**Measure**

Yokogawa conducted an approximately two-week field survey to obtain the following information.

- Control rooms and production control systems
- Work flows in operation and production planning
- Organization
- Production and shipment planning
- Future expansion and renewal plans
- Requests for consolidation

Checking the figures and diagrams is not enough; we tried to visit as many control rooms as possible. We met operators and staff working at the sites and confirmed the situation, thus correctly grasping the present state and drawing up a future vision based on the actual status of the site. Figure 1 shows photos of the site visit and survey.

The ultimate goal of the project is to consolidate the current over 40 control rooms into a single PMC. Each unit at the Moscow refinery is separated by vast distances. It would be a great risk if all the operators were to be stationed at one place. In case of emergency, a delay in field operations and decisions is critical for safe operation. To minimize the risk, field operating personnel must be stationed within an appropriate distance from the process equipment. We have defined these locations as satellite centers (SC) and examined the required number, locations, operation procedure and organization considering the required functions.

A two-step consolidation scenario as shown in Figure 2 was also examined. In this scenario, the control rooms are partially consolidated into several local centralized control rooms (LCCR) in the first step and then consolidated to a PMC in the next step. Buildings for LCCR were selected considering the following: whether the existing control rooms have enough space for both SC and LCCR, whether buildings can be expanded, whether new control rooms must be built as part of the new plant project, and where the best locations are. The number of consolidation work steps, the number of SCs and LCCRs, types of buildings and plant grouping influence both the investments and their benefits. Accordingly, eight scenarios were created, and then the best scenario was selected based on return on investment and risks during the transition.

**Figure 2** Conceptual diagram of stepped consolidation

- Estimation of benefits by control room consolidation
- The benefits of the consolidation can be divided into two: improvements in operation efficiency and production efficiency.
- By control room consolidation, usually, plants can be operated by fewer operators and maintenance staff. These benefits derive from improved automation and operator assistance systems of the latest production control system. The effect is further increased by reassessing the operational work flows and shift work scheme of operators and maintenance staff. In the case of the Moscow refinery, we estimated that the number of personnel could be reduced to 60 to 70% of the current number. To utilize the surplus but valuable human resources, we estimated the number of people effectively used

**Figure 1** Visit and survey

**Analyze**

Based on the obtained information, we conducted various analyses while clearly defining Moscow’s expectations. Some of the study results are summarized below.

- Consolidation scenarios
for the new process equipment planned to be constructed, for reference.

Once the plants are operated in the consolidated PMC environment, inefficiencies caused by scattered plants and control rooms will be minimized. The present scattered operation environment is not suitable for sharing real-time operation information, coordinating operations by close communications among units, reporting operation results immediately, or instructing changes in operation promptly. Even a conservative estimate of the value of the effects of consolidated operation amounts to approximately 400 million yen a year.

APC, OMS & Blending and OTS

Along with control room consolidation, other system modernization studies are conducted simultaneously. APC will be introduced one by one in accordance with the estimated benefits and considering the system migration plan and the process unit expansion/modification plan. Benefits of OMS & Blending were also estimated by the reduction of inventory and reduction in quality give away. OTS is a very effective tool for training operators who must cover a larger area of units as a result of consolidation of the control rooms and its introduction schedule was determined.

Improve

An interim meeting was held for the members of the Moscow refinery study team to share the study results and their background. At the meeting, all reconfirmed the direction of the study. We also discussed the remaining work and received additional information, and requests on the final report.

Control

The final report was presented at both the Moscow refinery site and the headquarters of Gazprom Neft. Based on our recommendation, Gazprom Neft appreciated one of the scenarios that is superior in terms of both safety during the migration and investment efficiency. The migration schedule was also discussed in detail.

CUSTOMER APPRAISAL OF THE MOSCOW REFINERY

The studies on establishing a PMC and creating an effective investment/migration plan, which were the purposes of this study, were completed within the specified period. The Moscow refinery and the headquarters of Gazprom Neft appreciated this study, stating that it was not a mere migration plan but a comprehensive plan for modernizing operations including proposals for improvements in operation. We hope that control room consolidation and migration of the production control system will be carried out according to the established master plan and that the expected benefits will be materialized.

CONCLUSION

Yokogawa offers not only production control systems, but also services involving working with customers to achieve common goals in the areas of improving production efficiency, safety performance, operating environments and return on investment such as the Master Planning. Yokogawa will continue to meet customers’ expectations and offer valuable proposals through extensive studies.

In closing, we would like to thank the people at the Moscow refinery for participating in the project and cooperating as study members.

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