Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 10-11, 2007

I&C System Upgrade Process Development of NPPs in Korea

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1. Introduction

Nuclear power plants are required safety operation and higher availabilities, Instrumentation and control (I&C) system upgrading program from the conventional system to the latest digital system will contribute to improve system reliability, testability, and maintainability. To upgrade I&C system in the near future also contribute to conduce plant life extension, short maintenance outage, and periodical safety review.

This upgrading program will be applied commonly to various plants that have different historical design backgrounds. So, the important thing is to standardize the planning process, the system architecture, and the upgrading procedure so as to ensure successful design and modification activities, and simplify maintenance, economical operation thereof.

In this paper, we discuss I&C upgrades planning guideline, preparatory and further work in system evaluation for upgrade, and upgrade procedures considering.

2. I&C Upgrade Program

2.1 I&C Upgrade Planning Guideline

The goal of the program is to develop a strategic plan that will allow demonstration plant to perform all necessary I&C upgrades in the most timely and cost effective manner. The key objectives of the program include functional and hardware software minimization, reducing operation and maintenance cost, improving plant efficiency, reducing the cost and schedule of modifications, improving the man-machine interface, improving information availability, and developing long-range maintenance plans for systems that will not be upgraded.

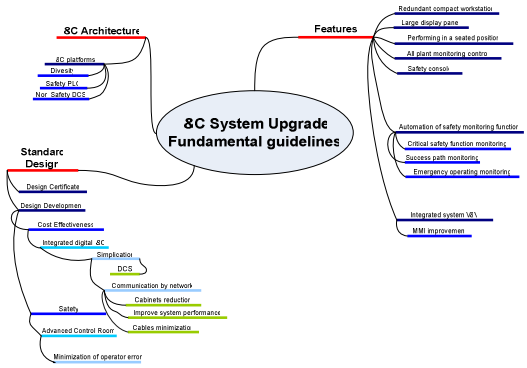

Fig. 1 I&C system upgrade fundamental guidelines

In Fig. 1, I&C system upgrade fundamental guideline is described, whose philosophy of I&C system upgrade is almost common for all the upgrading I&C systems.

2.2 Decision making

There are several interrelated decisions for us to take for each plant which will have a fundamental attitude on the nature of I&C upgrades. What level of approach to adopt between minimum and maximum. Whether the upgrade is to be conducted system-by-system, or whether a more integrated approach should be adopted to choose the manner in which the necessary functions are to be achieved. Whether constraints are to be placed on the extent of use of computer systems in the safety system.

2.3 I&C Upgrade Preparatory Work

Once the goals are in the upgrade process established, the overall system requirements, the architecture plan, and the system evaluation process are fed into as factors forming the system upgrade functional requirements. In the system evaluation, several factors are examined, which are data collection, analysis and problem definition, root cause determination, and prioritization as shown in Fig. 2 [1][2].

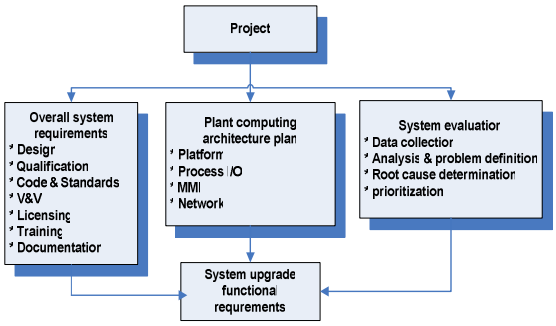

Fig. 2 Mainly three factors forming I&C system upgrade functional requirements

In the upgrade preparatory work, an important part of addressing the digital upgrade issues is the evaluation and resolution of potential failure modes. So, failure analysis interacts with all the I&C upgrade activities including system upgrade functional requirements.

Under upgrading preparatory work, we will complete the development of the system upgrade evaluation

system for the purpose of determining of the ranking of system upgrade this early year.

Based on the preparatory work, the further work is to be planned for the system re-evaluation, which are called "logical grouping" aiming at the optimal I&C upgrade process in the manner of cost-benefit performance in the following year. In the process of the further work, the interface between I&C and Man machine interface (MMI) should be certainly considered on the basis of upgrade process.

Fig. 3 shows the system upgrade ranking using the system evaluation to be developed. Fig. 4 shows the system logical grouping, that is, the re-ranking of prioritization of system upgrade, considering sites restraints or needs.

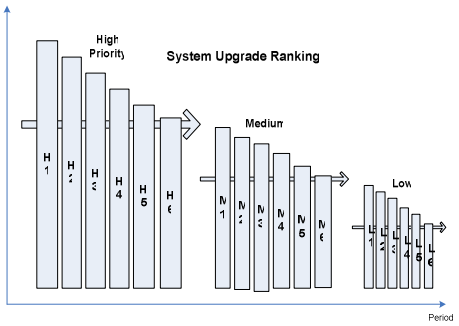

Fig. 3 I&C system upgrade ranking using system evaluation

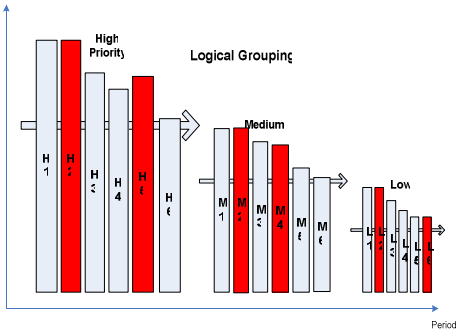

Fig. 4 I&C system logical grouping

In our study, among feasible sites restraints will physical boundary, inter related system impact, outage period, budget, and mechanical and electrical systems upgrade schedule etc. be examined toward the well planned I&C upgrade process.

2.4 I&C Upgrade Procedure Considering

2.4.1 Temporary systems

Knowing the design of the whole I&C system, it is not so practical to replace all the I&C systems at the same time. So, it is feasible to perform replacement work each by each during plant refueling outage. From this view, the examination on the plant wide system architecture, and the examination on the feasibility of the temporary system configuration are inevitable.

2.4.2 Interface issues between systems

Interface between systems will change along with the upgrading schedule as the digital systems already replaced and the existing systems, mixed in the temporary. Although the changes are a necessary activity, it is crucial to establish the upgrading program that minimizes the changes in design of the interface of already replaced system.

From this view, the priority of the upgrading system, in our work, so called logical grouping, is under examination to minimize the cost and to realize easier work process. This process will be revealed in at the end of 2008 in our work.

3. Successful approaches to I&C System Upgrades

Not only the examination on the plant wide system architecture, but also the examination on the feasibility of the temporary system configuration is important.

In case of the digital systems replaced and the existing systems, with mixed in the temporary configuration, the interface between systems will be surely changed along with the upgrading schedule. It is important to set up the upgrading program that minimizes the changes in design of the interface of already replaced system.

Therefore, the order or priority of the system replacement will be carefully examined to minimize the cost and to realize easier work process, aiming at plant wide long-term upgrading program. From this view, the logical grouping methods in I&C system upgrade process will be the leading solution forward cost-benefit performance which will be developed in our study.

4. Conclusion

This upgrading program will be applied commonly to various plants that have different historical design backgrounds. So, the important thing is to standardize the planning process, the system architecture, and the upgrading procedure so as to ensure successful design and modification activities, and simplify maintenance.

In this paper, we discussed the I&C upgrade planning guideline, the preparatory and further work in system evaluation for our future upgrade, the upgrade procedures considering, and finally the successive approach to I&C system upgrades.

REFERENCES

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[2] Ornellas, R.P., Gross, R.S., Strategies for instrumentation and control upgrades, Nuclear Science Symposium and Medical Imaging Conference, 1994, IEEE vol.3 p1047 - 1050