Y2K Strategies for Korean Nuclear Industry

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Abstract

The Korean nuclear industry is unique in the sense that Korean nuclear power plants were influenced by a combination of French, U.S., and Canadian technologies. The Korea Electric Power Corporation(KEPCO) and the Korea Power Engineering Company(KOPEC) have jointly developed a project for resolving the Y2K problem in the Korean nuclear industry. This unique Korean environment provides a special situation and the Korean nuclear industry as a whole is under a tight schedule considering the remaining time frame. The concerns and activities related to the Y2K problem are presented herein with a look into the stepwise planning strategies.

1. An overview of Korean Nuclear Industry

Including two units in North Korea that are going to be constructed by KEDO(Korea Energy Development Organization), with multinational funding, there are currently fourteen nuclear power plant units in operation plus eight units in planning or under construction.

In past twenty years, there were four major nuclear supply vendors from three countries that arrived on the Korean peninsula. They are: Westinhghouse, ABB-CE, AECL, and Framatome representing the United States, Canada, and France. The technological level of Korean nuclear industry received a booster when technology transfer was started for the Korean Standard Nuclear Power Plant project.

Now Korean utility authorities are looking at the possibility of adopting standard 1400MW units as next generation reactors. After twenty years of operating experience and ten years of plant design experience, Korean nuclear industry is currently in the second phase of the next generation reactor design.

A multiplicity of vendors has put the Korean nuclear industry in somewhat complex position relative to resolving the Year 2000(Y2K) problems. This gives more problems to be handled as a whole and requires careful and considered planning plus strategy development by the responsible parties and individuals, especially having the short time frame given.

Both technical and administrative managers of the Korean nuclear industry view the Y2K situation as an issue which is half technical and half political, since most vendors of the outdated components or systems have not given any clear position about troubleshooting of their equipment.

2. Brief History of Governmental Efforts

The Y2K problem of nuclear safety was selected by government as one of the ten most critical areas to be looked at among the public sectors. They include banking and finance, telecommunications, and electric power utilities, etc.

At the same time, the Ministry of Science and Technology(MOST) was nominated by the Korean government as the leading authority regarding technical monitoring and policy making of the Y2K problems, especially for the nuclear safety issues at a meeting among governmental institutes (The "Year 2000 General Policy Meeting", April, 1998).

The Y2K task force team was established on the same day of the meeting and the members included are;

- Safety Surveillance Director (Team Head)
- Manager of Nuclear Safety (MOST)
- A representative from each of the following institutions or companies

  - Korea Electric Power Corporation (KEPCO), the government subsidized sole electric utility
  - Korea Atomic Energy Research Institute (KAERI)
  - Korea Institute for Nuclear Safety (KINS), the nuclear regulatory institution
  - Korea Nuclear Fuel Company (KNFL).

- Scholars from the nuclear engineering discipline from universities that added up to twelve additional members.

The main philosophy of the task force team are as follows;

- Each nuclear facility shall take responsibility in formulating detail planning and strategies.

- Each nuclear power plant site shall form its own task force team to plan, supervise, and conduct its Y2K activities.

- Nuclear fuel cycle facilities and research reactor sites shall set up an internal team for the planning and surveillance of Y2K activities.

3. Findings and Status Quo of the Computer Systems;

For LWRs, high level, modern type(32 bit) computer systems are not directly used for protection and control of the plant power. But some of the monitoring computer programs, that are closely related to plant availability, may have date/time problems related to Y2K. And they are going under close scrutiny and modification testing.

KORI 1, which recently went through a major overhaul including steam generator replacement and digital I&C systems upgrade, was closely worked on by the engineers for Y2K problems, and the replaced portion appears to be Y2K problems free.

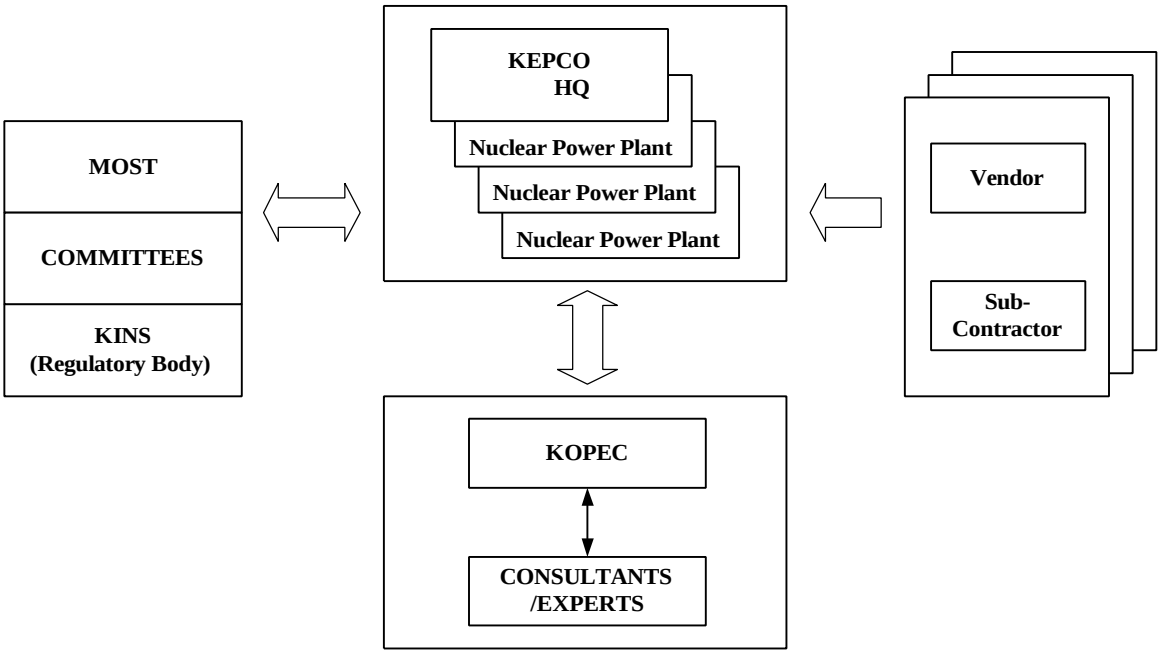

Figure 1. Y2K Readiness Structure for Korean Nuclear Industry

Among the nuclear power plant systems in operation, the CANDU computer systems that are used for protection and control of the plant power have gone under analysis and testing for Y2K problems, and have shown no major problems related to the safe operation of the plants.

According to the reports and information received from the nuclear fuel cycle facilities and research reactor sites, the government task force team concluded that there are no distinguished Y2K problems. But as can be expected, there appears to be some concerns about outdated embedded chips, processors, and clocks for which full vendor support is no longer available.

The Korea Power Engineering Company(KOPEC) is one of the main contractors for providing technical support to KEPCO's Y2K project. The overall strategy for Y2K problem remediation in Korean nuclear power plants is both integrated and segregated, integrated in project management and segregated in the specific resolution method for each problem facility. KEPCO had to lay out a plan that is consistent throughout all the plant sites at a higher level considering the tight schedules and the diversity of the problems.

For all the plants involved, KEPCO has developed a unified plan and rules along with nominated task force teams and it makes the whole plan consistent. At the same time, any distinguished problems will be contracted out to the vendor or subcontractor who has specific knowledge and technical capability necessary for solving the problems.

In Figure 1, the reporting structure and organizational interfaces are presented with diagrams. The Ministry of Science and Technology(MOST) is the governmental policy maker and the Korea Institute for Nuclear Safety(KINS) is the regulatory body reporting to MOST. They jointly supervise the safety related issues on nuclear commercial and research activities.

KOPEC works closely with KEPCO providing technical assistance as the BOP and NSSS designer and sent technical personnel to the sites. These engineers work jointly with KEPCO's site engineers and experts from subcontractors and/or vendors.

The areas of major concerns are related to embedded systems. Troubleshooting is subcontracted to the vendors/subcontractors that can analyze or test those components. Where an analysis report is sufficient, initial and detailed assessment are performed, and where tests are needed, a test schedule is arranged with appropriate documentation.

4. Stepwise Planning Strategy

Among the managers and supervisors of KEPCO and KOPEC, an effective awareness program was conducted by distributing the information regarding GL 98-01, NEI/NUSMG 97-07, and other documents. The engineers to be dispatched to the plant sites were given training with the materials that describe initial and detailed assessment procedures along with internally developed guidelines for test procedures.

The overall strategy which has been adopted for resolving the Y2K problem is as follows:

Develop Unified Plan - A unified approach to addressing the Y2K problem was developed to assure a consistent and through methodology is followed throughout the Korean nuclear industry. The plan is applicable for:

- Operational Electrical Power Generation Reactors
- Research Facility Reactors
- Nuclear Fuel Cycle Facilities

The plan includes the formation of a special Y2K task force with overseeing authority, definition of the general methodology for addressing the Y2K issue, completion schedule, and contingency plans.

Identify Systems which Utilize Digital Computer - The safety, control and monitoring systems associated with each Korean nuclear facilities are to be examined in order to identify if digital computer processors are utilized for the aforementioned functions.

Asses Extent of Problem - For those nuclear facilities which have been identified as utilizing digital processor for safety, control, or monitoring functions; analysis and/or testing is to be conducted to asses the extent (if any) of the Y2K problem associated with these systems.

Corrective Action - For those nuclear facilities in which a Y2K problem has been identified, corrective action is to be taken to remedy the root cause. These may involve use of external vendors or contractors, as applicable, due to specialized or non-standard implementation approach for these processors.

As shown on Figure 2, planning strategy is divided into four steps. Promoting awareness, initial assessment, followed by Y2K impact analysis were considered as the preliminary stage which is part of step one. Following the preliminary stage, detailed assessment was performed by the site personnel. The total number of detailed assessment reports from each site varied between thirty

to fifty that added up to over four hundred reports and about four thousand pages.

For step two, the remediation process will involve subcontractors and vendors. Vendors were given the contract for areas where the problems seem to be more than at the component level. One example would be the Plant Computer System of YGN 3 and 4.

For step three, testing and validation will be performed by the site personnel along with the experts from subcontractors/vendors, with assistance from KOPEC and others. The evaluation of those tests will be performed by KOPEC engineers stationed at the sites.

For step four, notification will be done by the site test team leader reporting to the Y2K project manager of KEPCO via proper reporting channel.

At the end of the project, the final report will be drafted by the site personnel and finalized by KOPEC's system design engineering group.

Figure 2 is a diagram showing the stepwise planning strategy and Figure 3 shows the Y2K assessment procedure. Table 1 is the statistical summary of initial assessment from the plant sites and Table 2 is the overall statistical summary of detailed assessment. Table 3 is the major milestone.

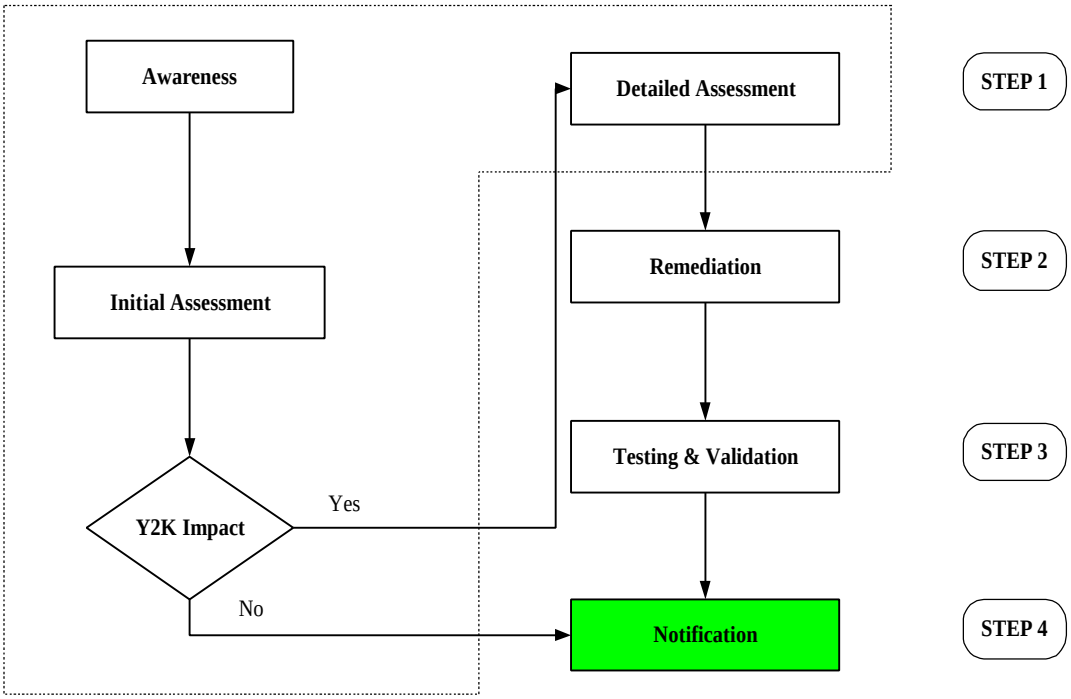

Figure 2. Stepwise Planning Strategy

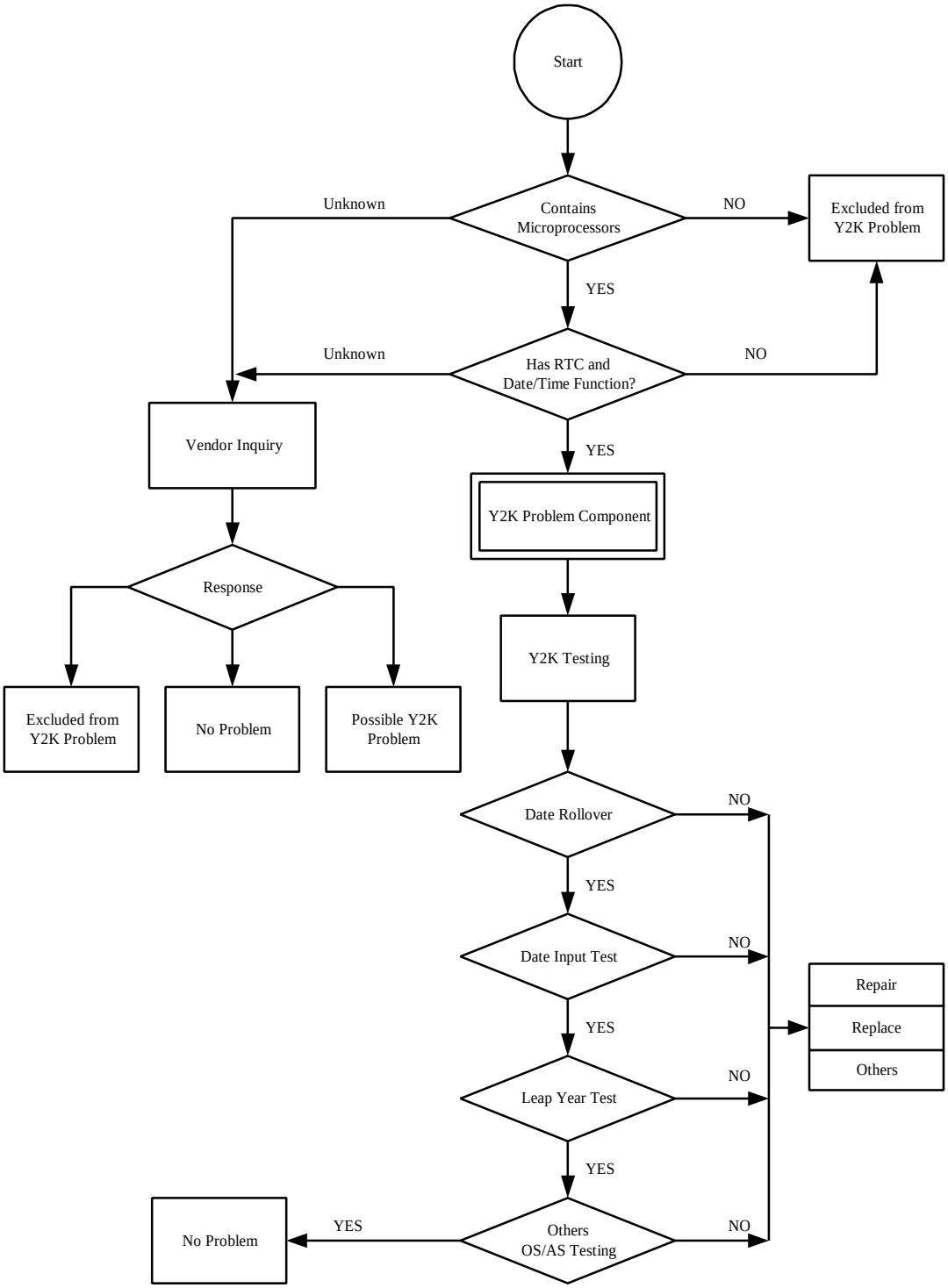

Figure 3. Procedure for Y2K Assessment

Table 1. Initial Assessment Statistics Summary

sites	Number of Facilities Inspected	Y2K Related Problems	
		Yes	No
Kori 1	81	54	27
Kori 2	54	29	25
YGN 1	24	12	12
YGN 2	32	11	21
Wolsong 1	38	19	19
UCN 1	42	6	36
Total	271	131	140

YGN : Yonggwang
UCN : Ulchin

Table 2. Detailed Assessment Statistics Summary

	Safety Related Facilities	Control Facilities	Monitoring Facilities	Other Facilities	Individual Equipment	Total
No Impact	6	38	68	19	90	221(52%)
Ready without Repair	0	14	23	19	50	107(25%)
To be Repaired	0	5	35	4	55	99 (23%)
Total	6 (1%)	57 (13%)	126 (30%)	42 (10%)	196 (46%)	427 (100%)

Table 3. Major Milestones

Tasks	1998				1999											
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1. Facility Assessment																
a. Analysis of Initial Assessment																
b. Detailed Assessment																
c. Categorical Planning																
2. Facility Repair and Replacement																
a. Implementation Planning																
b. Facility Design Change Doc.																
c. Technical Specification and Evaluation																
d. Testing and Verification																
e. Document and Drawing Modification																
3.Contingency Planning																
a. Scope Analysis																
b. Contingency Planning Documents																
4. Technical Support																
a. Information Gathering and Analysis																
b. Standard Procedure Documents																
c. Licensing and QA																
d. Final Reports																

5. Contingency Plans

Unexpected power cutbacks or shutdowns of the power plants may occur from various causes such as halting of the computer systems, external power failures, unavailability of communication hardware and/or software. An example of contingency plan is presented below which shows a typical LWR situation after a plant computer failure.

Following is only a scenario and doesn't mean to insinuate any specific system. Therefore, "Application Program" was adopted as the name for an example system.

Risk Identification

The Plant Computer System(PCS) consists of many engineering and general purpose application programs and provides real time monitoring of the power plant status with critical safety function parameters plus other plant parameters.

Application Program(AP) is one of the most critical among PCS engineering application programs. AP may have Y2K problem that involves date and time calculation for the plant power.

Risk Analysis

If the PCS computer is halted, a "PCS watchdog timer alarm" is annunciated in the MCR. Also any part of the PCS software, such as trend functions or AP, may pause or abort resulting from Y2K related problems. Other causes for program failure may include invalid calculation results or loss of continuity of trend displays.

Emergency Response Measures

Possible options for preventing the computer failures resulting from Y2K related problems, although tentative, are;

- Run the AP application only on a Y2K problem free computer.
- Set the year on the computer back by 28 years. This will tend to provide the same functionality as the year 2000.

For an application program that has failed;

- Have a computer system engineer or a technical staff closely observe execution of certain application programs.
- Restart the failed programs manually after the Y2K time frame.
- For other failures that cannot be immediately recovered, follow the "Procedure for PCS computer failure recovery".

For invalid calculation results;

– Either manually calculate power related parameters or follow the "Procedure".

For loss of continuity of trend display;

- Switch from master to slave computer.
- Restart the trend display program only.

6. Conclusion

Having a set of diverse nuclear power plant vendors tends to impose more burden relative to the Y2K problems on the Korean nuclear industry. KEPCO, the utility company, and KOPEC, the engineering company, have established a Y2K project that is both integrated and segregated, integrated in project management and segregated in the specific resolution method for each problem facility.

Engineers are supplied to the plant sites including the engineers from BOP design group and NSSS design group, each from KOPEC, outside experts, and engineers from the vendors. To accelerate review and refinement of the detailed assessment reports, additional manpower resources are allocated in the beginning phase of the project.

It is expected that major remediation activities of the Y2K project are to be completed by June 30th, 1999. After the remediation activities are completed, efforts to retain the continuity of operation and documentation work will follow through the end of 1999.

For the Y2K problems, there may be legal concerns regarding the customer satisfaction and any possible negative consequence to the operating plants. Legal actions by the customers are a major concern of KEPCO's high level management. Given the tight schedule for resolving Y2K problems, KEPCO and KOPEC need to look closely at the legal arena. Also, for licensing and qualification, it is strongly recommended for the overall scheme to be verified by certified third party consulting companies or individuals.

References

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