

Regulatory Strategy and Status for the Y2K Readiness Program of the Nuclear Power Plants

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Abstract

KINS established a Regulatory Strategy for Y2K Readiness Program of the Nuclear Power Plants in May 1998. On July 29, 1998, the Regulatory Action was enforced on licensees to setup the Y2K Readiness Program and report the stepwise Implementation Results of the Program. KEPCO established the Y2K Readiness Program and finished the Detailed Assessment following the Program. The Assessment showed that 108 out of 726 assets are Non-Compliant. KINS has performed the evaluation for Initial & Detailed Assessment Reports and the site audit for the Wolsong Site Division. Through those regulatory activities, we have gotten much assurance that no Y2K problem will impact on safety-related systems. And considering the progress forwarded by the licensee, we expect that all Y2K issues can be resolved before July 1999. However, to obtain the perfect assurance of the safety against the challenge of Year 2000, we will perform a thorough Audit for Validation Tests at Sites, perform a proper review for the major issues, and complete an in-depth evaluation of Submittals including Contingency Plan.

I. Background

The government recognizes the seriousness of Y2K problems, and has been acting on a Y2K solution to establish a millennium bug-free environment. The OGPC (Office for Government Policy Coordination) under the Office of the Prime Minister kicked off "The Year 2000 Problem Council" and issued "The Executive Directions of the Year 2000 Conversion" on April 17, 1998.[1] The

Council established an implementation structure to cooperate and communicate between the ministries, local governments and major private sectors so as to assure that no computer program experiences disruption because of the Y2K problem. Nuclear Power Plants were designated by OGPC as one of the 10 key critical sectors that are essential to the national economy and public life. And MOST (Ministry of Science and Technology) was nominated by the OGPC as the leading authority regarding technical monitoring and policy making for the Y2K problems, especially for nuclear safety issues. (See Fig. 1 “ Governmental Organization for Y2K Readiness”)

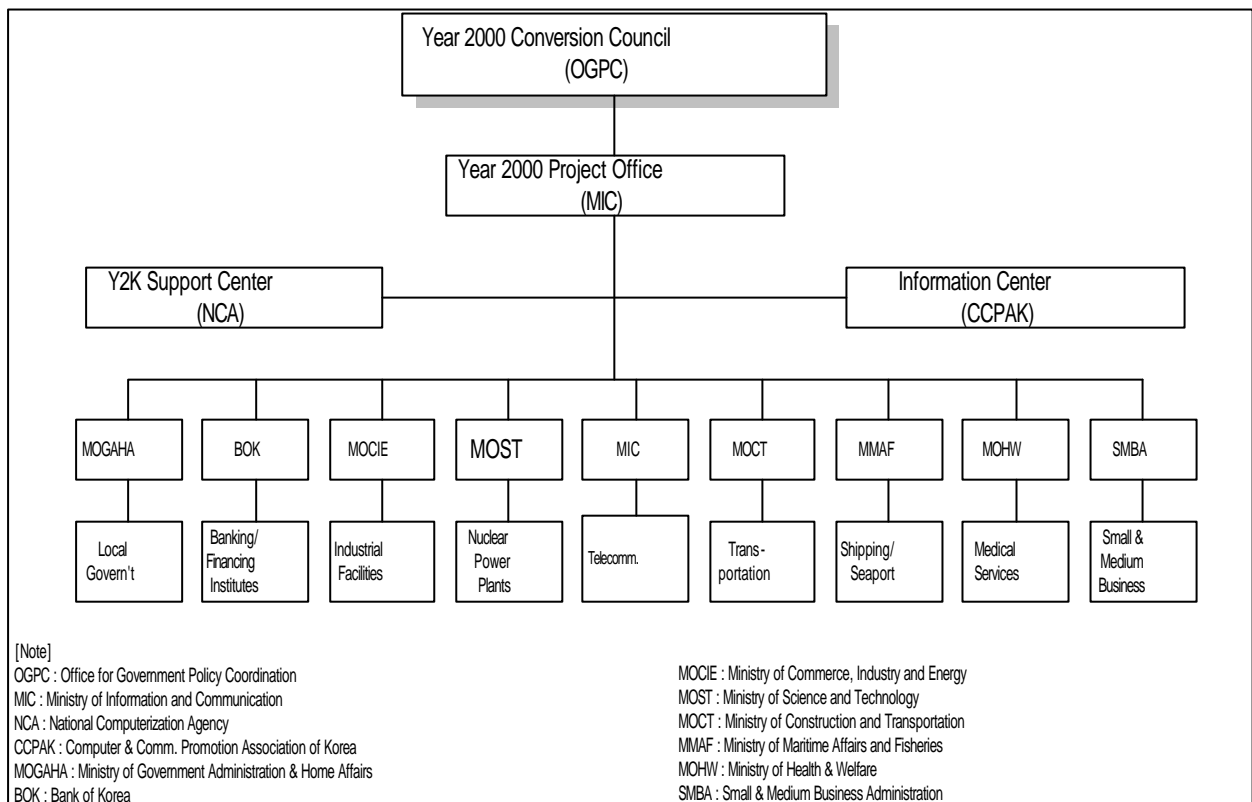


Fig. 1 Governmental Organization for Y2K Readiness

The Y2K Task Force Team for Nuclear Facilities was established under MOST on April 24, 1998. The Team consists of staffs from MOST, KINS, KEPCO, KAERI, KNFC. Their missions are to support policy making for Y2K problems, to present status/plan and discuss pending problems of each regulatory body or licensees, and to suggest countermeasures against Y2K challenges.

In step with those government side activities for Y2K problems, KINS established a regulatory strategy for Y2K Readiness Program of Nuclear Facilities and has performed activities according to the strategy. Considering the size of facilities and the Y2K impact on safety and operability, this paper only concentrates on the regulatory strategy and status for nuclear power plants.

II. Regulatory Strategy for Y2K Readiness Program of NPPs

KINS established a Regulatory Strategy for Y2K Readiness Program of the Nuclear Power Plants in Korea in May 1998. The strategy consists of Regulatory Action, Evaluation of Submittals, Site Audit, Research Project, and International Cooperation. Under this strategy, we perform regulatory activities against Y2K challenges for the Nuclear Safety. (See Fig. 2)

- **Regulatory Action** to require that licensees establish a program against Y2K problems, perform activities according to the program, and report the result of the activities according to a basic Time-Frame
- **Evaluation of Submittals** to evaluate licensee's activities with submittals which should be handed in following the Regulatory Action.
- **Site Audit** to evaluate the effectiveness of measures licensees are taking to identify and correct Y2K problems at their facilities.
- **Research Project** to develop assessment guidelines for the licensee's responses on Year 2000 Problems in Nuclear Power Plants.
- **International Cooperation** to discuss regulatory and industrial strategies on Y2K issues, and to exchange information such as Y2K problems, resolving measures, evaluation results, audit results, and unsolved issues, etc. which have arisen or experienced during Regulatory Activities.

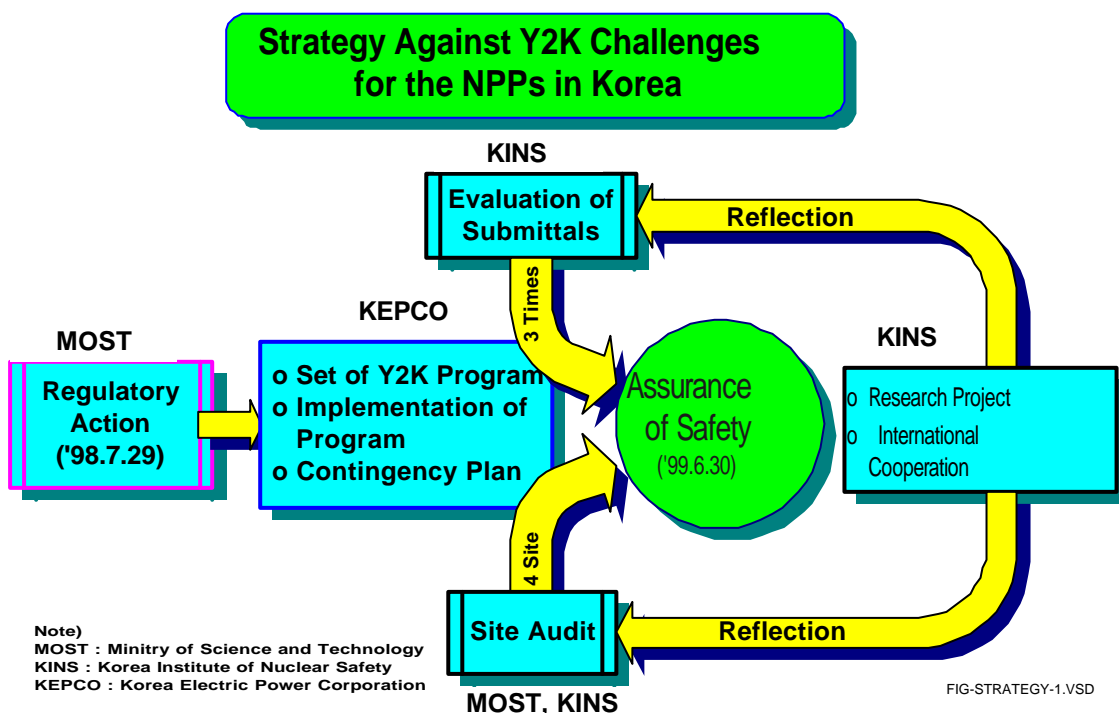


Figure 2. Regulatory Strategy against Y2K Challenges for the NPPs in Korea

III. Regulatory Actions

KINS suggested regulatory requirements against the Y2K challenges to MOST. Based on the requirements, Regulatory Actions was issued by MOST to the licensees on July 29, 1998. According to the Regulatory Action, licensees should submit the following documents;

- **1st Submittals (No later than August 20, 1998)**

- Y2K Readiness Program including organization, staffs, milestones, and bills
- Inventory List classified into safety, control, monitoring, and the others facilities
- Initial Assessment Report including the list and functions of facilities initially assessed to be influenced by Y2K
- Description of stepwise activities performed for the implementation of the Y2K Program
- Applied Guidelines

- **2nd Submittals (No later than October 15, 1998)**

- Detailed Assessment including vendor evaluation results, utility evaluation, the Y2K impacts on facilities, and remediation plans.
- Test & Validation Plan
- Quality Assurance Plan

- **3rd Submittals (No later than June 30, 1999)**

- Certificates confirming the Y2K readiness of facilities including the results of testing and validation
- Schedule of remaining-readiness actions
- Contingency Plan

IV. Licensee's Y2K Readiness Program

KEPCO, a licensee which manages nuclear power plants, 14 units in operation and 6 units under construction in Korea, organized the Y2K Readiness Task Force Team for NPPs in the Nuclear Power Division of Head Quarter. The Team held a Y2K Issue Conference to take countermeasures, then set about the Y2K project in earnest in July 1998. The Team set up the Y2K Readiness Program according to Regulation Action enforced by MOST.

The Y2K Readiness Program consists of 4 steps, i.e., Awareness and Initial/Detailed Assessment,

Remediation, Testing & Validation, Notification. (See Fig. 3) The activities for each step of the Y2K Readiness Program is based on the guideline, NEI/NUSMG 97-07 “Nuclear Utility Year 2000 Readiness” which was published by NRC in October 1997.[2]

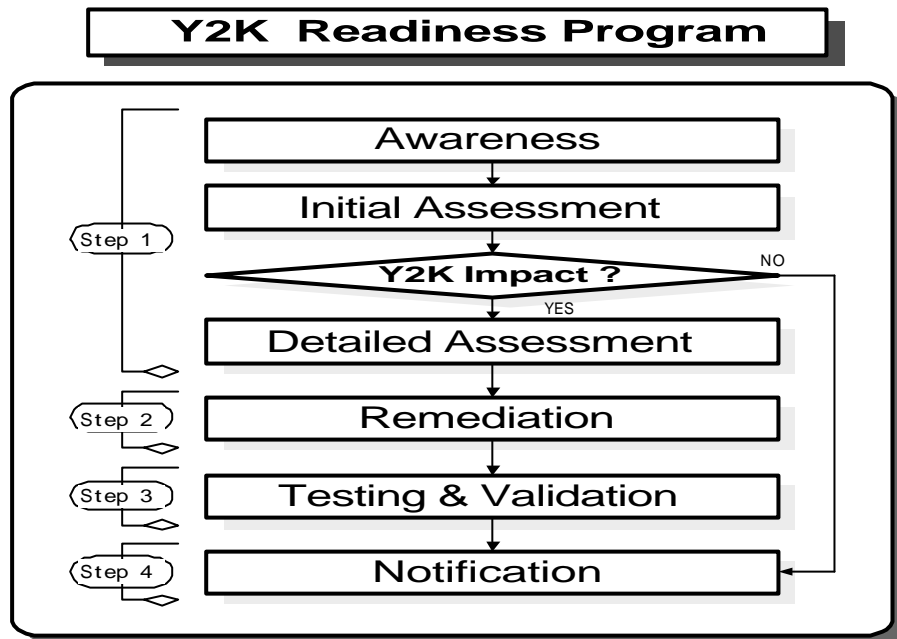


Fig. 3 Y2K Readiness Program for the Nuclear Power Plants

In October 1998, KEPCO finished the Inventory Survey and Detailed Assessment. The results of the survey and assessment showed that 108 out of 726 assets were Non-Compliant as seen on Table 1.

Table 1. Statistical Summary of Detailed Assessment

Impact Facility Type	Compliant	Impacted Facilities or Equipment			Total
		Ready	Non-Compliant	Sub Total	
Safety	11	3	0	3	14 (1.9%)
Control	52	22	3	25	77 (10.6%)
Monitoring	57	63	42	105	162 (22.3%)
Others	28	31	9	4	68 (9.4%)
Off-line Equip.	124	227	54	281	405 (55.8%)
Total	272 (37.5%)	346 (47.7%)	108 (14.9%)	454 (62.5%)	726 (100%)

Based on the results of the Detailed Assessment, they tentatively decide as follows;

- There is no Y2K problem in safety-related facilities (Reactor Protection Systems) since :
 - almost all safety related systems in NPPs are hard-wired analog systems without software, and
 - no date-related problem is contained in the digital safety-related systems.

- A large number of control/monitoring facilities and off-line equipment are affected by Y2K problems such as :
 - Control Facility: Liquid Radwaste System(LRS), SG Level DCS
 - Monitoring Facility: radiation monitoring system, plant computer system, etc.
 - Test Equipment: Recorder, Analyzer, S/W Configurator, etc.

After the Detailed Assessment, KEPCO made a contract with KOPEC (Korea Power Engineering Company), a nuclear engineering company, to get technical support for the remaining activities of Y2K Readiness Program such as Supplementary Detailed Assessment, Remediation, Testing and Validation, Notification, and Contingency Plan. They performed the Supplementary Detailed Assessment to make up for the Detailed Assessment and established the Draft Contingency Plan. The Supplementary Detailed Assessment and the Draft Contingency Plan are reviewed recently by KINS after submitted in March 1999.

V. Evaluation and Audit for Licensee's Activities

1. Evaluation for the 1st Submittals

In September 1998, KINS performed the evaluation of the 1st Submittals, such as Y2K Readiness Program, Inventory List, Initial Assessment Report, Description of Stepwise Activities, Applied Guidelines, which were handed in following the Regulation Action enforced by MOST.

After the evaluation for the 1st Submittals, the following general comments were made ;

- KEPCO's Y2K Readiness Program were practically and systematically established based on the NRC guideline, NEI/NUSMG 97-07 [2], which could be effectively used in Korea,
- their activities were well forwarded according to the Program, and
- Inventory Survey and Initial Assessment were adequately performed.

However, KEPCO was requested **1st Supplements** to make up for the weak points which were raised as a result of the evaluation. They are following;

- Increase of Personnel Dedicated to Y2K Project

According to KEPCO's Program, they assigned a total of 40 members to the Y2K Project

including 7 members in the Y2K Readiness Task Force Team at the KEPCO Head Quarter and 4 ~ 6 members in each Nuclear Power Site Division. (KEPCO has 14 nuclear power units in operation and 6 units under construction at 4 Site Divisions.) Those human resources were deemed insufficient, considering their huge mission such as ;

- at the KEPCO Head Quarter: establishing Y2K Readiness Program, developing guidelines for the implementation of the Program, checking the implementation status of each Site Division, and deciding resolution methods for the major problems, etc.
- at Site Division: surveying and testing the bulky inventory(total of about 4,000 facilities in 726 assets), performing the initial/detailed assessment, performing the remediation, and establishing the contingency plan, etc..

So, an increase of personnel dedicated to the Y2K Project was requested.

- **Provision against Invalid Embedded Systems**

Embedded systems, which are used everywhere, are widely reported as that most of them are running in obsolete equipment, that documentation for them is generally rare, that they can be reprogrammed but with great difficulty, and that processors, circuit boards, and sometimes the whole unit must be replaced to remediate them.[3] Considering the above problems, KEPCO was requested to establish a provision against invalid embedded systems by;

- surveying the embedded systems which is used in nuclear power plants
- checking and diagnosing the Y2K problems of embedded systems
- making remediation plans for the their problems

2. Audit for Wolsong Nuclear Power Site Division

From November 11 through 12, 1998, MOST and KINS staff conducted an audit of the Y2K Readiness Program at Wolsong Nuclear Site Division (Unit 1,2,3,4). The audit team checked or performed the following;

- Status of Y2K Readiness Program: Organization, Implementation Progress, and Contingency Plan
- Test: DCC, GEM(Gas Effluent Monitoring System), and Seismic Monitoring System
- Document Review: SDS1/2 PDC, Mark-V(Turbine Control), and Fuel Machine Pressure Controller

As a result of the audit, the following evaluations were made ;

- The Y2K Readiness Program, set up by the Task Force Team at the KEPCO Head Quarter, is generally well implemented at the Wolsong Site Division.
- The certificates for the Shutdown System PDC Computers, which were provided by AECL, give us much assurance that no Y2K problem will impact on Safety System.
- The forwarded progress report on assessment, remediation, or contracts with vendors assures us that Control/Monitoring systems, assessed as Y2K Non-Compliant, would be bug-free before July 1999.

However, the Wolsong Site Division was requested **Supplements for Wolsong** to make up for some insufficiencies, which were pointed out during the audit. They are as follows;

- Supplementary Assessment for GEM (Gas Effluent Monitoring System)

Check List for Assessment of GEM omit some test cases, which should be tested during Initial/Detailed Assessment following the guideline such as KEPCO' s own or NEI/NUSMG 97-07.[2] Hence, a supplementary assessment for GEM was requested.

- Establishment of Software Configuration Management Plan

According to the Y2K Quality Assurance Plan prepared by the Task Force Team of the KEPCO Head Quarter, all software changes, occurring during the implementation of the Y2K Readiness Program, should be managed and listed by SCMP (Software Configuration Management Plan) of Site Division. But, the SCMP of Wolsong Site Division was not established. So, Wolsong Site Division was requested to establish the SCMP.

3. Evaluation for the 2nd Submittals

In December 1998, KINS completed the evaluation of the 2nd Submittals, such as the Detailed Assessment Report, Test and Validation Plan, and Quality Assurance Plan, which were handed in following the Regulation Action enforced by MOST. After the evaluation for the 2nd Submittals, the general comments were made as follows;

- the Detailed Assessments were adequately performed
- the Quality Assurance Plan is well established, except for some weak points.

KEPCO was requested **2nd Supplements** to make up for the weak points which were raised as a result of the evaluation.

- Establishing Management Plan for Temporary Compliant Facilities

According to the Detailed Assessment Report, some facilities are Compliant during the limited period, for example;

- Plant Annunciation System: ~ 2027.12.31
- CEDMCS (Control Element Drive Mechanism Control System): ~ 2030
- MOVATS (Diagnostic System for Motor Operated Valve): ~ 2038

Considering the fact that the number of temporary Compliant facilities can not be underestimated and the limiting years are different one another, all those facilities have to be listed and well managed to prevent from another confusion in the not so distant future.

Therefore, KEPCO was requested to establish a management plan for the temporary Compliant facilities.

- Establishment of Oversight Plan

NEI/NUSMG 97-07 [2] recommends that an appropriate level of oversight for the Y2K project should be performed by individuals or groups not directly involved in the management of performance of the Y2K project activities. But the Quality Assurance Plan for the Y2K Project is not including the oversight plan. Therefore, KEPCO was requested to establish an oversight plan for the Y2K project, in the following form;

- planned periodic audits
- inspections at documented hold points, or
- reviews of approved documents.

VI. Major Issues

Through the evaluations and the audits for the implementation of KEPCO's Readiness Program, we have suggested or requested a lot of supplements to KEPCO. KEPCO reported that they had completed **1st Supplements** and **the Supplement for Wolsong**. And for the **2nd Supplements**, it is known that the supplementary actions are in progress. KINS has confirmed that the supplementary

actions completed were adequate. Especially, KEPCO made a contract with KOPEC to provide technical support to KEPCO's Y2K project, as a part of 1st Supplements. The contract increased by 200 Man-Month for the Y2K project. This supplementary action is considered to be enough human resources for the Y2K Readiness Program to be completed well.

However, there are some issues of which regulation degrees have to be reviewed carefully. **The Major Issues** are the following;

- **Temporary Measures**

We are concerned with some temporary remediation measures such as Date Back and Windowing Approach, which is known KEPCO to use. Date Back, so called Envelope, is a time machine that makes the application function as if it were running 28 years ago. The system date in the machine is set back 28 years, thus extending the life of the equipment. Windowing Approach is to insert logic to window the dates, allowing the program to interpret the century as 19 or 20 based on parameters defined by user or programmer.[3]

These measures maintain the two-digit-year format to save cost and time. But, it is widely reported that those measures may cause many problems known or unknown. And the changed program must be well documented so that those who change the code later understand the value of the window when a code change is processed. Not knowing the data can result in the placement of “**time bugs**”, which occur when the window logic fails.

Now, our concerns are focused on the yardstick, (ex, importance and/or impact) to decide if the Non-Compliant facilities or equipments to which application of those temporary measures are acceptable. And we will request KEPCO some supplementary action such as management plan for the facilities or equipments applying those temporary remediation measures.

- **Simulated Functional Test for Safety-Related System**

Through the Evaluations and Audit for the implementation of Licensee's Readiness Program, we have gotten much assurance that there are no Y2K problems in safety-related facilities such as

- NPS in Kori 1 : NSSS Protection System
- CPCS in YGN 3,4 and UCN 3,4 : Core Protection Calculation System
- ILS in YGN 3,4 and PCS in UCN 3,4 : Interposing Logic System for BOP-ESFAS

- ICCMS in YGN 3,4 and UCN 3,4 : Inadequate Core Cooling Monitoring System
- SDS#1/#2 PDC in Wolsong units 1,2,3,4 : SDS #1/#2 Programmable Digital Comparator

But, the assurances are only from document analysis such as system manuals or vendor's responses without validation test because those safety-related facilities, except ICCMS, have no tools to set time. So, our concern is focused on testability, that is to verify the safety function by performing the actual functional test of the safety-related system after the system date is set to year 2000 or later. Our position is that every safety-related facility should be functionally tested under year 2000 simulation, unless it were demonstrated the test is impossible.

- **Contingency Plan against the external electrical grid system problems**

It is reported that electrical grid systems might be impacted by the Y2K problems. NEI/NUSMG 98-07 [4], "Nuclear Utility Year 2000 Readiness Contingency Planning", lists the transmission/distribution system events as one of the external risk. The transmission/distribution system events include loss of off-site power, grid instability and undervoltage, load/demand fluctuations and loss of grid control systems. Unstable electrical grid systems or loss of off-site power affect on the safe operation and control of nuclear power plants. Therefore, KEPCO was requested to establish the mitigation strategies against the external electrical grid system problems.

VII. Posterior Plan

The site audits will be continued to confirm that no Y2K problem impacts on the safety-related facilities in Youngkwang, Ulchin, and Kori Site Divisions. We will evaluate the 3rd Submittals that should be handed in by June 30, 1999. It is planned to perform a 2nd round site audit to validate the function of major facilities remediated and to check the effectiveness of contingency plans, for all Site Division from July to September, this year.

VIII. Conclusion

KINS has evaluated the licensee's implementation results of the Y2K readiness program and performed the site audit for Wolsong Site Division. After each evaluation and audit, many

supplementary actions were requested to KEPCO to make up for the insufficient points of the implementation activities. KINS has confirmed that the supplementary actions completed were adequate. Especially, KEPCO made a contract with KOPEC to provide technical support to KEPCO's Y2K project, as a part of the 1st Supplements. The contract increased by 200 Man-Month for the Y2K project. This supplementary action is considered to be enough human resource for the Y2K Readiness Program to be completed well.

Now, there are three issues of which regulation degrees have to be reviewed carefully. First, it is known that some temporary measures would be applied by KEPCO during remediation step. The extent to which temporary measures are to be applied, should be decided after deliberate consideration of the importance and impact of the facilities. Second, the assurance that there are no Y2K problems in safety-related facilities are only from document analysis without validation test because almost safety-related facilities have no tools to set time. So, our concern is focused on testability, that is to verify the safety function by performing the actual functional test on the safety-related system after setting the system date to year 2000 or later. Third, unstable electrical grid systems or loss of off-site power affect on the safe operation and control of nuclear power plants. So, KEPCO should establish the mitigation strategies against the external electrical grid system problems that might be induced by Y2K problems externally.

Consequently, we expect that all Y2K issues can be resolved before July 1999, considering the progress forwarded by the licensee. However, to obtain perfect assurance of the safety against the challenge of Year 2000, we will perform a thorough Audit for Validation Tests at the Sites, perform a proper review of the major issues, and complete the in-depth evaluation of 3rd Submittals including the Contingency Plan.

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