Transactions of the Korean Nuclear Society Autumn Meeting
Gyeongju, Korea, October 24-26, 2012

A Study on the Implementation of an Integrated Environmental Qualification Management System(EQMS) for Nuclear Power Plant

[a]Keug-Jin Bhang , [b]Sun-Chul Jeong, [c]pil-Sun Kang

[a]*KHNP CRI, 1312-70gil Yuseong-daero Yuseong-gu, Daejeon 305-380, Korea*
kjbhang@khnp.co.kr

1. Introduction

Environmental Qualification Management System (EQMS) for Nuclear Power Plant is a web based program for preventing degradation and managing original functions of environmental qualification equipments during nuclear power plant life cycle by inspecting and improving status of them periodically. But cognitive issues have stayed in the construction phase of EQMS: almost EQ equipments are not registered in DREAMS that is the groupware of KHNP and it is difficult to utilize the maintenance functions in DREAMS because the approach is not based on a standard data structure.

In this study, we are to obtain the requirements of integrated EQMS by considering a standard and surveying the problems of current EQMS.

2. Methods and Results

2.1 Analysis functions of integrated EQMS

The core functions of integrated EQMS must be able to manage that maintaining the state of EQ equipments during equipment lift-time and perform various which are required for processing the documents regarding EQ, such as purchase, storage, maintenance and production.

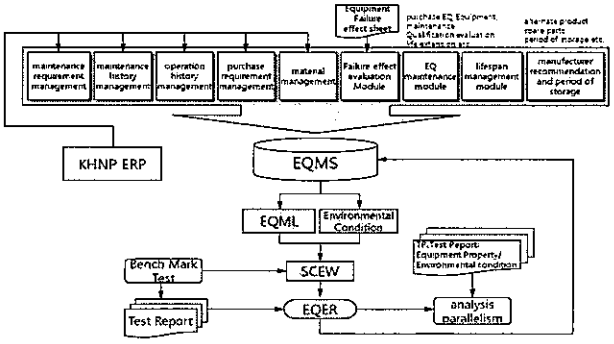

Figure 1. Integrated EQMS Module Diagram

Required functions of EQMS are as follows:

1) Function of EQ equipment maintenance
   The function provides printing capability regarding maintenance requirement at OH(overhaul) or breakdown maintenance and also creating capability of a summary for a number of operation request letter and maintenance results when the maintenance of EQ equipment is terminated
2) Function that purchase component of EQ equipment:
   The function provides the report regarding system performance and environmental condition when a component or an equipment is replaced. In case that the same part is out of stock, the function attaches EQTR to purchase order.
   Items that included in EQTR are as follows:
   - Equipment property
   - Technical base of qualification test
   - Method of Verification
   - Requirement of performance
   - Environmental conditions
   - DBA Profile
3) Function for the evaluation of life-time verification:
   The function creates the list for equipment that lifecycle is expired through EQML analysis monthly and support lifecycle valuation work as follow:
   - support failure log research function
   - support lifetime valuation function
   - calculate an arithmetic mean of result during two periods after nuclear fuel replace
   : Environmental temperature :
   (measuring temperature × measuring period)/total measuring period
   : Radiation dose
   - Utilization of monitoring data at least 3 month
   - Items that included in lifespan statement are as follows
   : Equipment property
   : Environmental condition
   : Aging target components
   : Life time calculation during normal operation

$$QL = tage \times \exp\left(\frac{E_a}{K} \times \left(\frac{1}{T_{ser}} - \frac{1}{T_{age}}\right)\right)$$

   t_{age} : Accelerated degradation time (hour),
   T_{ser} = operating temperature(°K),
   T_{age} = accelerated degradation temperature(°K),
   K = Boltzmann constant(8.617×10-5ev/°K),
   QL= life verification,
   E_a = activation energy(ev)
4) Analysis function of the effects of failure on verification:
   In case of EQ equipment or component failure, the function analysis the effects of failure on verification
5) Management function of verification document maintenance:
   The function manages all handling histories such as Tag No of EQ equipment after install
   - Maintenance history of EQ equipment
   - Effect evaluation sheet of failure equipment

- Radiation and temperature of EQ equipment
- Lifespan statement
- EQER
- EQ accident profile

6) Management function of EQER:
The function has to be able to evaluate suitability of EQ test by comparison and analysis between EQ accident analysis profile and EQTR.

7) Management function of EQML:
By performing special safety or auxiliary function live in poor surroundings, manage EQML necessarily performed EQ

8) SCEW management function:
The function is that manage environmental condition and requisites for performance of EQ equipment using manufacturer and environmental condition information

9) Cable management function:
The function is managing about cable information related to EQ equipment
- 3D cable drawing tool based on object technology
- tool that export and save information from 3D cable Dwg.
- 3D visualization tool using 3D cable Dwg. and cable information

10) Function that manages environmental condition:
The function displays and manages environmental conditions in EQ area
- managed factor : pressure, radiation, humidity, temperature, flooding, chemical sprinkling etc.

2.2 Problem Analysis of existing EQMS

1) Some EQ equipments are not registered in DREAMS
- manages EQ equipment as component
- Only mother equipments and main components are registered in DREAMS

2) EQMS DB is different from other Unit
- different service company
- requirement of each Unit differs from others
- development company of EQMS is different from each Unit

3) So, the requirements of Integrated EQMS are as follows:
- register all the EQ equipments in DREAMS
- Integration of EQMS DB of each Unit
- develop EQMS by utilizing DREAMS

2.3 Constitutional Directions of integrated EQMS

1) make the best use of data in DREAMS
- synchronization between master DB and EQMS
- efficient that manage integrated Database

2) establish standard DB schema

3) new establish DB of environmental condition (temperature, radiation, DBE profile)
- determine EQ environmental condition as location installed equipment

4) register EQ document to LDM and link with EQMS
- EQTR, EQER, equipment checklist etc.
- determine DBE profile as each Unit

5) approval function for EQ maintenance
- approval system to add/delete/modify data of EQ equipment

6) Integrated management system to verify equipment
- Including an earthquake-resistant and electromagnetic shielding equipment

2.4 scope of Integrated EQMS

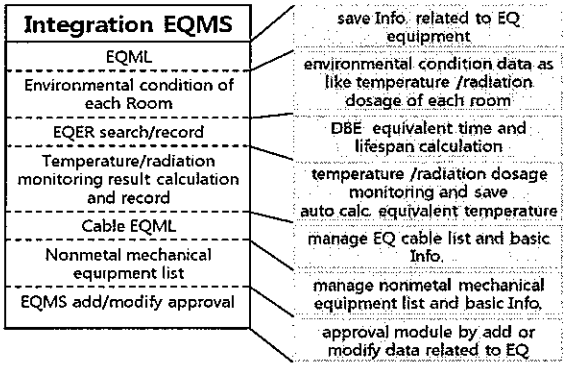

Figure 2. scope of Integrated EQMS

3. Conclusion

Each EQ Equipment has to assure that function of safety should be performed during verification time through EQ maintenance according to 10CFR50.49 and section 1 article 3 of article 24 of Nuclear Safety Act.

So far, EQMS has been built to satisfy PSR of nuclear power plant but it is difficult to utilize the groupware of DREAMS because a standard for the database is not considered.

For satisfying safety improvement request of regulatory agency by follow-up action of Fukushima accident and uninterrupted operating nuclear power plant, integrated EQMS can manage EQ equipments more efficiently if integrated EQMS linked with DREAMS by the standard database.

Also it is looked for the contribution to the export of EQMS database to global nuclear power plant market.

REFERENCES

[1] 10CFR50.49 Environmental Qualification of Electric Equipment Important to Safety Nuclear Power Plants

[2] USNRC Reg. Guild 1.89 Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants, 1984

[3] S.Y. Kim, Analysis of Nuclear Power Plant Cable using DMA, Korea Nuclear Society, 2005 October

[4] IEEE Std 323-1983, Qualifying Class 1E Equipment Nuclear Power Generating Stations

[5] Korea Nuclear Safety Act, article 24 , Periodic safety review for Nuclear Power Plants, 2011