Utilization of Concept Mapping Program at the Root Cause Analysis of Events

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1. Introduction

KHNP introduced the Corrective Action Program (CAP) as a part of the nuclear operation innovation. The Key program of the CAP is the Root Cause Analysis (RCA) program. The RCA is a technique to extract root causes and take actions to prevent a recurrence in the event that management doesn't want it to happen again. KHNP establishes a temporary team for RCA of some event. KHNP should assign some human resources to the temporary team. KNPEI introduced a RCA training program from Comanche Peak Steam Electric Station in 2005 and began training the engineers from 2006. But the RCA Program doesn't operate well at the stations because of two reasons.

KNPEI performed a research project from March 2006 to September 2007 to capture experience knowledge from seniors and transfer it to juniors. As part of the research activity KNPEI introduced a Concept Mapping Program and set up a Concept Mapping server to capture experience knowledge. Originally, the Concept Mapping Program was to teach conceptual knowledge by remote. But this Concept Mapping Program has some characteristics that can be used in root causes analysis.

The purpose of this report is to suggest the utilization method in root causes analysis in the Concept Mapping.

2. RCA program introduction and difficulty in application

KHNP introduced the RCA Program to improve nuclear operations, but met two challenges. The first one is difficulties to assigning human resources to the temporary team for the RCA because KHNP tried to introduce many kinds of innovative programs for safe nuclear operations at the same time. The second one is the lack of customized personnel for the RCA technique. It is related to the style of KHNP organizational management for the RCA work.

3. Characteristics of Concept Mapping Program

A key characteristic of the Concept Mapping Program is the means to present a conceptual knowledge. Concept Map presents the big concept and the small concept to explain the relationship between two concepts. This presentation method for conceptual knowledge is useful in application of root cause analysis. The RCA is a technique to extract the relationship of the causes and effects of text type information related to the

event. Therefore, the Concept Mapping Program that presents concepts and their relationship can be used to find causes & effects of an event effectively. Also this present method is the same with cognitive structures of humans for conceptual information. This characteristic prevents us from confusing with a lot of information related to the event. Also, it is possible to link some related information to the concept box to exchange information with each other.

The second important characteristic of the Concept Mapping Program is that it has a remote communication function, which makes it possible to brainstorm without the restrictions of space and time. The team leader for a RCA can make a Concept Map file on the Concept Mapping server, and then all team members can write information on the map and change the map at his office anytime. Therefore RCA team members don't need to be together for the RCA job at a fixed space and time.

The third characteristic of the Concept Mapping Program is the excellent information sharing function. The Concept Mapping Program has the ability to present the map on the web automatically when the map file is made. It means that anyone can see the RCA work process in real time. The sharing of the RCA process makes the implementation of the corrective actions easier and the results of the analysis by spreading the information to the stakeholder. Also it is useful to upgrade the technique of the RCA of the plant personnel with indirect experience with the RCA work.
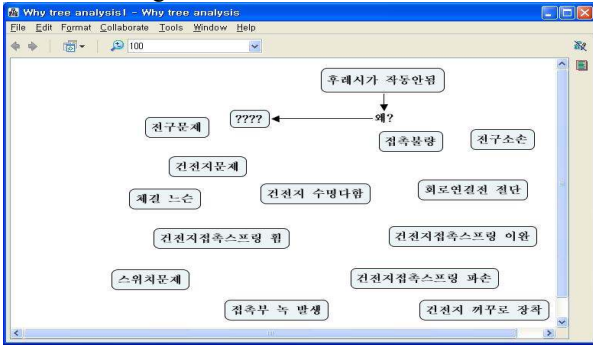
4. Utilization Methods of Concept Mapping Program in RCA

Finding the root causes is to find the chains of causes and effects for the event. It can't be found with common sense, so it needs some tools. Many kinds of tools are used in the RCA. But this report suggests the utilization of the Concept Mapping Program for the most common three RCA tools.

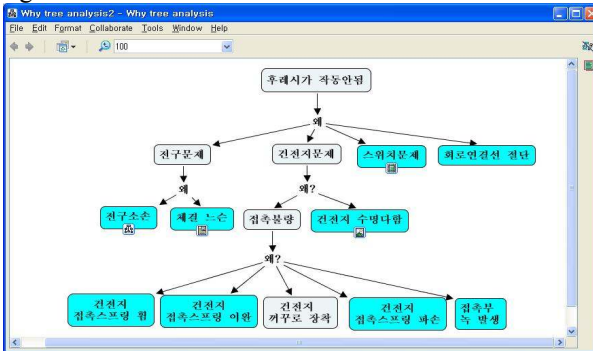### 4.1 Concept Mapping Program Utilization in Why Tree Analysis

Why Tree Analysis is to ask why the event happened. The response to this why can be many things. Each response is verified with facts. The response can be extracted with brainstorming among team members in remotely in the Concept Mapping Program server. The team leader makes a Concept Map file for the RCA item in the Concept Mapping server, and then all team members can join in the brainstorming on the Concept

Map file without restrictions of time. And then they mark some key words on the Concept Map file for the reasons like figure 1.

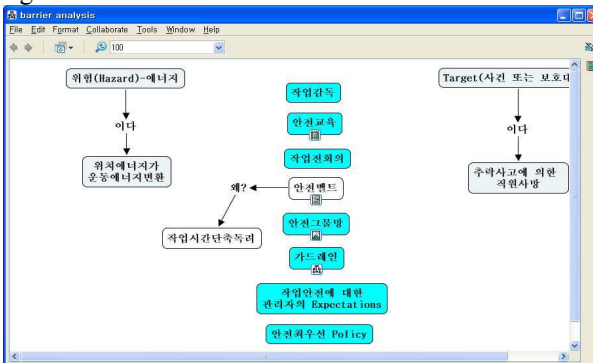[Figure 1 **Brainstorming Example on Concept Mapping Program**]

After reviewing the information package and brainstorming for enough time, arrange the position of each cause & effect and its relationship logically like figure 2.

[Figure 2 **Rearrangement for each item to be logical**]

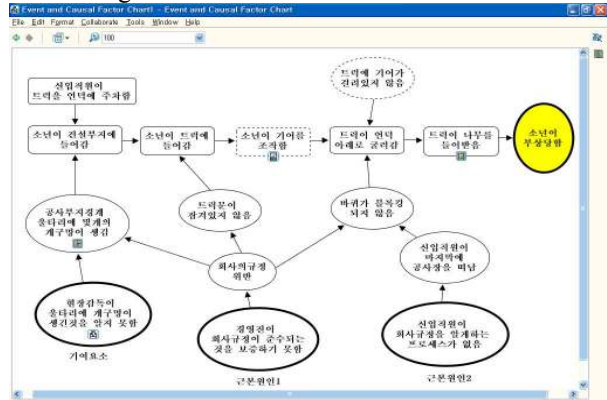*4.2 Concept Mapping Program Utilization in Barrier Analysis*

The barrier analysis analyzer defines the target that should be protected and the hazard. And then he finds the failed barriers between target and hazard while brainstorming on the Concept Map file on the Concept Mapping Program server remotely. The example is in figure 3.

[Figure 3 **Example of Barrier Analysis by Concept Mapping Program**]

4.3 Concept Mapping Program Utilization in Event & Causal Factor Charting

The Event & Causal Factor charting is to draw on one information sheet gathered during the event investigation. Display the events in order as they happened in rectangular box and then put the conditions at the upper or lower position of the related events. And then link arrow lines to related events and conditions. Refer to figure 4.

[Figure 4 **Example of Rearranged Events and Conditions in Concept Mapping Program**]

This chart gives a good understanding of the event with big picture, so the relationship between causes and effects becomes apparent.

This work can be performed without restriction of time and distance with the Concept Mapping Program.

5. Conclusions

KNPEI established Concept Mapping server program as a part of knowledge preservation activities with the preliminary retired personnel, and on try to capture the knowledge to preserve on the Concept Mapping server. This Concept Mapping Program has some characteristics to use at the RCA. This report demonstrated that RCA work can be performed with Concept Mapping Program effectively due to the characteristics of the program. If KHNP uses this method for the RCA, the problems related to the lack of human resources and skills for performing RCA can be resolved.

REFERENCES

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