Study on Understandability of Seismic Information on Nuclear Power Plant

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SUMMARY:
The purpose of this study is to communicate the seismic information on nuclear power plant to the local resident understandably. It is based on the teachings of the Niigataken-Chuetsu-oki earthquake which occurred in 2007. For communicating understandable information, we have been building Kashiwazaki-Kariwa model, and devised the process recipe which constructs the framework of communication and the information recipe which arranges the information effectively. In the field survey, it has confirmed that the gap of the understanding which exists between the sender and the recipient was decreasing by practical use of these recipes. Furthermore, the growth of the university student as a listener who intervened between the sender and the recipient was confirmed.

Keywords: understandable information, nuclear seismic safety, Kashiwazaki-Kariwa model

1. INTRODUCTION

The Niigataken-Chuetsu-oki earthquake (MJMA 6.8) occurred on July 16, 2007. In the Kashiwazaki-Kariwa nuclear power plant located in this area, all the nuclear reactors stopped safety and were able to avoid the critical situation. However, there were some problems about handling of the safety information. Nuclear and Industrial Safety Agency of Japan discussed those problems, and proposed the solution that expert should provide understandable information to the local resident by improving the expression. Immediately after the earthquake, the resident wanted brief and understandable information to provide by a suitable means. When time passed, they wanted detail and understandable information. The purpose of this study is to analyze how the seismic information on the nuclear power plant is plainly communicated to the local resident, and to formulize the process. First, “Kashiwazaki-Kariwa model” as a working scheme had been suggested. Next, the concept of the model was embodied and the availability was verified by the field survey.

2. CONSTRUCTION OF UNDERSTANDABLE COMMUNICATION MODEL

2.1. Kashiwazaki-Kariwa model

This study is advanced according to the following steps, in order to realize effective communication in the area with nuclear power plant. (1) To collect and analyze the information on the gap between expert as sender and local resident as recipient, and organize the factors of the gap. (2) To develop manual that provides the course of action regarding understandability and visualization, based on the result obtained above. (3) To describe the implementation processes of (1) and (2) clearly in order to help apply the model to other area. (4) To incorporate the process in (3) into the manual and develop it as a "Kashiwazaki-Kariwa model".

To the objective of (1), we confirmed that the communication which made a listener intervene between the sender and the recipient was effective in collecting the information on the gap. In the field survey at that time, Japan Nuclear Energy Safety Organization acted as the sender of information, and Niigata Institute of Technology acted as the listener. To attain (2), the following two problems must be solved.

- Method of arranging understandable information based on the knowledge of "Engineering accountability and Understanding"
- Construction of the structure which feedback the information analyzed and summarized to the sender

2.2. Process recipe & Information recipe

Fig.1 details the concept of the Kashiwazaki-Kariwa model. The process recipe is the procedure to construct a framework of communication. The information recipe arranges information to communicate and finds out understandable expression. In the process recipe, the characteristic of the area is defined, and contents of a communication are determined. Next, a communication plan is developed and carried out. In this communication, a listener intervenes between the sender of information (expert) and the recipient (local resident), collects recipient's opinions, judges the understanding, and analyzes the factor of understandability. The listener's candidate should be the organization trusted in the area, and the university is suitable. The purpose of the information recipe is to clarify the sender's intention to communicate and the part where a recipient feels difficult to understand. The information arrangement table of the information recipe utilizes the knowledge of "Engineering accountability and Understanding". By describing the items of Table 1 and Table 2, the information is able to arrange smoothly.

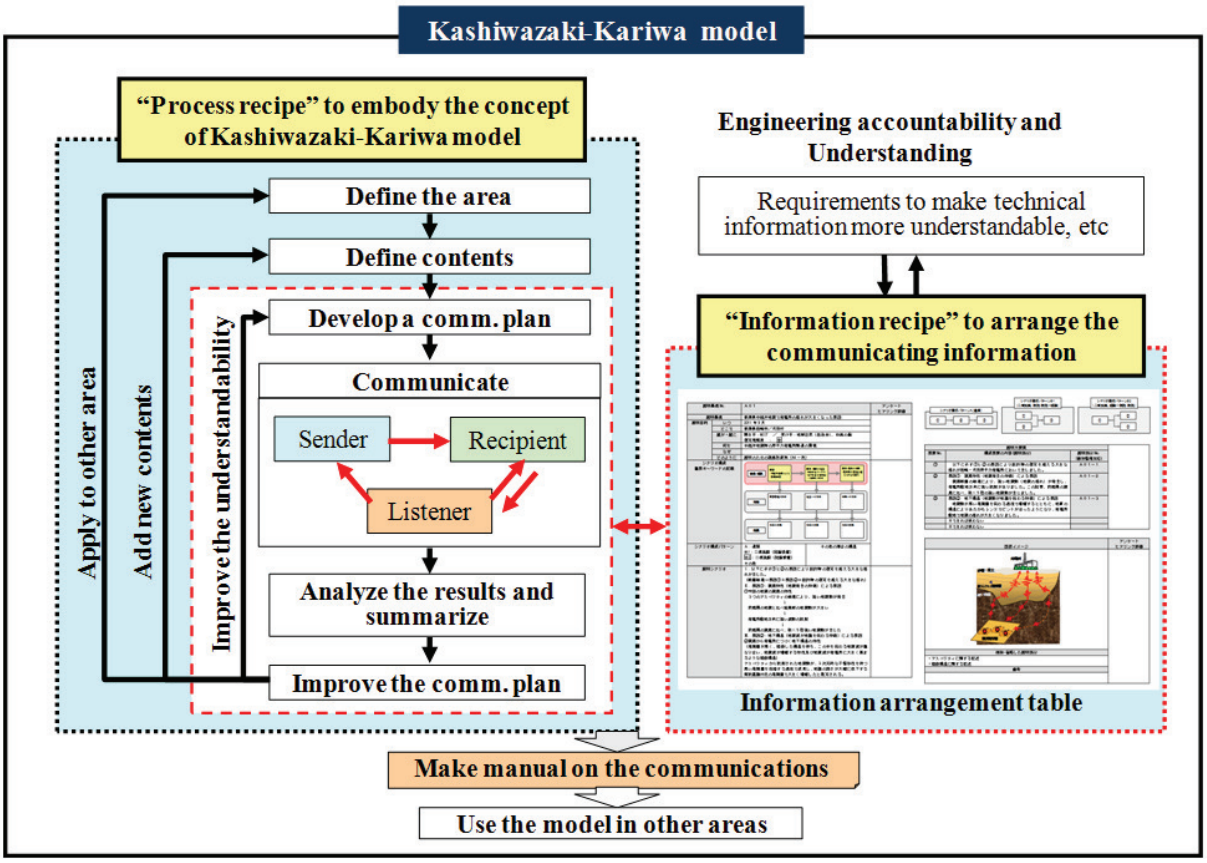

Figure 1. Kashiwazaki-Kariwa model

Table 1. Arrangement of explanatory structure

- Explanatory matter (short sentence)
- Explanatory purpose (When, Where, Who/Whom, What, Why, How)
- Structure (occurrence/measures)
- Pattern of scenario (chain/emphasis)
- Chart image
- Important keywords

Table 2. Arrangement of explanatory component

- Uncertain information
- Evaluated information
- Technical term
- Answer to question and objection
- Contrast and Figurative expression

3. VERIFICATION OF KASHIWAZAKI-KARIWA MODEL BY FIELD SURVEY

3-1. Flow of field survey

In order to verify the process from development of a communication plan to improvement in the model, a field survey was performed in Kashiwazaki-Kariwa area. First, experts in seismic safety as sender utilized information arrangement tables and made two explanatory materials:

(E1) The factor to which the shake of plant became large in the Niigataken-Chuetsu-oki earthquake.

(E2) The evaluation and the result of the soundness of equipment after the earthquake.

Fig.3 shows a example of the explanatory material (E1). In order that the sender may grasp the part where a recipient cannot understand, the explanation and the figure were numbered. The number was not shown to the recipient. Next, the university as listener took in the explanatory material to the questionnaire, and investigated the recipient's information needs and the understanding. The judgment of understanding was on the basis of the recipient's self-assessment, and was performed by dividing into explanation (term, logic/structure) and figure. The listener needed to correct the judgment according to the reason for the reply, the individual attribute, etc. Finally priority was given to the understanding of the explanation, and synthetic understanding level was determined based on Table. 3. Furthermore, in order to investigate a cause difficult to understand deeply, recipient's representatives were elected from the middle and the low understanding level, and were interviewed.

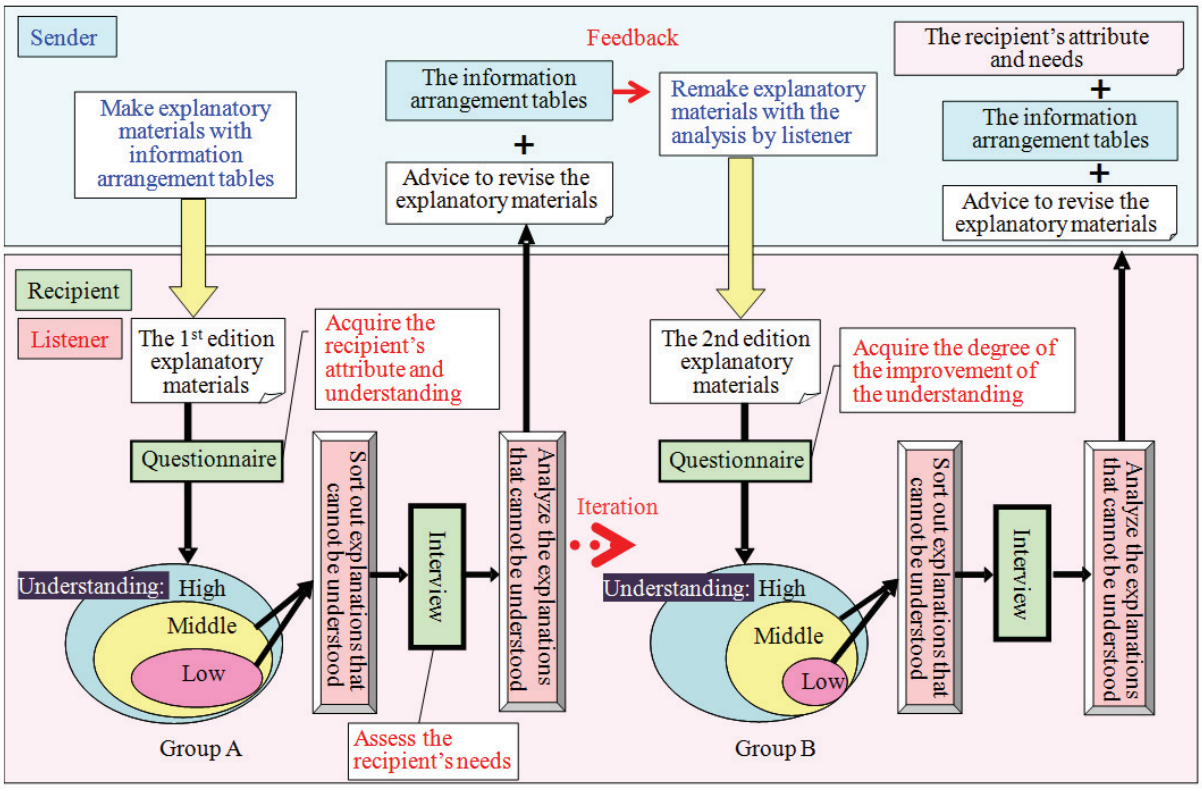

Figure 2. Field survey to verify availability of the Kashiwazaki-Kariwa model

The analysis information about the recipient's needs and factor difficult to understand, which had been clarified by the questionnaire or interview, was added to the information arrangement table, and was utilized when the sender remade the explanatory materials. In the field survey using the 2nd edition explanatory material, recipients were elected from another group of the same layer.

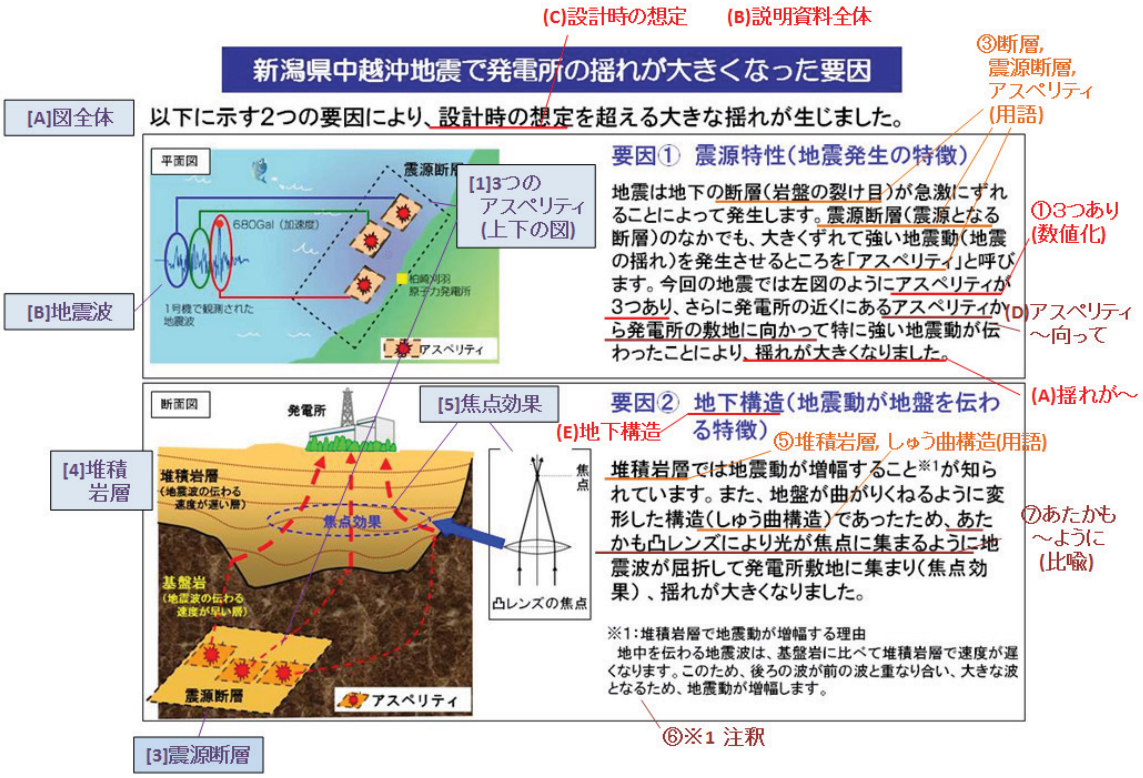

Figure 3. Example of the explanatory material E1 in which a sender's intention was traced

Table 3. Judging standard of understanding level
(Yes: The explanation is understandable / No: There is a part difficult to understand)

Answer pattern	Explanation		Figure	Understanding level	
	Term	Logic/Structure			
1	Yes	Yes	Yes	High	H1
2	Yes	Yes	No		H2
3	No	Yes	Yes	Middle	M1
4	Yes	No	Yes		M2
5	No	Yes	No		M3
6	No	No	Yes	Low	L1
7	Yes	No	No		L2
8	No	No	No		L3

3-2. Improvement of recipient's understanding

The number of questionnaire replies in the field survey using the 1st edition was 61 persons, and the 2nd edition was 54 persons. The respondent has chosen out of various layers, such as an office worker, a housewife, a student, etc. who live in the Kashiwazaki-Kariwa area. The distribution of the understanding level judged from the questionnaire is shown in Fig.4. The number of understanding level "High (H1, H2)" in the field survey using the 2nd edition increases and "Low (L1, L2, L3)" is becoming fewer. Main factors which the understanding has improved were as follows:
(1) In the explanatory material E1, the resistance decreased by having reduced the technical term in consideration of a recipient's opinion. (2) In the explanatory material E2, although the technical term

was increased, the explanation to the technical term was made appropriately. (3) The figure and the explanation were corresponded appropriately.
The above results showed that the process recipe and the information recipe had contributed to the improvement of understandability.

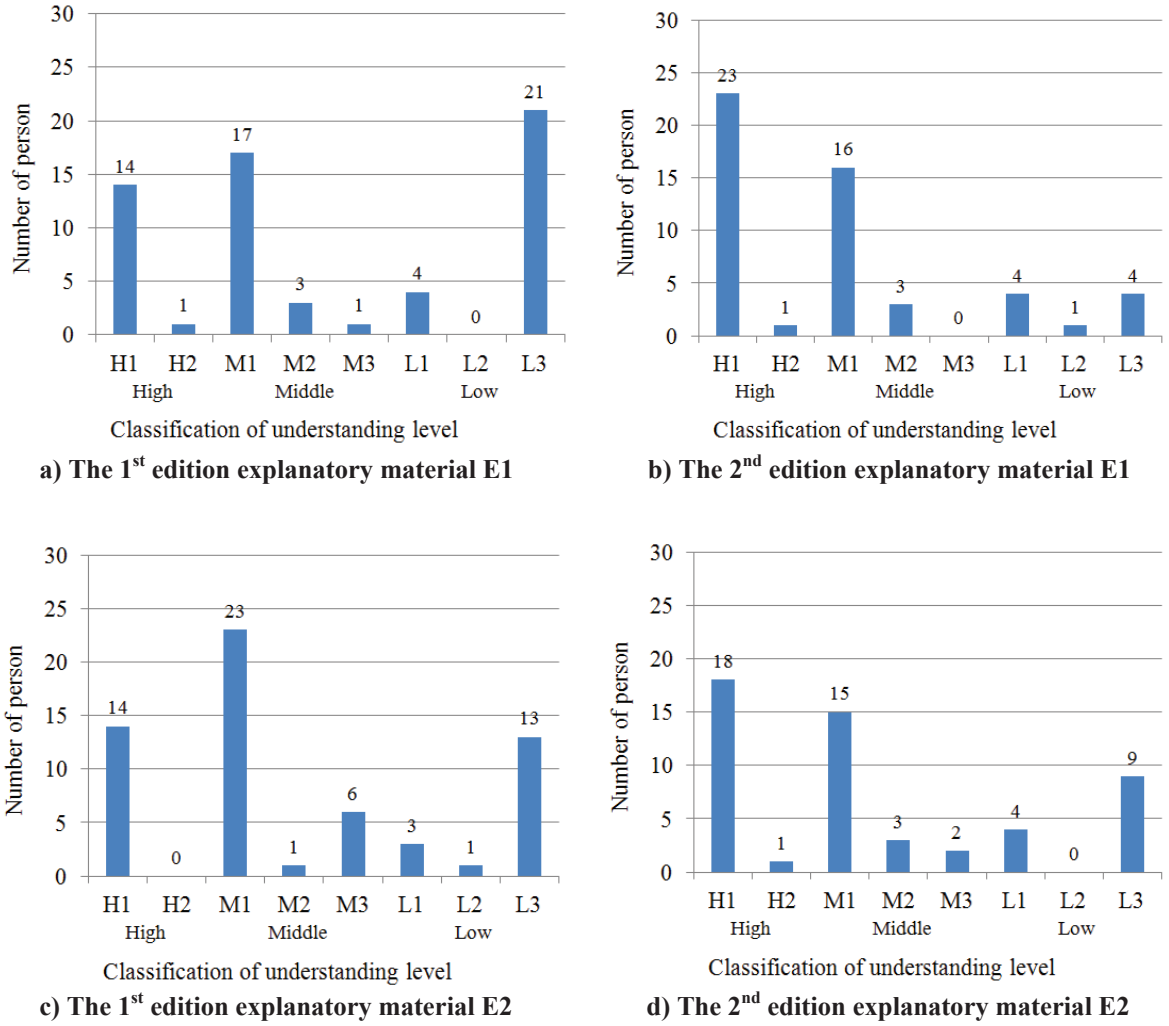

Figure 4. Distribution of the understanding level judged from the questionnaire

3-3. Listener's role and growth

Niigata institute of technology established Nuclear seismic and structural research center in 2010. It aims at the implementation of the study on nuclear safety, the provision of the information to the local resident, and the human resource development. Since the university was in a fair and neutral position, in verification of the Kashiwazaki-Kariwa model, it was able to contribute to the improvement of a recipient's understanding as a listener and to get continuous cooperation. Moreover, the university students took charge of the listener, and the improvement of their communication skills (mainly the capability of listening, collaboration, and information processing) was confirmed with the check sheet of growth which the university developed. It is considered that the practical use of the information recipe and the experience of the interview in the field survey have mainly contributed to the student's growth.

4. CONCUSION

The purpose of this study is to communicate the seismic information on nuclear power plant to the local resident understandably. For communicating understandable information, we have been building Kashiwazaki Kariwa model, and devised the process recipe which constructs the framework of communication and the information recipe which arranges the information effectively. In the field survey, it has confirmed that the gap of the understanding which exists between the sender and the recipient was decreasing by practical use of these recipes. Furthermore, the growth of the university student as a listener who intervened between the sender and the recipient was confirmed.
We plan in the future to make manual for applying the model to other area and to include the contents on the Fukujima Dai-ichi nuclear power plant suffered major damage from the earthquake and tsunami that hit Japan on March 11, 2011.

AKCHOWLEDGMENT
This study was made possible by a grant from Japan Nuclear Energy Safety Organization.

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