Draft Guidance for Protective Action Strategies Development

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1. Introduction

National nuclear emergency preparedness and response (EPR) framework has been improved since the Fukushima accident in 2011. For example, definition and radius of an emergency planning zone (EPZ) was revised and provisions of emergency exercises was reinforced by implementing more frequently and introducing new exercise focused on protective actions for offsite public [1, 2]. However, in detail, there are still many needs to be amended and improved in regulatory requirements and technical criteria to warrant efficacy of the EPR framework.

As an important part of the framework, protective actions have to be implemented with optimized and justified manner during whole emergency phases. In this study, to enhance protective action strategies in response to severe accident or general emergency, existing procedures were reviewed. And generic guidance to develop protective action recommendations (PARs) was proposed considering revised EPZ and recent technical information on protective action strategies.

2. Methods and Results

2.1 Review of Existing Procedures of Protective Action Recommendations Based on Plant Conditions

As a regulatory requirement, nuclear licensee has to describe methods to recommend public protective actions depending on the state of nuclear facilities in its radiological emergency plan (REP) [3]. This would be an alternative way to complement PARs based on assessment of radiological consequences and projected dose to public. Figure 1 showed an existing procedure of PARs based on plant status described in a REP of a domestic nuclear power plant.

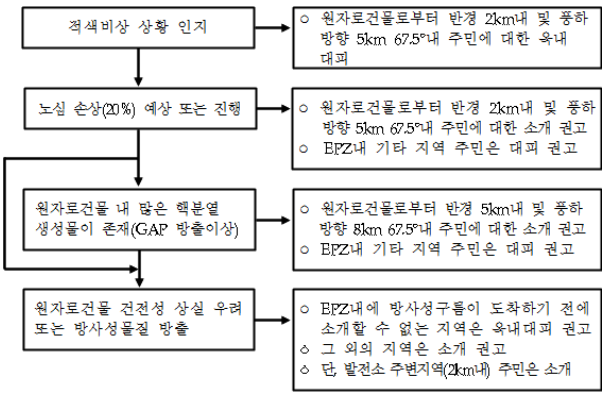

Fig. 1. A procedure of protective action recommendation based on plant conditions [4]

This procedure is focused on protective actions at an early phase (usually up to a couple of days) of emergency. It provides guidance for the immediate protective actions of those closest to the nuclear power plant and criteria for the expansion of protective actions. It simplifies decision making on initial protective action and implementation. Also it is expected to gain additional time for evacuation management if the expansion of evacuated area is necessary.

However there are some defects in this procedure. The range of initial protective action does not aligned with the definition of a precautionary action zone (PAZ) (3-5 km radius of a reactor). As a conservative manner, licensee has to recommend initial protective action to whole PAZ upon a general emergency (GE) declaration. In national EPR framework, evacuation is considered as an initial protective action in PAZ before any significant release of radioactive material occurs in order to avoid or to minimize severe deterministic effect off the site [5]. So the procedure which recommends sheltering in place (SIP) as an initial protective action has to be revised according to the framework.

This procedure did not provide specific PARs based on accident progression. Especially, for a rapidly progressing accident, nuclear licensee has to consider not only facility status but also off-site factors, such as evacuation time estimate (ETE) to recommend appropriate protective actions [6]. Because it would be difficult to accomplish the evacuation in a timely manner especially in high population density areas.

2.2 Generic Guidance for Protective Action Recommendations

In figure 2, generic guidance for PARs was introduced as a logic diagram. It was focused on PARs during an early phase of emergency. It was rendered with relatively simple steps and procedures in order to reduce confusion and delay to on- and off-site decision makers. This guidance provides technical basis to develop site-specific PARs procedures by nuclear licensees. There were some basic assumptions and technical backgrounds in this guidance.

As mentioned above, evacuation is an initial protective action in closest area regardless of impediments to implementation such as severe weather condition. There were some reasons of no delay in an evacuation. The release can occur over a couple of days such as the Fukushima accident. Some researches proved that even in the plum it is more effective protective action than sheltering [7]. Also staged evacuation was introduced because it would be more efficient than a radial evacuation of whole affected region [8].

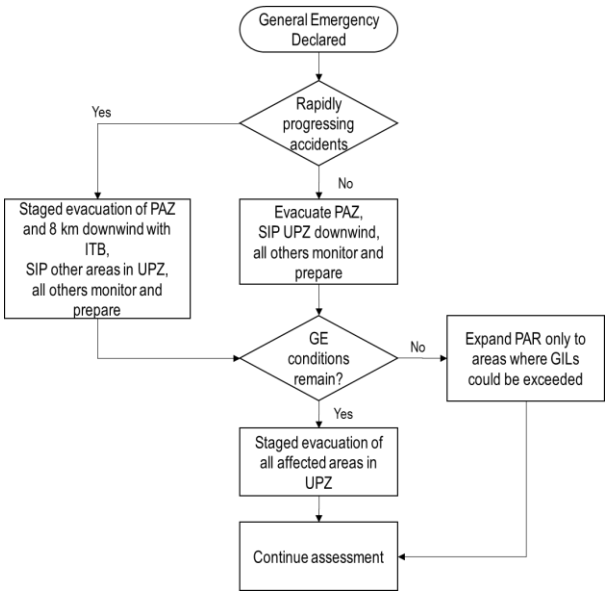

Fig.2. Generic Guidance for PARs

A rapidly progressing accident is a GE with rapid loss of containment integrity and emergency core cooling functions [9]. In this scenario, significant radioactive release would occur within about 1 hour from GE declaration [6]. The consequence would warrant large evacuation including an urgent protective action planning zone (UPZ). Also iodine thyroid blocking (ITB) should be combined with other protective actions to reduce the uptake of radioiodine from inhalation of passing plume [7]. However, other GE scenarios, ITB is not always justified since there would be enough time to evacuate before arrival of the plume. These accidents are considered to have a much lower frequency than other severe accident conditions [6]. However, arrangements in EPR have to consider the full range of possible accident conditions [10].

Generic intervention levels (GILs) were applied as a primary radiological criteria for protective action [11]. Though there are some newly developed criteria applicable in a nuclear emergency, the national EPR framework endorsed GILs.

The diagram was closed with ‘continue assessment’. Because there would be needs of transition to other accident phase, such as intermediate or recovery with long term emergency response as necessary.

3. Conclusions

The generic guidance for PARs based on facility status was introduced. Revision of EPZ and some recent information on protective action strategies, such as staged evacuation, specific approach for rapidly progressing accident were considered. It would be employed as a basis to develop site-specific strategies of PARs and regulatory guidance for emergency plan by nuclear licensee. It was focused on an early phase of nuclear emergency. Further efforts to develop site specific strategies of PARs and strategies which cover full range of nuclear emergency would be followed by several stake holders.

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