

## RESPONDERS ON SITE IN THE LATE PHASE AFTER AN ACCIDENT – THE ALARA APPROACH

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In the late phase after an accident, the work on-site aims at the dismantling of the damaged facility, including the management of the corresponding waste. The source is considered as secured and the radiological situation is a priori characterized. However, it could be a period of several years, at the end of the intermediate phase and the beginning of the recovery phase, in which the source is stabilized without being totally secured and some aspects of the situation are not fully characterized (e.g. hot spots). Significant hazards can still occur. The experiences from Chernobyl and Fukushima showed that the dismantling of a damaged facility is different, from a radiological protection point of view, from the dismantling of a decommissioned facility. This presentation aims to explore some of the specific topics that arise when applying the ALARA principle to the responders on-site in the aftermath of a nuclear accident.

In such a period, many workers are involved in the response on-site, more than during the normal operation of the facility. At Fukushima, the number of workers goes from around 2000 (April 2011) to 7500 (March 2014). Some are regular workers from the plant, but most of them are outside workers (e.g. contractors). They are all under the responsibility of the operating management of the damaged facility, even for outside workers, without prejudice of the responsibility of each employer. Many of these responders are not radiation workers. They are recruited for jobs they usually accomplish in workplaces without radiation, such as civil engineering and they stay in the damaged facility a small part of their working life-time.

The conditions of work are unprecedented and difficult. The site has suffered damages and is contaminated. At the beginning of the phase, the on-site radiological situation is partially unknown and requires full characterization. Human error or an external aggression may lead back to an emergency. In such prevailing circumstances, the workers can still be considered as responders. With time, the better the situation is characterized, the more the management of workers can be consistent with the system applicable to occupational exposure. However, flexibility is still needed. The optimization process should be adapted to the prevailing circumstances.

In such situation, the classical factors of time, distance and shielding of the optimisation process have to be questioned. First, the number of responders involved and the duration of their stay on-site should be maintained at levels considered necessary. Decontamination procedures may be implemented. Because most of the workers do not know the facility and have no particular skill and competences in radiological protection, attention should be paid to their risk-awareness and training. The training is a learning process focussed to the way to do the job in the best conditions under the prevailing circumstances. The responders should be involved in their own protection. A coaching may be organised by the operating management in order to balance the lack of radiological protection culture. Any responder should be properly equipped for the task assigned and the areas of work. In case of special circumstances, some dispensations may be applied for a limited time.

In terms of dose restriction, the application of dose limits is not well appropriate and the application of a reference level is preferable. The reference level should be selected according to the circumstances and after consultation. It should not be more than 100 mSv at the beginning and should decrease to 20 mSv or lower in the recovery phase. It might still evolve during the phase. Continuous efforts should be developed to improve the working conditions in the optimisation process. Doses should not exceed 100 mSv during the whole response. When a radiation worker is involved as responder, the corresponding dose should be treated separately and a medical examination may be appropriate before return to a regular work.

This paper reflect the work of the Task Group 93 of International Commission on Radiological Protection (ICRP), in charge of updating Publications 109 and 111 but does not necessarily reflect the views of the ICRP.