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Model of Performance Indicators in Nuclear Energy Emergency Plan Assessment applied to Emergency Exercises

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Abstract

This paper presents a model of performance indicators applied to nuclear emergency exercises for the assessment of a nuclear energy plan. The model was designed from the relationship between the actions forecasted in a nuclear emergency plan and the objectives challenged in emergency exercises. The nuclear emergency plan comprises a protocol that addresses structures, actions and procedures aimed at controlling and minimizing the effects of a nuclear emergency. The emergency plan is the last level of defense in depth used to ensure nuclear safety. Thus, the emergency plan must be efficient in preparing and organizing current means in order to ensure and assure an adequate protection of the population in the case of accidents in nuclear power plants. The model of performance indicators developed is based on the functional dependence observed in several different nuclear emergency plans, which facilitates the analysis of the state of preparedness of nuclear emergency response organizations. The model allows comparing different stages of preparedness of a nuclear emergency plan as well as nuclear emergency plans for different facilities.

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Keywords: performance indicators; nuclear emergency plan; emergency response exercises.

1. Introduction

Nuclear energy safe use involves the structuring of public policies aimed at ensuring the safety of nuclear facilities, personnel, population and environment. The emergency plan is a protocol intended to the response to a nuclear emergency, which is composed by structures, actions and procedures aimed at controlling and

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minimizing its effects. This protocol involves private and public structures, military forces and civilians, management activities, single or combined enforcement activities, all operating in strict synchronism.

In this paper, we present a model of performance indicators intended for a nuclear emergency plan assessment system. The model developed is based in the functional dependence observed in several nuclear emergency plans which functionally relates emergency plans, response structures, actions and activities.

The remainder of this paper is organized as follows: Section 2 presents the relationship between emergency plan and nuclear emergency exercises. Section 3 describes the characteristics of the performance indicators used in emergency plan assessment. Section 4 supplies the implementation of the model. Finally, the conclusions and proposals are described in Section 5.

2. Emergency plan and nuclear emergency exercises

Nuclear accident scenarios taken into account to prepare nuclear emergency response plans are based on theoretical studies, power plant technical tests and the study of accidents occurred in similar nuclear power plants [1].

The nuclear accidents considered in nuclear emergency response planning include from accidents forecasted as design basis (small consequences for the public and the environment) to very severe accidents with low probability of occurrence (accidents beyond the design basis) [2].

When a nuclear accident occurs, its characteristics and local conditions should guide the implementation of protective measures. Decisions concerning the adoption of urgent measures to protect the population are taken based on the reactor conditions, integrity of defense in depth structures, probability of release of radioactive material into the environment, environmental conditions, dose avertable and risks associated to the implementation of protective measures.

The organization of a nuclear emergency response requires mechanisms of prompt assessment and projection of the likely evolution of the accident, implementation of urgent protective measures, promotion of panic control strategies, rescue mechanisms and decontamination of persons in classified areas, as well as definition of the long-term actions to be taken after the accident [3].

Among prompt nuclear emergency response actions, the following should be enhanced: accident classification, leak containment as well as prevention of deterministic and stochastic effects on health. The deterministic effects can be reduced by minimizing the contact of personnel with radionuclides and limiting the doses with immediate consequences on the health of the public and emergency workers. The reduction of stochastic effects (tumors, gene mutation and embryonic malformations) can be obtained through long-term protective actions and/ or control of the public and emergency worker doses [4].

According to the International Atomic Energy Agency, one way of establishing a nuclear emergency response preparedness structure is to organize functional coordinating groups that perform actions of accident assessment, analysis of power plant conditions, definition of radioactive protection criteria and protective actions, environment monitoring and analysis of environment samples.

The adequacy of the set of actions necessary for emergency response preparedness should be continuously assessed to support the review of plans, procedures and established infrastructure. One of the most accepted ways of preparedness assessment is through nuclear emergency exercises.

A nuclear emergency response exercise comprises the practical execution of plans and procedures of nuclear emergency response on a simulated situation. Nuclear emergency response exercises can identify problems, weaknesses or gaps in preparedness for response [5].

A nuclear emergency response exercise can identify where planning improvements are necessary, evaluate whether the reviewed procedures (designed from the results of previous exercises) are correct, as well as help to develop an adequate preparedness for emergencies.

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