Electronic & Magnetic Sensing Based Integrated Simulation Platform System Solution to OSI Trainings and Exercises

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CTBTO PREPARATORY COMMISSION

INTRODUCTION AND MAIN RESULTS

OSI trainings and exercises can be practical and meaningful only if they could be conducted under the nuclear radiation environment.

This work would carry out an electronic & magnetic sensing based integrated simulation platform system solution to nuclear test event OSI trainings and exercises. Electronic & magnetic devices could be applied to replace the radioactive sources during the training and exercises.

After being detected by the corresponding specially designed detection equipments, the data would be sent from the equipment to the integrated information management platform for data visualization, situation awareness of radioactive hazards and signatures, training or exercises activities support.

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Demand Background

The implementation of the verification activities requires a lot of training and practice from the verification personnel. The practical and effective nature of these training and practice lies in the fact that they must all be conducted in real scenarios.

Practical problems

The training and practice for verification activities often require a real nuclear radiation environment, which poses significant challenges in terms of personnel protection and the prevention of radioactive leakage.
The actual training scenarios have limited setup conditions, and the number of application scenarios available for trainees is also limited, making it difficult to achieve particularly good training results.

The solution

Using electromagnetic simulation technology to simulate the radiation source, the simulation equipment receives simulated electromagnetic signals and provides data feedback that is consistent with the real scenario. This enables the verification personnel to complete the training and practice for different devices.

The simulated radioactive sources can generate nuclear pulse signals that conform to the physical laws of radioactive source decay based on parameters such as the activity level and type of the source. By placing multiple simulated radioactive sources with different parameters in the simulation training area, different types of simulated radiation fields can be constructed to provide simulation training conditions for various scenarios.

The simulation equipment automatically acquires simulated radiation levels, measurement and analysis data within the simulated radiation field. Relying on the simulation training system, it enables the visualization of simulated radioactive data, training and simulation of radioactive characteristics and hazards, as well as perception of radiation field situations.

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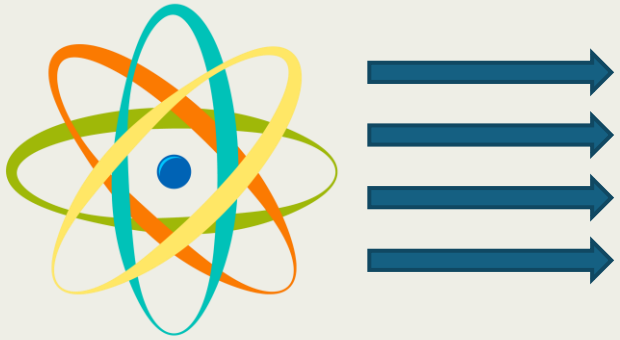
Simulation of radioactive sources and radiation fields

The radiation source simulator contains information such as the types and activity levels of the radiation sources, generating nuclear pulse signals and transmitting them wirelessly. The time intervals between the generation of nuclear pulse signals are random and follow an exponential distribution pattern, and the amplitude distribution is consistent with the type of the radiation source.

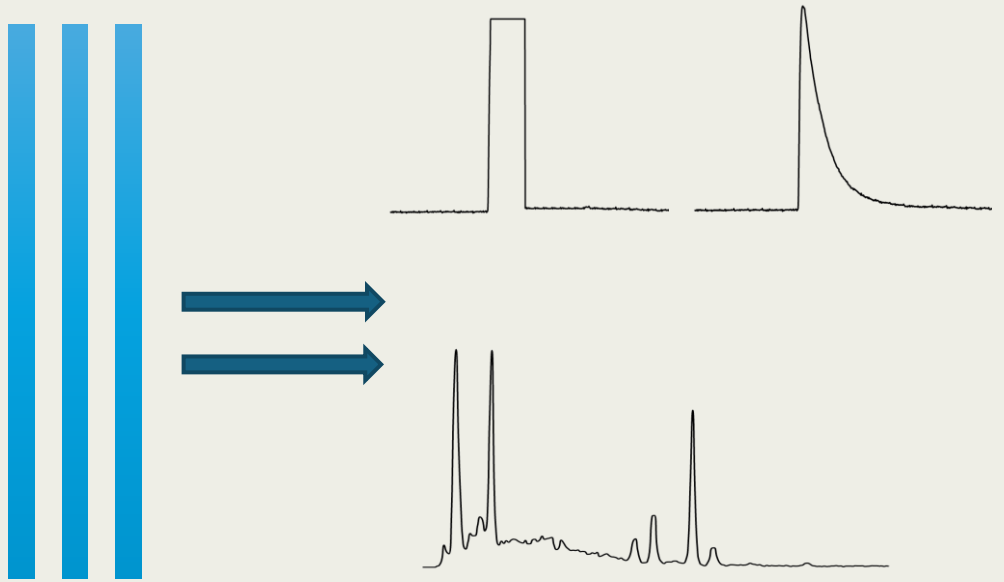
The radiation source simulator generates a simulated radiation field in the surrounding environment, and the dose rate levels at different positions in the environment are obtained through theoretical calculations. By setting up different numbers and types of radiation source simulators, different simulated radiation fields for nuclear radiation scenarios can be constructed.



Shielding material simulation

The shielding material simulator uses realistic materials and an internal electronic system to incorporate information such as the types, thickness, and density of the shielding materials.

When the shielding materials are placed in the simulated radiation field, the simulation training system automatically obtains the relative positions of the radiation source and the shielding materials, and performs shielding correction on the radiation field.



Digital simulation

Different data acquisition device simulators, such as handheld spectrometers, environmental dose rate meters, personal dosimeters, etc., are equipped with positioning and wireless communication circuits. They automatically receive the nuclear pulse signal data transmitted by the simulation training system and calculate and display the dose rate, energy spectrum, activity, etc. of the data. All operations and data calculations are consistent with those of the real equipment.

The positioning information and related parameters of the radioactive source simulator, shielding material simulator, and data acquisition device simulator in the radiation field are transmitted, calculated, and updated in real time through the simulation training system, providing training personnel with training conditions that are close to the real radiation environment and equipment usage.

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System Composition and Implementation

The simulation training system generally consists of positioning base stations (in indoor areas), simulated radiation sources, simulated shielding materials, simulated equipment, and other deployment facilities.

The system calculates simulation data based on the relative positions between the simulated detection equipment and the simulated radiation source, which is used for the response and display of the equipment. Trainees obtain radiation field perception data by operating the simulated detection equipment and complete emergency training scenarios such as equipment operation and verification.

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Application scenarios

On-Site Inspection training uses electromagnetic simulation technology to simulate radiation fields, instead of using real radiation sources, to eliminate the risk of radiation source leakage and personnel exposure.

Simulation teaching provides a simulated radiation environment for students to learn about the laws of radioactive decay, detection methods, and protection techniques.

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The conclusion

The simulation training system uses electromagnetic simulation technology to simulate the data of radioactive sources and radiation fields, providing environmental conditions for training and learning in various nuclear radiation scenarios. It has the following significant advantages:

- It poses no threat to personnel safety;
- There is no risk of radioactive leakage, ensuring safety and environmental protection;
- It can construct data of different types of radioactive sources and radiation fields, which is convenient and reliable;
- The training data can be traced back, effectively improving the training effect;
- It can be quickly deployed and recovered, almost unaffected by the site and environment.