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## **Development of quantitative measurement and analyze instrument for continuously source items investigation in NPP**

The collective dose of nuclear power plant workers mainly comes from the outage period of nuclear power plant. The corrosion activation products deposited in the pipelines and the radiation dose field formed are the main sources of occupational exposure of workers in the nuclear facilities, and the changes of their numerical value also reflect the operating state of the NPP unit. Therefore, it is of great significance to monitor the activity and dose rate contribution changes of radionuclides in key pipelines and points in real time, and which is useful to take necessary protective measures for subsequent maintenance work and reducing the collective dose as much as possible.

At present, the nuclear power plant only adopts the dose rate of the maintenance area to implement the corresponding protective measures during the outage period. Some nuclear power plants have implemented the source items investigation during the outage period, and have analyzed the radionuclide activity and dose rate contribution ratio of key pipelines and points in detail. And this work provides a reliable data basis for subsequent source items decontamination and dose reduction. However, during the oxidation operation of the outage period, it is change continuously for the activities of radionuclides at some key points. But there is no relevant instrument to monitor the trend of changes in the radioactivity in the pipeline in real time, which is reserved data blank for the subsequent radiation protection optimization and NPP unit operation evaluation.

In view of the above situation, a portable source term continuous investigation instrument which can quantitative measurement and analyze is developed based on CZT as the core radiation detection device. The core component of the instrument is 101010mm CZT crystal and multi-channel analyzer. And tungsten alloys are used as collimating shields for detectors to expand the dose rate application range of the instrument. According to the different dose rate of the key pipelines, an automatic drive device is used to select the aperture of the collimator. To reduce operator exposure dose, wireless data communication and control module is used between portable devices and tablet computers. The radionuclide activity and dose rate contribution analysis software integrates an automatic spectrum analysis algorithm and a passive efficiency calibration software based on Genat4, which can quickly calculate and analyze the activity and dose rate contribution proportion of key nuclides in the energy spectrum.

The experimental result shows that the energy resolution of the detector for Cs137 is 1.6%, the ranging range is 3cm-10m, the dose rate adaptation range is 1 $\mu$ Sv/h-3mSv/h, and the weight is less than 10Kg. The main nuclide activity and dose rate contribution ratio in the pipeline can be analyzed in real time, such as Co58, Co60, Nb95, Ag110m, etc. The device is compact in structure and easy to operate, and can be widely used in fixed-point continuous source item monitoring during outage period of nuclear facilities.

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