

High Energy X-ray Study on Nondestructive Detection of Fuel Assemblies

Xiang-Yang Zhang, Guo-Bao Wang, Gao-Kui He, Qiao Xie, Zi-Zeng Qiang, Zheng-Qiang Liang and Xin Wang

China Institute of Atomic Energy, Beijing, China

Corresponding author: Xin Wang <vx082701@139.com>

Nuclear fuel assembly is the core component in reactor, the characteristics of assembly is directly related to the safe operation of nuclear reactors and the effective use of nuclear fuel components, During the running of reactor, fuel pellets will be swelling and cracking under the condition of solid and gas fission products, thermal stress, neutron irradiation etc, and will be breaking in severe cases, which will directly threaten the safety of nuclear facilities. Therefore, periodic testing of nuclear fuel assembly is particularly important, irradiated nuclear fuel components have strong radioactivity, and there are some technical difficulties for the detection of nuclear fuel assembly, according to investigation and related research ,nondestructive detection technology research of High energy X-ray is a kind of efficient means of detection.

China institute of atomic energy has performed the technique research for several years,we have designed detector system, precision machinery system,motion control system,imaging system, simulation of nuclear fuel assembly etc., a platform of nuclear fuel components detection system has been set up,and has realized tomography imaging acquisition of simulated fuel assembly.now we are performing further research of detection system optimization ,data interference reduction algorithm under strong radiation environment,effective method study of improving the quality of imaging. All of these will lay a solid foundation for the detection of nuclear fuel assembly in hot cell.

System composition and structure

The detection system of nuclear fuel component consists of multiple subsystems, each sub detection system working normally and coordinating orderly is the premise of effective detection , the subsystem is mainly composed of high energy X-ray source, detection system, high precision mechanical movement and the control system, imaging detection system, etc.The system structure diagram is shown in Figure P17.

Results

As we know, irradiated nuclear fuel components have strong radioactive ,In order to reduce strong radiation interference and realize effective detection, high energy linear accelerator ray source is very necessary. we use 9 Mev high energy X- ray source in this system, high-energy accelerator mainly include X-ray head, water cooling system, modulator, control system, etc.The research group conducted exploration and research on simulated nuclear fuel assemblies. The detection results are shown in Figure P18.

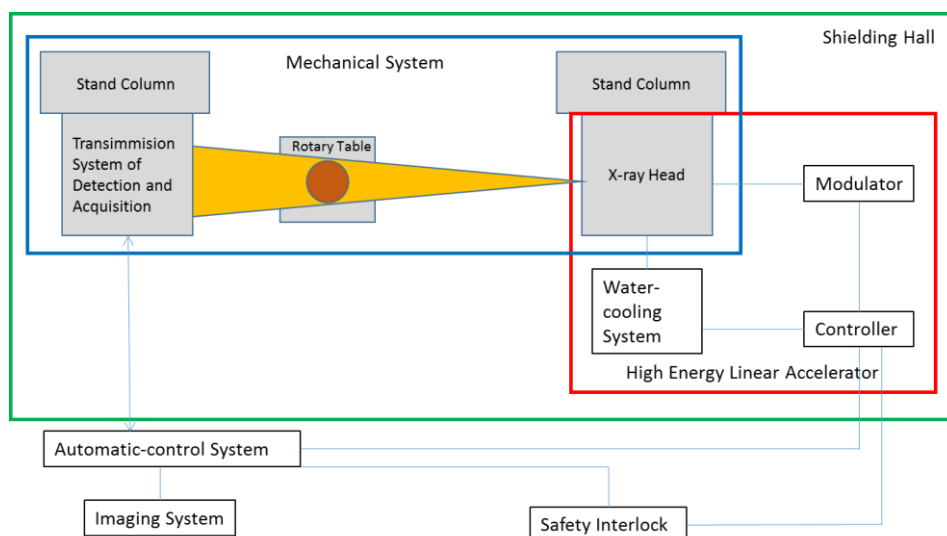


Figure P17:
Schematic diagram of
system structure.

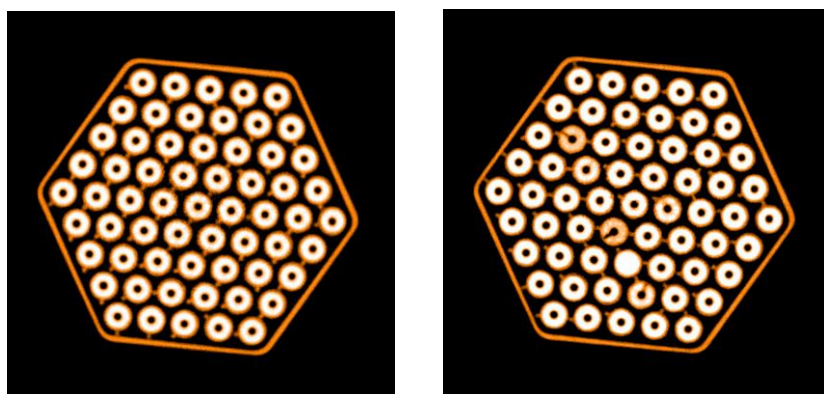


Figure P18: Computed
tomography image of simulated
nuclear fuel assembly

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