Monitoring and evaluation of environmental dose equivalent levels around HFETR

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Introduction

High-Flux Engineering Test Reactor (HFETR) is pressurized water reactor with a design power of 125 MW. Due to high neutron flux rate, flexible reactor loading and large irradiation space, it is mainly used for irradiation test of power reactor materials and high specific activity radioisotope production.

Effluents are sources of radiation effects on the environment from reactors and ancillary facilities, primarily in the form of airborne effluents and liquid effluents.

Airborne effluent

The radioactive airborne effluent is mainly derived from the research and production activities of HFETR, radiochemical laboratory and waste treatment facilities. It is purified by high-efficiency aerosol filter and iodine removal filter and finally discharged into the atmosphere. The concentration limit of radionuclide emission in airborne effluent:

- inert gas ≤ 6×10^{14} Bq/a
- ^{3}H ≤ 1.5×10^{13} Bq / a
- particles (half-life greater than 8d) ≤ 5×10^{10} Bq/a
- iodine ≤ 2×10^{10} Bq/a.

Liquid effluent

The radioactive liquid effluent is generated from the operation, maintenance and isotope production of the HFETR.

The radioactive waste liquid is discharged into the environment after evaporation and ion exchange treatment to meet emission standards.

● The total amount of total beta radionuclide emissions in the liquid effluent is:

≤ 5×10^{10} Bq/a

●The emission control concentration of total beta radionuclide emissions in the liquid effluent is:

<100 Bq/L

●The total discharge of 3H is:

≤ 7.5×10^{13} Bq/a

constraint value

The results of real-time online monitoring and sampling monitoring over the years indicate that the total emissions and concentrations of radioactive airborne effluents and liquid effluents emitted by HFETR are lower than the requirements of a standard.

The operating dose constraint value of HFETR implements the requirements of the Chinese national standard GB6249-2011, that is, "the dose of radioactive material released to the environment by any nuclear power reactor at any site to any person in the public must be less than 0.25mSv per year."

Method

In order to protect the radiation safety of the surrounding environment and the public, 54 ambient dose equivalent monitoring points were set up in different azimuths within 50 km around HFETR between 1980 and 2018.

The measurement points are generally selected on the surface where the terrain is flat, open, without water, exposed soil or covered by vegetation, and is not measured during rain and within 6 hours after rain.

Result

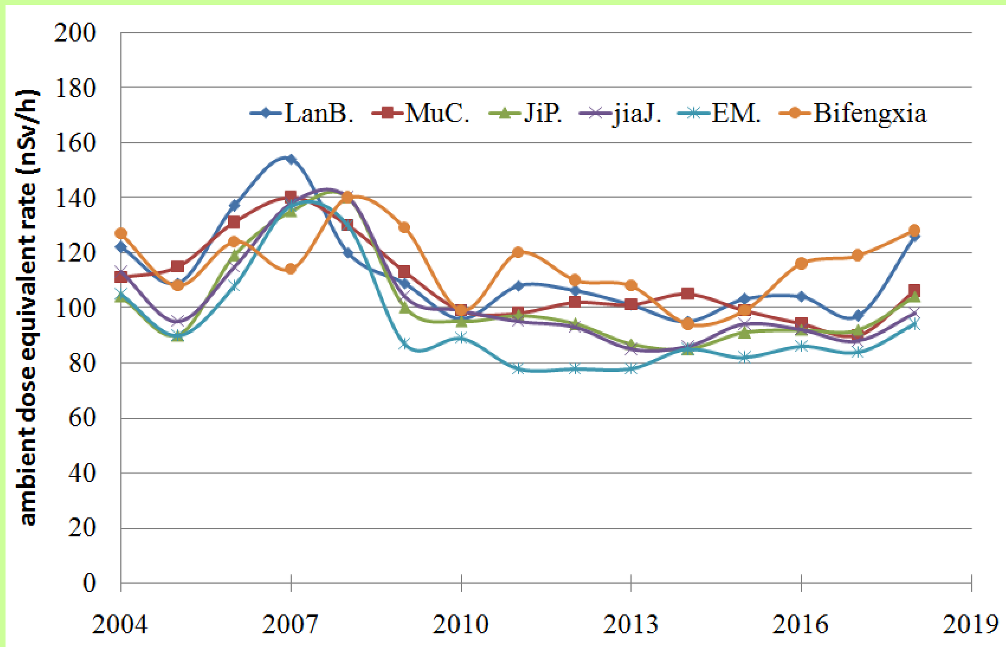
The monitoring results show that, for each quarter of the monitoring point, the average of the ambient dose equivalent rate is 107 nSv/h, which includes the contribution of cosmic rays.

It is even lower than the average value of the reference point Bifeng Gorge(116 nSv/h) at 57 km northwest of HFETR.

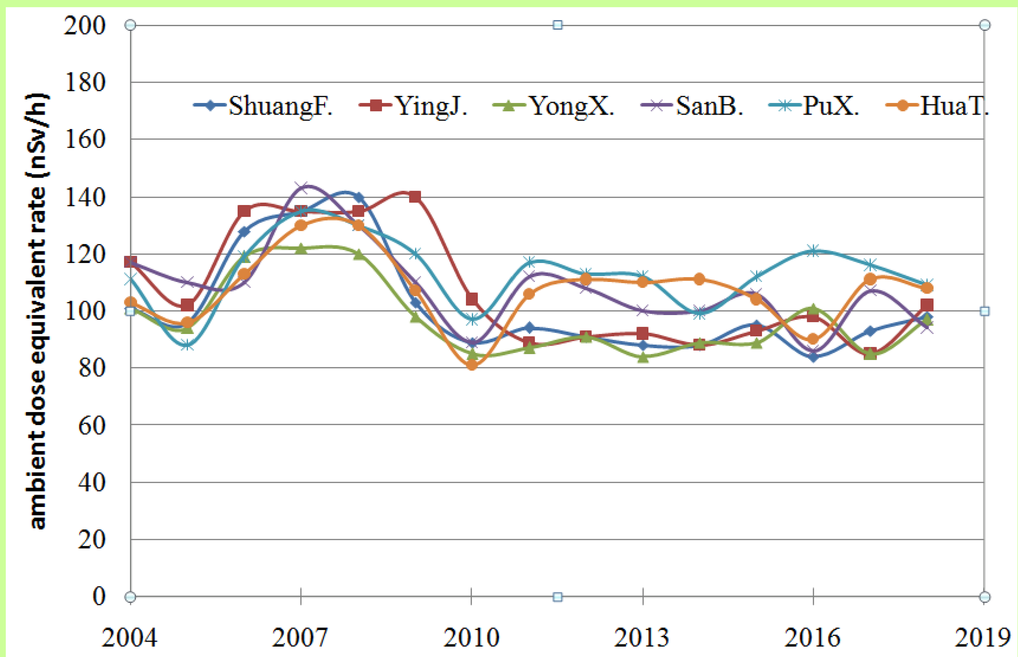
Compared with the natural environmental radiation level (100±20) nSv/h in Sichuan Province in 1989, the monitoring results of the ambient dose equivalent rate of each monitoring point over the years were in the normal natural background fluctuation range.

In addition, cumulative doses of 16 monitoring points in different orientations around the HFETR were monitored using thermoluminescent dosimeters.

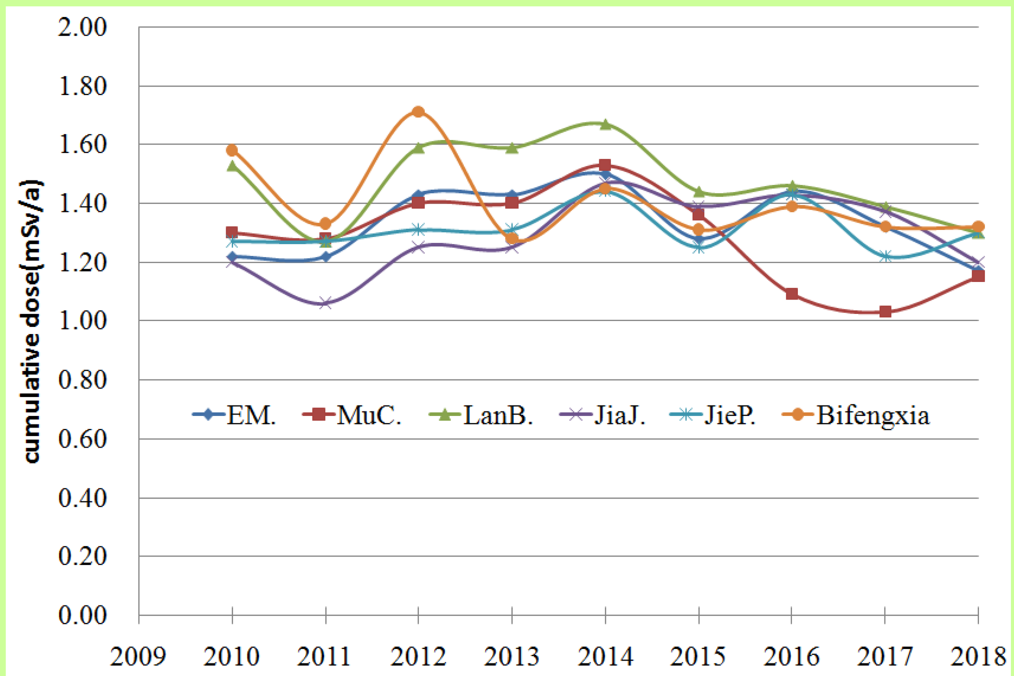
The monitoring results were basically consistent with the instantaneous monitoring average of the ambient dose equivalents.



The ambient dose equivalent rate of LanB, MuC, JieP, jiaJ, EM and Bifengxia as a function of time.



The ambient dose equivalent rate of ShuangF, YingJ, YongX, SanB, PuX and HuaT as a function of time.



The cumulative dose of ShuangF, YingJ, YongX, SanB, PuX and HuaT as a function of time.

Conclusion

The monitoring results of the ambient dose equivalent rate over the years show that each monitoring point is basically at the same level as the reference point, and both are within the statistical fluctuation range of radioactivity measurement.

The cumulative doses of 16 monitoring points in different orientations around the HFETR were monitored using thermoluminescent dosimeters.

Combined with more analytical projects, it showed that the normal operation of HFTER had no appreciable impact on the surrounding environment and the public.