# RADIATION PROTECTION IN THE MINISTRY OF NUCLEAR INDUSTRY

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## I. PREFACE

The complete system of fuel cycle has been established and operated in China. The two nuclear power plants are under construction, and more and more radioisotopes are produced and used year by year. Since founding the Ministry of Nuclear Industry much attention has been paid to radiation protection by our government. The principles "Safety First, Quality First" and "Radiation Protection Leading the Way" have been worked out and implemented strictly, and a series of necessary protection measures taken, so that no acute radiation sickness has occurred for near 30 years. A large amount of radioactive waste has been handled, treated and conditioned, and it has been proven through environmental survey that no serious pollution has taken place. Following the issue of ICRP Publication No. 26 a new radiation dose limitation system has been adopted and occupational and public, individual and collective, radiation doses have been reduced gradually.

## II. RADIATION PROTECTION MANAGEMENT

### (1) Regulations

The first national radiation protection regulation was issued in 1960 and a revised edition was published in 1974. Since then, the Ministry of Nuclear Industry has issued a series of safety regulations; Table 1 shows the title of these regulations. We began revision of the national radiation protection regulation in 1981; the final edition was completed in 1986 and submitted to the government for approval. The basic contents of this regulation is the same as IAEA safety series No. 9 "The Basic Safety Standards for Radiation Protection", but contains more detail relatting to optimization and assessment of radiation protection. Table 2 shows the title of regulations to be issued.

**TABLE 1**
**RADIATION PROTECTION REGULATION (ISSUED)**

1. Regulations for Radiological Protection of Nuclear Fuel Element
2. Regulations for Radiological Protection of Reactors
3. Regulations for Criticality Safety of Fissile Material Processing
4. Regulations for Criticality Safety of Fissile Material Storage and Transport
5. Regulations for Occupational Radiation Exposure Records
6. Regulations for Monitoring and Data Report of Personnel

**TABLE 2**
**RADIATION PROTECTION REGULATION (TO BE ISSUED)**

1. General Regulations for Quality Assessment of Nuclear Radiation Environment
2. Regulations for Safe Transportation of Radioactive Materials
3. Safety Standards for Package of Radioactive Solid Waste with Low- and Intermediate-Level
4. Regulations for Radioactive Waste Management
5. Regulations for Radiation Protection in Production of Radioactive Isotopes
6. Regulations for Short-Term Storage of Radioactive Waste
7. General Quality Assurance for Ionization Radiation Monitoring
8. Regulations for Medical Supervision for Workers in Nuclear Power Plant
9. Emergency Planning and Preparedness for the Accident of Nuclear Power Plant

### (2) The Organization

The Bureau of Safety, Protection and Health, MNI was set up in 1960 in order to manage research for radiation protection, to protect the environment and to establish and implement radiation protection programmes. The infrastructure of the safety and radiation protection authority, MNI is shown in Fig. 1. The Bureau is divided into five divisions:

- Administrative Office,
- Nuclear Safety and Protection,
- Technological Safety,
- Environment Protection,
- Radiation Hygiene and Health.

There are several institutes engaging in research relating to radiation protection.

1) The Institute of Radiation Protection was founded in 1962. This is a multidisciplinary institute which covers radiation protection measurement, radiation dosimetry, environment protection, radioactive waste management, standardization of radiation protection, radiomedicine, radiobiology, radioecology etc.
2) The Institute of Atomic Energy situated in Beijing is another research unit in the field of radiation protection and nuclear safety, which covers radiation protection, environmental protection, radioactive waste management, nuclear safety, criticality safety etc.

In addition to these, each nuclear factory, research and design unit has its own department of radiation protection.

In order to strengthen the administration of radiation protection, the Ministry of Nuclear Industry decided to set up four centres in the Institute of Radiation Protection in 1986:

- Personnel dose monitoring service and assessment,
- Environmental monitoring and assessment,
- Calibration of radiation protection instruments,
- Occupational disease registration.

The tasks of these centres are as follows:

- Collect and analyse the records of occupational individual and public exposure, arising from the release of liquid and airborne effluents, solid waste and occupational disease cases,
- Write an annual report on radiation safety and submit it to the Ministry of Nuclear Industry,
- Ensure quality assurance of radiation protection measurements,
- Conduct environmental surveillance and individual radiation exposure monitoring.

## III. RADIATION PROTECTION AND ENVIRONMENT ASSESSMENT

For all nuclear facilities, radiation monitoring should be performed in accordance with an appropriate radiation monitoring programme worked out on the principle of radiation protection optimization.

### (1) Personnel Monitoring [1]

The personnel monitoring devices used to measure external radiation exposure are X-ray film badges in the 1960s, both film badges and fluorescent glass in the 1970s and TLD for about one third of monitored workers. Internal dose monitoring commenced in 1963. The major nuclides measured were uranium and plutonium, iodine and cesium in some cases, as well as radon and its daughters in uranium mining and milling. The internal monitoring techniques are not yet complete; major methods are bioassay and whole body counting. Routine monitoring measures uranium or tritium in the excreta of the workers; the methods recommended by ICRU publication 30 are used to estimate the internal dose. The average intake may be calculated by using data relating to the concentration of aerosols in the respiratory zone of the working place.

The annual average dose equivalent from external exposure during 1959–1984 is shown in Fig. 2. From 1968–1976 the annual average dose equivalent was much higher than other years because radiation management was not good during that period.

The total number of workers monitored is 60 000 man.year. The collective dose equivalent from external radiation is about 600 man.Sv. The annual average individual dose equivalent is 9.2 mSv.

As personnel monitoring and management, and protective measures are improved, collective and individual doses are reduced. A trend has shown that the doses to occupational workers are gradually decreasing. The annual average equivalent was less than 5 mSv, during 1981–1984 and the annual average committed effective dose equivalent from uranium and tritium was less than 5 mSv. The results are shown in Table 3.

**(2) Environment Monitoring and Assessment** [2]

The requirements for environment protection in siting nuclear facilities are considered to be an important factor. In order to minimize the population dose, the sites of nuclear facilities are selected as far as possible in areas with small populations. Each nuclear facility and research unit has an environment protection department, responsible for monitoring and assessment. The ranges of monitoring areas are from 10 to 20 kilometres. All nuclear units are required to investigate the background radiation levels before the nuclear facility begins operation.

In order to assess the impact of the nuclear industry completely and systematically we have a programme of environmental assessment; the programme began in 1980. Results show that the annual average dose of critical groups is well below 5 mSv; 77 per cent are below 0.25 mSv. The collective dose within 80 kilometres of sites are about 0.01% of the collective dose due to natural radiation.

Most nuclear facilities are located in the Yangzi river basin and members of the public are concerned about the possibility of impact. Comprehensive investigations were carried out twice in the 1970s and in 1983 [3,4]. The main results are shown in Table 4 and these indicate that the Nuclear Industry has no impact on Yangzi River.

## IV. CONCLUSION

China's policies for controlling occupational exposure and release of radioactive materials into the environment have proved effective. From the viewpoint of optimization of radiation protection there are many problems that need to be researched. In order to strengthen radiation protection and nuclear safety, we should improve the scientific management of radiation safety, clarify the goals of radiation safety, establish a data bank of radiation safety information and enhance research related to risk analysis and management, safety system engineering and optimization of radiation protection.

## REFERENCES


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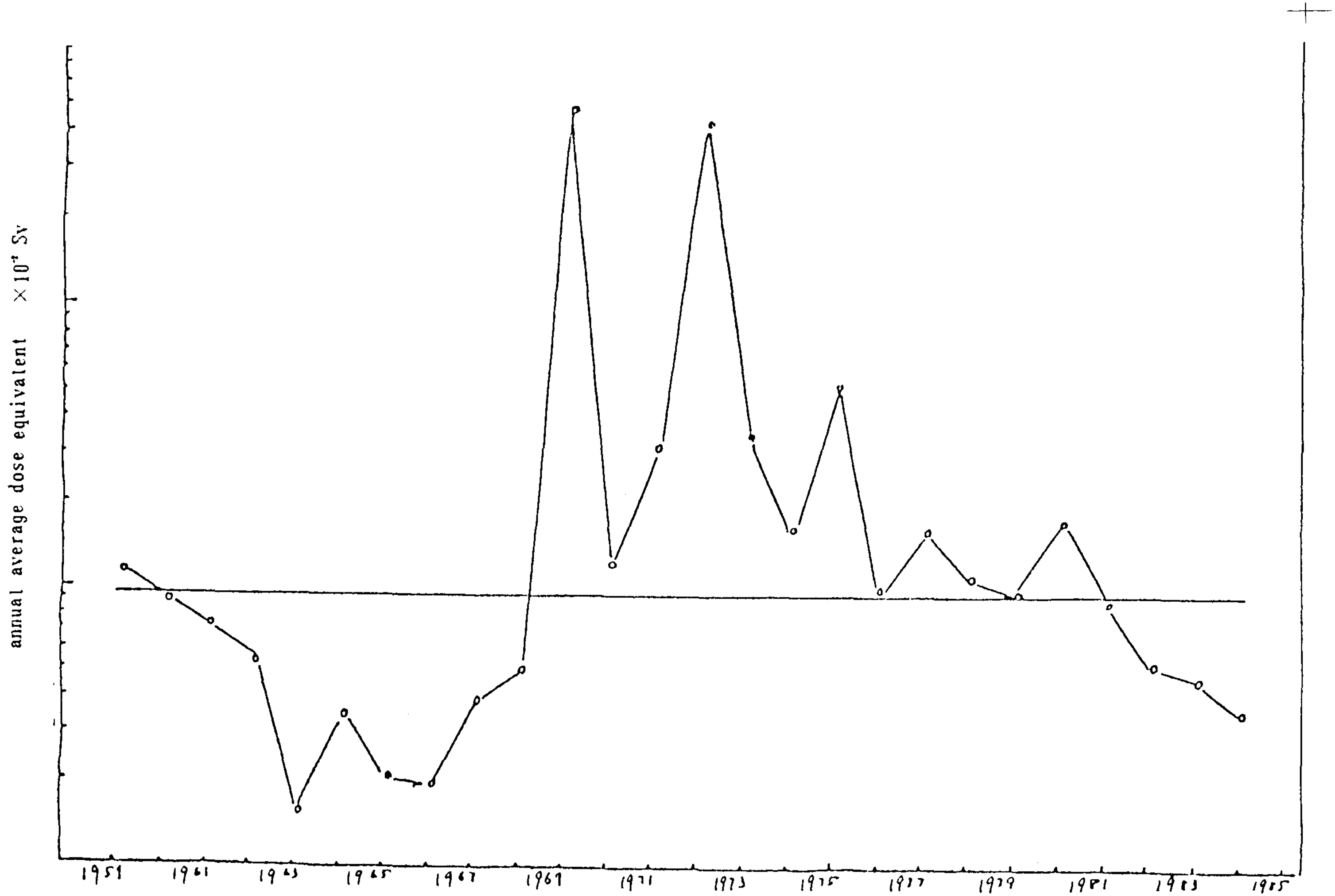


Fig. 2 The annual average dose equivalent from external exposure during 1959-1984

TABLE 3. INDIVIDUAL EXTERNAL DOSE EQUIVALENT
AND DISTRIBUTION FOR OCCUPATIONAL WORKERS IN 1980—1984

| year | total number | collective dose equivalent S (man.Sv) | average dose equivalent per a.person $\bar{H}$ ($\times 10^{-2}$) | ≤ 5 mSv number | % | 5-15 mSv number | % | 15-25 mSv number | % | 25-50 mSv number | % | 〉50 mSv number | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1980 | 5112 | 60.49 | 1.16 | 2984 | 57.3 | 1244 | 23.9 | 370 | 7.10 | 331 | 6.35 | 283 | 5.43 |
| 1981 | 5356 | 46.92 | 0.88 | 3206 | 59.9 | 1357 | 25.3 | 361 | 6.74 | 302 | 5.64 | 130 | 2.43 |
| 1982 | 5485 | 29.26 | 0.53 | 3780 | 68.9 | 1225 | 22.3 | 296 | 5.40 | 165 | 3.01 | 19 | 0.35 |
| 1983 | 5658 | 27.83 | 0.49 | 3930 | 69.5 | 1327 | 24.7 | 261 | 4.61 | 135 | 2.39 | 5 | 0.09 |
| 1984 | 6322 | 23.62 | 0.37 | 4915 | 77.7 | 1112 | 17.6 | 207 | 3.27 | 74 | 1.17 | 14 | 0.02 |

TABLE 4 RADIOACTIVE LEVEL OF WATER SAMPLE IN YANDZI RIVER

| nuclides | | average level 1979-1980 | average level 1983-1984 |
|---|---|---|---|
| total α | Bq/l | 0.059 | 0.063 |
| total β | Bq/l | 0.104 | 0.104 |
| U | Bq/l | 0.86 | 0.86 |
| Th | Bq/l | 0.17 | 0.15 |
| $^{226}Ra$ | Bq/l | 0.001 | 0.010 |
| $^{3}H$ | Bq/l | 10.36 | 8.039 |
| $^{137}Cs$ | Bq/l | 0.0002 | 0.0006 |
| $^{90}Sr$ | Bq/l | 0.0089 | 0.0118 |