

# **RADIATION MONITORING AND QUALITY ASSURANCE IN DECOMMISSIONING OF NUCLEAR FACILITIES**

**Huang Zhijian**

(China Institute for Radiation Protection)

(P.O.Box 120, Taiyuan, Shanxi, China ,030006)

## **1. Introduction**

Radiation monitoring in decommissioning of nuclear facilities is a major part of the entire decommissioning engineering. Quality of radiation monitoring has a direct influence on the quality of decommissioned work. Decommissioning due to poor engineering quality will result in not only great economic loss but also poor social impact. Therefore, it is not difficult to understand in decommissioning of nuclear facilities the radiation monitoring quality is of special importance. The paper is intended to present the characteristics of radiation monitoring in nuclear facility decommissioning, quality assurance system, quality assurance requirements and the related issues.

## **2. Characteristics of radiation monitoring in nuclear facility decommissioning**

Radiation monitoring in decommissioning of nuclear facility involves the dismantlement, decontamination and cleaning of equipment, facilities and buildings as well as radioactive waste disposal, including source term survey, decommissioning monitoring, termination survey, and verification inspection survey<sup>[1-4]</sup>, etc. The work amount of various monitoring categories varies greatly with the different stages of decommissioning. Decommissioning monitoring requires the large amount of work to be done, lasting long time throughout the full process of the decommissioning. the termination and verification inspections are to check and certificate the quality of decommissioning monitoring. So issues on radiation monitoring quality discussed in the paper is mainly focused on decommissioning monitoring.

## **3. Radiation monitoring quality assurance system**

Radiation monitoring quality assurance system is shown in Fig. 1. The decommissioning project is contracted by licensee or contractor(s). The licensee sets up Decommissioning Office (DO) and Quality Supervision Office (QSO). Radiation Monitoring Leading Group (RMLG), led and supervised by decommissioning office, include Radiation Monitoring Group (RMG) and Quality Assurance Group (QAS), which is also guided and supervised by the QSO. The RMG consists of decommissioning operating monitoring, radiation protection monitoring, and environmental monitoring, which are also guided and supervised by the QAG according to decommissioning plan. The QAG is responsible for preparation of monitoring program, preparation and provision of quality assurance documents, organization of personnel training, selection of monitoring instruments, determination of measuring and analytical methods, determination of sampling and sample preparation methods, review of monitoring data and report. The QAG is also responsible for organization of post-decommissioning termination radiation survey and providing of termination survey report. These monitoring groups separately exert interior and exterior quality control measures according to quality control requirements. Termination verification inspection survey for decommissioned nuclear facilities should be undertaken and carried out by the inspection survey group entrusted by competent authority.

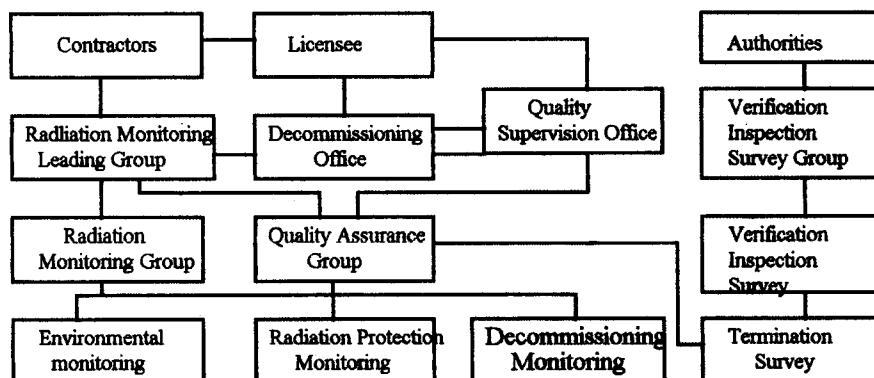


Fig. 1. Radiation monitoring Quality Assurance System

#### 4. Quality requirements for radiation monitoring

It is the final quality target of radiation monitoring during nuclear facility decommissioning to enable the residual radioactive contamination level of decontaminated equipment, facility, building, field, and site to meet the standards required by decommissioning project, and to identify these items can be open for the public to use on a restricted or unrestricted basis. After decommissioning, radioactivity inventory and disposal must be clear. Thus, in preparation of nuclear facility decommissioning program, the quality requirements for the process of monitoring should taken into account.

##### 4.1 Quality requirements for source terms survey

Source terms survey at the preparatory stage of nuclear facility decommissioning mainly involves two factors: residual radioactivity and radioactive contamination. The former means the amount of radioactive materials left within the decommissioned nuclear facility while the latter means the extent to which the decommissioned object is contaminated and the related contamination amount. In principle, the quality requirement for source term investigation is to give accurate or comparatively precise magnitude for the large while contamination source survey is to discriminate contaminated objects, types, and extent, giving the estimates of contamination.

##### 4.2 Quality requirements for decommissioning monitoring

###### 4.2.1 Training

Scope of training includes basic features and properties of decommissioning project; types, distribution and magnitude of contaminating nuclides; underlying know-how and regulations of radiation protection; contents and requirements of decommissioning monitoring; control limits of nuclides of concern; monitoring methods; performance of monitoring instruments; operating procedures; sampling requirements; analytical methods; target and requirements of quality assurance; format of records and monitoring report.

###### 4.2.2 Selection and use of instruments

Detectable lower limit of instrument should meet the specified decommissioning standards. Probe surface area of surface contamination monitor should perfectly be same with that specified by decommissioning standards.

Reference standards used for calibration of monitoring instrument and sample analysis should be traceable to the national standards. All of monitoring and analytical instruments should be confirmed to be steady and reliable.

###### 4.2.3 Quality control in decommissioning monitoring

Quality control in decommissioning monitoring requires conducting full-range scanning monitoring with view to not omitting hot points and above-standard points. So the extent of decommissioning monitoring should properly larger than the contamination extent indicated by source term investigation. In the process of monitoring, decontaminated area and volume of items should be given, and magnitude of radioactivity decontaminated should be estimated in a timely manner, so as to sort contaminated parts and determine where the decontaminated contaminants are located. Parameters, such as types of nuclides and inventory of radioactivity, should be presented during packaging of radioactive waste into drums.

#### 5. Implementation and control of standards

In decommissioning of nuclear facility, the objective of radiation monitoring is to identify whether or not the residual radioactivity level on the decontaminated or cleaned equipment, facility, building and field meet the specified standards or limits. In implementation and control of standards, there would be an issue that is: what is above standard or above standard point. Because any of specified standards or limits is a absolute value. This can be reflected in instrument reading, or measuring data or analytical results of sample, where there will exist a variety of errors. There should be a confidential interval in implementing standards:  $A \pm k\sigma$ , where A is a number value specified by standards,  $\sigma$  is total error of measurement and k is a coefficient related to confidential level. In decommissioning radiation monitoring, standard can be implemented in terms of  $A \pm k\sigma$ ,  $k=1$ , with relative error 30%. This means that standards is implemented in terms of 2/3. However, for termination survey and verification inspection survey, standard should be implemented in terms of  $A \pm k\sigma$ .

#### References.

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