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Ministry of Ecology and Environment of the People's Republic of China

Introduction to Radiation Environmental Protection for Exploitation and Utilization of Other Radioactive Mines in China

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SUMMARY

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I . Introduction

- The impact of exploitation and utilization activities of other radioactive mines on the regional radiation environment has attracted the attention and importance of the government, the public and enterprises.
- The Chinese government has gradually strengthened the supervision of radiation environment in this field.
- From 2017 to 2019, Ministry of Ecology and Environment of China carried out the census of other radioactive mines nationwide, began to study and formulate laws and regulations, technical standards and guidelines for effluents, solid waste and radiation monitoring.



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Intro of Survey on NORM Industries



Overall Objectives

- ❑ Obtaining the basic information in the process of development and utilization of NORM industries, including:
 - Types, distribution areas and quantities of minerals with high radioactivity level
 - Type and concentration of radionuclides
 - Discharge pathway of radioactive effluent
 - And measures for prevention and control of radioactive pollution



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Overall Objectives

- ❑ Establishment and improvement of information database of pollution sources
- ❑ Providing technical support for radiation environment supervision



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General Approach

- ❑ Screening and identifying survey objects with radiation environmental impact and supervision as the core
- ❑ Determine the pollution sources to be investigated according to the main pollutants affecting the radiation environment
- ❑ Identifying basic information on distribution and discharge of main pollutants and sources
- ❑ Providing support for the identification of regulatory targets



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- The 15 types of mineral resources of the survey include rare earth, tantalum/niobium, zircon and zirconia, tin, lead/zinc, copper, steel, vanadium, phosphate, coal, aluminum, molybdenum, nickel, germanium/titanium, and gold.
- The main materials of the survey include ore, concentrate, products (including intermediate products), waste rock, tailings, slag, rare earth acid slag, rare earth neutral slag, rare earth lead slag, red mud, etc.



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Organization for Survey

National Pollution
Sources Survey
Office

- Unified leadership to carry out various tasks

Radiation source
safety supervision
department

- Guide and supervise associated radioactive survey

Nuclear and
Radiation Safety
Center

- Survey technical support unit, Organize the development of associated mineral surveys

Committee of
Experts

- Solve technical problems in the survey



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- ❑ Established a quality assurance organization and prepared a quality assurance work plan.
- ❑ Tissue γ monitoring site comparison, and laboratory comparison of water and solid samples.
- ❑ Reviewed the implementation plans and quality assurance plans for associated radioactive mines survey in all 31 provinces.



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- All the identifying survey have been completed.
- Industries with higher levels of radioactivity appear in rare earth, zirconium, lead/zinc, titanium, nickel/molybdenum, etc.
- The highest radioactive concentration nuclides in rare earth reaches $8.3E+06Bq/g$, the highest in zirconium reaches $8.7E+04Bq/g$, the highest in lead/ zinc is $4.1E+04Bq/g$, the highest in titanium is $6.4E+04Bq/g$.



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Regulatory Requirements





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Law of the People's Republic of China on the Prevention and Control of Radioactive Pollution (2003)

Basic system and requirements for radiation environmental protection of NORM industries

13th Five-Year Plan for Nuclear Safety and Radioactive Pollution Prevention and Control and the Vision Target of 2025

Main tasks on radioactive pollution prevention and control in mineral resources development and utilization.

List of Supervision and Management of Radiation Environment for Mineral Resources Development and Utilization (first batch) (2013)

Incorporation of five rare earth and other minerals into radiation environmental monitoring

Measures for Environmental Radiation Monitoring and Information Disclosure in Enterprises for Development and Utilization of Associated Radioactive Mines (Trial Implementation) (2018)

Generally speaking, the laws, regulations and technical standards on associated radioactive ores still need to be improved.



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III. Regulatory requirements

Clear regulatory targets

- At present, the exemptions concentration of natural radionuclides is 1 Bq/g in the 'Activity concentration for material not requiring radiological regulation'.
- Supervision is mainly for enterprises with any nuclide activity concentration of U and Th decay chain is greater than 1 Bq/g in the ore, intermediate products, tailings (slags) or other residues.



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III. Regulatory requirements

Enterprises directory management

- For mining enterprises, the level of radioactivity is relatively stable. However, for smelting enterprises, changes in material sources may cause large changes in radioactivity levels.
- On the basis of the census, the provincial administrative department of ecology and environment shall establish enterprises directory that should be included in the supervision, and make directory publicly and dynamically updated to the public.



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III. Regulatory requirements

Radiation environmental impact assessment

- Enterprises engaged in other radioactive mines exploitation and utilization should conduct environmental impact assessments and submit to the provincial administrative department of ecology and environment for review and approval.
- Directory of Supervision and Management of Radiation Environment for Mineral Resources Exploitation and Utilization (First Batch) clarified that rare earth, niobium/tantalum, zircon and zirconia, vanadium and stone coal should be independently developed radiation environmental impact.



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III. Regulatory requirements

Radioactive pollution prevention and control facilities

- Integrated radioactive pollution prevention and control facilities shall be designed, constructed, and put into operation at the same time as the main part of the project.
- Radioactive pollution prevention and control facilities shall be checked and accepted at the same time as the main part of the project.
- Only after checking and accepting that the standards are met can the main part of the project be put into production or operation.



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III. Regulatory requirements

Storage and disposal of solid materials

- Tailings repositories shall be constructed for the storage and disposal of tailings produced during other radioactive mines exploitation and utilization. Tailings repositories shall conform to radioactive pollution prevention and control requirements.
- Solid materials, especially tailings (slags) produced by smelting enterprises, are temporarily stored in temporary facilities within the enterprises, which is a realistic problem for the current regulatory.
- Ministry of Ecology and Environment is preparing the 'Technical specification of radiation environmental protection for associated radioactive material's storage and solid waste's disposal', which clarifies the specific requirements for prevention and control of radioactive pollution in the law.



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III. Regulatory requirements

Effluent and radiation environment monitoring

- The 'Measures of Environmental Radiation Monitoring and Information Disclosure for Enterprises Engaged in Other Radioactive Mines Exploitation and Utilization (Trial)' requires enterprises to carry out monitoring to rely on the personnel, places and equipment of the enterprise or entrust an organization with corresponding qualifications.
- The enterprise is responsible for the truthfulness, accuracy and completeness of its monitoring results and information disclosure content.



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III. Regulatory requirements

Effluent and radiation environment monitoring

- Enterprises should formulate environmental radiation monitoring programs. Environmental radiation monitoring programs and their adjustments, changes should be disclosed to the public in a timely manner.
- The enterprise shall prepare and complete the annual environmental radiation monitoring report of the previous year before February 1 of each year, and to be made public.
- The provincial administrative department of ecology and environment shall be responsible for organizing and carrying out supervising monitoring work.



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III. Regulatory requirements

Effluent and radiation environment monitoring

Environmental medium	Sampling point	Indicator		Frequency	Remark
Exhaust gas	Mine: exhaust shaft	Associated U	^{222}Rn and radioactive decay product	Once every half year	The interval between two monitoring should be no less than 3 months.
		Associated Th	^{220}Rn		
	Other exhaust outlet with radioactive materials	Associated U	U		
		Associated Th	Th		
Waste water	Workshop discharge outlet, total discharge outlet, tailings (slags) repository water seepage discharge outlet	Associated U	U, ^{226}Ra	Once every month	Workshop discharge outlet refers to the treatment workshop that treats radioactive waste water separately.
		Associated Th	Th		



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III. Regulatory requirements

Effluent and radiation environment monitoring

Environmental medium	Sampling point or monitoring point	Indicator		Frequency	Remark
Air	The nearest residential area around the facility; the nearest residential area within 500 meters of the down wind of the maximum wind frequency, contrast point	Associated U	^{222}Rn and radioactive decay product	Once every half year	The interval between two monitoring should be no less than 3 months.
		Associated Th	^{220}Rn		
Land γ	No less than 4 points around the boundary of the plant (include the factory boundary of the down wind of the maximum wind frequency, the distance can not exceed 500 meters); air and soil sampling points; roads that are easy to spill minerals; control point	Gamma radiation dose rate		Once every half year	



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III. Regulatory requirements

Effluent and radiation environment monitoring

Environmental medium	Sampling point or monitoring point	Indicator		Frequency	Remark
Surface water	500 meters upstream and 1000 meters downstream of the discharge outlet	Associated U	U, ²²⁶ Ra	Once every half year	If there is a tributary, sampled before and after the entrance.
		Associated Th	Th		
Groundwater	Representative residential drinking wells or irrigation wells within 200 meters of tailings (slags) repositories, stope, storage yard and industrial sites	Associated U	U, ²²⁶ Ra	Once a year	
		Associated Th	Th		
Soil	Soil within 500 meters around the boundary of the plant, soil of the down wind of the maximum wind frequency at the exhaust outlet within 500 meters, boundary of the plant and the nearest farmland of the discharge outlet, control point	Associated U	U, ²²⁶ Ra	Once a year	Including the soil near the ground location of maximum exhaust concentration.
		Associated Th	Th		
Sediment	Same as surface water	Associated U	U, ²²⁶ Ra	Once every half year	
		Associated Th	Th		



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III. Regulatory requirements

Radiation protection

- Enterprises engaged in other radioactive mines exploitation and utilization shall conduct radiological safety education and training for their staff, and take effective protective safety measures.

Building materials

- The use of materials from radioactive slag or containing natural radioactive material for construction and fittings shall conform to state standards for the control of radionuclides in construction material.



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Management of Radioactive Solid Waste from NORM Industries



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IV. Management of radioactive solid waste

- The solid waste, mainly smelting waste residue, is a realistic problem. There are several main reasons.
- First, China's industrial solid waste, hazardous waste and radioactive waste storage and disposal facilities have clearly excluded radioactive waste.
- Second, the distribution in China is relatively scattered, and the quantity is far more than the radioactive waste generated by the nuclear industry. It is not suitable for long-distance transportation.
- Third, the half-life of natural radionuclide is particularly long, bringing more complicated follow-up management problems.



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IV. Management of radioactive solid waste

- We are also studying how to properly handle this problem. There are several main ideas.
- One is to encourage comprehensive utilization and minimize waste.
- The second is to study the feasibility of using tailings (slags) repositories of uranium mining and milling enterprises.
- Third, a relatively concentrated area for enterprises to unify the construction of natural radioactive solid waste facilities.
- These efforts require coordination of relationships between local governments, enterprises and other sectors.



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Thank you