

# Internal Exposure Dose Assessment Using Urine Analysis

RADIATION &  
ENVIRONMENT  
DEPT.

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A technique which evaluates internal exposure doses of radiation workers using indirect method(In-vitro). Internal exposure dose means exposure by radioactive materials in the body. To evaluate this, a detector(HPGe or NaI(Tl)) can be used outside of body or a radioactive material in urine can be measured. Internal exposure dose assessments using urine are effective way to detect low-exposure dose compared with the direct method and it takes shorter analysis times giving high convenience to the radiation worker.

## Description

### \* Background

Internal exposure dose assessments are essential for the radiation safety management of radiation workers. In the case of nuclide which emits low-energy gamma rays like uranium, it takes a lot of time and is difficult to detect low-exposure dose by direct method. To overcome these shortcomings and manage low-exposure dose, internal dose assessments using indirect method are necessary.

### \* Purpose and Necessity

- Development of an internal exposure dose assessment system for radiation workers using indirect method
  - Nitric acid dilution method, microwave method, UTEVA resin method, etc. are used
  - Measurement of minimum uranium(about 20~200 ng/L) from the urine sample using ICP-MS
- The only way to measure Type F uranium which is quickly absorbed from the lungs to the blood
  - Establishing a system that can respond quickly in case of an emergency such as UF6 leakage accident, etc.

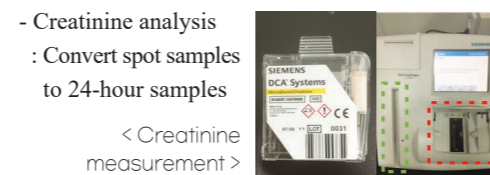
- Exposure dose can be assessed according to a various intake situation
  - Evaluating internal dose by ingestion, which cannot be evaluated by direct method
- Reducing radiation worker's inconvenience
  - Shorten more than 30 minutes compared to lung radioactivity measuring system
  - Increase convenience of worker's sample submission thanks to using spot urine sample

### \* Technical Composition and Procedure

- Technical Composition
  - Urine sample quality management : Use sterilized sample bottle and keep it in the refrigerator which can control temperature
  - Quadrupole ICP-MS : Analyse uranium in the sample after pre-processing after pre-processing



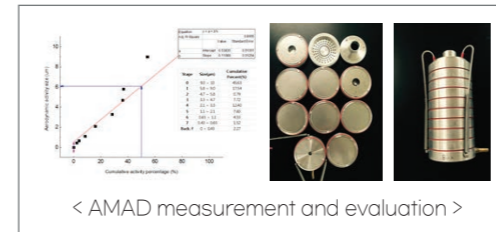
< ICP-MS >      < Pre-processing room >



< Creatinine measurement >

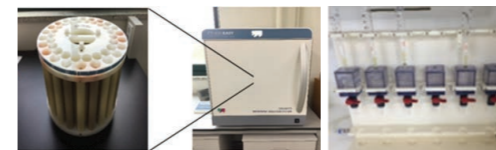
- Internal dose assessment : Evaluate worker's intake amount and assess committed effective dose.
- Work Procedure
  - Registration of personal details : Management of working days, uranium enrichment information of working process and radioactive concentration information in the air during the process.
  - Applying the analysis information of working area environment : uranium dust size during

the process (AMAD) and uranium chemical type(Type F, M, S).



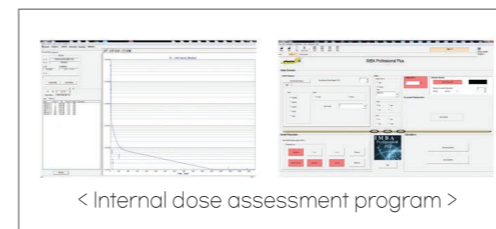
< AMAD measurement and evaluation >

- Collect worker's urine sample : Submitting urine samples within the monitoring period
- Pre-processing of urine sample : Analyse uranium in urine sample by ICP-MS after pre-processing such as nitric acid dilution method, microwave method and UTEVA resin extraction method



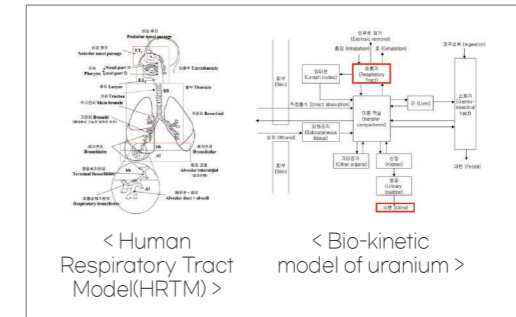
< Microwave oven >      < Resin extraction >

- Measurement of uranium and elimination of background : Analyse uranium concentration in worker's sample after removing the background, the amount of uranium contained in the urine of the public.
- To minimize errors caused by matrix effect, the results of uranium measurements are calibrated by the internal standard
- Convert spot urine sample to 24-hour : Convert the amount of uranium in the spot sample to the amount of uranium released 24 hours using the creatinine concentration
- Exposure dose assessment : Evaluation of worker's exposure dose using computer program considering intake type(inhalation/ingestion), chemical type, intake pattern(acute/chronic), working time and remaining uranium.



< Internal dose assessment program >

- Estimation of internal exposure dose by multiplying the amount of uranium intake by effective dose coefficients(e50). (Using HRTM and GI model from ICRP)



## Distinctiveness

### \* Characteristics

- Providing measurement for low exposure dose by intake of uranium
- Deliver faster results than direct measurement
- Providing analysis of F uranium(UO<sub>2</sub>, UO<sub>2</sub>F<sub>2</sub>) Type

### \* Benefits

- Convenient analysis method compared to lung radioactivity measuring system
- Providing exposure dose by uranium ingestion in daily life
- Providing alternative method of analysis other than lung measurement in case of an emergency situation
- Providing results of exposure dose assessment which is faster than direct method to a large number of workers

## Experience

- Performing internal exposure dose assessments for radiation workers(2018.1.~)
- Preparing for the registration of dose assessment license
- Development of urine sample analysis on the beta/gamma rays emit nuclides

## Deliverables

- Establishment of bioassay laboratory
- Provide an internal dose assessment method manual
- Provide the information of exposure dose assessment for uranium-intake workers

TECHNOLOGY  
READINESS  
LEVEL(TRL)

• Actual system proven through operation

BUSINESS  
MODEL

Technology Transfer

Licensing

Joint search

Service Execution

Others