

Review on establishing of Emergency Classification Grade at KAERI Nuclear Fuel Fabrication Facility

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1. Introduction

After enacting of 'the act of physical protection and emergency preparedness for nuclear facilities' on February 2004, the establishment of emergency plan for NFFF (Nuclear Fuel Fabrication Facility) which use uranium materials to fabricate nuclear fuel was in duty bound to do. To establish emergency plan, the emergency classification should be determined in advance. In this paper, the methodology to establish emergency classification grade of NFFF was reviewed.

2. Review on the Basic Data and Condition

2.1 Derived Air Concentration for Uranium

In the MOST Notice 2002-23[1], the DAC (Derived Air Concentration) is described for each nuclide. This Notice describes the methodology to set the value of DAC for each nuclide. According to this Notice, DAC was derived to fit the dose limit of radiation worker which is 20 mSv for one year. In this derivation, the 2,000 hr work time and 1.2 m³/hr breathing rate was assumed, and also the dose conversion factor from IAEA Safety Series 115 was used.

The minimum value of DAC for uranium is 1 Bq/m³. It means, if a work place was kept this air concentration, a worker will be exposed in the dose limit for radiation worker. So the relationship between limits for uranium can be derived like under description.

$$1 \text{ Bq/m}^3 = 20 \text{ mSv/yr} = 20 \text{ mSv}/2000 \text{ hr} = 1 \text{ E-}02 \text{ mSv/hr}$$

2.2 Operational Intervention Level

There is intervention level to determine the protective action to the public in case of radiation emergency. Because the unit of intervention level is set as the dose, the calculation should be preceded to use this value. So the operational intervention level (OIL) was derived to use easily without calculation in the field. The operational intervention level was described in the national radiation emergency plan [2].

The operational intervention level to determine of the protective action is 1 mSv/hr. This value can be used for the basis of establishing of radiation emergency classification grade.

2.3 Air Diffusion Factor at KAERI Site Area Boundary

The main down wind direction distance to the site area boundary from NFFF is about 800m. So, the air diffusion factor (χ/Q) at site area boundary should be considered at this distance. Recently, the air diffusion factor for HANARO research reactor was calculated. The location of NFFF is similar with HANARO, so the factor for HANARO was used in this paper. According to the result of calculation, the χ/Q at site area boundary from 0 to 2 hours in the emergency situation is 7.00E-04 sec/m³.

3. Calculation of Emergency Classification Grade

The emergency classification grade should be established by the system indicator value which can be detected easily in the facility. Because the uranium is alpha emitter, the level of external dose rate is very low. So the air concentration level of RMS at HFFF was considered as the emergency classification basis.

3.1 Alert Basis

The alert is the emergency inside facility. According to review in the section 2.2, If the radiation level inside facility was exceeded the OIL for the protective action, the facility is basically in the situation of alert. So the 1 mSv/hr is the basis value of alert. According to section 2.1, 1E-02mSv/hr is 1 Bq/ m³ for uranium, so the OIL, 1mSv/hr can be transformed to 100 Bq/ m³.

In conclusion, the basis value of alert at the NFFF is 100 Bq/ m³.

3.2 General Emergency Basis

The general emergency is the emergency beyond of the site area. If the radiation level at the site area boundary was exceeded the OIL for the protective action, the facility is basically in the situation of general emergency. According to the section 3.1, the value of OIL, 1 mSv/hr, is 100 Bq/m³, so the value for the general emergency is 100 Bq/m³ at the site area boundary. But we need general emergency basis as the indicating value of NFFF. The data for calculation is described in section 2. The stack release rate can be calculated like under description.

Stack release rate (Bq/sec)
 =air concentration at site area boundary (Bq/m³)
 ÷ γ/Q (sec/m³) =1.4E05 Bq/sec=5.04E08 Bq/hr

From the stack release rate, the stack air concentration can be calculated like under description. By the facility data, the stack vent rate for NFFF is 31,500 m³/hr.

Stack air concentration (Bq/m³)
 = stack release rate (Bq/hr) ÷ stack vent rate (m³/hr)
 =16,000 Bq/m³

To calculate the air concentration inside facility, the efficiency of HEPA filter which is 99.97% should be considered, in this aspect, the calculation is continued like under description.

Facility air concentration (Bq/m³)
 =Stack air concentration (Bq/m³) ÷ (1-0.9997)
 =5.33E07Bq/m³

In conclusion, the basis value of general emergency is 5.33E07Bq/m³ inside facility and 16,000 Bq/m³ at stack.

3.3 Site Area Emergency Basis

The site area emergency is the emergency inside site area boundary. If the radiation level inside the site area boundary was exceeded the OIL for the protective action, the facility is basically in the situation of site area emergency. So the site area emergency is between alert and general emergency. In this condition, the proportional interim value considered as the site area emergency basis like under description.

Site area emergency basis
 =Alert basis × proportional value
 =7,300 Bq/m³

In case of stack, if the radiation level at stack was exceeded the OIL for the protective action, the facility is basically in the situation of site area emergency. So the air concentration, 100 Bq/m³, at stack can be considered as the basis of site area emergency.

In conclusion, the basis value of site area emergency is 7,300 Bq/m³ inside facility and 100 Bq/m³ at stack.

3. Conclusion

In this paper, the methodology to establish emergency classification grade for nuclear fuel fabrication facility was considered, and by this methodology, the basis value for emergency classification grade was derived. The calculated value was simplified and summarized like under table. This calculation will be used to improve the KAERI NFFF emergency classification grade.

Emergency classification	Air concentration (Bq/m ³)	
	Inside facility	Stack
Alert	≥ 100 < 7,000	-
Site area emergency	≥ 7,000 < 5.33E7	≥ 100 < 16,000
General emergency	≥ 5.33E7	≥ 16,000

REFERENCES

- [1] ‘The basis on the radiation protection’, MOST Notice 2002-23, MOST (2003)
- [2] ‘The national radiation emergency plan’, MOST (2005)