



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
SUPPORTING AMENDMENT NO. 12 TO LICENSE NO.

UNIVERSITY OF MISSOURI RESEARCH REACTOR
UNIVERSITY OF MISSOURI - COLUMBIA
DOCKET NO. 50-166

Introduction

By letter dated February 15, 1977, as supplemented by letters dated March 27, 1978 and March 16, 1979, the University of Missouri - Columbia (the licensee) proposed an amendment to Technical Specification 3.7.a appended to Facility Operating License No. R-103 for the University of Missouri Research Reactor (MURR). The proposed amendment would change the limitations on gaseous radioactive releases from the research reactor facility.

Discussion

The licensee has stated that by increasing operation from 90 to 100 hours per week at a 10 Megawatt power level to near continuous operation, the resulting increased total activity released from the facility exhaust stack will bring the yearly averaged release concentration of Argon-41 close to the present Technical Specification 3.7.a limit of 250 times the maximum permissible concentration (MPC) as given in Appendix B, Table II, Column I to 10 CFR Part 20, when averaged over a year. Since September 1977, the licensee has reduced the Argon-41 releases by removing a pneumatic tube test facility from service in order to meet the present Technical Specification 3.7.a during continuous operation. The licensee considered that Technical Specification 3.7.a was unnecessarily restrictive, and proposed to amend this specification to limit the maximum concentration for all radioactive materials in gaseous effluents (noble gases, tritium, particulates and halogens) from the facility exhaust stack to 1000 times MPC, when averaged over a 24 hour period. In a letter dated August 4, 1977, the NRC requested additional information to support this proposed amendment. On March 27, 1978, the licensee submitted the additional information on: (1) the bases for the proposed change, (2) the stack monitor, (3) a summary of yearly stack releases and (4) changes in facility operation that would have impact on the gaseous effluents.

By letter dated March 16, 1979, the licensee submitted additional information on the proposed change to Technical Specification 3.7.a. The licensee committed to place TLD monitoring stations at the following locations around his facility: one station on each of four outside walls of the reactor building, four stations at a distance of approximately 150 meters from the building (the prevailing wind direction and 90°, 180° and 270° from this direction), one station at Dalton Research Center in the Research Park area and one station on University of Missouri property near the nearest residence. The

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licensee estimated that the annual exposure from gaseous effluents at present operating levels (1800 Curies Argon 41 per year) is 7.2 mrem per year total body dose at the nearest residence. This residence is 760 meters from the reactor building based on an aerial photograph measurement. The licensee provided data from his environmental monitoring program on concentrations of Argon 41 in the air at the side of the reactor building downwind of the stack. The concentrations of Argon 41 in the air were measured to be half the maximum permissible concentration MPC for Argon 41 in air in Table II to Appendix B to 10 CFR Part 20 for unrestricted areas. The minimum level of detection for Argon 41 for these measurements was less than the measured concentration for Argon 41. Additional measurements of concentrations of Argon 41 at 75 meters from the reactor building which is within the exclusion boundary were less than the minimum level of detection for the measurements (4×10^{-9} μ Ci/cc). This is one tenth of an MPC of Argon 41 in air in unrestricted areas. These measurements were made while the reactor was at full power (i.e., 10 megawatts).

Safety Evaluation

We have performed an independent evaluation of the licensee's proposed amendment to Technical Specification 3.7.a. Our evaluation consisted of the following: (1) a review of the information provided by the licensee in his February 15, 1977, March 27, 1978, and the MURR - Reactor Operations Annual Report 1977-78, September 1978 submittals, (2) a review of the radioactive waste treatment and effluent control systems described in the licensee's Hazard Summary Report (HSR), including amendments through September 1978, and (3) a review of the methodology used to calculate an annual average relative concentration (X/Q) applicable to the MURR site at Columbia, Missouri. We found that the proposed Technical Specification 3.7.a to limit the maximum concentration for all radioactive material in gaseous effluents from the facility exhaust stack to 1000 times MPC, when averaged over a 24 hour period, would exceed the limits of 10 CFR Part 20.106a and, therefore, was unacceptable. The staff considered an alternate change that is evaluated below.

During normal and anticipated operational occurrences, the gaseous effluents from the MURR are monitored and released via the facility exhaust stack. Table 1 provides a summary of the operating experience for the MURR, indicating the radioactive gaseous effluents reported during six years of operation, July 1972 through June 1978. The principal radionuclide in gaseous effluent is Argon-41 (greater than 99%) and the principal radionuclide in liquid effluents is tritium (greater than 99%). Argon-41 is generated by neutron activation of air, and tritium by the neutron activation of deuterium in the cooling water. The amount of Argon-41 and tritium released from the facility is directly

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proportional to the power generated by the reactor. For comparison, we calculated the Argon-41 and tritium annual releases based on effective full power days. As shown in Table 1, the tritium releases are expected to stabilize at approximately 0.1 curies per effective full power day, as a result of the increased operating capacity. Table 1 also shows that the licensee has acted to reduce the Argon-41 releases from the facility, based on the reduction from 8.26 curies to 6.28 curies per effective full power day during the past years. We conclude that the licensee is making a reasonable effort to maintain releases of radioactive materials in gaseous effluents as low as is reasonably achievable, pursuant to 10 CFR Part 20.1(c).

We used meteorological data collected at the Callaway Plant, Units Nos. 1 and 2, located near Fulton, Missouri, approximately 30 miles east of the MURR site. These data were collected between May 5, 1973 and May 4, 1975, and are reasonably representative of long-term conditions expected at the MURR site. The highest offsite annual average relative concentration (X/Q) value was calculated by the staff to be 3×10^{-4} seconds per cubic meter at a distance of 150 meters from the MURR facility. This is the exclusion boundary at the MURR facility which is described in the MURR Safety Evaluation, Amendment No. 8, dated February 8, 1978.

We calculated that the maximum concentration in the facility exhaust stack discharge for all radioactive isotopes other than particulates and halogens with half-lives greater than 8 days should not be greater than 350 times MPC, when averaged over one year. The value of 350 is the average dilution factor that would reduce the maximum calculated annual average concentration of Argon-41 at the exclusion boundary to one MPC for the unrestricted area. The release rate is based on an annual flow rate of 9.63 cubic meters per second from the facility exhaust stack as provided in Addendum 2 to the Hazard Summary Report, dated May 1966, for the MURR.

The unrestricted area for the MURR facility is that area outside the walls of the reactor building. The licensee has measured the concentration of Argon-41 at the side of the building downwind of the stack at roof level while operating at full power. Based on these measurements, the maximum concentration in the stack discharge for Argon-41 should not be greater than 380 times MPC for the concentration of Argon-41 in the unrestricted area to be less than one MPC. This is based on 6.28 curies of Argon-41 per effective full power day. Based on this, we conclude that a gaseous concentration in the facility exhaust stack for all radioactive isotopes other than particulates and halogens with half-lives greater than 8 days that does not exceed

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350 times MPC, when averaged over one year, should meet the requirements of 10 CFR Part 20.106(a). Because the measurements of Argon-41 were made at normal wind conditions without the wind speed or wind stability class being measured, we have asked the licensee to place TLDs around the facility to measure the annual dose from Argon-41 released from the facility. The licensee has agreed to place four TLDs around the reactor building; four at the exclusion boundary, one at Dalton Research Center and one on University of Missouri property near the nearest residence. The TLDs will be located about one meter above the ground and will be replaced quarterly. If these TLDs indicate that the maximum concentrations of Argon 41 in Technical Specification 3.7.a is too high to meet the requirements of 10 CFR Part 20.106(a) the Specification will be revised. The licensee will include the measured annual dose from Argon-41 from these TLDs in his Annual Report to NRC.

In addition, we calculated that the instantaneous concentration of the facility exhaust stack for all radioactive isotopes other than particulates and halogens with half-lives greater than 8 days should not be greater than 3500 times MPC at any time. This limiting condition for operation provides reasonable assurance that radiation levels to an individual in the unrestricted area, at or beyond the exclusion boundary, will not be exposed to a whole body dose at any time exceeding the limitations of 10 CFR Part 20.105 while providing the licensee operational flexibility for unusual operating conditions.

The MURR research reactor is located about 0.5 miles south of the southern border of the residential area of Columbia, Missouri. Between 0.5 and 1.0 mile from the reactor facility are approximately 5,700 people of the 58,000 people of Columbia. This is taken from Section 5.0 in Addendum 3 dated August 1972 to the MURR Hazards Summary Report and based on the 1970 population census. We have estimated the radiation exposure to the total population of Columbia from the reactor's present operations to be about 10 man-rem/year. Based on an estimated present population census, the radiation exposure may be about double the above 10 man-rem/year or 20 man-rem/year. This small amount of exposure is a minute fraction of the exposure to the population from background radiation and does not seem to warrant any additional efforts by the licensee to reduce radioactive releases from the facility.

Since the anticipated population dose is calculated so small, we will only require the licensee to perform confirmatory calculations based upon records of exposure to TLD's placed around the facility over an operating year and a more accurate up-to-date description of the population density out to 10 miles from the reactor facility, including Columbia, Missouri. Beyond the 10 miles distance the short-lived Argon-41 has decayed and been dispersed to insignificant concentrations in the air. The licensee, based on the confirmatory calculated radiation exposure to the population, is to determine if any additional changes to the facility are economically warranted using the \$1,000 per man-rem (Section II.D of Appendix I to 10 CFR Part 50) for the social cost of radiation exposure reduction. The results of this value/impact assessment is to be provided to the staff for review and approval.

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Based on the above, we have concluded that the licensee's proposed Technical Specification 3.7.a is not acceptable. The licensee has not provided data to justify increasing the present limits in Technical Specification 3.7.a for particulates and halogens with half-lives greater than 8 days. Technical Specification 3.7.a for all other radioactive isotopes should be amended to increase the maximum release concentration to be averaged over one year from 250 times MPC to 350 times MPC and the maximum instantaneous release concentration from 2500 times MPC to 3500 times MPC, at any time, as discussed in the evaluation above. We discussed these changes with the licensee, and the licensee has agreed to these modifications.

Conclusion

The staff has concluded, based on the considerations discussed above, that: (1) because the change does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the change does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Environmental Impact Appraisal

We have determined that the amendment modified by the staff and agreed to by the licensee does not authorize a change in effluent type nor an increase in power level. As described above, the amendment would allow an increase in the maximum annual concentration of Argon-41 in the stack discharges from 250 times MPC to 350 times MPC (i.e., from 3037 to 4252 curies of Argon-41 per year). Argon-41 is the principal isotope released in gaseous effluents from MURR. We calculated the annual average relative concentration (X/Q) for continuous stack releases and ground-level conditions to the nearest residence at 760 meters from the stack to be 2.4×10^{-5} sec./m³. Based on the methodology provided in Regulatory Guide 1.109 (Rev. 1), we calculated that an individual located at the nearest residence would receive an annual average dose of 13 mrem per year total body based on the present releases of Argon-41 from MURR (i.e., 1925 curies per year for 1977 to 1978). The licensee calculated a dose rate of 32.2 mrem total body per year based on 1800 curies of Argon-41 released per year which is what they expect for their present operations. The change to Technical Specification 3.7.a would allow the licensee to release up to 4250 curies of Argon-41 per year. This would be an annual average dose to an individual at the nearest residence of 29 mrem per year total body. We would expect, on present operations, that the MURR facility would not release more than 3015 curies of Argon-41 per year. This is based on 100% continuous operation at full power for the year and 8.26 curies of Argon-41 releases per effective full power day. The present operation is only at 6.28 curies of Argon-41 per effective full power days. At 3015 curies of Argon-41 per year, the annual average dose to an individual at the nearest

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residence is 21 mrem total body per year. By comparison, the concentration limits of 10 CFR Part 20 require that an individual located in the unrestricted area be limited to a total body dose less than 500 mrem/yr. The staff has also calculated the annual average relative concentration (X/Q) for continuous stack release and ground level conditions to the Dalton Research Center at 350 meters from the stack to be 8.0×10^{-5} sec/m³. Compared to the X/Q value calculated at the nearest residence location, this is higher by a factor of 3.3. However, the potential increase in dose to personnel at the Dalton Research Center is offset by a shorter occupancy time at the location (i.e., a decrease by a factor of 4 when considering a 40-hour workweek compared to a 168-hour residence occupancy time). The staff, therefore, concludes that the annual average dose to personnel at the Dalton Research Center is not significantly different from those analyzed above for an individual at the nearest residence location. Although the amendment allows up to 40% increase in the amount of Argon-41 released, the increased dose impact resulting from this change will be a small fraction (less than 2%) of the dose limitations of 10 CFR Part 20.105.

Conclusion and Basis for Negative Declaration

On the basis of the foregoing evaluation, it is concluded that there would be no significant environmental impact attributable to the proposed action. Having made this conclusion, the Commission has further concluded that no environmental impact statement for the proposed action need be prepared and that a negative declaration to this effect is appropriate.

Dated: July 5, 1979

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Table 1
SUMMARY OF OPERATING EXPERIENCE FOR THE
UNIVERSITY OF MISSOURI RESEARCH REACTOR (MURR)
DOCKET NO. 50-186

Gaseous Effluent Release Data (in Curies/year)^a

<u>Radioactive Waste</u>	<u>July 1972- June 1973</u>	<u>July 1973- June 1974</u>	<u>July 1974- June 1975</u>	<u>July 1975- June 1976</u>	<u>July 1976- June 1977</u>	<u>July 1977- June 1978</u>
Total Noble Gases (A-41)	1055	970	1790	1734	1734	1925
Total Iodine-131		$<4 \times 10^{-4}$	2.4×10^{-3}	1.6×10^{-3}	8×10^{-4}	1.3×10^{-3}
Total Halogens		<0.01	<0.006	0.006	0.016	0.11
Total Particulates		<0.006	0.001	<0.001	<0.001	0.002
Total Tritium			1.8	3.6	4.8	26.24

Facility Operating Conditions

Maximum Thermal Power (Mwt)	5	5	10	10	10	10
Annual Megawatt Days	1047	960	2168	2100	2100	3065
Facility Operating Capacity	0.57	0.53	0.59	0.58	0.57	0.84
A-41 Releases (curies per Effective Full Power Day)	5.04	5.05	8.26 ^b	8.26	8.26	6.28 ^c
Tritium Releases (curies per Effective Full Power Day)			0.008	0.017	0.023	0.086

a - Reactor Operations Annual Report for MURR, July 1977 to June 1978 (Docket No. 50-186) and a summary of MURR airborne releases provided by letter, dated March 27, 1978.

b - Increase due to increasing the power level.

c - Decrease due to removing a pneumatic tube from service.