

SAFETY EVALUATION REPORT
FOR LARGE ANIMAL RESEARCH STATION
AT UNIVERSITY OF ALASKA, FAIRBANKS
NRC MATERIALS LICENSE 50-02430-07, DOCKET 030-01179

I. EXECUTIVE SUMMARY

The University of Alaska, Fairbanks (UAF, the licensee) submitted a license amendment request to the U.S. Nuclear Regulatory Commission (NRC) by letters dated December 13, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16356A229) and May 5, 2017 (ADAMS Accession No. ML17128A506). The licensee proposed to release the Large Animal Research Station (LARS) facility from its NRC materials license (License Number 50-02430-07, ADAMS Accession No. ML12361A445). The licensee has ceased use of radioisotopes for research purposes at its LARS facility and would like to relocate animals (reindeer and muskoxen) from its other facilities to the LARS for research not involving the use of radioisotopes. All animals that were the subject of the licensee's radioisotope studies, which ended in 2012, are deceased (not as a result of the experiments) and their carcasses were incinerated in accordance with the licensee's byproduct materials license. Following the completion of any future non-radioactive research studies performed at the LARS facility, the University would like to sell and distribute the reindeer meat to the public for human consumption.

The licensee submitted a site characterization survey of the LARS facility in support of the license amendment request, which included the results of soil and water analyses performed by the Oak Ridge Associated University (ORAU) and modeling of annual dose rates using the RESRAD-ONSITE, Version 7.2, computer code (RESRAD). The licensee's results indicated that some areas at LARS would not meet unrestricted release criteria until 2020. Accordingly, the licensee requested that the LARS site be released for restricted use in the meantime, so that three pens at LARS which did meet unrestricted use criteria under 10 CFR 20.1402 could be used for other animal operations, not involving licensed materials, including meat production.

The NRC staff conducted a detailed technical review of the licensee's proposal, in part, to ensure compliance with the regulatory requirements under 10 CFR 20.1402, "Radiological criteria for unrestricted use." The staff concluded that the licensee's inputs and assumptions for its RESRAD modeling were overly conservative. The staff's own RESRAD analysis indicated that all areas at the LARS site already met the criteria for unrestricted use and that the licensee would not have to wait until 2020 to release the LARS site for unrestricted use.

The NRC staff prepared this Safety Evaluation Report (SER) of the radiological and safety consequences for releasing the site for unrestricted use in accordance with 10 CFR 20.1402, "Radiological criteria for unrestricted use." The SER was developed using the guidance provided in NUREG-1757, Volume 1, Revision 2, Consolidated Decommissioning Guidance (ML063000243), Appendix G, "Safety Evaluation Report Outline and Template." The NRC determined that an environmental assessment for the LARS facility would not be required, based on a categorical exclusion under 10 CFR 51.22(c)(20)(iii). The basis for this determination is discussed in detail in Section VI of this report.

II. FACILITY OPERATING HISTORY

The University of Alaska Fairbanks' byproduct license, NRC 50-02430-07, allows for the use of radiotracers at the LARS site. The specific applications have included radiotracer methodologies for evaluating body composition, body water turnover, milk production, and metabolism of large animals. These methods used tritiated water as the radiotracer, while other applications utilized carbon-14-labeled nutrients for determining the metabolism of those nutrients. The experimental animals, including reindeer, caribou, and muskoxen, were permanent experimental animals that were owned by the licensee.

Radioisotope use at LARS ceased in 2012. All animals involved in radioisotope studies are deceased (not as a result of the experiments) and their carcasses were incinerated in accordance with the licensee's byproduct materials license. At this time, no further use of radioisotopes is planned for the LARS site. The licensee would like to move its current reindeer herd from its Experimental Farm to LARS for husbandry studies and for research on meat production.

III. FACILITY DESCRIPTION

The LARS site encompasses a total area of approximately 151 acres (61 hectares) and is completely enclosed by a chain-link fence. LARS consists of approximately 28 pens and pastures, in addition to several buildings and equipment storage areas. There are two buildings that were used for animal handling - the animal handling facility and the research barn. There are twelve small pens located in the vicinity of the barns (pens 1-12), three small pens near the entrance to the property (A, B and C), and eleven larger pastures located around the periphery of the site (pens 13-18, west pasture, north pasture, east pasture, south pasture, and lower west pasture).

The LARS site is located on UAF-owned land approximately two miles northwest of the UAF campus. Approximately one-half of the area is cleared of trees and shrubs. Vegetation on the non-cleared areas are primarily spruce and birch/aspens. Grasses are grown on most of the cleared area and are used for summer grazing by experimental animals. The site consists of rolling hills with considerable variability in slope, ranging from flat to 5 percent – 10 percent slope towards the seasonal melt pond that catches the surface runoff. The site is classified as well-drained brown soils containing lenses of fine grained material with isolated ice lenses near the surface. The soil texture is medium loamy. Soils are from 0 to 8 meters deep and overlay gravely to sandy materials. Erosion potential is slight.

The water table in the hills northwest of Fairbanks varies from approximately 30 to 70 meters below the surface. Water wells in the general area, i.e., northwest of Fairbanks, are typically at depths of greater than 30 meters and many wells are at depths of greater than 100 meters. The depth of the water well at the LARS site is approximately 61 meters (200 feet). The water is chemically hard and not suitable for human consumption. There are no irrigation wells and no commercial agriculture projects in the area. There are no streams on or adjacent to the site. The only running water would be surface runoff during spring melt or at times of heavy rainfall.

IV. RADIOLOGICAL STATUS OF FACILITY

The NRC staff reviewed the information presented in the licensee's site characterization survey for LARS using the guidance provided in NUREG-1757, Volume 1, Sections 16.2 and 16.3. Based on this review, the NRC staff has determined that the licensee provided sufficient information to aid the staff in its evaluation of the radiological status of the facility and the applicable input-parameters for conducting RESRAD analyses.

The radionuclides of concern include tritium (hydrogen-3) and carbon-14. All other radionuclides that were released at LARS are short-lived and have passed through at least ten half-lives, and can therefore be considered negligible in terms of activity.

The licensee conducted a site characterization survey in 2015 to delineate the extent of radioactive contamination throughout the site. The results of this survey, including maps and individual data points, are included in the licensee's letter dated December 13, 2016 (ADAMS Accession No. ML16356A229). Based on historical knowledge of previous research activities, areas of the site were distributed into two groups. The two groups consist of Class 1 areas, which are considered impacted and have a potential for delivering a dose above the release criterion; and Class 2 areas, which are considered impacted and have a low potential for delivering a dose above the release criterion.

The licensee's survey included surface contamination samples from the two barns at LARS (the animal handling facility and the research barn) that had been used for animal radioisotope studies; soil samples of areas surrounding the two barns, as well as representative pens (pens 3 and 5) near the barns and pens 15 through 17; and water samples from a seasonal melt pond that represents the only source of surface water on site. Soil and water samples were analyzed by the ORAU laboratory.

Using the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) methodology, the licensee demonstrated that there was no residual surface contamination in either of the two barns, and no indication of contamination in the seasonal melt pond. Soil analyses for four of the eleven areas sampled did indicate residual carbon-14 contamination that necessitated further investigation by the licensee using the RESRAD computer code. The areas that indicated carbon-14 contamination included Pens 3 and 5 and the pads located on the south and west sides of the Animal Handling Facility, which were all located in Class 1 areas. Since residual radioactive contamination was found on the LARS site, the licensee used RESRAD to calculate doses to individuals currently working on the site as well as doses associated with reasonably foreseeable future land uses at the site.

This project was designated as a Group 4 decommissioning project consistent with the guidance provided in NUREG-1757, Volume 1, Revision 2. Group 4 facilities have residual radiological contamination present in building surfaces and soils, the licensee chooses to use site-specific release criteria, and the groundwater beneath the site is not contaminated.

V. DOSE MODELING

A. Evaluating Doses Associated with Proposed Near-Term Site Activities

The licensee performed analyses using the RESRAD computer code to model the potential dose received by a person living and working at LARS. The licensee conservatively assumed Pens 1-12 were contaminated at an average concentration based on the four

areas of contamination identified in Pens 3 and 5. The licensee stated that Pens 15-17 and the other more distant pastures were not included in the modeling inputs because the soil concentrations did not exceed the DCGLs or were not anticipated to do so. The licensee concluded, based on its RESRAD analyses, that the total dose per year would exceed a total effective dose equivalent (TEDE) of 25 millirem per year (mrem/year), until 2020.

The licensee performed RESRAD analyses that considered the dose contributions from the soil ingestion, inhalation, and external gamma exposure pathways. Table 1 summarizes the results from these RESRAD analyses.

Table 1. Relative contributions of external gamma, inadvertent soil ingestion, and inhalation exposure pathways to the annual dose for individuals living and working at LARS.

Annual Dose (mrem/yr)					
Year	Pen 5	Barn Pad	West Barn Pad	Pen 3	Pens 1, 2, 4, 6-12
2015 (@t=0)	1.95×10^{-2}	1.26×10^{-2}	8.71×10^{-3}	2.36×10^{-2}	1.12×10^{-1}
2016 (@t=1)	3.65×10^{-3}	2.35×10^{-3}	1.68×10^{-3}	4.34×10^{-3}	2.11×10^{-2}
2018 (@t=3)	1.43×10^{-4}	9.20×10^{-5}	6.60×10^{-5}	1.70×10^{-4}	8.27×10^{-4}
2019 (@t=4)	2.83×10^{-5}	1.82×10^{-5}	1.31×10^{-5}	3.36×10^{-5}	1.64×10^{-4}
2020 (@t=5)	5.61×10^{-6}	3.61×10^{-6}	2.59×10^{-6}	6.65×10^{-6}	3.25×10^{-5}

NRC staff reviewed these analyses and agrees that the selected exposure pathways represent the current and near-term activities occurring at LARS, provided groundwater and drinking water pathways are not used at the site and individuals currently working on the site do not consume any of the plants grown in the soil or the animals raised on the site. The results documented in Table 1, above, indicate the resulting doses would not be a major contributor to the annual dose to individuals working at the site. In addition, doses calculated for this scenario are assumed to be overly conservative as the analyses unrealistically assume that the individual spends their entire year in a single area of the site.

B. Evaluating Doses Associated with Reasonably Foreseeable Future Land-Use Activities

The licensee also estimated the doses associated with reasonably foreseeable future land uses associated with the LARS site. The RESRAD analyses submitted by the licensee considered a resident farmer scenario for the site but did not include the radon and aquatic food pathways, which was acceptable for this site. The licensee used all of the default RESRAD parameter values except the “area of contaminated zone” and the radionuclide soil concentrations. Specific “area of contaminated zone” values were used for each of the Class 1 areas and the H-3 and C-14 concentrations were calculated based on the samples collected in that specific Class 1 area. Since no radionuclide soil concentration data specific to Pens 1, 2, 4, and 6-12 was collected, the licensee used the average concentration for all Class 1 areas where contamination exceeded the screening value for C-14 listed in NUREG- 1757, Volume 1, Appendix B.

The NRC staff reviewed the RESRAD analyses performed by the licensee to assess whether the results were representative of reasonably foreseeable land-use scenarios for current activities being performed on the site now and in the near future as well as scenarios that may occur further into the future. Characteristics of the site, including minimal surface water and limited groundwater mobility, as well as current activities being performed on the site, were taken into consideration. It should also be noted that the radionuclides of concern, H-3 and C-14, act differently than other radionuclides in RESRAD and therefore use a separate

dose assessment model. For example, since the majority of the C-14 that is taken up into the plants is via gaseous diffusion and not through root uptake, whatever C-14 is associated with the groundwater on the site would be expected to have minimal impact on the plant, milk, and meat consumption pathways.

The NRC staff determined that the RESRAD analysis submitted by the licensee did not accurately assess doses associated with the LARS site. Not only are many of the exposure pathways considered in the licensee's RESRAD analysis not expected to contribute to the dose received by an individual associated with the site but RESRAD assumes steady state conditions for all exposure pathways involved. In other words, at time zero, all of the exposure pathways being considered are assumed to contain concentrations of H-3 and C-14. This would not be the case for the LARS site due to the long period of time it takes radionuclides to migrate to the groundwater for use as drinking water for livestock or humans. In addition, the introduction of "clean" animals that were not previously exposed to H-3 and C-14 prior to being released on the site would not provide an immediate exposure through the consumption of meat and milk. The default values for other parameter values, such as those related to the movement of material through soil, the weather, and the fractions of time spent indoors and outdoors, would also be expected to be different in an environment such as Fairbanks, Alaska.

Using the information provided by the licensee, the NRC staff made some modifications to the RESRAD analyses included with the submittal to demonstrate that doses associated with the samples collected at LARS were overly conservative and that doses associated with reasonably foreseeable future land uses would meet the 10 CFR 20.1402 dose requirements. Changes to parameter values associated with these independent analyses included increasing the "well pump intake depth" parameter value from 10 m to 61 m to address the fact that the groundwater on the site is 200 feet below the surface. The RESRAD transport parameter (Kd) values for H-3 and C-14 were also increased from 0 to 1 so that the radionuclides do not immediately end up in the groundwater where it can then be used for irrigation, drinking water, and livestock water use. Although not likely to occur in the foreseeable future, these independent analyses included the same exposure pathways included in the RESRAD analyses submitted by the licensee.

Table 2. Total doses calculated by NRC staff using the modified RESRAD analyses.

Annual Dose (mrem/yr)					
Year	Pen 5	Barn Pad	West Barn Pad	Pen 3	Pens 1, 2, 4, 6-12
2015 (@t=0)	7.00	1.49	0.332	10.2	68.2
2016 (@t=1)	0.30	7.66×10^{-2}	2.71×10^{-2}	0.431	2.57
2017 (@t=1)	5.68×10^{-2}	2.18×10^{-2}	1.24×10^{-2}	7.74×10^{-2}	0.18
2018 (@t=3)	3.58×10^{-2}	1.46×10^{-2}	8.65×10^{-3}	4.83×10^{-2}	7.89×10^{-2}
2019 (@t=4)	2.55×10^{-2}	1.04×10^{-2}	6.20×10^{-3}	3.44×10^{-2}	5.50×10^{-2}
2020 (@t=5)	1.83×10^{-2}	7.49×10^{-3}	4.45×10^{-3}	2.47×10^{-2}	3.94×10^{-2}
2025 (@t=10)	5.96×10^{-2}	8.48×10^{-2}	3.36×10^{-2}	9.62×10^{-2}	0.135

The results computed by the NRC staff are documented in Table 2 above, which demonstrate that doses associated with reasonably foreseeable future land uses meet the unrestricted use criteria provided under 10 CFR 20.1402 dose requirements.

C. Dose Modeling Conclusions

The licensee submitted its RESRAD analyses to demonstrate that although doses associated H-3 and C-14 contamination at the LARS site will not currently meet the NRC's regulatory requirements for partial site release they will be able to release the site for unrestricted use by 2020. Upon completing its review of the submitted data and RESRAD analyses as well as performing its own independent analyses, NRC staff made the following findings and conclusions.

- i. The NRC staff agree that the proposed immediate future use of the LARS site is as a research facility where individuals would be exposed to H-3 and C-14 through external gamma, inadvertent soil ingestion, and inhalation pathways is reasonably foreseeable and justified. NRC staff also agree that doses to individuals associated with the site would be similar to the values provided in Table 10 of the submittal (and Table 1 above).
- ii. When considering reasonably foreseeable future land use scenarios the RESRAD analyses submitted by the licensee should be considered overly conservative. In addition, decisions should not be based on the combined dose values provided in Table 9 of the submittal since it is not possible for a single person to be located in each location at the same time and be exposed to all of the exposure pathways for the time periods considered in the submitted RESRAD analyses.
- iii. The RESRAD code, by design, assumes steady-state conditions at time zero for all of the exposure pathways being considered. Since the animals being brought to the LARS site have not previously been exposed to radioactive material it is not accurate to assume that exposure pathways such as meat and milk ingestion would yield doses in such a short amount of time. In addition, many of the default RESRAD parameter values used by the licensee are not representative of the characteristics of the LARS site and do not result in a representative overall dose.
- iv. Based on the NRC staff's review of the information and analyses provided in the submittal, we agree that the information submitted is acceptable and the LARS site can be released for unrestricted use via partial site release in 2020. More defined RESRAD analyses performed by NRC staff suggest that the doses would be lower than the values included in the submittal. Based on characteristics of the site, all five Class 1 areas currently meet the regulatory requirements for unrestricted use, and the licensee would not have to wait until 2020 to release the LARS site for unrestricted use.

VI. ENVIRONMENTAL INFORMATION

The NRC determined that an environmental assessment of this partial site release would not be required, based on the licensee's proposed action satisfying the criteria for a categorical exclusion under 10 CFR 51.22(c)(20)(iii), namely, "decommissioning of sites where licensed operations have been limited to the use of radioactive materials in such a manner that a decommissioning plan is not required by 10 CFR 30.36(g)(1) and the NRC has determined that the facility meets the radiological criteria for unrestricted use in 10 CFR 20.1402 without further remediation or analysis."

Title 10 CFR 30.36(g)(1) states in part, that "A decommissioning plan must be submitted if required by license condition or if the procedures and activities necessary to carry out decommissioning of the site or separate building or outdoor area have not been previously

approved by the Commission and these procedures could increase potential health and safety impacts to workers or to the public, such as in any of the following cases:

- (i) Procedures would involve techniques not applied routinely during cleanup or maintenance operations;
- (ii) Workers would be entering areas not normally occupied where surface contamination and radiation levels are significantly higher than routinely encountered during operation;
- (iii) Procedures could result in significantly greater airborne concentrations of radioactive materials than are present during operation; or
- (iv) Procedures could result in significantly greater releases of radioactive material to the environment than those associated with operation.”

No decommissioning plan is required by any condition of the University’s materials license. For decommissioning of the LARS site, no procedures or activities are necessary that would increase potential health and safety impacts to workers or the public.

VII. UNRESTRICTED USE CRITERION

The NRC staff has reviewed the sample collection results and dose modeling analyses for the LARS site located at the University of Alaska, Fairbanks and performed its own independent analyses using a combination of the conceptual model, exposure scenario, mathematical model and input parameters to calculate a reasonable estimate of dose. Based on the NRC’s independent analyses, the dose estimate provides reasonable assurance that the dose to the average member of the critical group is not likely to exceed the 0.25 mSv (25 mrem) annual dose criterion in 10 CFR 20.1402. Upon release of the LARS site from the UAF license all activities associated with the site, including the sale and distribution of reindeer meat to the public for human consumption, could proceed without NRC oversight.

VIII. REFERENCES

The following references are available for inspection at NRC’s Public Electronic Reading Room at <http://www.nrc.gov/reading-rm/adams.html>:

University of Alaska Fairbanks, “Site Characterization Survey: University of Alaska Fairbanks Large Animal Research Station,” December 13, 2016 (ML16356A229)

University of Alaska Fairbanks, Request for Additional Information and Responses, May 5, 2017 (ML17128A506)

U.S. Nuclear Regulatory Commission, Materials License Amendment No. 61, University of Alaska Fairbanks, License No. 50-02430-07, December 26, 2012 (ML12361A445)

U.S. Nuclear Regulatory Commission, NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1, August 2000 (ML003761445)

U.S. Nuclear Regulatory Commission, NUREG-1757, Consolidated Decommissioning Guidance
Decommissioning Process for Materials Licensees, Volume 1, Revision 2, September 2006
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U.S. Nuclear Regulatory Commission, NUREG-1757, Consolidated Decommissioning Guidance
Characterization, Survey, and Determination of Radiological Criteria, Volume 2, Revision 1,
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U.S. Nuclear Regulatory Commission, NUREG-1575, Supplement 1, Multi-Agency Radiation
Survey and Assessment of Materials and Equipment Manual (MARSAME), January 2009
(<https://www.epa.gov/radiation/marsame-manual-and-resources>)

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