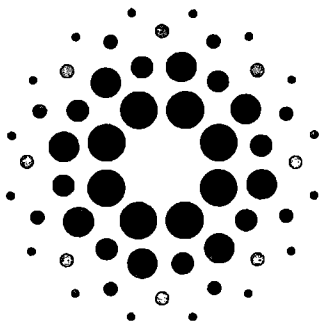
NWMI
NORTHWEST MEDICAL ISOTOPES

ATTACHMENT 1

Northwest Medical Isotopes, LLC

Response to the U.S. Nuclear Regulatory Commission
Request for Additional Information
Environmental Review of the Northwest Medical Isotopes, LLC
Construction Permit Application
(Document No. NWMI-2015-RAI-001, November 2015)

Information is being provided via hard copy



NWMI

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Response to the U.S. Nuclear Regulatory Commission Request for Additional Information Environmental Review of the Northwest Medical Isotopes, LLC Construction Permit Application

NWMI-2015-RAI-001, Rev. 0
November 2015

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Response to the U.S. Nuclear Regulatory Commission Request for Additional Information Environmental Review of the Northwest Medical Isotopes, LLC Construction Permit Application

NWMI-2015-RAI-001, Rev. 0

Date Published:
November 23, 2015

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Title: **Response to the USNRC Request for Additional Information – Environmental Review of the NWMI Construction Permit Application**	
Checked by: **N/A**	
Approved by: **Carolyn Haass**	***Signature***: Carolyn C. Haass

REVISION HISTORY

Rev	Date	Reason for Revision	Revised By
0	11/23/2015	Issued for Submittal to USNRC	NA

TERMS

Acronyms and Abbreviations

^{41}Ar	argon-41
^{99}Mo	molybdenum-99
^{131}I	iodine-131
^{133}Xe	xenon-133
ALARA	as low as reasonably achievable
BLM	Bureau of Land Management
CATSO	Columbia Area Transportation Study Organization
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CSR	Code of State Regulations
Discovery Ridge	Discovery Ridge Research Park
DOT	U.S. Department of Transportation
EH&S	Environmental Health & Safety
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
FHWA	Federal Highway Administration
H_2	hydrogen gas
HAP	hazardous air pollutant
HEU	highly enriched uranium
HIC	high-integrity container
HVAC	heating, ventilation, and air conditioning
LEU	low-enriched uranium
LLMW	low-level mixed waste
MDNR	Missouri Department of Natural Resources
Mo	molybdenum
MU	University of Missouri
MURR	University of Missouri Research Reactor
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHC	n-hydrocarbon
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NWMI	Northwest Medical Isotopes, LLC
O_2	oxygen
O_3	ozone
OAR	Oregon Administrative Rule
OSHA	Occupational Safety and Health Administration
OSTR	Oregon State University TRIGA Reactor
OSU	Oregon State University
Pb	lead
PM	particulate matter

PM-2.5	particulate matter, 2.5 micron
PM-10	particulate matter, 10 micron
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
RO	Reactor Operator
ROI	region of influence
RPF	Radioisotope Production Facility
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SO_x	sulfur oxides
SPA	Special Planning Area
SPCC	spill prevention, control, and countermeasure
SRO	Senior Reactor Operator
TCE	trichloroethylene
Terracon	Terracon Consultants, Inc.
TNM	Traffic Noise Model
TRIGA	Training, Research, Isotopes, General Atomics
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound

Units

µCi	microcurie
µg	microgram
A	ampere
Bq	becquerel
Ci	curie
dBA	A-weighted decibel
ft	feet
ft^2	square feet
ft^3	cubic feet
g	gram
gal	gallon
ha	hectare
hr	hour
in.	inch
kg	kilogram
km	kilometer
kVA	kilovolt-amp
L	liter
lb	pound
m	meter
m^2	square meter
m^3	cubic meter
Mgal	million gallons
mi	mile
mL	milliliter
ML	megaliter
mm	millimeter

mrem	millirem
MW	megawatt
ppb	parts per billion
ppm	parts per million
t	tonne (metric)
VAC	volts alternating current
wt%	weight percent
yd^3	cubic yard
yr	year

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No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Air Quality				
AIR-1A	*Clarify if Table 19-58 of the Environmental Report presents emission factors or emissions for off-road construction equipment. If Table 19-58 does present emissions for off-road construction equipment, verify the emissions presented for particulate matter less than 2.5 microns.*			✓	

Table 19-58 provides emissions for off-road construction. The emissions in Table 19-58 have been verified. Changes to the table include removing "Factors" from the table title and correcting the mislabeled column headings. Table 19-58 has been revised and is presented below.

Table 19-58. Air Pollutant Emissions for Off-Road Construction Equipment

Equipment	Qty	Hours	Pollutant(s): NO_x (kg)	NO_x (lb)	CO (kg)	CO (lb)	PM-10 (kg)	PM-10 (lb)	PM-2.5 (kg)	PM-2.5 (lb)	CO_2 (kg)	CO_2 (lb)	SO_x (kg)	SO_x (lb)
Bulldozer	1	100	140	310	19	41	6.3	14	4.7	10	13,000	29,000	23	51
Compactor	1	120	160	340	21	46	7.0	15	5.3	12	15,000	32,000	26	57
Excavators	1	60	49	110	7.5	17	2.4	5.4	1.8	4.0	4,500	10,000	8.1	18
Front loaders	1	120	68	150	10	23	3.4	7.4	2.5	5.6	6,200	14,000	11	25
Graders	1	80	66	150	10	22	3.2	7.2	2.4	5.4	6,000	13,000	11	24
Paver	1	80	64	140	10	22	3.2	7.0	2.4	5.3	5,900	13,000	11	23
Asphalt roller	1	80	100	230	14	31	4.7	10	3.5	7.7	9,700	21,000	17	38
		Total	647	1430	91.5	202	30.2	66.0	22.6	50.0	60,300	132,000	107.1	236

Source: EDF-3124-0009, *Off-Road Emissions During Construction*, Rev. 1, Portage, Inc., Idaho Falls, Idaho, July 31, 2015.

PM-2.5 = particulate matter, 2.5 μ. PM-10 = particulate matter, 10 μ.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Air Quality (continued)				
AIR-1B	*Section 19.4.2.1.2.5 of the ER states: "Emissions data shown in Table 19-63 provide an estimate of vehicle emissions. Calculations used to obtain the estimates are based on an average workforce of 25-50 vehicles/day using a specific vehicle ratio (60 percent light-duty autos, 30 percent light-duty gas trucks, and 10 percent light-duty diesel trucks) and a round trip of 40 mi/day..." However, Table 19-6 lists that during operation the average workforce and peak workforce will be 98. Explain why 25-50 vehicles/day were assumed during the operation phase to estimate workforce vehicle emissions.*			✓	

The stated estimate assumed that employees will carpool, with two to three people per vehicle. To provide a more bounding evaluation, the calculation has been reanalyzed assuming that each individual will drive their own vehicle and that 100 vehicles are used. Table 19-63 has been revised and is presented below.

Table 19-63. Vehicle Emissions During Operations

Vehicle type	Fuel	CO		NO_x		CO_2		PM-10		PM-2.5		SO_x	
		kg	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg	lb
Light duty autos	Gas	1,085	2,392	95	210	225,239	496,569	1	3	1	3	2	5
Light duty trucks	Gas	1,323	2,917	122	268	129,506	285,513	2	4	1	3	1	3
Light duty trucks	Diesel	35	77	70	154	37,004	81,580	6	14	6	13	0	1
Total		2,443	5,385	286	631	391,748	863,662	9	21	9	19	4	9

Source: EDF-3124-0013, *On-Road Emissions for Vehicles During Operation*, Rev. 1, Portage, Inc., Idaho Falls, Idaho, July 31, 2015.

PM-2.5 = particulate matter, 2.5 μ. PM-10 = particulate matter, 10 μ.

Table 19-64 has been revised and is presented to the right.

Table 19-64 Expected Green House Gas Emissions from Radioisotope Production Facility Project

Source	CO_2	
	kg	lb
Construction phase onsite	44,000	97,000
Construction phase offsite	610,000	1,330,000
Normal plant operations (per year)	23,000,000	51,000,000
Operations on-road vehicle travel (per year)	392,000	864,000

Source: EDF-3124-0011, *Greenhouse Gas Emissions*, Rev. 1, Portage, Inc., Idaho Falls, Idaho, July 31, 2015.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Air Quality (continued)				
AIR-1C	*Section 19.4.2.1.2.5 of the ER states "During the operations phase, vehicular air emissions would result from the commuting workforce and from routine deliveries to and from the proposed RPF." Table 19-6 of the ER provides an estimate of vehicle emissions. Clarify if Table 19-6 emissions account for both commuting workforce and from routine deliveries to/from the RPF.*			✓	

Table 19-63 has been revised to reflect 100 vehicles a day. This number includes both workforce commuters and routine deliveries to the Northwest Medical Isotopes, LLC (NWMI) Radioisotope Production Faction (RPF). The revised Table 19-63 is provided in the AIR-1B response.

AIR-1D	*Table 19-56 of the ER identifies 100 for workforce travel during the construction phase. However, Table 19-6 identifies a peak workforce of 82 during construction. Clarify why 100 workforce travel was used in Table 19-6.*			✓	

The peak workforce is assumed to be 82 during construction, with an average workforce assumed to be 38. By estimating the mileage for 100 vehicles, the calculation bounded any potential emissions, including those by other service providers such as for routine deliveries. Table 19-63 accounts for the commuting workforce and routine deliveries to/from the RPF. The revised Table 19-63 is provided in the AIR-1B response.

AIR-1E	*Table 19-59 of the ER considered fugitive dust, windblown dust, and emissions from off-road construction equipment from construction presented in Tables 19-55 and 19-58. However, the total amount presented in Table 19-59 does not equate to the sum from Tables 19-55 and 19-58. Clarify the differences in these values.*			✓	

The values in Tables 19-55 and 19-58 represent the results of the calculations documented in each referenced engineering design file and are rounded to the appropriate number of significant figures. Table 19-59 has been revised to the summation of values presented in Table 19-55 and 19-58 and is presented below.

Table 19-59. Anticipated Gaseous Effluents and Their Associated Air Quality Parameters for Construction

Effluent	Amount		Concentration		Regional air quality parameter
	kg	lb	at 112 m	at 375 m	
PM-10	1,503	3,226	2.91 $\mu g/m^3$	1.20 $\mu g/m^3$	[a]150 $\mu g/m^3$
PM-2.5	304	674	61 $\mu g/m^3$	25 $\mu g/m^3$	[b]35 $\mu g/m^3$
NO_x	647	1,430	68 ppb	28 ppb	[c]100 ppb
CO	91.5	202	0.016 ppm	0.006 ppm	[d]35 ppm
SO_x	107	236	0.008 ppm	0.003 ppm	[e]0.075 ppm

Source: EDF-3124-0014 rev-01, *Emission Modeling for Construction Activities using AERSCREEN*, Rev. 0, Portage, Inc., Idaho Falls, Idaho, July 30, 2015.

[a] 24-hr, not to be exceeded more than once per year on average over three years.
[b] 24-hr, 98th percentile, averaged over three years.
[c] 1-hr, 98th percentile, averaged over three years.
[d] 8-hr, not to be exceeded more than once per year.
[e] 1-hr, 99th percentile of 1-hr daily maximum concentrations, averaged over three years.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Air Quality (continued)				
AIR-1F	*Table 19-61 and Table 19-62 of the ER present total annual and hourly emissions from the four natural gas boilers. Hourly and annual emissions, however, from these two tables do not match. Clarify and provide the correct annual and hourly total emissions from the gas-fired boilers.*			✓	

Table 19-61 contained several errors on conversion of pounds (lb)/hour (hr) to kilogram (kg)/hr. The second and third column headers were mislabeled in Table 19-62. Table 19-61 and 19-62 have been revised and are presented below.

Tables 19-61. Natural Gas-Fired Boiler Total Annual Emissions

Pollutant	Annual emissions		Average hourly emissions	
	t/yr	(ton/yr)	kg/hr	(lb/hr)
CO	16	18	1.9	4.2
NO_x	10	11	1.13	2.5
PM (total)	0.36	1.6	0.18	0.39
NHC (VOC)	1.1	1.2	0.23	0.28
SO_2	0.12	0.13	0.015	0.030
CO_2	24,000	26,000	2,722	6,000

Source: EDF-3124-0008, *Emissions from Natural Gas-Fired Boiler Operation*, Rev. 0A, Portage, Inc., Idaho Falls, Idaho, June 26, 2014.

NHC = n-hydrocarbon.
PM = particulate matter.
VOC = volatile organic compound.

Tables 19-62. AERSCREEN Model Total Annual Emissions

Pollutant	Hourly emissions[a] (lb/hr)	Emissions[b] (ton/yr)	Maximum concentration (123 m) (µg/m^3)	Modeled concentration to closest residential receptor (375 m) (µg/m^3)	NAAQS (µg/m^3)
CO	4.2E+00	18	7.2E+01	4.6E+01	4.0E+04
NO_x	2.5E+00	11	4.3E+01	2.7E+01	1.9E+02
PM-10 (total)[c]	3.9E-01	1.6	6.5E+00	4.2E+00	[g]150
PM-10 (filterable)[d]	9.8E-02	0.40	1.6E+00	1.0E+00	[g]35
VOC[e]	2.8E-01	1.2	-	-	-
SO_2	3.0E-02	0.13	4.7E+00	3.0E+00	1.97E+02
CO_2[f]	6.0E+03	26,000	5.1E-01	3.3E-01	NA

Source: EDF-3124-0012, *Emission Modeling for Process and HVAC Boilers Using AERSCREEN*, Rev. 1, Portage, Inc., Idaho Falls, Idaho, February 4, 2015.

[a] The stack effluent maximum concentration was determined to be at 136 meters (m) (446 feet [ft]).
[b] Based on 50 weeks/year.
[c] Used as PM-10 values.
[d] Assumed to represent PM-2.5.
[e] No NAAQS for volatile organic compounds.
[f] No NAAQS for carbon dioxide.
[g] 24-hr standard for PM-10 and PM-2.5

NA = not applicable.
NAAQS = National Ambient Air Quality Standards.
PM-2.5 = particulate matter, 2.5 µ.
PM-10 = particulate matter, 10 µ.
VOC = volatile organic compound.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Air Quality (continued)				
AIR-1G	*Section 19.4.2.1.1 of the ER identifies batch plant operations as a source of fugitive dust. Clarify if a batch plant will be onsite and if emissions from batch plant operations are accounted for in Section 19.4.2.1.1 of the ER.*			✓	

The batch plant in assumed to be offsite. The two references to the batch plant being onsite were removed from Section 19.4.2.1.1. Emissions from the batch plant are not included in Section 19.4.2.1.1.

The closest batch plant from the RPF is Columbia Ready Mix located at 2600 N. Stadium Drive, Columbia, Missouri. Columbia Ready Mix is 7.6 kilometer (km) (4.7 mile [mi]) from the RPF. The delivery of the concrete to the RPF site is included in our emission estimates in Table 19-57.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
AIR-2A	*Section 19.2.3.1.2 of the ER states: "The offgas containing the fission product gases goes through a series of cleanup columns. The nitrogen oxides (NOx) is removed by a reflux condenser and several NOx absorbers, the fission product gases (noble and iodine) are captured on absorbers, and the remaining gas is filtered and discharged into the process ventilation header." Table 19-86 of the ER states "The RPF would emit minor emissions of NO_x and CO_2 along with levels of radionuclides below 10 CFR 20 levels." Furthermore, Section 19.4.2.1.2.3 of the ER, states: "Gaseous effluents resulting from the production process are based on a 50-week/year operating schedule. There are no emissions of CO, Pb, O_3, or particulate matter from the process exhaust system." However, Section 19.4.2.1.2.3 does not discuss NO_x, SO_2, or CO_2 emissions or quantify the amount of NOx, SO_2, or CO_2 emitted resulting from the RPF production process. Clarify if NOx, SO2, or CO2 would be emitted during the production process. If so, provide NO_x, SO_2, and CO_2 emissions resulting from the production process.*			✓	

Primary process system reactions do not generate quantities of carbon dioxide (CO_2) or sulfur dioxide (SO_2) as reaction products. However, actual materials may generate trace quantities of these components due to the presence of impurities or solution radiolysis. As an example, offgas from dissolution of uranium metal is reported to contain nitrous oxide (N_2O), CO_2, carbon monoxide (CO), and hydrogen gas (H_2) at concentrations that are approximately 0.1 percent of the total nitrogen oxides (NO_x) ($NO + NO_2$) generated. The formation of CO_2 and CO is attributed to the dissolution of carbon impurities in the uranium that was dissolved. While H_2 and oxygen (O_2) are the dominant components produced by aqueous solution radiolysis, there is a potential for RPF solutions containing nitrate and sulfate solutes to generated trace quantities on NO_x and SO_2 from radiolysis. The trace sources of these potential emissions have not been quantified and are unlikely to be present at measurable concentrations in the stack emissions. The estimate of NO_x generation from dissolution is 582.5 kg NO_x/year (yr) as nitrogen dioxide (NO_2), and the bounding stack emission is 42.64 kg NO_x/yr as NO_2.

The third paragraph in Chapter 19.0, Section 19.4.2.1.2.3 has been revised and is provided below.

Each process offgas subsystem would treat the process offgas components separately to prevent mixing of waste constituents (additional information is provided in Section 19.2.3.2.12). Gaseous effluents resulting from the production process are based on a 50-week/yr operating schedule. There are no emissions of CO, lead (Pb), ozone (O_3), or particulate matter (PM) from the process exhaust system. The bounding stack emission estimate of NO_x is 42.64 kg NO_x/yr as NO_2. Iodine fission products would be removed using absorption methods. Fission product gases such as xenon and krypton would be removed using decay beds.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
AIR-2B	*Section 19.4.2.2.4 of the ER states that emission-specific strategies would be developed and implemented to ensure compliance with NAAQS and NESHAP standards. However, the ER does not quantify the hazardous air pollutants emitted resulting from operations. Identify sources of hazardous air pollutants (HAPs), quantify HAP emissions from these sources during construction, operation, and decommissioning, and provide supporting calculations.*			✓	

The RPF will mitigate any hazardous air pollutants (HAP) to meet standards/release limits. The only source of HAPs identified is trichloroethylene (TCE), which is used in the target fabrication system during low-enriched uranium (LEU) target material washing. Spent TCE recovery is described in Chapter 4.0, Section 4.4.2.8.1, and Table 4-75 estimates the RPF inventory at 53 gallons (gal). The TCE systems will be designed to meet Title 40, *Code of Federal Regulations*, Part 61 (40 CFR 61), "National Emission Standards for Hazardous Air Pollutants" (NESHAP) standards and be significantly less than the Missouri *de minimis* level for total volatile organic compounds (VOC) of 40 tons/year.

AIR-2C	*Provide the following ER references for review:* • *EDF-3124-0011, Greenhouse Gas Emissions, Rev. 0, Portage, Inc., Idaho Falls, Idaho, June 26, 2014.* • *EDF-3124-0008, Emissions from Natural Gas Boiler Operation, Rev. 0, Portage, Inc., Idaho Falls, Idaho, June 26, 2014* • *EDF-3124-0012, Emission Modeling for Process and HVAC Boilers Using AERSCREEN, Rev. 1, Portage, Inc., Idaho Falls, Idaho, February 4, 2015.* • *EDF-3124-0013, On-Road Emissions for Vehicles During Operation, Rev. 0, Portage, Inc., Idaho Falls, Idaho, June 26, 2014.*	✓			

The reference documents listed above (or most current revisions of those documents) are attached in Appendix A, B, C, and D, respectively.

AIR-3	*The ISG augmenting NUREG-1537, Part 1, Section 19.1.2, "Regulatory Provisions, Permits, and Required Consultations," and 10 CFR 51.45(d) state that an applicant should list and summarize the status of all applicable Federal, State, local, and other regulatory requirements, permits, and consultations that would be required for the proposed facility to be constructed and operated.* *Table 19-4 in the ER identifies that construction and operating air permits from the Missouri Department of Natural Resources (MDNR) are not required. Has NWMI contacted MDNR regarding the determination that air emission sources will be exempt from permitting requirements and has MDNR confirmed that air permits will not be required? If so, provide documents (e.g., letters) of such communication. Otherwise, indicate the applicant's plans and associated timeframe).*			✓	

NWMI made the determination that air permits from the Missouri Department of Natural Resources (MDNR) are not required for the construction and operation based on MDNR's published regulations. However, NMWI anticipates contacting MDNR with a specific request by March 2016.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Alternatives				
ALT-1	*The ISG augmenting NUREG-1537, Part 1, Section 19.1.1, "Purpose and Need for the Proposed Action," states that the ER should describe how the proposed action would satisfy global, national, or regional projected demands for the radioisotope products to be produced through implementation of the proposed action. Section 19.5.1 of the ER states that "[t]he current demand for ^{99m}Tc in the U.S. requires a weekly supply of approximately 6,000 six-day Ci of ^{99}Mo, approximately 50 percent of the annual U.S. demand." This seems contradictory. Is 6,000 six-day Ci of ^{99}Mo the current demand or 50% of the demand?*			✓	

Historically, the U.S. demand for molybdenum-99 (^{99}Mo) is 6,000 six-day curies (Ci), which is 50 percent of the world demand (NAS, 2009, *Medical Isotopes Production Without Highly Enriched Uranium*; and NEA, 2012, *A Supply and Demand Update of the Molybdenum-99 Market*). Currently, the world demand is estimated to be 10,000 six-day Ci/week with U.S. demand at 5,000 six-day Ci per week (NEA, 2015, *The Supply of Medical Isotopes – 2015 Medical Isotope Supply Review: ^{99}Mo/^{99m}Tc Market Demand and Production Capacity Projection 2015-2020*). Section 19.5.1 was modified to state the following: "The current demand for ^{99m}Tc in the U.S. requires a weekly supply of approximately 5,000 to 6,000 six-day Ci of ^{99}Mo, approximately 50 percent of the world demand."

ALT-2A	*Make available for docketing the Alternative Site Selection presentation given at the site audit.*			✓	

The NWMI Site Alternative Study presentation given at the site audit is attached in Appendix E.

ALT-2B	*Section 19.5.2.2 of the ER identifies available space as a screening criterion and states that all sites have the minimum amount of space required for the production facility, but differences in available space could impact the complexity of facility design. Discuss the space limitations at the MURR, Oregon State University TRIGA reactor (OSTR), and McClellan Business Park alternative sites.*			✓	

If the RPF were to be constructed and operated near one of the university reactors, the complexity and cost of the facility is anticipated to increase compared to the Discovery Ridge Research Park (Discovery Ridge) site. All of the sites next to university reactors have the minimum amount of space required to construct and operate an RPF. However, all sites had less than half of the space available at Discovery Ridge. Space availability near each of the university reactors is limited due to existing structures and space allocation by the owners of the sites. The differences in available space between the sites near university reactors and Discovery Ridge are anticipated to lead to increased intricacies of the facility design, which leads to operational complexities (e.g., hot cell processing, facility deliveries, personnel movement), increase in construction (e.g., greenfield construction verses construction within existing infrastructure) costs, and limits the ability to expand the RPF in the future (e.g., education, research and development).

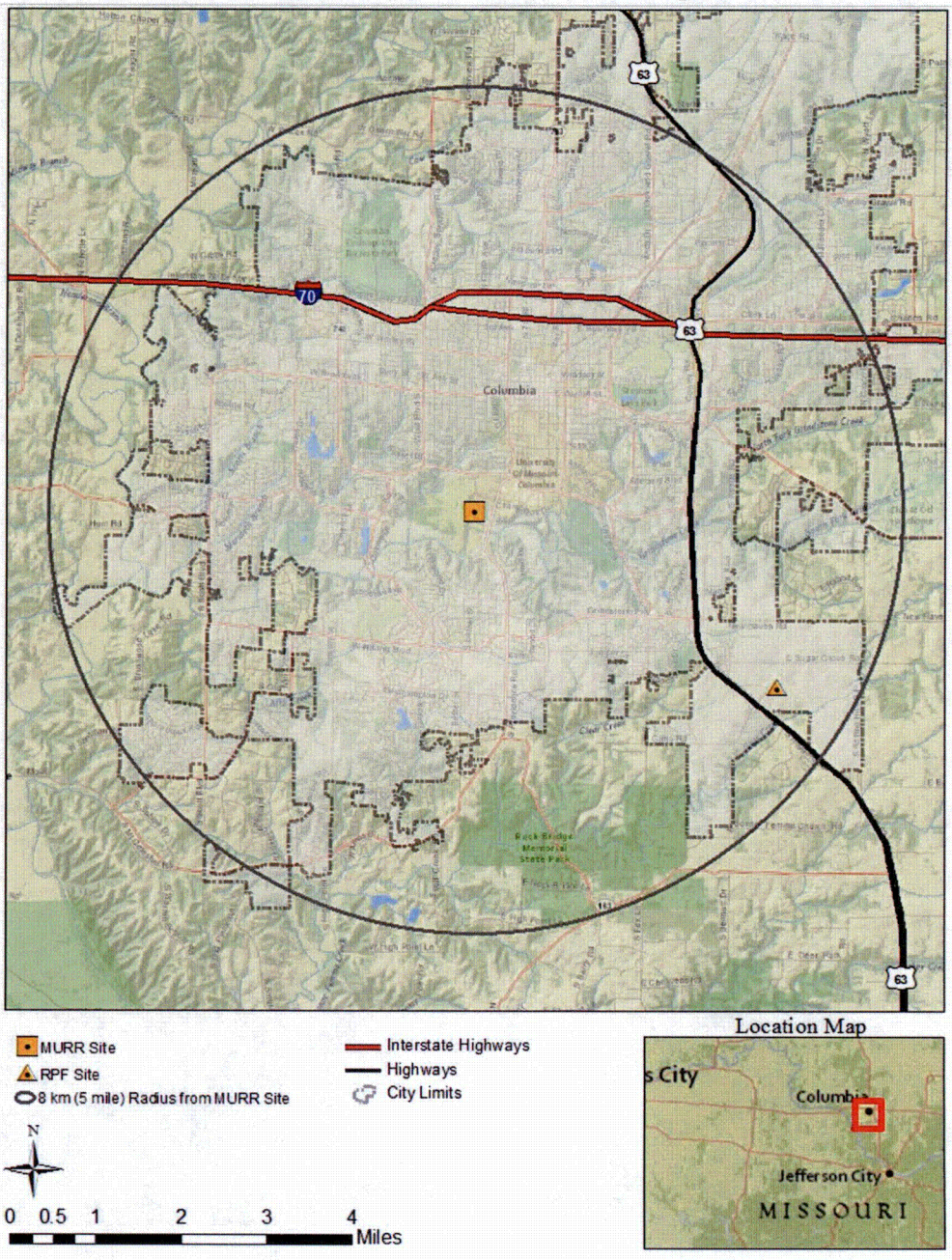
ALT-3A	*The ISG augmenting NUREG-1537, Part 1, Section 19.5 "Alternatives," states that for each reasonable alternative site, a description should be provided In the ER. Provide the following figures pertaining to the MURR alternative site.* *Radioisotope Production Facility site boundary at the MURR alternative site (similar to what was provided for the Discovery Ridge Site in Figure 19-6 of the ER).*			✓	

The requested figure of the University of Missouri Research Reactor (MURR) site is provided on the following page.


Simmons Field
Carrie Francke Dr.
Research Park Dr.
S. Providence Rd
Mick Deaver Memorial Dr.
RPF Facility Alt 3
MURR Site
MURR Fence
RPF Site
8 km (5 mile) Radius from RPF Site
Interstate
Highways
City Limits
N
0 0.03 0.06 0.12 0.18 0.24
Miles
Location Map
Columbia
COLUMBIA RGNL AIRPORT

No.	Request for additional information	Type of requested information			
		Reference	Procedure	Response	Presentation
ALT-3B	*8 kilometer (5-mile) radius figure from the center of the facility at the MURR alternative site (similar to what was provided for the Discovery Ridge Site in Figure 19-5 of the ER).*			✓	

The requested figure of the 8 km (5-mi) radius from the MURR site is provided below.



No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Conclusions				
CON-1	*10 CFR 51.45(e) and the ISG augmenting NUREG-1537, Part 1, Section 19.6, "Conclusions" state that the ER should include a discussion on the unavoidable adverse environmental impacts of the proposed action. Section 19.6.1 states that "[i]f the site is returned to its current state, there would be no unavoidable adverse environmental impacts associated with the proposed action." Yet, Sections 19.6.1.1 and 19.6.1.2 determines SMALL unavoidable impacts to construction and operation. Unavoidable impacts are, by definition, not avoided simply through decommissioning. Unavoidable adverse impacts are predicted adverse environmental impacts that cannot be avoided and that have no practical means of further mitigation. Clarify how there can be "no unavoidable adverse environmental impacts" as stated in the header Section 19.6.1 of the ER and yet there are such impacts, albeit small ones, as discussed in Subsections 19.6.1.1 and 19.6.1.2 of the ER. Further, reconcile the statement in Section 19.6.1 with the statements in Section 19.6.2.1 and 19.6.2.2 that "[s]ome small adverse environmental impacts could remain after all practical measures to avoid or mitigate them are taken."*			✓	

The unavoidable impacts defined in Sections 19.6.1.1 and 19.6.1.2 are "unavoidable" during both the construction and operating phases of the RPF. The impacts may include air emissions and land use changes and are defined in Table 19-92. Transient unavoidable impacts (e.g., air emissions) will cease after the RPF is decommissioned. Unavoidable impacts (e.g. impacts to land use) would be mitigated once the RPF has been decommissioned and the site is returned the current state. The first paragraph, fourth sentence of Section 19.6.1 has been revised to read as follows: "If the site is returned to its current state, no unavoidable impacts are expected to remain."

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Connected Actions				
CONN-1A.1	*Describe a hypothetical third research reactor that is representative of the research reactors. NWMI is considering. Include the following environmental parameters:* *A description of necessary or anticipated modifications at the reactor to support target irradiation. Identify:* *If modifications would be internal or external to the existing structures and if there would be any associated ground-disturbing activities (quantify acreage affected)*			✓	

No external or internal modifications would be required to the hypothetical third reactor. Three equipment refurbishments and/or needs have been identified for the hypothetical third reactor to handle both unirradiated and irradiated LEU targets. These equipment refurbishments and/or needs include:

- **Equipment refurbishments**
  - Refurbish an existing overhead crane (e.g., replacement of contactors, motor brushes, etc.). Any modification will follow the process described in 10 CFR 50.59, "Changes, Tests, and Experiments," for making changes to a facility.
- **Equipment needs**
  - Design and build an intermediate target transfer cask to transfer irradiated targets from the primary reactor tank to a Type B transport cask. This cask will be similar, both physically and functionally, to the current TRIGA single-element transfer cask that is routinely used for fuel movements at TRIGA-fueled facilities worldwide.
  - Design and build an unirradiated LEU target storage rack. The storage rack is anticipated to be a metal box with two holding plates containing guide tubes in a grid pattern necessary to maintain a geometrically safe criticality configuration.

These potential activities are anticipated to be internal to existing structures and will not require ground-disturbing activities.

CONN-1A.2	*Additional workforce needed to support modifications*			✓	

The additional workforce needed to support modifications or equipment needs will be temporary for the hypothetical third reactor. The refurbishment of the overhead crane will be performed by subcontracted personnel with supervision by reactor personnel. The fabrication of the transfer cask and unirradiated LEU target storage rack will be outsourced to a qualified mechanical fabrication vendor.

CONN-1A.3	*Depth of excavation expected to be required for new/modified facilities and utility connections*			✓	

No new/modified facilities or utility connections will be required for the hypothetical third reactor. Thus, ground-disturbing activities that require excavation are not required.

CONN-1A.4	*Duration of activities to complete modifications and to commission the modified facilities and equipment*			✓	

The equipment modifications or fabrication of required equipment at an off-site vendor is anticipated to take two months to complete at the hypothetical third reactor.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
CONN-1A.5	*Any additional noise, traffic, or air emissions from facility modification activities*			✓	

The transport of the fabricated unirradiated LEU storage racks and transfer cask will result in a single delivery for each when completed. The increase in traffic due to the crane modifications will involve a commute to the third reactor facility by one vehicle for a short duration (e.g., less than two weeks). This volume of traffic is considered within the normal traffic patterns expected at the third reactor. Due to minimal traffic and no ground-disturbing activities at the hypothetical reactor, there will be no appreciable increase in either noise or traffic.

CONN-1B	*Land-use classification of the third reactor*			✓	

Land use is a general indication of how land is used—residential, commercial, industrial, open space, etc. Land use defines broad categories; zoning is used to implement land use plans. These plans can be developed by a number of entities such as universities, cities, counties, regions, or states.

The land use for the hypothetical third reactor is anticipated to be similar to both MURR and Oregon State University (OSU) TRIGA Reactor (OSTR). Thus, the land use will be a university-planned district area that will have a mixed use.

CONN-1C	*Additional workforce needed to support operation activities for irradiating targets*			✓	

For the hypothetical third reactor, an increase in staff is expected and is anticipated to be similar to OSTR. The operational tempo is anticipated to increase from a nominal 40-hr work week irradiation schedule to 24/7 operations on a weekly basis when commercial LEU target irradiation services are being provided by the hypothetical third reactor. The anticipated required staff of the hypothetical third reactor will comprise four Senior Reactor Operators (SRO) and three Reactor Operators (RO). At least four additional SRO and six additional RO positions are assumed to be required to oversee and manage the increase in operational tempo. The university setting offers flexibility in hiring; thus, additional staff will likely be drawn from the existing university population.

CONN-1D	*Identify if target handling and irradiation will result in changes in the types or increases in the non-radiological effluent releases and waste streams at the reactor. Provide sources, types, and approximate quantities of non-radiological effluents or waste and discuss non-radiological waste management impacts of target handling and irradiation.*			✓	

No anticipated changes in the sources, types, and quantities of nonradiological effluent releases and waste streams are expected from the handling of unirradiated or irradiated LEU targets at the hypothetical third reactor.

CONN-1E	*Additional water use to complete modifications and to support operation activities for irradiating targets (as compared to existing operations)*			✓	

No additional water use to complete modifications and to support operation activities for irradiation targets is anticipated at the hypothetical third reactor.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
CONN-1F	*Discuss the storage and treatment of non-radioactive material from target handling and irradiation at the reactor.*			✓	

No additional nonradioactive material is anticipated to be generated other than the manufacture of an unirradiated LEU target storage rack. Built entirely of stainless steel, these racks are anticipated to be square, lockable containers with rack locations (i.e., guide tubes) for the unirradiated LEU targets. Approval for the geometry, design, and construction will be promulgated through a license amendment request by the hypothetical third reactor.

CONN-1G.1	*Discuss human health impacts due to target handling and irradiation. Specifically, address the following:* *Provide a list of reporting requirements for non-radioactive waste streams to the Environmental Protection Agency (EPA) applicable state agencies.*			✓	

At the hypothetical third reactor, reporting of nonradioactive hazardous waste streams will be required annually to the appropriate state agency. The hazardous wastes that require reporting include the hazardous waste listing and descriptions in 40 CFR 261, "Identification and Listing of Hazardous Waste." Other non-hazardous waste streams are unlikely to have reporting requirements.

CONN-1G.2	*Provide a copy of or discuss the procedure that workers would use for identifying industrial hazards prior to performance of jobs.*			✓	

The hypothetical third reactor located within a university environment will have a Safety Policies and Procedures Manual (or equivalent) that will provide guidelines and information for employees about programs and services provided by Environmental Health & Safety (EH&S) (or equivalent). The policies and procedures included in this manual will reflect requirements, standards, and statutory and regulatory mandates established at the Federal, State, and local level for occupational and environmental safety and health. Program areas covered and services provided by EH&S will include the following:

- **Audits and inspections**: Responsible for facility audits, including all campus and off-campus laboratories, classrooms, facility operations, research and experiment stations, and extension centers.
- **Biosafety**: Responsible for biosafety implementation, control of select agents, compliance with Federal and State regulations, assistance with granting agency compliance and animal welfare, and research and teaching support for the campus and off-campus facilities.
- **Chemical safety**: Responsible for chemical safety, use, and management, and compliance with Federal, State, and local regulations for the campus and off-campus facilities.
- **Construction and plan review**: Responsible for construction safety, design criteria development, and plan review for EH&S design requirements related to capital and remodel projects for the campus and off-campus facilities.
- **Emergency response and on-call service**: Responsible for emergency and non-emergency response to hazardous substance spills and customer concerns for unsafe conditions for the campus, and providing assistance to the campus during other natural emergencies.
- **Environmental protection**: Responsible for air, water, and soil resource protection; monitoring; and permitting for the campus and off-campus facilities.
- **Fire and life safety**: Responsible for fire and life safety prevention and inspections for campus facilities.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation

- **Hazardous waste and shipping**: Responsible for hazardous waste management and shipping of dangerous goods and samples for the campus and off-campus facilities.
- **Industrial hygiene**: Responsible for industrial hygiene monitoring and employee protection for the campus and off-campus facilities.
- **Lead and asbestos**: Responsible for identification and management of lead and asbestos-containing materials for the campus and off-campus facilities.
- **Occupational safety**: Responsible for occupational safety evaluations, consultations, and OSHA compliance for the campus and off-campus facilities.
- **Public health**: Responsible for implementation, monitoring, and permitting of water systems and sewage disposal systems; pesticide safety; and vectors, housing units, and other areas regulated by health departments for the campus and off-campus facilities.
- **Radiation safety**: Responsible for the regulation of ionizing and non-ionizing sources of radiation, compliance with the university's broad scope license and Federal and State regulations, and laser safety for research and teaching operations for the campus and off-campus facilities.
- **Training outreach**: Responsible for creating and delivering training outreach materials to faculty and staff, including training record tracking and training certificate issuance for the campus and off-campus facilities.

CONN-1G.3	*Provide a copy of or discuss the anticipated emergency response plan.*			✓	

Possessing and maintaining an emergency response plan is a requirement of any university research reactor facility license. The hypothetical third reactor emergency plan will follow the guidance found in NUREG-1537, *Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors*, and ANSI/ANS 15.16, *Emergency Planning for Research Reactors*, as endorsed in Regulatory Guide 2.6, *Emergency Planning for Research and Test Reactors*.

CONN-1G.4	*Provide a copy of or discuss the anticipated recycling and reuse plan.*			✓	

The hypothetical third reactor will follow the policies and procedures of the university organization assigned the responsibility. The hypothetical university recycling programs will provide information on the types of materials acceptable for recycling (e.g., paper, plastics, metals, glass, batteries, compost, electronic media, ink/toner cartridges, packing peanuts, wood, Styrofoam, comingling limits, etc.), provide containers specific to the materials of interest, and provide pick-up and delivery services scheduling.

CONN-1H	*Distance travelled of targets to and from the reactor.*			✓	

The distance travelled of targets to and from the reactor will be bounded by the discussion of the hypothetical third reactor described in Section 19.4.10.1.2 of the Construction Permit Application.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
CONN-11	*Identify if target handling and irradiation will result in changes in the types or increases in the radiological effluent releases and waste streams at the reactor. Provide sources, types, and approximate quantities of radiological effluents or waste and discuss radiological waste management impacts of target handling and irradiation. Discuss any expected radiological impacts to the workers at those facilities due to those expected changes. Discuss any expected radiological impacts from transportation due to the shipment to and from the reactor.*			✓	

The amount of radioactive solid waste that would be generated from the hypothetical third reactor as a result of handling and irradiating LEU targets is not anticipated to increase significantly, as the targets will be minimally handled with little or no potential for contamination. The majority of the waste generated would be solid dry wastes (e.g., paper, gloves, and absorbent materials) from handling the targets on receipt at the reactor. After irradiation, the targets will be moved from the reactor core and into the intermediate transfer cask underwater in the primary tank. Estimates of the added amount of dry-solid-compactable radioactive wastes at the hypothetical third reactor is 0.11 to 0.17 cubic meters (m^3) (4 to 6 cubic feet [ft^3]) annually. No liquid radioactive waste is anticipated to be generated from these activities.

With respect to gaseous emissions, no gaseous emissions are expected from the LEU targets themselves but gaseous releases from the operation of the hypothetical third reactor may change depending on how the facility is operated. For the hypothetical third reactor, the average amount of gaseous emissions will increase. The only isotope normally measured and emitted from a research reactor is argon-41 (^{41}Ar).

The hypothetical third reactor will have a limit on the annual average effluent concentration in their technical specifications to ensure that the concentration of ^{41}Ar in the unrestricted areas will be below the applicable effluent concentration value in 10 CFR 20, "Standards for Protection Against Radiation," Appendix B, Table 2, assuming continuous discharge. This technical specification will likely be based on the guidance provided in Regulatory Guide 4.20, *Constraint on Releases of Airborne Radioactive Materials to the Environment for Licensees Other Than Power Reactors*. Conservatively assuming that the hypothetical third reactor increases its operational tempo from 10 full power hours a week to 24/7/365 operations, the total activity released could increase by a factor of 16.8 (168/10 = 16.8 weekly). Although the total amount of ^{41}Ar may increase from the increased operating tempo, the concentration will remain the same.

The handling of both unirradiated and irradiated LEU targets is not anticipated to significantly increase the occupational doses at the hypothetical third reactor. Based on information obtained from TRIGA-fueled reactors that have gone through highly enriched uranium (HEU)-to-LEU fuel conversion in the past eight years, the receipt of fresh LEU TRIGA fuel may be indicative of what should be expected for unirradiated LEU targets. The fuel received for conversions was 20 percent enriched and 30 weight percent (wt%) standard TRIGA fuel containing a nominal uranium mass of 820 grams (g) within a stainless-steel clad cylinder with outer dimensions similar to the proposed targets. Typical dose equivalent rate readings on contact and at 0.3 m (1 ft) were 0.1 to 0.3 and 0 millirem (mrem)/hr, respectively. No measurable dose equivalent rate at 0.3 m (1 ft) from a fully loaded storage container was observed. Due to this, no appreciable increase in the occupational dose equivalent is expected from the handling of the proposed unirradiated LEU targets at the hypothetical third reactor. Additionally, no appreciable increase in dose to the general public is expected from handling the unirradiated LEU targets due primarily to the very low-dose equivalent rates observed with the unirradiated LEU TRIGA fuel handling and a lack of proximity of the general public to the targets.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	The occupational doses from handling irradiated targets are not anticipated to significantly increase at the hypothetical third reactor. All research reactors have procedures for handling fuel elements and have established radiation protection and ALARA (as low as reasonably achievable) programs. A shielded transfer cask will be used to remove irradiated targets from the reactor and load them into the shipping cask. While some increase will be observed, due to the very nature of handling radioactive material, the dose increase will not be significant due to the established programs and handling experience. The quantity, type, and packaging associated with transport of radioactive materials are discussed in Section 19.2.8.2. The radiological impacts from shipment to and from the hypothetical third reactor are discussed in Section 19.4.10.				
CONN-2	*In support of analyzing the site-specific environmental impacts associated with the connected actions, identify if target handling and irradiation will result in changes in the types or increases in the non-radiological effluent releases and waste streams at the two identified research reactors (MURR and OSTR). Provide sources, types, and approximate quantities of non-radiological effluents or waste and discuss non-radiological waste management impacts of target handling and irradiation at MURR and OSTR.*			✓	
	No anticipated changes in the sources, types, and quantities of nonradiological effluent releases and waste streams are expected from the handling of the unirradiated or irradiated LEU targets at MURR or OSTR.				
CONN-3	*In support of analyzing the site-specific environmental impacts associated with the connected action of irradiation services, discuss the storage and treatment of non-radioactive material from target handling and irradiation at MURR and OSTR.*			✓	
	No additional nonradioactive material is expected to be generated other than the manufacture of an unirradiated target storage rack. Composed entirely of stainless steel, these racks are anticipated to be square, lockable containers with rack locations (i.e., guide tubes) for the unirradiated LEU targets. Approval for the geometry, design, and construction will be promulgated through license amendments for each of the reactor facilities.				
CONN-4.A	*Discuss human health impacts due to the connected actions of target handling and irradiation at MURR and OSTR. Specifically, for MURR and OSTR, address the following:* *Provide a list of reporting requirements for non-radioactive waste streams to EPA applicable state agencies.*	✓		✓	
	At the OSTR, OSU is required to annually report the amount by volume of all hazardous wastes generated and disposed of to the Oregon Department of Environmental Quality. The hazardous wastes that require reporting include the hazardous waste listing and descriptions in 40 CFR 261. Additionally, Oregon Administrative Rule (OAR) 340-101-0033, "Additional Hazardous Wastes," lists wastes that are state of Oregon-only hazardous waste and must be reported. These wastes include pesticides residues and mixtures of wastes containing constituents of Federal P (3 percent) and U (10 percent) listed wastes. At MURR, the University of Missouri (MU) is required to complete a quarterly Generator's Hazardous Waste Summary Report. This report lists the quantity, type, and status of all 10 CFR 261 listed and described hazardous wastes shipped offsite during the reporting period.				

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
CONN-4.B	*Provide a copy of the procedure that workers would use for identifying industrial hazards prior to performance of jobs.*	✓		✓	

At the OSTR, identifying industrial hazards prior to performance of jobs falls under the requirements of occupational health and safety policies and procedures administered by OSU Enterprise Risk Services. The OSU Safety Policies and Procedures Manual is provided at http://fa.oregonstate.edu/saf-manual. Industrial and laboratory safety instructions are numerous and are provided online at http://oregonstate.edu/ehs/safety-instructions.

At MURR, identifying industrial hazards prior to performance of jobs falls under the requirements of occupational health and safety policies and procedures administered by the MU Department of Health and Safety. The manual governing the policies and procedures is provided in the MU *Business Policy and Procedure Manual* available at http://bppm.missouri.edu/.

CONN-4.C	*Provide a copy of the emergency response plan for each reactor.*	✓		✓	

A copy of the OSTR emergency response plan is provided in Appendix F. A copy of the MURR emergency response plan is provided in Appendix G.

CONN-4.D	*Provide a copy of the recycling and reuse plan for each reactor.*	✓		✓	

At OSTR, recycling and reuse is governed by university policies and procedures administered by Campus Recycling, reporting to the Finance and Administration-Business Affairs Office. This service is managed online at www.recycle.oregonstate.edu.

At MURR, recycling and reuse are governed by university policies and procedures administered by the Sustainability Office, and are managed online at http://sustainability.missouri.edu/topics/recycling.html.

Information related to a third reactor cannot be supplied at this time, as the reactor has not yet been selected. The answer to this question for the third reactor is anticipated to be similar to that for OSTR.

CONN-5	*In support of analyzing of the environmental impacts associated with the connected actions, identify if target handling and irradiation will result in changes in the types or increases in the radiological effluent releases and waste streams at the two identified reactors (MURR and OSTR). Provide sources, types, and approximate quantities of radiological effluents or waste and discuss radiological waste management impacts of target handling and irradiation at the two identified reactors. Discuss any expected radiological impacts to the workers at those facilities due to those expected changes. Discuss any expected radiological impacts from transportation due to the shipment to and from the two identified reactors.*			✓	

As stated in Sections 19.4.13.3.1, 19.4.13.3.2, and 19.4.13.3.3, the solid waste stream will minimally increase, and the liquid waste streams will likely not be affected as a result of handling both the unirradiated and irradiated LEU targets.

With respect to gaseous emissions, no gaseous emissions are expected from the targets, but gaseous releases from the operation of the reactor may change depending on how the facility is operated. At MURR, there will be no expected increase in gaseous emissions because the operating tempo of the reactor will not change. At OSTR, the average amount of gaseous emissions will increase.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation

The only isotope ever measured and emitted at OSTR is ^{41}Ar. As reported in annual reports required by the facility technical specifications, the typical annual concentrations at the point of release from OSTR is approximately 5.2E-3 becquerel (Bq)/milliliter (mL) (1.4E-7 microcurie [μCi]/mL), with a corresponding total annual radioactivity of approximately 7.4E11 Bq (20 Ci). Conservatively, assuming that the OSTR runs 24/7/365, the total activity released could increase by a factor of 4.8 (168/35 = 4.8 weekly). However, although the total amount of ^{41}Ar may increase from the increased operating tempo, the concentration will remain the same.

As stated in Sections 19.4.13.1.1.2 and 19.4.13.1.2.3, the handling of both unirradiated and irradiated targets should not significantly increase the occupational doses. Those sections describe historical fuel movement experience, how that is similar to moving targets, and the occupational doses incurred.

The quantity, type, and packaging associated with transport of radioactive materials are discussed in Section 19.2.8.2. The radiological impacts from transportation due to the shipment to and from the reactors are discussed in Section 19.4.10.

CONN-6A	*Section 19.4.13 of the ER identifies facility modifications at the two identified reactors (MURR and OSTR) needed to support the handling and irradiation of targets. Provide the following information regarding facility modifications and handling and irradiation of targets:* *A.) Additional workforce needed to support modifications*			✓	

At MURR, all additional workforce needed to support modifications will be temporary. The fabrication of the storage racks and the transfer cask will likely be outsourced to a qualified mechanical fabrication machine shop. The manufacture of the new reflector elements will be completed by existing MURR staff. Construction of a new airlock will involve an estimated four to six construction workers.

At OSU, all additional workforce needed to support modification will be temporary. The fabrication of the storage racks and the transfer cask will be outsourced to a qualified mechanical fabrication machine shop. The work on the overhead crane will likely be performed by one or two individuals contracted to perform the work.

CONN-6B	*Additional workforce needed to support operation activities for irradiating targets*			✓	

For MURR, no increase in facility staff is expected, as the handling and irradiation of the LEU targets will be consistent with existing expertise and workload.

For OSTR, an increase in staff is expected to provide commercial irradiation services. The operational tempo is anticipated to increase from a nominal 40-hr work week irradiation schedule to 24/7 operations on a weekly basis when commercial LEU target irradiation services are being provided. The anticipated required staff for OSTR will comprise four SROs and three ROs. At least four additional SRO and six additional RO positions are assumed to be required to oversee and manage the increase in operational tempo. The university setting offers flexibility in hiring; thus, additional staff will likely be drawn from the existing university population.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
CONN-6C	*Duration of activities to complete modifications and to commission the modified facilities and equipment*			✓	

The equipment modifications or fabrication of required equipment at an off-site vendor is anticipated to take two months to complete at both MURR and OSTR.

CONN-6D	*Depth of excavation expected to be required for new/modified facilities and utility connections*			✓	

No ground-disturbing activities are anticipated to occur at either MURR or OSTR as a result of handling and irradiation of targets at either reactor.

No new/modified facilities or utility connections will be required for either MURR or OSTR. Thus, ground-disturbing activities that require excavation are not required.

CONN-6E	*Additional water use to complete modifications and to support operation activities for irradiating targets (as compared to existing operations)*			✓	

No additional water use to complete modifications and to support operation activities for irradiation targets is anticipated at either reactor.

CONN-6F	*Any additional noise, traffic, or air emissions from facility modification activities*			✓	

The transport of the fabricated unirradiated LEU storage racks and transfer cask to both MURR and OSTR will result in a single delivery for each when completed. Increase in traffic due to the crane modifications will involve commute to the third reactor facility by one vehicle for a short duration (e.g., less than two weeks). This volume of traffic is considered within the normal traffic patterns expected at MURR and OSTR. Due to minimal traffic and no ground-disturbing activities at the hypothetical reactor, there will be no appreciable increase in either noise or traffic.

CONN-6G	*Would modifications be internal or external to the existing structures? If external modifications are necessary, would there be any associated ground- disturbing activities? If so, quantify the acreage and identify the nature of the areas that may be impacted.*			✓	

All modifications and/or equipment refurbishments or needs would be internal to existing structures at both reactors.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Cumulative Impacts				
CI-1A	*Identify any additional state, county, and regional documents that were reviewed (other than the cited City of Columbia FY2013 CIP Planning Document) to develop Table 19-86. Provide associated URLs for this reference information and specifically identify for which of the listed projects each source provides supporting information.*	✓		✓	

In addition to the City of Columbia FY 2013 CIP Planning Document, the following documents were also reviewed:

- City of Columbia, 2008, *2030 CATSO Long Range Transportation Plan*, City of Columbia Department of Planning and Development, http://www.gocolumbiamo.com/community-development/wp-content/uploads/sites/14/2015/09/2030TransportationPlanFinal.pdf, Columbia, Missouri, June 20, 2008
- Boone County Planning and Zoning Commission's meeting agendas for 2013, https://www.showmeboone.com/resourcemanagement/PZCommission/Agenda/PZAgenda.asp?YEAR=2013
- RS&H No. 226-1077-000, *Columbia Regional Airport (COU) Columbia, Missouri Draft Environmental Assessment*, City of Columbia and U.S. Department of Transportation – Federal Aviation Administration, http://www.flycou.com/?page_id=342, Columbia, Missouri, January 2012.
- City of Columbia, 2012a, *City of Columbia FY 2013 CIP Planning Document*, https://www.gocolumbiamo.com/Finance/Services/Financial_Reports/index.php, Columbia, Missouri, October 1, 2012.
- CDT, 2013, "MU, Company Partner to Boost Supply of Isotope used in Diagnostic Drug," *Columbia Daily Tribune*, http://www.columbiatribune.com/news/education/mu-company-partner-to-boost-supply-of-isotope-used-in/article_0c707d88-4909-11e3-9ef7-10604b9f6eda.html, Columbia, Missouri, November 9, 2013.
- CW&L, 2013, "New South Substation & Transmission Lines Public Hearing," https://www.gocolumbiamo.com/WaterandLight/Electric/ProposedElectricTransmission.php, Columbia Water and Light, Columbia, Missouri, July 15, 2013.

CI-1B	*Provide the name, description, location, and status of any additional past, present or reasonably-foreseeable projects or actions at or in the vicinity of the proposed RPF that have been identified since the applicant's ER was prepared.*			✓	

The information provided in the following table identifies the name, description, location, and status of additional projects in the vicinity of the proposed RPF that have been identified since the Environmental Report (ER) was prepared. The Gans Road route 163 to Bearfield road is anticipated to convert some existing farm fields to road surface, which would be considered a minor loss of agricultural lands. The cumulative effect is considered small. All other impacts associated with the new road are anticipated to be within the cumulative impacts already addressed by other projects with the ER, and the resulting cumulative impacts are anticipated to remain the same as documented in the ER.

Recently Identified Past, Present, and Reasonably Foreseeable Future Actions

Project name	Project start date	Project end date	Distance from RPF (distance band, km)	Distance from RPF (distance band, mi)	Retained for cumulative analysis	Basis	Source
Buildings/Facilities							
Fulton Medical Center	TBD	TBD	0.40	0.25	N	Certificate of Need was not approved underdetermined when or if it will be built.	CDT, 2015a and CDT, 2015b
Kraft Heinz plant expansion	TBD	TBD	Greater than 8	Greater than 5	N	Construction limited to previously disturbed lands at a distance from the FPR site.	CDT, 2015c
Landmark Hospital Transitional Care Center of Columbia	TBD	TBD	6 to 8	3.7 to 5	N	Construction limited to previously disturbed lands at a distance from the FPR site.	MHFRC, 2015
Streets and Sidewalks							
Gans Road: Route 163 to Bearfield Road	1/2015	12/2015	2 to 4	1.3 to 2.5	Y	Construction include newly disturbed lands and potential cumulative effects from air emissions and effect to land use.	CATSO, 2015a and CATSO, 2015b

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
Ecology					
ECO-1	*Describe any site investigations that examined vegetation (grasses, shrubs, and trees) and wildlife (mammals, reptiles and amphibians, and birds) on or near the site, including transient wildlife that may only use the site as a temporary resting or foraging ground, or wildlife that only uses the site seasonally. In addition, describe any site investigations that focused on invasive species.*			✓	

A site investigation to examine vegetation, wildlife, and invasive species on the site was conducted by a combination of photographic interpretation, evaluation of the literature, and the ecological site description of grass prairie of the area around Columbia, Missouri. The site is an area that has experienced continuous land disturbance associated with agriculture practices at least since 1934 (Terracon 2011a, provided in Appendix H). In addition, the site is devoid of natural landscapes such as forest, prairies, and other natural plant communities. A site reconnaissance was conducted by NWMI in June 2014 to confirm the site investigation findings.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
ECO-2	*Section 19.3.5.7.1 of the ER states that "representative plant species include little bluestem (Schizachyrium scoparium), sideoats grama (Bouteloua curtipendula), winter bentgrass (Agrostis hyemalis), and Atlantic camas (Camassia scilloides) (Nigh and Schroeder, 2002; Faber-Lagendoen, 2001)." Provide the technical basis for why NWMI assumes these plants occur onsite. Describe the percent cover of the most common vegetative species on site.*			✓	

The representative plant species are based on photographic interpretation and the ecological site description of grass prairie in the area around and near Columbia, Missouri. A site investigation was conducted on September 30 and October 1, 2015. The results of this survey are provided in the attached report: NWMI-2015-RPT-002, *Radioisotope Production Facility Vegetation Assessment* (Appendix I).

ECO-3	*Section 19.3.5.7.1 of the ER states that "potential native plant species that may occur within the proposed site include those associated with tall grass hardpan prairie (Nigh and Schroeder, 2002)." Nigh and Schroeder (2002) describe numerous native species. Describe which native species occur on site and provide a summary of how NMWI determined which native species occur on site, such as onsite ecological surveys.*			✓	

A site investigation was conducted on September 30 and October 1, 2015. The results of this survey are provided in the attached report: NWMI-2015-RPT-002, *Radioisotope Production Facility Vegetation Assessment* (Appendix I).

ECO-4	*Figure 19-39 of the ER shows the locations for wetlands near the proposed RPF site. The large size of the symbol for the proposed RPF makes it difficult to confirm the location of any wetland onsite or near the site. Confirm whether any wetlands are located on the proposed site and describe the distance from the proposed site to the nearest wetland. Describe wetland and wildlife species that are likely to occur in nearby wetlands.*			✓	

Based on the United States Fish and Wildlife Service (USFWS) National Wetlands Inventory GIS data, there are no wetlands located onsite or near the site. The closet wetland to the site is a 4.9 hectare (ha) (12.15)-acre pond with an earthen dam, which is 0.24 km) (0.15 mi) to the northwest of the site.

A qualitative survey of the properties immediately surrounding the site was conducted on September 30 and October 1, 2015. The results of this survey are provided in NWMI-2015-RPT-001 (Appendix J).

The survey identified Bullfrog (Rana catesbeiana), Green Frog (Rana clamitans melanota), Painted Turtle (Chrysemys picta bellii), and Northern Pintail (Anas acuta) within the northwestern pond. The property south of the RPF site to Gans Creek was surveyed and found to have American Elm (Ulmus americana), Eastern Red Cedar (Juniperus virginiana), Post Oak (Quercus stellate), Bitternut Hickory (Carya cordiformis), and Shagbark Hickory (Carya ovate). At the time of the survey, Gans Creek was not flowing; however, Creek Chub (Semotilus atromaculatus) were observed in small pools within the creek channel. Blanchard's Cricket Frog (Acris crepitans blanchardi) and Eastern Gray Squirrel (Sciurus carolinensis) were also observed in this area.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation

The man-made pond to the northwest of the property was also observed and Green Frog (Rana clamitans melanota), Canada Goose (Branta Canadensis), Northern Pintail (Anas acuta), and Trumpeter Swan (Cygnus buceinator). Signs posted around the pond note that is was stocked with largemouth bass, catfish, and crappie by the Missouri Department of Conservation for recreational purposes. The bird species also indicate that the surrounding water bodies may be used by migratory birds.

ECO-5	*Describe the aquatic species, such as fish and invertebrates that are likely to occur within the stormwater management ponds, Gans Creek, and nearby streams.*			✓	

As described in Section 19.3.5.6, "Aquatic Communities and Potentially Affected Water Bodies," the aquatic species that are likely to occur within the stormwater management ponds, Gans Creek, and nearby stream include mayflies, stoneflies, caddisflies, dragonflies, beetles, small crustaceans, snails, shiners, suckers, redhorse, sunfish, bass, darters, and stonerollers. No Federally listed threatened or endangered fish species are known to exist in Gans Creek. No specific data is available on the species within the stormwater management ponds; however, the species and habitats are considered to be similar to those found in Gans Creek.

ECO-6	*Describe the most common vegetative species (grasses, shrubs, and trees), wildlife species (mammals, reptiles and amphibians, and birds), and aquatic species (fish and macroinvertebrates) at each alternative site.*			✓	

Based on photographs of the alternative sites, the common vegetation includes the types used for landscaping, including ornamental grasses, shrubs, and trees. The wildlife species using these sites would be limited to species that occur in urban/industrial settings, including rodents, some song birds, and insects. Aquatic species are not anticipated to use these sites due to a lack of water.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Geologic Environment				
GEO-1	*Provide clarification of the information presented in Sections 19.3.3, including 19.3.3.8 and 19.3.4.3, of the ER with respect to the greater Discovery Ridge site development. Specifically, provide a description of the scope and timing of proposed site-specific geotechnical and hydrological studies to be performed of the RFP site (Lot 15) and of any adjoining areas that may be used for laydown or site access. Include studies such as proposed baseline preoperational groundwater and surface water quality monitoring (including sampling parameters) as well as studies to address such potential issues as soils with high-shrink swell potential, karst features, and confirmation of the depth to perched groundwater or water-table conditions.*			✓	

NWMI anticipates conducting site-specific geotechnical and hydrological studies starting in January 2016. Bore holes are anticipated to be drilled a maximum depth of approximately 15.2 m (50 ft) below surface level, or 6.1 m (20 ft) into sound bedrock. The number of bore holes per 9.2 square meters (m^2) (100 square feet [ft^2]) will be dependent on the foundation type anticipated in a specific area. For each core, the soil/rock profile will be documented and classified, and engineering and geotechnical properties determined. The liquefaction potential of soils will also be determined. Groundwater encountered will be documented, and several samples of the groundwater encountered will be collected to determine the baseline groundwater quality. There is no intention of verifying the depth to the Mississippian aquifer, which lies approximately 548 m (1,800 ft) below the surface. Baseline surface water samples will be collected from Gans Creek and the stormwater management ponds prior to the initiation of operations.

GEO-1B	*As part of the site-specific characterization studies referenced in (A) above, describe the number, spacing, diameter and proposed depth, and installation method of any groundwater monitoring wells to be installed, such as to verify and monitor depth to groundwater. Specify whether the wells, if any, would be retained for operational phase groundwater monitoring and/or leak detection.*			✓	

As noted in the ER, the NWMI RPF is designed to have zero liquid discharge from the radiologically controlled area. The groundwater aquifer beneath the proposed NWMI site is the Mississippian Aquifer (also referred to as the Kimmswick-Potosi Aquifer). There are no defined liquid effluent release pathways, and the groundwater is not expected to be contaminated due to operation of the RPF. Therefore, groundwater sampling was not included in the radiological environmental monitoring plan.

Shallow groundwater has been detected in two previously drilled boreholes near the NWMI RPF site. As noted in the response to GEO-1A, if encountered during boring, water will be sampled and noted during the site-specific hydrological studies. However, the NWMI RPF is designed to have zero liquid discharge from the radiologically controlled area and as such, these boreholes will not be retained for operational phase groundwater monitoring.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
GEO-1C	*Provide the following references as cited in the ER for docketing:* *1.) Terracon, 2011a, Phase I Environmental Site Assessment Discovery Ridge Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18, Terracon Consultants, Inc., prepared for University of Missouri and Trabue, Hansen & Hinshaw, Inc., Terracon Project No. 09117701, March 23, 2011 (cited in ER Section 19.3.4.3.1).* *2.) Terracon, 2011b, Preliminary Geotechnical Engineering Report Discovery Ridge–Certified Site Program Lots 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18, Terracon Consultants, Inc., prepared for University of Missouri and Trabue, Hansen & Hinshaw, Inc., Terracon Project No. 09105094.1, February 11, 2011 (cited in ER Section 19.3.3.8.1)*	✓			

Reference documents are attached in Appendix H and K, respectively.

GEO-2	*Section 19.2.3 of the ER indicates that the depth of the processing hot cell below grade, without footers, is 4.6 m (15 ft). Section 19.4.3.1 of the ER states that the maximum depth of excavation is anticipated to be 15.5 ft. below ground surface, presumably for the hot-cells, waste storage areas, and transfer tunnel as referenced in the ER. Confirm that this excavation depth is still bounded by the facility design and include relevant information on the thickness and material of construction of the outer walls and basement floor of the below ground portions of the RPF in support of your response.*			✓	

Section 19.2.3 describes the baseline depth below finished grade of the tank skid hot cell and the high-integrity container (HIC) vault. The top of finished concrete for these two deepest areas within the RPF is 4.6 m (15 ft). This depth is in reference to the finished grade, not to the existing site surface.

The baseline composition of the floors for these two rooms is a reinforced concrete mat slab, nominally 45 to 60 cm (18 to 24 in) thick. The room walls will be reinforced concrete, ranging in thickness from 61 to 122 cm (24 to 48 in), based on the structural loading and shielding requirements for each section. The nominal depth of excavation beyond the slab will vary based on the results of the geotechnical survey and the requirements of the structural design. The over-excavation typically ranges from 15 to 30 millimeters (mm) (6 to 12 inches [in.]) to 1.5 to 1.8 m (5 to 6 ft), based on these factors. The over-excavation will be minimized. If the existing site surface is close to the site finished grade in the area of these two rooms, the maximum excavation depth could range from 5.2 to 7.0 m (17 to 23 ft).

Section 19.4.3.1, referenced excavation calculation uses the nominal finished site elevation to determine excavation volumes. The calculation then adds 37 percent to address uncertainties then rounds that total up another 3 percent to reach the 6,881 m^3 (9,000 cubic yards [yd^3]) total used in Section 19.4.3.1. The excavation depth and total volume remain reasonable bounding conditions.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Historic and Cultural Resources				
HC-1	*Identify whether the applicant has prepared a Cultural Resource Management Plan, and/or any procedures that would be followed in the event that human remains or other items of historic or cultural value are inadvertently discovered during construction, operation, and decommissioning of the facility.*			✓	

NWMI has not prepared a Cultural Resource Management Plan. A Cultural Resource Management Plan will be prepared prior to initiating construction of the facility and will be submitted to the Missouri State Historic Preservation Office.

HC-2	*Provide information on whether the proposed RPF would be visible from any surrounding National Register of Historic Places (NHRP)-listed or-eligible historic properties.*			✓	

Based on the visual impact analysis in Section 19.4.1.2.1, the RPF stack could potentially be visible at the David Gordon House and Collins Log Cabin, and the Maplewood House NHRP properties.

HC-3	*Section 19.3.6.8 of the ER indicates that the applicant initiated consultation with the Missouri SHPO and six Federally-recognized tribes in 2013, and indicates in Section 19.4.6 that the Missouri SHPO has reviewed and concurred with the findings of the Phase I archaeological survey. Provide copies of any letters or communications, to and from the Missouri SHPO, Federally-recognized Indian tribes that may have ancestral or historical ties to the project area, or local historical societies that have occurred subsequent to those discussed in the ER.*			✓	

There have been no additional communications to or from the Missouri State Historic Preservation Office (SHPO), Federally recognized Indian tribes, or historical societies subsequent to those discussed in the ER.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Human Health – Non-Radiological				
HH-NR-1	*The ISG augmenting NUREG-1537, Part 1, Section 19.1.2 "Regulatory Provisions, Permits, and Requires Consultations," states that applicable federal, state, local, and other regulatory requirements should be summarized. Provide a list of reporting requirements for non-radioactive waste streams to EPA and MDNR as discussed in Section 19.3.8.3 of the ER.*			✓	

Table 19-4 in the ER provides a listing of the applicable Federal, State, local, and other regulatory requirements. The table notes that NWMI is required to notify the U.S. Environmental Protection Agency (EPA) of any Resource Conservation and Recovery Act (RCRA) (42 U.S.C. § 6901 et seq.), Subtitle C, activity and any spill prevention, control, and countermeasures for storage of oil, if required. As a small quantity hazardous waste generator, NWMI will be required to prepare a Notification of Hazardous Waste Activity form to obtain both a Missouri generator identification number and a Federal (EPA) generator identification number. NWMI would be required to submit a Generator's Hazardous Waste Summary Report Form to MDNR annually.

There are no specific reporting requirements associated with the use of weed killer and fertilizer on or near the site noted in Section 19.3.8.3. The statement "Nonradioactive liquid, gaseous, and solid waste effluents from facilities within the Discovery Ridge development are required to report hazardous effluents to the MDNR and the EPA," is not applicable to the section and has been removed.

HH-NR-2	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.10, "Human Health" states that the ER should provide an assessment of the physical occupational hazards. Provide a copy of the plant procedure that workers would use for identifying industrial hazards prior to performance of jobs*		✓		

The plant procedures for identifying industrial hazards prior to performance of jobs have not yet been developed. The procedures will be developed and included in the Operating Permit Application.

HH-NR-3	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.9, "Waste Management," states that the ER should provide a description of the proposed waste management systems designed to collect, store, and process waste. Provide a copy of the recycling and reuse plan discussed in Section 19.4.8.1.2.4 of the ER.*		✓		

The recycling and reuse plan has not yet been developed. This plan will be developed and included in the Operating Permit Application.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Human Health – Radiological				
HH-R-1	*The ISG augmenting NUREG-1537, Part 1, Section 19.3.8, "Human Health," states that the ER should provide effluent release points and expected radioactive effluent releases and exposures from construction, operational, and decommissioning activities. Baseline radiation levels for the general area are discussed in 19.3.8 of the ER, and consist of reports from reactors like MURR and Callaway Plant, Unit 1. Since it is stated in 19.4.8.2 of the ER that there is possibility that the RPF will release gaseous and liquid radionuclides into the environment, current radiation levels are important to quantify. Clarify if any baseline monitoring will be performed at the RPF, and how effluent releases will be monitored/mitigated during construction, operations, and decommissioning.*			✓	

A radiological survey will be conducted before startup of the RPF to provide a baseline. The operational radiological monitoring program discussed in Section 19.4.8.4 will provide the baseline for decommissioning. There are no plans to conduct a radiological baseline survey for construction activities.

Additional information on the NWMI's Radiological Monitoring Program is provided in the Part 2 Construction Permit Application, Chapter 11, "Radiation Protection and Waste Management."

HH-R-2	*The ISG augmenting NUREG-1537, Part 1, Section 19.3.8, "Human Health," states that the ER should provide a description of the facility's radiological programs and systems. Provide description of the program(s) for radiological worker protection and monitoring necessary to comply with 10 CFR Part 20.*			✓	

The radiological worker protection and monitoring program that complies with 10 CFR 20 is described in NWMI's Part 2 Construction Permit Application, Chapter 11.0, "Radiation Protection and Waste Management."

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Land Use				
LAN-1	*Table 19-15 of the ER describes U.S. Geological Survey (USGS) land use categories for the 8 km (5-mi) region of influence surrounding the proposed RPF. Describe the current land uses on site as defined by USGS.*			✓	

The current land use of NWMI's RPF site as defined by U.S. Geological Survey (USGS) is pasture/hay.

LAN-2	*Section 19.3.1.2.3 of the ER states that the site has an L sensitivity rating, as an area with low scenic values resulting from a low sensitivity to changes in visual quality by the type of users in the area, a low amount of use by viewers, low public interest in changes to the visual quality of the site, and a lack of special natural and wilderness areas. Provide the technical justification for this rating.*			✓	

The scenic quality of the proposed site was rated using the Bureau of Land Management (BLM) Visual Resource Management System (H-8410-1, *Visual Resource Inventory Manual*). The sensitivity level, a measurement of the public concern for scenic quality, is rated on a high (H), moderate (M), or low (L) scale. The sensitivity level was analyzed using six different indicators of public concern: types of users, amount of use, public interest, adjacent land uses, special areas, and the results of a potential viewability analysis from seven vantage points. Even though the facility is potentially viewable to different publics from all seven points, the analysis does not consider screening effects. At both near and far distances, a potentially viewable facility could easily be screened from view by intervening vegetation, structures, and topographic features. The analysis also does not consider time. A high number of viewers travel on the highway and roads near the proposed facility. The public may view the facility, but only briefly while traveling to their destinations.

Although the facility could be potentially viewed by a high number of people, and may at inception be perceived as having a high effect on visual sensitivity, the area overall has a low sensitivity to changes in visual quality. This is because of the type of users in the area (e.g., workers, residents, travelers), a low amount of use by viewers (i.e., not a public destination), low public interest in changes to the visual quality of the site (another facility in an industrial park would not be unexpected), and a lack of special natural and wilderness areas. Nearby residents would most notice the RPF on the landscape, although the facility would not be considered out of character with its location and context within the research park. Over time, the facility would be assimilated as a normal component of the landscape. Taking these factors into account, the site was determined to have a low (L) sensitivity rating.

LAN-3	*Section 19.4.1.1.1 of the ER states that "construction staging activities could also occur along Discovery Drive bordering the lot and the adjacent Discovery Ridge Lot 14. Staging activities would be temporary and would cease after construction of the facility." Describe the exact locations and approximate acreage of any offsite stages areas that would be used during construction.*			✓	

MU, the owner of Discover Ridge, has given initial approval for the NWMI constructor to access the NWMI site from the adjacent lot to the east (Lot 14). This plot is adjacent to both the NWMI site and Discovery Drive. The space needed for staging activities in the adjacent lot is estimated to be 23 m (75 ft) along Discovery Drive and 46 m (150 ft) along the common lot boundary between the two lots (approximately 0.1 ha [0.26 acre]). After construction activities are complete, the affected area in the adjacent lot will be revegetated with similar species as currently found throughout Discovery Ridge. Figure 19-14 will be updated to indicate the Lot 14 laydown area.

No.	Request for additional information	Type of requested information			
		Reference	Procedure	Response	Presentation
LAN-4	*Section 19.4.1.1.1 of the ER states that "after the facility is built, landscaping would mitigate disturbances caused during construction on the lot, both exterior of the perimeter fence and from the perimeter fence to the perimeter of the building." Provide a description of landscaping activities NWMI intends to complete. For example, would open areas be covered in grasses, shrubs, or ornamental flowers. Would any native species be used for landscaping? If known, provide the approximate percentage of space that would be landscaped vs. developed.*			✓	

Consistent with Discovery Ridge master plan and covenants, the site will have earthwork berms providing visual blockage from the adjacent streets. In addition, open areas and berms will be covered with ground materials such as grasses, shrubs, and/or ornamental flowers including native species. Figure 19-7 currently shows that grasses, shrubs, and trees show a general concept for landscaping. Approximately 68 percent of the site will be developed, providing 32 percent of the site for landscaping. To date, the specific ground coverage materials have not yet selected.

LAN-5	*Describe the current zoning classification at each alternative site.*			✓	

Discovery Ridge: Discovery Ridge Discovery Ridge was developed under Section 172.273 of the Missouri Revised Statutes, which provided that "the Curators of the University of Missouri may establish research, development, and office park projects in order to promote cooperative relationships and to provide for shared resources between private individuals, companies and corporations, and the University of Missouri, for the advancement of the University in carrying out its educational mission and such projects are declared to be in furtherance of the purposes of the University."

The Discovery Ridge Master Plan and Protective Covenants (MU, 2009) is the applicable land use guidance for the research park. Discovery Ridge is zoned commercial in the A-1 district (City of Columbia, 2012b), under the Section 29-18 provision, Board of Adjustment (City of Columbia, 2012c).

The Columbia Code (Section 29-18) has height restriction for A-1 of 10.7 m (35 ft). Missouri Revised Statute, Section 172.273, exempts university research parks, including Discovery Ridge, from local land development regulations. This allows MU to develop Discovery Ridge to its own master plan and to include non-agriculture-related structures with sizes in excess of the A-1 zoning requirements, provided MU gives Columbia courtesy review of the plan and design drawings and addresses the city's comments.

MURR: The current zoning at MURR (e.g., area encompassed by the reactor) is zoned as "M-1, General Industrial" by the City of Columbia. Conditional uses are allowed under Section 29-20(c), manufacture, compounding, or processing of hazardous materials.

OSTR: The current zoning at the OSTR/OSU is zoned as "Public Institutional" on the City of Corvallis Comprehensive Plan (City of Corvallis, 2000) and "Other Designations – Oregon State University" on the City of Corvallis Official Zoning Map. The OSU Master Campus Plan also describes the university planning expectations and must be consistent with the City of Corvallis Land Development Code.

McClellan Business Park: The current zoning at McClellan Business Park is zoned as a Special Planning Area (SPA). An SPA is created for an established area when the countywide zoning regulations do not adequately address local concerns. The SPA allows uses, regulations, and standards that would not be allowed under the countywide regulations.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Noise				
NOI-1	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.2, "Air Quality and Noise," states that the ER should provide the potential impacts to sensitive receptors. Section 19.4.2.3.1 of the ER states that the impacts of noise from construction are SMALL. However Table 19-90 of the ER state that the noise impacts from construction at the Discovery ridge site would be MODERATE. Clarify the noise construction impact level and reconcile the differences concluded regarding the impact level.*			✓	

The noise impacts for the Discovery Ridge site noted in Section 19.4.2.3.1 of the ER are small. The impact in Table 19-90 was incorrectly stated. The noise impacts at Discovery Ridge site are "Small."

NOI-2	*The ISG augmenting NUREG-1537, Part 1, Section, 19.3.2, "Air Quality and Noise" states that the ER should provide a description of any current or past noise studies and analyses conducted at the proposed site or within an audible range of the site. Section 19.3.2.3.1 of the ER states that "[b]ased on the most recent peak 1-hr traffic count summary from the Missouri Department of Transportation, the expected noise levels at the proposed RPF site resulting from traffic on U.S. Highway 63 range from 54 to 58 [A-weighted decibel] dBA (MoDOT, 2009)." The source cited, MoDOT 2009, identifies the peak 1-hr traffic count, however, it does not provide information on noise levels. Provide the basis for the stated 54 to 58 dBA and/or how that noise level was obtained.*			✓	

The noise levels provided in Chapter 19.0 were calculated using noise level estimates from Table 1 of the Federal Highway Administration's (FHWA) Traffic Noise Model (TNM) 2.5 Lookup Tables. The noise values assume hard ground and no noise barrier and were used to assess existing noise levels at the proposed RPF site. Current guidance (November 2015) from the FHWA states the TNM 2.5 Lookup Tables should not be used to estimate noise levels. To incorporate the FHWA's current guidance, noise modeling for the nearest resident has been performed using the TNM 2.5 model. This information indicates the change in existing noise levels will be less than 1 A-weighted decibel (dBA).

No.	Request for additional information	Type of requested information			
		Reference	Procedure	Response	Presentation
NOI-3	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.2, "Air Quality and Noise," states that the ER should provide predicted noise levels using the dbA-weighted scale and major sources of noise, including all models, assumptions, and input data. Section states that "[t]raffic associated with the construction workforce commuting to and from the facility site also generates noise. As previously discussed, the baseline noise conditions for traffic include airports, railways, and highways. The increase in noise relative to baseline conditions is most noticeable during periods of high activity onsite and during shift changes in the morning and late afternoon." However, predicted noise levels from the additional workforce and additional deliveries and offsite shipments was not provided in the ER. Provide predicted increase in noise levels resulting from the additional commuting workforce and deliveries and offsite shipments during construction, operations, and decommissioning along U.S. Highway 63 and Discovery Drive in the vicinity of the proposed RPF site.*			✓	

The predicted change in noise levels resulting from increased workforce traffic during construction, operations, and decommissioning have been modeled using FHWA TNM 2.5. Peak traffic counts were used to assess baseline noise conditions at the nearest residence. Noise levels resulting from the addition of 100 vehicles traveling 112.7 km/hr (70 mi/hr) on Highway 63 during peak traffic times were modeled to determine the potential increase over baseline conditions. Based on modeled results, an increase of less than 1 dBA is anticipated due to the increase in traffic from the workforce.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Proposed Action				
PA-1A	*Section 19.2 of the ER discusses the activities and schedule if the pre-operation phase. Clarify if the impacts of the pre-operational phase were considered within the construction phase or the operations phase impacts described in Section 19.4 of the ER.*			✓	

The impacts associated with the preoperational phase were considered within the operating phase of the RPF.

PA-1B	*Section 19.2.1 of the ER states the nominal operational processing capacity of the RPF would be one batch per week (up to 12 targets per batch) for up to 52 weeks, and approximately 30 targets from the OSTR or a third university reactor for eight weeks per year per reactor. The discussion further states that the assumed bounding scenario would be a total of 68 batches of irradiated LEU targets processed at the RPF annually. For the bounding scenario, clarify:* *1.) The estimated number of targets per batch, batches per week, and batches per year that would be separately processed from the OSTR and the third reactor, respectively.* *2.) The estimated annual number of targets to be fabricated, irradiated, and processed at the RPF.*			✓	

The estimated number of LEU targets that can be irradiated (e.g., per batch) at the OSTR or hypothetical third reactor is one batch per week with a maximum of 30 LEU targets/batch. Each reactor can irradiate up to eight batches per year for a total of 16 batches annually.

The RPF has been designed to fabricate a maximum of 20 LEU targets per week or 1040 targets annually to support irradiation at NWMI's network of University research reactors. The RPF does not irradiate LEU targets. The RPF has the capacity to process up to 900 irradiated LEU targets for ^{99}Mo production.

PA-2	*Section 19.2.1.1 of the ER states that the start date of site preparation/construction would be the first quarter of 2016 and an end date of construction of first 2017, which would result in a maximum construction phase of 15 months. However, Section 19.4.2.1.1.4 of the ER references an estimated construction period spanning 17 months. Clarify the construction duration phase and/or the difference in construction duration presented in Section 19.2.1.1 and Section 19.4.2.1.1.4 of the ER.*			✓	

The construction phase for the RPF is estimated to be 17 months; the end date of construction is estimated to be the end of third quarter 2017 (calendar year).

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
PA-3	*Section 19.2.1.2 of the ER states that 100% of the 3.0 hectare (7.4 acre) site would be permanently affected. Differentiate between the total estimated amount of land that would be temporarily affected by construction activities (e.g., land clearing, material and equipment lay-down areas) versus the amount that would be permanently affected by operational activities (e.g., building and support facility footprints, paved vehicle access and parking areas).*			✓	

100 percent of the site would be temporarily affected by construction activities. In addition, approximately 0.1 ha (0.26 acres) of the adjacent site to the east (Lot 14) would be temporarily affected to support construction activities. The response to LAN-3 provides additional information.

Approximately 68 percent of NWMI's RPF site will be permanently affected by operations activities. The remaining 32 percent of the site will be revegetated or landscaped. The responses to LAN-3 and LAN-4 provide additional information.

PA-4	*Section 19.2.1.3, Table 19-6 of the ER lists shipments by project phase to include delivery trucks and offsite radioactive materials and waste shipments. Section 19.2.8.2.2, Table 19-14 of the ER presents a different set of shipment information. Clarify the relationship of the values presented in Tables 19-6 and 19-14, specifically:* *A.) Whether the estimated delivery trucks listed in Table 19-6 during operation account for fresh LEU and irradiated target shipments identified in Table 19-14 of the ER, and* *B.) Whether the estimated offsite shipments identified in Table 19-6 during operation account for the unirradiated targets, ^{99}Mo product, spent LEU, and radioactive waste shipments during operation identified in Table 19-14 of the ER.*			✓	

The "delivery trucks" row of Table 19-6 does not include radioactive shipments. The LEU and irradiated LEU targets shipments (etc.) identified in Table 19-14 are included in the "Offsite radioactive materials and waste shipment" row of Table 19-6. In addition, the "Offsite radioactive materials and waste shipment" row includes unirradiated LEU targets, ^{99}Mo shipments, and radioactive waste shipments.

PA-5	*Section 19.2.2.3 of the ER indicates that the proposed RPF site would be connected to local power, sewer, and water infrastructure. Provide estimated annual sanitary sewer, electrical power, municipal water, and natural gas requirements required to support each phase of the project.*			✓	

The estimated annual sanitary sewer, electrical power, municipal water, and natural gas requirements are provided below.

Construction

- Municipal water usage (provided in Section 19.4.7.3): 23,242 liters (L)/day (6,140 gal/day).
- Sanitary sewer usage is estimated at zero; portable units will be provided.
- Electrical power usage is not provided in the Construction Permit Application. An estimated 600 amp (A) 480 VAC service for a site crane and a dedicated 500 kilovolt-amp (kVA) 208/120 VAC service are anticipated to be needed for the RPF construction.
- Natural gas usage is estimated at zero.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation

Pre-Operations Phase

- Pre-operations is assumed to be three months at operations phase estimates.

Operations Phase

- Municipal water usage includes the process water and sanitary needs.
  - Process water (provided in Section 19.2.4.1, Table 19-11): 890,910 L/year (235,360 gal/year)
  - Sanitary water: 4,073,000 L/year (1,076,000 gal/year) for a total of 4,964,000 L/year (1,311,000 gal/year)

  Total municipal water usage: 4,964,000 L/year (1,311,000 gal/year). (The WAT-1 response provides a detailed analysis of the municipal water usage.)
- Electrical power usage (provided in Section 19.4.7.3): approximately 10 megawatt (MW) annually.
- Natural gas usage (provided in EDF-3124-0008, *Emissions from Natural Gas-Fired Boiler Operation*): 5,880 L/min (12,460 CF/hr) for each of the four boilers that run simultaneously (two heating boilers and two process steam boilers), when running at their peak output.

Decommissioning

- Municipal water usage during decommissioning is not estimated in the Construction Permit Application. Water usage is estimated as being similar to the construction phase (provided in Section 19.4.7.3): 7,571 L/day (2,000 gal/day).
- Sanitary sewer usage is estimated at zero; portable units will be provided.
- Electrical power usage is not provided in the Construction Permit Application. An estimated 600 A 480 VAC service for a site crane and a dedicated 500 kVA 208/120 VAC service are anticipated to be needed for the RPF construction.
- Natural gas usage is estimated at zero.

PA-6	*Section 19.2.5.2 of the ER indicates that the RPF would use three electric boilers. Clarify how these boilers relate to the four natural gas boilers discussed in Section 19.4.2.1.2.4.*	✓

The RPF has two sets of boilers: one set of three boilers for the heating, ventilation, and air conditioning (HVAC) system, and the second set of two boilers for process steam. The three heating boilers are sized such that only two are operating and one is a spare. The process steam boilers are sized such that one operates and the other is a spare. All five boilers are natural gas-fired; however, only three would be expected to be operating at any one time (two heating and one process steam boiler).

The air quality impacts from operation, Section 19.4.2.1.2, evaluate operation of four natural gas-fired boilers to bound emissions from boiler operation.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Purpose and Need				
PN-1A	*In Section 19.2 of the environmental report, NWMI summarized the status of all applicable Federal, state, local, and other regulatory requirements, permits, and consultations that would be required. For the permits identified in Table 19-4 of the environmental report, provide a timeline or status update for when NWMI expects to apply for and receive the permits. If relevant, provide a specific regulatory or other milestone on which a given permit may be dependent upon.*			✓	

The required State and local Missouri permits described in Table 19-4 are accurate. The approximate dates for submittal of these permits are listed below.

Table 19-4. Regulatory Compliance Status (6 pages)

Agency	Regulatory authority[a]	Permit or approval	Activity covered	Status
	Federal			
U.S Nuclear Regulatory Commission	Atomic Energy Act 10 CFR 50.50	Construction Permit	RPF construction	Addressed in Construction Permit Application
	10 CFR 50.57	Operating License	RPF operation	To be addressed in operation license application
	10 CFR 30	By-Product Material License	Production, possession, and transfer of radioactive by-product material	To be addressed in license application
	10 CFR 70	Special Nuclear Materials License	Receipt, possession, use, and transfer of special nuclear material	To be addressed in license application
	National Environmental Policy Act 10 CFR 51	Environmental assessment or environmental impact statement	Site approval for RPF construction and operation	Addressed in this Construction Permit Application
U.S. Army Corp of Engineers	Clean Water Act 33 CFR 323	Dredge and Fill Permit (Section 404)	Discharges of dredged or fill material into U.S. waters	Not required

Table 19-4. Regulatory Compliance Status (6 pages)

Agency	Regulatory authority[a]	Permit or approval	Activity covered	Status
U.S. Environmental Protection Agency	Resource Conservation and Recovery Act 40 CFR 262	Notification of RCRA Subtitle C activity	EPA identification number for generation of hazardous waste	Notification to be submitted 60 days prior to construction Estimated submission date: 4/1/2016 Estimated receipt date: 7/15/2016
	Clean Water Act 40 CFR 112, Subpart D, Appendix F	SPCC plans for construction and operation[b]	Storage of oil during construction and operation	SPCC plans to be submitted 30 days prior to construction Estimated submission date: 5/1/2016 Estimated receipt date: No approval required
U.S. Department of Transportation	Hazardous Materials Transportation Act 49 CFR 107	Certificate of Registration	Transport of hazardous materials	Registration to be filed no later than June 30 of the calendar year or prior to offering hazardous materials for transport Estimated submission date: 6/30/2016 Estimated receipt date: 1/30/2017
State				
Missouri Department of Natural Resources	Federal Clean Air Act Missouri Revised Statute Chapter 643 10 CSR Division 10	Construction Permit	Construction of an air emissions source	Not required Verification 2/28/2016
		Part 70 Operating Permit	Operation of an air pollution emission source that has potential emissions exceeding 100 tons/yr of criterion pollutants	Not required Verification 2/28/2016
		Intermediate Operating Permit	Operation of an air pollution emission source that has the potential to emit is above major threshold, but a voluntary limits of operation is requested	Not required
		Basic State Operating Permit	Operation of an air pollution emission source that has the potential to emit is between *de minimis* and major levels	Not required

Table 19-4. Regulatory Compliance Status (6 pages)

Agency	Regulatory authority[a]	Permit or approval	Activity covered	Status
Missouri Department of Natural Resources (continued)	Clean Water Act Missouri Revised Statute Chapters 640 and 644 10 CSR Division 20	NPDES Construction Stormwater Permit	Land disturbance and discharge of stormwater from the construction site	Applications for general permits (Forms E and G) to be submitted 30 days prior to construction Estimated submission date: 5/1/2016 Estimated receipt date: 7/15/2016
		NPDES Industrial Stormwater Permit	Discharge of stormwater from the industrial site during operations	Permit to be submitted one year prior to operation Estimated submission date: 5/1/2016 Estimated receipt date: 5/1/2017
		Section 401 Water Quality Certification	Certifies that the Section 404 permitted activity complies with all applicable State water quality standards, limitations, and restrictions	Not required Request for a waiver: 12/30/2015 Estimated receipt date: 2/28/2016
	Resource Conservation and Recovery Act Missouri Revised Statute Chapter 260 10 CSR Division 25	Notification of Regulated Activity	Obtain Missouri identification number for generation of hazardous waste	Registration to be filed 90 days prior to generating hazardous waste Estimated submission date: 6/1/2017 Estimated receipt date: 10/1/2017
		Certified Resource Recovery Facility Application	Reuse, reclamation, or recycling 1,000 kg (2,204.6 lb) or more of site-generated hazardous waste in a month	Application to be submitted 90 days prior to operations Estimated submission date: 6/1/2017 Estimated receipt date: 10/1/2017
		Notification to MDNR of Conditional Exemption	Notify MDNR in writing and by certified delivery of the claim of a conditional exemption for LLMW stored and treated in the facility	Notification to be submitted 90 days prior to operations Estimated submission date: 2/1/2017 Estimated receipt date: 5/1/2017
		Hazardous Waste Permit	Treatment, storage or disposal of hazardous waste	Not required

Table 19-4. Regulatory Compliance Status (6 pages)

Agency	Regulatory authority[a]	Permit or approval	Activity covered	Status
Missouri Department of Health and Senior Services	Atomic Energy Act Missouri Revised Statute Chapter 192 19 CSR Division 20	Registration of sources of ionizing radiation	Protection against ionizing radiation	Radioactive sources will be managed under the NRC license and are excluded from Missouri regulation
Boone County				
Boone County Resource Management Department	Clean Water Act Missouri Revised Statute, Chapter 64 Boone County Stormwater Ordinance	Stormwater Discharge Permit	Stormwater management	Application to be submitted 30 days prior to construction Estimated submission date: 5/1/2016 Estimated receipt date: 7/15/2016
		Land Disturbance Permit	Activity disturbing 0.4 ha (1 acre) or more of land or disturbing 278.7 m^2 (3,000 ft^2) in environmentally sensitive areas	Application to be submitted 30 days prior to construction Estimated submission date: 5/1/2016 Estimated receipt date: 7/15/2016
	Missouri Revised Statute, Chapter 64 Boone County Zoning Regulations	Application for Commercial Building Permit	Construction of a commercial building	Application to be submitted 30 days prior to construction Estimated submission date: 5/1/2016 Estimated receipt date: 7/15/2016
Boone County Regional Sewer District	Clean Water Act Missouri Revised Statute Chapter 250 Chapter 2 of Boone County Sanitary Sewer Use Regulations	Sanitary sewer connection approval	Building connection to District wastewater treatment works	Required information to be submitted 30 days prior to construction Estimated submission date: 5/1/2016 Estimated receipt date: 7/15/2016
City of Columbia				
City of Columbia	Clean Water Act 10 CSR Division 60 Part II City of Columbia Code of Ordinances, Chapter 27	Application for utility service	Allows RPF to connect to Columbia Water Treatment Plant	Application to be submitted 30 days prior to construction Estimated submission date: 5/1/2016 Estimated receipt date: 7/15/2016

Table 19-4. Regulatory Compliance Status (6 pages)

Agency	Regulatory authority[a]	Permit or approval	Activity covered	Status
City of Columbia (continued)	Part II City of Columbia Code of Ordinances Chapter 6, Article II	Building Permit	Approval of building code and standards, including site plan	Application to be submitted 60 days prior to construction Estimated submission date: 4/1/2016 Estimated receipt date: 7/15/2016
	Part II City of Columbia Code of Ordinances Chapter 6, Article III	Electrical plan approval	Electrical Code	Information to be submitted 60 days prior to construction Estimated submission date: 4/1/2016 Estimated receipt date: 7/15/2016
	Part II City of Columbia Code of Ordinances Chapter 6, Article IV	Plumbing plan approval	Plumbing Code	Information to be submitted 60 days prior to construction Estimated submission date: 4/1/2016 Estimated receipt date: 7/15/2016
	Part II Code of Ordinances Chapter 6, Article V	HVAC plan approval	Mechanical Code	Information to be submitted 60 days prior to construction Estimated submission date: 4/1/2016 Estimated receipt date: 7/15/2016
	Part II City of Columbia Code of Ordinances Chapter 6	Certificate of Occupancy	Facilities meeting Building Code	Information to be submitted on completion of construction Estimated submission date: 9/30/2017 Estimated receipt date: 10/1/2017
	Part II City of Columbia Code of Ordinances Chapter 27, Article II	Fire Prevention Plan Approval	Fire Code	Information to be submitted 60 days prior to construction Estimated submission date: 4/1/2016 Estimated receipt date: 6715/2016

Table 19-4. Regulatory Compliance Status (6 pages)

Agency	Regulatory authority[a]	Permit or approval	Activity covered	Status
City of Columbia (continued)	Part II City of Columbia Code of Ordinances Chapter 12A, Article II	Land Disturbances Permit	Land disturbance activity, including construction on any site that results in a disturbed area of 1 acre or more.	Application to be submitted 30 days prior to construction Estimated submission date: 6/1/2016 Estimated receipt date: 7/15/2016
	Part II City of Columbia Code of Ordinances Chapter 12A, Article V	Stormwater Management Plan Approval	Approval required prior to approval for Land Disturbance Permit	Information to be submitted 45 days prior to construction Estimated submission date: 5/15/2016 Estimated receipt date: 7/15/2016

[a] Full references are provided in Section 19.7.

[b] Only required when oil is stored in a tank or shell with a capacity over 1,320 gal, and the oil could reasonably reach navigable water.

CFR = Code of Federal Regulations.
CSR = Code of State Regulations.
EPA = U.S. Environmental Protection Agency.
HVAC = heating, ventilation, and air conditioning.
LLMW = low-level mixed waste.
MDNR = Missouri Department of Natural Resources.
NPDES = National Pollutant Discharge Elimination System.
NRC = U.S. Nuclear Regulatory Commission.
RCRA = Resource Conservation and Recovery Act.
RPF = radioisotope production facility.
SPCC = spill prevention, control, and countermeasure.
U.S. = United States.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
PN-1B	*In accordance with Section 401 of the Federal Water Pollution Control Act (i.e., Clean Water Act (CWA)) (33 U.S.C. 1251 et seq.), a Federal agency cannot issue a permit or license for any activity that may result in a discharge to navigable waters of the United States until the state or tribe where the discharge would originate has granted or waived certification that the potential discharge will comply with applicable water quality standards. CWA Section 401(a)(1) specifies that the applicant for the Federal license or permit is responsible for providing the Federal licensing or permitting agency the certification or a waiver from the state in which the discharge originates. As appropriate, the state could also provide the applicant with documentation that no separate 401 certification is required.* *Section 401 requirements are cited under Section 19.1.2 of the ER and in Table 19-4, and Section 19.1.2.5.1.2 of the ER further states that "the construction, operation, and decommissioning of the RPF is not anticipated to need a Federal Section 404 permit or Section 401 certification...." Clarify whether the state of Missouri will require a separate CWA Section 401 certification for NRC-licensed construction and operation of the RPF. Indicate the applicant's plans, and associated timeframe, for providing the NRC with required CWA Section 401 documentation from the state of Missouri*			✓	

NWMI made the determination that a Section 404 or Section 401 certification is not required for construction and operation. NMWI anticipates contacting MDNR for a formal waiver from the state by March 2016.

PN-2	*The ISG augmenting NUREG-1537, Part 1, Section 19.2, "Proposed Action," states that the applicant should provide a description of the operational activities. Clarify if the NWMI facility would produce molybdenum (Mo-99), iodine-131 (I-131) and xenon-133 (Xe-133).*			✓	

The RPF has only been designed to produce ^{99}Mo. No iodine-131 (^{131}I) or xeonon-133 (^{133}Xe) will be separated as a product. The ALT-4 response provides additional information.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Socioeconomics				
SOC-1A	*Section 19.4.7.1.2 of the ER indicates "89 (non-management) permanent operations workers needed are available in the ROI." The next sentence states, "About 40 percent (36) of the operations workers and their families are assumed to relocate to reside in the ROI." These statements appear to be in conflict. There is also no discussion about the number of permanent management operations workers. In addition, Table 19-6 of the ER lists an average and peak operation workforce of 98. Clarify these statements and reconcile the differences.*			✓	

The wording in Section 19.4.7.1.2 will be modified to read "Although the required workers are located within the region of influence (ROI), many are assumed to currently be fully employed, and 40 percent (36) of the operations workers and 40 percent (4) of the management positions and their families are assumed to relocate from outside the ROI to reside in the ROI. Using the ROI average of 2.4 individuals per household, the total population increase in the various communities within the ROI due to operational workforce requirements is 96 people."

A revised Table 19-66 is provided below.

Table 19-66. Workforce Required for Operations

Occupation	Available in Columbia Area[a]	Required for Radioisotope Production Facility	Excess/ (deficient)
Technical support[b]	1,140	30	1,110
Production workers	170	43	127
Management[c]	290	9	281
Production worker support	280	16	264

[a] BLS, 2012, "May 2012 Metropolitan and Nonmetropolitan Area Occupational Employment and Wage Estimates," www.bls.gov/oes/current/oessrcma.htm, U.S. Bureau of Labor Statistics, Washington, D.C., accessed September 2013.
[b] Includes all architecture and engineering occupations.
[c] Includes architectural and engineering managers, and medical and health services managers.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Socioeconomics (continued)				
SOC-1B	*Section 19.4.7.1.3 of the ER states that during peak construction, an estimated 81 workers would be required for decommissioning. However, Table 19-6 of the ER lists a peak workforce of 28. Reconcile the differences in workforce numbers discussed in Section 19.4.7.1.3 and Table 19-6 during decommissioning.*			✓	

Table 19-6 is revised and provided below to reflect a peak workforce of 81 and an average workforce of 38 anticipated during decommissioning. The responses to AIR-1B, AIR-1C, and AIR-1D provide additional information.

Table 19-6. Resources Required During Radioisotope Production Facility Phases

Resource	Construction	Pre-operation	Operation	Decommissioning
Average workforce	38	21	98	38
Peak workforce	82	98	98	[a]81
Delivery trucks (per week)	20	2	4	1
Offsite radioactive materials and waste shipments (per week)	1	0.5	10	20
Fuel (diesel), L/month (gal/month)	[b]1,647 (435)	[c]189 (50)	[c]189 (50)	1,647 (435)
Low enriched uranium kg/year (lb/year)	0	[d]416 (917)	50 (110) [e]170 (375) [f]170 (375)	0

[a] The peak number of deliveries during construction is estimated at 30 vehicles.
[b] The majority of the diesel fuel is consumed during the first three months of construction.
[c] Diesel fuel is used for backup generator.
[d] LEU needed for hot commissioning and initial RPF startup.
[e] LEU needed in Operation Year 3 for addition of second university reactor.
[f] LEU needed in Operation Year 5 for addition of third university reactor.

LEU = low-enriched waste.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Socioeconomics (continued)				
SOC-2A	*Section 19.4.7.6.1 of the ER states that during peak construction, traffic volume is estimated to be 30 heavy vehicles (dump truck and deliveries) and 82 vehicles (pickup trucks and cars) daily. However, Table 19-6 of the ER lists 20 delivery trucks (per week) and 1 offsite material waste and shipment per week. Reconcile the differences in traffic volume discussed in Section 19.4.7.6.1 and shipments identified in Table 19-during construction.*			✓	

The delivery trucks noted in Table 19-6 are assumed to be an average number delivery trucks per week. A footnote was added to Table 19-6 noting "[a] The peak number of deliveries during construction is estimated at 30 vehicles." The revised Table 19-6 is provided in the SOC-1B response. Additional information is provided in the SOC-1B, AIR-1B, AIR-1C, and AIR-1D responses.

SOC-2B	*Section 19.4.7.6.3 of the ER states that there are an estimated 30 heavy vehicles (waste trucks) and 81 vehicles (pickup and cars) traveling to and from the site daily during the decommissioning phase. However, Table 19-6 of the ER lists 20 waste shipments per week and a peak workforce of 15. Reconcile the differences in traffic volume discussed in Section 19.4.7.6.3 and shipments and workforce identified in Table 19-6 during decommissioning.*			✓	

The peak number of waste trucks is an estimated at 20. Section 19.4.7.6.3 will be changed to reflect a peak of 20 heavy vehicles. Per SOC-1B, the peak number of workers is revised to 81 during decommissioning. Additional information is provided in the SOC-1B, AIR-1B, AIR-1C, and AIR-1Dresponses.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
Storage, Treatment and Transportation of Nonradioactive Materials					
STT-NR-1	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.9, "Waste Management," states that the ER should provide anticipated disposal plans for the waste and a description of waste- minimization plans to reduce or minimize generation of waste. Provide copies of the chemical management plan and product handling plan discussed in Section 19.2.8.1.1 of the ER.*		✓		

The chemical management and product handling plans have not yet been developed. These plans will be developed and included in the Operating Permit Application.

STT-NR-2A	*Clarify whether Section 19.2.8.1.2 applies to the treatment and temporary storage of non-radioactive wastes. The preamble sentence of the section refers only to radioactive and mixed wastes.*			✓	

The first sentence of Section 19.2.8.1.2 was changed to read: "Treatment and temporary storage of hazardous, radioactive, and mixed wastes are performed predominantly onsite within the RPF." A new bulleted item was added that states: "Nonradioactive hazardous wastes are accumulated in satellite accumulation areas or less-than 90-day accumulation areas, prior to on-site treatment and packaging."

STT-NR-2B	*Discuss the processes intended to manage transportation of non-radioactive materials and wastes.*			✓	

The transportation of nonradioactive materials and waste are governed by the U.S. Department of Transportation (DOT) regulations cited within Section 19.2.8.2, "Transportation of Material." For clarification, the first sentence of the section was changed to read: "The transport of radioactive and nonradioactive materials, waste, and other hazardous materials associated with the RPF must comply with applicable U.S. Nuclear Regulatory Commission (NRC) and DOT regulations."

STT-NR-3	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.10, "Transportation" states that the ER should provide estimated transportation distance from the originating site to the projected destination of non-radioactive waste. Section 19.4.10.1.6 of the ER states that a non-radioactive waste recycling drop-off point is located approximately 4 miles from the RPP. Clarify that statement. Will NWMI be transporting non-radioactive recyclables to that drop off point or will the waste broker pick up the recyclables at the RPF?*			✓	

The Civic Recycling Center is located at 3300 Brown Station Rd, Columbia, Missouri. NWMI has not yet determined if a recycling contract will be used to collect recyclables or if NWMI will deliver recyclables to the recycling center.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Waste Management – Nonradiological				
WM-NR-1A	*Provide the chemical composition of the waste streams listed in Tables 19-12 and 19-13 of the ER.*			✓	

The composition of waste streams was compiled from the MURR and OSTR mass balance worksheets (NWMI-2013-CALC-002, *Overall Summary Material Balance – OSU Target Batch*, and NWMI-2013-CALC-006, *Overall Summary Material Balance – MURR Target Batch*) and are provided in the following table for reference.

Waste Stream Chemical Compositions

Process	Liquid waste streams: Target fabrication	Target disassembly and dissolution	Mo recovery and purification	U recovery and recycle	Solidified waste streams: Solid waste encapsulated	High-dose solidified liquids	Low-dose solidified liquids
	Concentration, kg/L						
Al					6.79E-02		
$Fe(SO_3NH_2)_2$				1.13E-12		1.12E-03	1.13E-08
Grout					1.73E+00		
HNO_3		2.50E-03	8.40E-03	5.84E-03	4.27E-05	1.89E-32	
H_2O	9.72E-01	9.52E-01	9.84E-01	9.97E-01	7.02E-04	5.78E-01	7.81E-01
H_3PO_4			1.34E-03	0.00E+00		2.82E-05	2.81E-10
HSO_3NH_2				8.85E-13		8.74E-04	8.82E-09
NH_4NO_3							7.29E-03
$NaNO_2$		4.66E-02	3.14E-02			1.58E-03	1.58E-08
$NaNO_3$		6.73E-02	5.99E-06			5.58E-01	3.60E-02
NaOH		9.45E-03	4.49E-05				
NaH_2PO_4			1.49E-02			3.13E-04	3.12E-09
Na_2SO_3		1.89E-03				3.72E-05	3.73E-10
Na_2SO_4		1.44E-03				2.83E-05	2.84E-10
UO_2	7.79E-06	2.83E-07	6.49E-10	0.00E+00	1.85E-03	4.15E-07	1.06E-06
$UO_2(NO_3)_2$	9.34E-11	8.07E-05	1.85E-05	4.57E-08	1.78E-04	4.31E-06	2.54E-07
Sorbent						3.00E-01	3.00E-01

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Waste Management – Nonradiological (continued)				
WM-NR-1B	*Provide the anticipated mass (in a unit applicable to solid material) of the waste streams listed in Table 19-13 of the ER.*			✓	

The anticipated mass of the waste streams is provided below in Table 19-13.

Table 19-13. Solid Waste Produced at the Radioisotope Production Facility

Process	Components	Annual waste: Volume	Mass
Target fabrication	NA[a]	NA	NA
Target disassembly and dissolution[b]	Target cladding materials from disassembly	1,100 L (290 gal)	1,700 kg (3,748 lb)
Mo recovery and purification[b]	Exchange resins and other solid waste	20 L (5 gal)	34 kg (75 lb)
Uranium recovery and recycle[a,b]	Exchange resin and media	~1,350 L (~360 gal)	530 kg (1,169 lb)
Waste management[c]	Solid wastes encapsulated in cement	8,000 L (2,113 gal)	15,000 kg (33,069 lb)
	High-dose solidified liquids	200,000 L (52,834 gal)	300,000 kg (661,380 lb)
	Low-dose solidified liquids	150,000 L (39,625 gal)	225,000 kg (496,035 lb)
Laboratory facilities	Municipal waste (e.g., chemicals) Potentially contaminated laboratory waste (e.g., sample vials and containers)	4,000 L (1,056 gal)	[d]760 kg (1,675 lb)
Facility support	Municipal waste (e.g., paper)	26,000 L (6,868 gal)	[e]4,056 kg (8,942 lb)
	Potentially contaminated waste (e.g., decontamination materials, PPE)	40,000 L (10,566 gal)	[e]6,240 kg (13,757 lb)

[a] Solid waste generated during target fabrication is anticipated to be decontaminated and free-released.

[b] Transferred to waste processing system for final disposition.

[c] The waste quantities current bounding estimates. Optimization of waste processing should reduce the volume of liquid waste generation.

[d] Based density of whole glass (uncompacted) municipal waste of 550 lb/yd^3 (or 0.19 kg/L), Mississippi Department of Environmental Quality (http://www.deq.state.ms.us/MDEQ.nsf/page/Recycling_MaterialDensity andVolumeConversion).

[e] Based density of commercial/industrial waste (uncompacted) municipal waste of 450 lb/yd^3 (or 0.156 kg/L), from Mississippi Department of Environmental Quality (http://www.deq.state.ms.us/MDEQ.nsf/page/Recycling_ MaterialDensityandVolumeConversion).

NA = not applicable. PPE = personal protective equipment.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Waste Management – Nonradiological (continued)				
WM-NR-2	*The ISG augmenting NUREG-1537, Part 1, Section 19.2, "Proposed Action" states that the ER should identify treatment and packaging procedures for radioactive and nonradioactive wastes and radioisotope products; transportation packaging systems to be used for waste; and estimated transportation distance to which radioactive and nonradioactive waste would most likely be sent. Provide a list of anticipated waste disposal companies and disposal sites for the waste streams, including construction wastes, listed in Section 19.2.7 of the ER.*			✓	

Process system liquid wastes are solidified and disposed of as solid Class A and B waste. These wastes would be transported and disposed of by Waste Control Specialists at their facility in western Andrews County, Texas.

Nonradiological specialty waste is anticipated to be collected by a company such as Veolia or Clean Harbors for separation, processing, and disposal.

Solid waste would be disposed at the City of Columbia Sanitary Landfill, 5700 Peabody Road, Columbia, Missouri. Columbia Solid Waste Services may be used to pick up solid waste from the RPF.

Construction waste would be disposed at the City of Columbia sanitary landfill. Hazardous construction waste would be collected by a company such as Veolia or Clean Harbors for separation, processing, and disposal.

WM-NR-3	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.9, "Waste Management," states that the ER should provide a description of the sources, types, and approximate quantities of solid, hazardous, and mixed wastes expected from the proposed action. Provide a list of non-radioactive waste streams, their chemical composition, and their mass.*			✓	

Table 19-13 provides a solid waste estimate for the RPF. Based on EPA's estimate of municipal waste adjusted for NWMI facility operations, the major components of the non-radiological facility wastes are paper, plastics, and food wastes. Other wastes constituents will include rubber, cloth, and metals. Additional information, total mass, is provided in the WM-NR-1 response.

WM-NR-4	*The ISG augmenting NUREG-1537, Part 1, Section 19.2, "Proposed Action" states that the ER should identify the type of hazardous materials associated with the facility. Clarify whether the radioisotope production facility will be a large or small quantity hazardous waste generator under the Resource Conservation and Recovery Act (RCRA).*			✓	

The RPF is currently anticipated to generate less than 1,000 kg of hazardous waste per month and to be a small quantity generator under RCRA.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Waste Management – Radiological				
WM-R-1	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.9, "Waste Management," states that the ER should provide information with respect to waste management as a result of construction, operation, and decommissioning activities. Part of the information necessary to properly determine the environmental impacts of the proposed action is the type and class of radioactive wastes generated at the facility Table 19-14 of the ER lists the types of radioactive materials and wastes generated by or required for use at the RPF. For the radioactive wastes generated and shipped to Waste Control Specialist (WCS), clarify what those wastes are and what class of radioactive waste (i.e., Class A, Class B, Class C, Greater Than Class C (GTCC)) that will be produced, treated, stored, and shipped.*			✓	

NWMI's Part 2 submission of the Construction Permit Application describes the RPF radioactive waste handling program in Chapter 9.0, Section 9.7.2. Radioactive wastes anticipated to be transported and disposed of by Waste Control Specialists in Texas will include the following:

- **High-dose solidified liquid waste** – The high-dose solidified liquid waste consists of liquid waste streams generated by the RPF processes containing a majority of radioisotopes separated from molybdenum (Mo) product and recycled uranium. High-dose liquids are accumulated, neutralized (by addition of caustic), concentrated, and combined with a solidification agent prior to transfer into a disposal container. The quantity of this waste stream is bounded by 300,000 kg/yr as a solid. Solidified high-dose waste is currently projected to be a Class B waste stream for disposal.
- **Low-dose solidified liquid waste** – The low-dose solidified liquid waste mass is dominated by condensate generated by process stream concentrators containing small quantities of radionuclides. A portion of the condensate is recycled for reuse as water input for selected process unit operations. Condensate that cannot be recycled is accumulated, neutralized (by addition of caustic), partially evaporated, and combined with a solidification agent prior to transfer into a disposal container. The quantity of this waste stream is bounded by 225,000 kg/yr as a solid. Solidified low-dose waste is a Class A waste stream for disposal.
- **Encapsulated solid waste** – The encapsulated solid waste consists of solid materials generated by the RPF processes. Solid wastes are dominated by cladding pieces generated during the irradiated target disassembly system and filters containing undissolved target particles generated by the irradiated target dissolution system. Solid wastes are collected in a disposal container. After filling with solid waste, a grout material is added to the disposal container to encapsulate the collected waste. The quantity of this waste stream is bounded by 15,000 kg/yr as a solid. Encapsulated solid waste is currently projected to be a Class B waste stream for disposal.

Waste process optimization activities are anticipated to be performed as part of the final design, with the goal of reducing the high-dose solidified liquid waste (and possibly encapsulated solid waste) volume generated by RPF operation. Volume reduction has the potential to change the disposed waste classification from Class B to Class C as a result of optimization activities, and results will be described in the Operating Permit Application.

No greater than Class C waste will be generated by NWMI RPF operations.

No.	Request for additional information	Type of requested information			
		Reference	Procedure	Response	Presentation
	Waste Management – Radiological (continued)				
WM-R-2	*The ISG augmenting NUREG-1537, Part 1, Section 19.4.9, "Waste Management," states that the ER should provide information with respect to waste management as a result of construction, operation, and decommissioning activities. Part of the information necessary to properly determine the environmental impacts of the proposed action is the amount of storage a facility has to handle the radioactive wastes generated at the facility.* *Clarify how long radioactive waste must be stored on site for decay before shipping, and if sufficient storage space is available for all anticipated radioactive wastes and radioactive materials necessary for operation.*			✓	

The disposed waste package radionuclide inventory was compared to transport cask design limits for radionuclides and heat generation. The comparison indicates that high-dose solidified liquid waste should be stored more than ~15 weeks for decay prior to transport to a disposal site. Encapsulated solid waste should be stored more than ~12 weeks prior to transport. No decay time requirements are currently defined for transport of Class A low-dose solidified liquid waste. However, a cost incentive may exist for allowing the low-dose solidified liquid waste to decay for ~12 weeks prior to disposal.

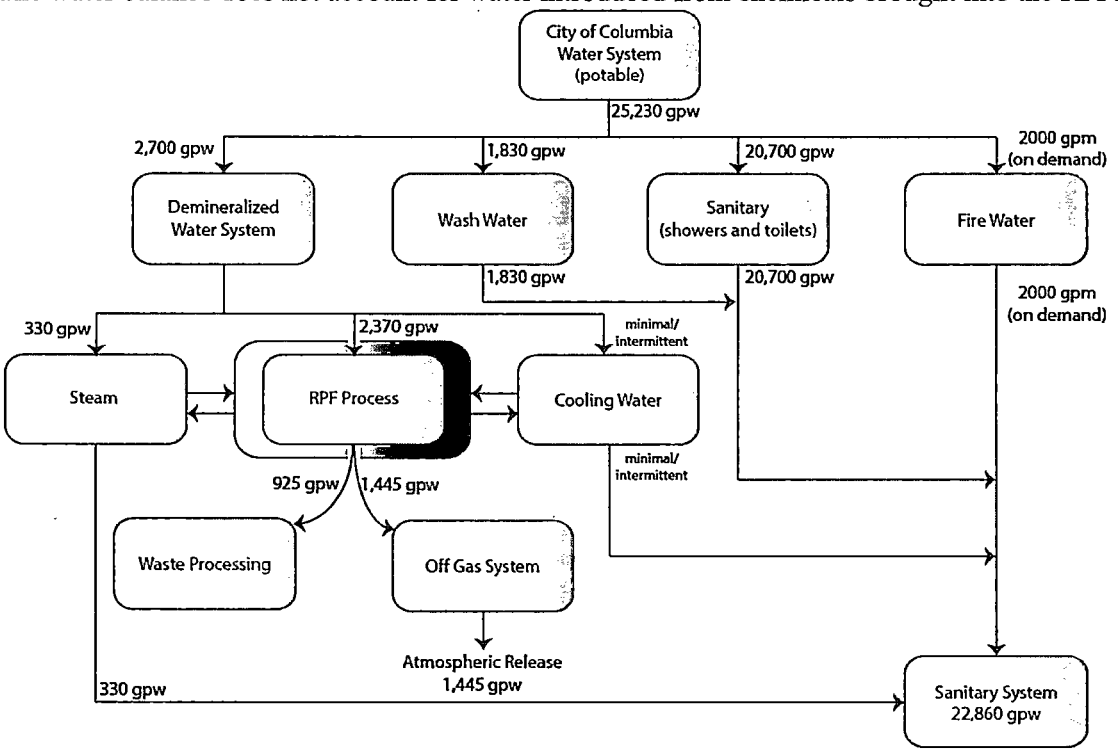
Sufficient storage space to support RPF operations has been included. Process material lag storage elements are described by the process descriptions in Chapter 4.0 of the NWMI Part 2 Construction Permit Application. The process lag storage elements discussed throughout Chapter 4.0 are indicated by comparison of the bounding and nominal special nuclear material inventories shown in Tables 4-1 and 4-2. Storage space for radioactive waste is described in Chapter 9.0.

Information related to third reactor cannot be supplied at this time, as the reactor has not yet been selected. Site visits to the potential third reactor sites have indicated that anticipated changes in the sources, types, and approximate quantities of radiological effluents or waste streams; radiological impacts to the workers; and radiological impacts from transportation due to the shipment to and from the reactor will be similar to that assumed for the OSTR.

No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Water Resources				
WAT-1A	*Section 19.2.4.1 and Table 19-11 of the ER provide a narrative description and tabular summary, respectively, of the projected water demands, and Section 19.2.7.1 summarizes liquid waste streams associated with operation of the proposed RPF. Provide a supporting process water balance (water use diagram) for the facility showing flow rates to and from the various water systems, water system interconnections and interdependence, points of consumption, and source and discharge locations. Specifically identify RPF process, cooling, steam production, fire protection, potable and sanitary, floor and equipment washdown, and any other specific water uses and identify consumptive losses.*			✓	

The following diagram is based on several assumptions, which include the following:

- Demineralized water is required at a rate of 540 gal/day for 5 days/week.
- Steam is required for 3 days/week for 24 hr/day.
- Steam recharge (blowdown) is assumed at 10 percent of peak load requirement defined in NWMI-2015-SDD-011, *Utility Systems SDD*.
- Cooling water makeup is minimal and intermittent.
- Waste includes approximately 50 percent solids.
- Water out the stack is assumed to be 10 gal/hr 24/7.
- Recycle is not included in the water balance.
- The water balance does not account for water introduced from chemicals brought into the RPF.



No.	Request for additional information	Type of requested information: Reference	Procedure	Response	Presentation
	Water Resources (continued)				
WAT-1B	*ER Table 19-11, which reports total annual water consumption for the RPF, implies that all facility water use is "demineralized water" with separate columns included for "wash water." Raw potable water usage does not appear to be accounted for and, except for the activity "faculty support," there appears to be no provision to meet the potable and sanitary water needs of the 98 facility staff. Address and clarify these apparent discrepancies.*			✓	

In Table 19-11, "Faculty" [sic] should have been "Facility." The various water usage systems that are supplied by the municipal water system is described below.

"The municipal water system will be split into for main users within the RPF: the demineralized water system, the wash water system, the sanitary (drinking, showers, and toilets) system, and the firewater system. Wash water will be used to washdown the tractor/trailers. The firewater system is described in Chapter 9.0, Section 9.3."

The demineralized water system usage has been revised and is provided below.

"The demineralized water system supplies demineralized water to the process for water addition, flushing, and chemical dilution. The demineralized water system can also potentially provide make-up water to the steam boilers."

The sanitary water usage has been inserted into Table 19-11 and is provided below. In addition, a note has been added to Table 19-11 to address fire water and irrigation usage.

Table 19-11. Radioisotope Production Facility Water Flow Rates and Consumption Information

Activity	Annual demineralized water[a] L	Annual demineralized water[a] gal	Annual wash water L	Annual wash water gal	Annual sanitary water L	Annual sanitary water gal
Target fabrication	25,000	6,600	–	–	–	–
Target disassembly and dissolution	1,500	400	–	–	–	–
Mo recovery and purification system	–	–	–	–	–	–
Uranium recovery and recycle system	500,410	132,200	–	–	–	–
Waste management	–	–	–	–	–	–
Laboratory facilities	2,000	530	–	–	–	–
Facility support[c, d]	2,000	530	360,000	95,100	4,073,000	1,076,000
Total	**530,910**	**140,260**	**360,000**	**95,100**	**4,073,000**	**1,076,000**
[b]Average daily use	2,042	539	1,385	366	15,665	4,140

[a] These numbers do not account for planned process recycle.

[b] Assumes 260 days of operation per year.

[c] Note that there is anticipated to be a (180,000 gal) firefighting water storage tank that will be filled over an 8-hr period at 1,419.5 L/min (375 gal/min). This water usage is not included in the above totals.

[d] Annual landscape irrigation is not included in the above totals. Landscape irrigation is assumed to not be required.

No.	Request for additional information	Type of requested information			
		Reference	Procedure	Response	Presentation
WAT-1C	*As cited in Table 19-11, reconcile the cited average daily use values (539 + 366 gal) with the value of 1,286 gal/day given in Section 19.6.3.1.2 of the ER.*			✓	

Section 19.6.3.1.2, "Water Resources," has been revised and is provided below.

"The RPF requires water from the Consolidated Public Water Supply District #1 water supply system for construction, isotope production, potable water, fire protection, and facility heating and cooling. The Consolidated Public Water Supply District #1 presently supplies 5.49 megaliter (ML)/day (1.45 million gallons [Mgal]/day). Construction requirements of the RPF are small compared to the available water supply. As noted in Section 19.2.4, the RPF would require 19,094 L/day (5,044 gal/day) during operations, less than one percent of the total Consolidated Public Water Supply District #1 operational capacity. This leaves a significant excess capacity. Because there would be significant excess capacity within the Consolidated Public Water Supply District #1, there are no indirect effects associated with the demand from the RPF. There are also no direct impacts to water quality or hydrology from the RPF, and therefore, there would be no irreversible impacts."

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10 CFR 50.59, "Changes, Tests, and Experiments," *Code of Federal Regulations*, Office of the Federal Register, as amended.

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," *Code of Federal Regulations*, Office of the Federal Register, as amended.

40 CFR 261, "Identification and Listing of Hazardous Waste," *Code of Federal Regulations*, Office of the Federal Register, as amended.

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APPENDICES

Appendix A –
EDF-3124-0011, Greenhouse Gas Emissions

Document ID:EDF-3124-0011
Revision ID:1
Effective Date:July 31, 2015

Engineering Design File

Greenhouse Gas Emissions

Portage Project No.: 3124

Project Title: NWMI Environmental Report

Portage

TEM-9002
09/29/09
Rev. 0

ENGINEERING DESIGN FILE

1. Portage Project No.: 3124 2. Project/Task: NWMI Environmental Report

3. DCN #

4. Title: Greenhouse Gas Emissions

5. NPH PC or SDC: N/A

6. SSC Safety Category: N/A

7. Summary: This EDF presents the total CO_2 emissions from all the sources identified for both the construction phase and annual operation.

8. Distribution: (Portage, Inc.)

9. Review (R) and Approval (A) Signatures:
(Identify minimum reviews and approvals. Additional reviews/approvals may be added.)

	R/A	Printed Name/ Organization	Signature	Date
Author/Design Agent	A	Gary McManus		7/31/15
Independent Review	R	Dave Thorne		7/31/15
Independent Review	R			
Project Manager	R/A	John Beller		7/31/15

Registered Professional Engineer's Stamp (if required) ☒ N/A

INTRODUCTION AND PURPOSE

Greenhouse Gases trap heat in the atmosphere, absorbing and emitting radiation in the thermal infrared range. The most important of these gases are CO2, methane, nitrous oxide, and fluorinated gases. GHGs are reported as CO2 equivalent (CO2e) and refer to the global warming potential of the GHG or gases being emitted.

Activities associated with the proposed RPF site that are expected to contribute to GHGs include:

Construction activities at the site (assumed to last 17 months, 73.7 weeks) principally resulting in emissions of CO_2; GHG emissions associated with construction activities include:

- The commuting construction workforce.
- Operation of construction equipment at the site.
- Operation of on-road construction vehicles.

These GHG emissions are summarized in Table 1 below.

Table 1. GHG Emissions from Construction Phase Activities

Source	(lbs)	(kg)	(ton)	(tonne)
Commuting Construction Workers [a]	1,220,000	552,000	610	552
Operation of Construction Equipment at site [b]	56,600	125,000	28	13
Operation of on-Road Construction Vehicles [a]	97,000	43,000	49	43
a. EDF 3124-0005, *On-road Vehicle Emissions During Construction* Rev 1. Portage, Inc, Idaho Falls, ID, July 31, 2015 b. EDF 3124-0009, *Off-road Vehicle Emissions During Construction* Rev 1. Portage, Inc, Idaho Falls, ID, July 31, 2015				

Plant operation activities associated with the operation of plant equipment and the operations workforce. This includes:

- The commuting work force
- The four natural gas boilers
- The emergency diesel generator

These GHG emissions are summarized in Table 2 below:

Table 2. GHG Emissions during Plant Operation

Source		(lbs)	(kg)	(tons)	(tonnes)
Daily Workforce Commuting [a]		860,000	390,000	440	400
Natural Gas Boilers [b]		51,000,000	23,000,000	26,000	23,000
Emergency Diesel Generator [b]		97,000	44,000	49	44
a. EDF 3124-0013, *On-road Emission for Vehicles Suring Operation*, Rev 1. Portage, Inc, Idaho Falls, ID, July 31, 2015 b. EDF 3124-0008, *Emission from Natural Gas Boiler Operation*, Rev 0. Portage, Inc, Idaho Falls, ID, June 26, 2014					

From Tables 1 and 2 the total GHG emissions for the construction and operation phases of the project are summarized and presented in Table 3 below.

Table 3. Total GHG Emissions during Construction Phase and Normal Operations Phase

Source	(lbs)	(kg)	(tons)	(tonnes)
Construction Phase	1,500,000	660,000	730	660
Operation Phase	52,000,000	24,000,000	26,000	24,000

Attachment: Excel spreadsheets of calculations

	Source	(lbs)	(kg)	(tons)	(t)
	Commuting Construction Workers	1,220,000	552,000	610	552
	Operation of Construction Equipment at site	97,400	43,300	49	43
	Operation of on-Road Construction Vehicles	124,602	56,518	62	57
	Total	**1,442,002**	**651,818**	**721**	**652**

Construction Phase					
	Commuting Construction Workers	**CO2**			
		(kgs)	**(lbs)**	**(tonnes)**	**(ton)**
	Light Duty Auto (gas)	320,000	700,000	320	350
	Light duty Trucks (gas)	180,000	400,000	180	200
	Light duty Trucks (diesel)	52,000	120,000	52	60
	Total	**552,000**	**1,220,000**	**552**	**610**
Operation of Construction Equipment at site		**CO2**			
		(kgs)	(lbs)	(tonnes)	(ton)
Light Heavy Duty Delivery Trucks		15,000	34,000	15	17
Heavy Duty Construction Trucks	**Haulers**	3,300	7,200	3	4
	Concrete	24,000	54,000	24	27
	Asphalt	1,000	2,200	1	1
	Total	**43,300**	**97,400**	**43**	**49**
Operation of Off-Road Construction Equipment at site		**CO2**			
		(kgs)	**(lbs)**	**(tonnes)**	**(ton)**
	Bulldozer	13,025	28,715	13	14
	Compactor	9,670	21,318	10	11
	Excavators	9,065	19,986	9	10
	Front Loaders	3,126	6,892	3	3
	Graders	6,044	13,324	6	7
	Paver	5,919	13,048	6	7
	Asphalt Roller	9,670	21,318	10	11
	Total	**56,518**	**124,602**	**57**	**62**

	GHG Release During Plant Operation				
	Daily Workforce Commuting	CO2			
		(kgs)	(lbs)	(tonnes)	(ton)
	Light Duty Auto (gas)	225,239	496,569	225	248
	Light duty Trucks (gas)	129,506	285,513	130	143
	Light duty Trucks (diesel)	37,004	81,580	37	41
	Daily Workforce Commuting	391,749	863,662	392	432
	Natural Gas Boilers	23,586,803	52,000,000	23,187	26,000
	Emergency Diesel Generator	44,000	97,003	44	49

Operations Summary				
Source	**(lbs)**	**(kg)**	**(tons)**	**(t)**
Daily Workforce Commuting	863,662	391,749	432	392
Natural Gas Boilers	52,000,000	23,586,803	26,000	23,587
Emergency Diesel Generator	97,003	44,000	49	44
Operation Phase	**52,960,665**	**24,022,552**	**26,480**	**24,023**
Construction Phase	**1,451,967**	**658,598**	**726**	**659**