NEXTera ENERGY
DUANE ARNOLD

April 14, 2021

NG-21-0008

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Duane Arnold Energy Center
Docket No. 50-331
Renewed Op. License No. DPR-49

2020 Annual Radioactive Material Release Report

Please find as the Enclosure to this letter, a copy of NextEra Energy Duane Arnold, LLC's (hereafter, NextEra Energy Duane Arnold) 2020 Annual Radioactive Material Release Report for the Duane Arnold Energy Center (DAEC). This report satisfies the requirements of Defueled Offsite Dose Assessment Manual (DODAM) Section 8.2.1 and Technical Specification Section 5.6.3.

This letter makes no new commitments nor changes to existing commitments.

Should you have any questions regarding this matter, please contact Michael Casey at (319) 851-7606.

P Hansen

Paul Hansen
Decommissioning Director
NextEra Energy Duane Arnold, LLC

Enclosure

cc: Administrator, Region III, USNRC
Project Manager, DAEC, USNRC
Inspector, DAEC, USNRC

Enclosure to NG-21-0008

Duane Arnold Energy Center
2020 Annual Radioactive Material Release Report

517 pages to follow

2020

Annual Radioactive Material Release Report

Duane Arnold Energy Center

Cedar Rapids, Iowa

Docket No. 50-331

January 1, 2020 through December 31, 2020

2020
Annual Radioactive Material Release Report

Duane Arnold Energy Center
DOCKET NUMBER. 50-331

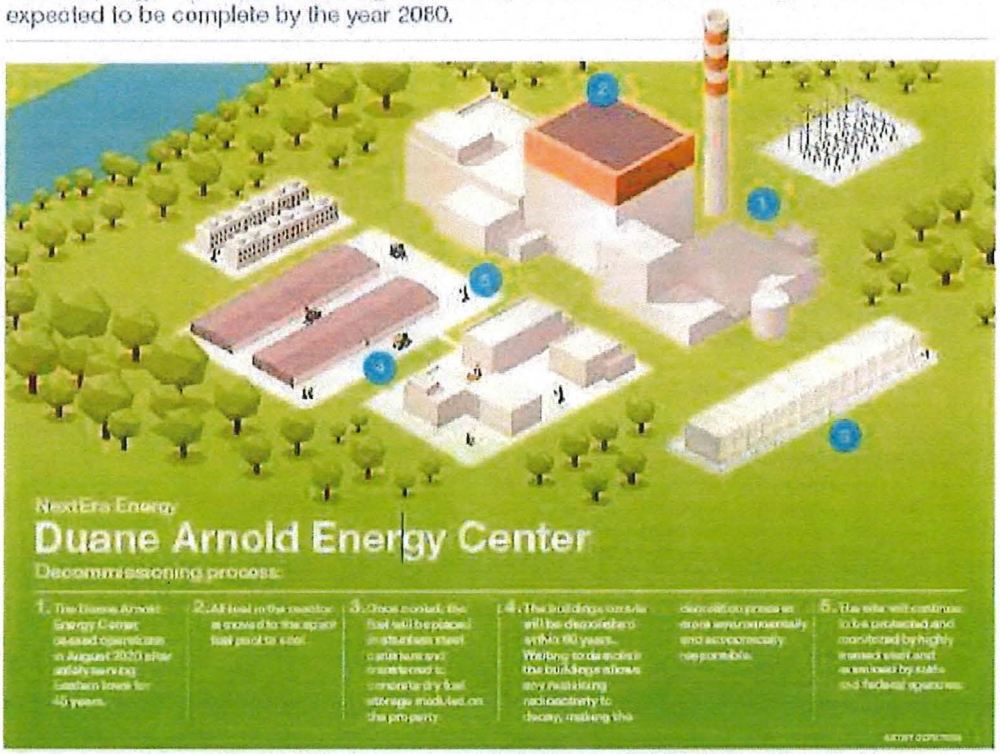
Prepared By: _____ Date: 4/8/21
Daron Tanko, Rad-Effluents Coordinator

Approved By: _____ Date: 4/9/21
Michael Casey, DAEC Chemistry Manager

NextEraEnergyResources.com

Duane Arnold Energy Center Decommissioning

Decommissioning is a well-defined Nuclear Regulatory Commission (NRC) process for shutting down a nuclear power plant. It includes transferring the used fuel from the Duane Arnold Energy Center into safe, long-term storage. The overall process is gradual, and is expected to be complete by the year 2080.



Emergency preparedness

After the plant shuts down, the possibilities for an emergency decrease dramatically. The Duane Arnold Energy Center will maintain capabilities to address any possibility of an emergency at the plant, no matter how unlikely, until all fuel has been placed in long-term storage. Once all the used fuel has been placed in long-term storage, the risk of an emergency that could affect the community is virtually eliminated. However, a security force will remain to protect the facility.

Funding

NextEra Energy Resources and the joint owners will pay for Duane Arnold's decommissioning. Nuclear power plants are required by the NRC to put aside funds for decommissioning while the plant is operating. The money is invested in dedicated trusts over the lifetime of the plant. The fund distribution is carefully monitored by a third party. NextEra Energy Resources estimates the decommissioning of Duane Arnold is fully funded.

Learn more: NextEraEnergyResources.com/DuaneArnoldInfo

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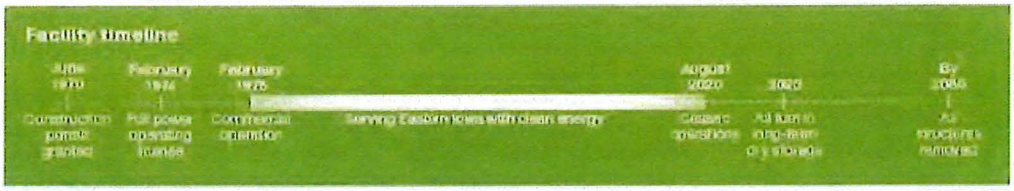

Frequently Asked Questions

What happens to the nuclear material on site?

The used fuel will be placed in long-term dry storage on site within three years of the plant shutting down.

The reactor building has accumulated some residual radioactive particles over the life of the plant. The buildings will remain vacant for 50 years before being demolished. The eventual demolition of the reactor building will be conducted with care and respect for the surrounding environment. Any other buildings remaining on the site will also be demolished at this time.

Why are you waiting so long to demolish the buildings?

While the Duane Arnold Energy Center is a very clean facility, the equipment used over the lifetime of the plant has residual radioactive particles. By maintaining the buildings, we allow time for the natural processes to reduce the intensity of the radioactive particles. When the time comes to take buildings down, it will be easier on the environment and more economical to remove material from the site.

The site will continue to be protected by a security force and monitored for any possible environmental impacts until all spent fuel is removed from the site.

NextEra Energy Resources believes it's important to operate its business in harmony with the environment and our neighbors. We take our responsibility to see that the site is maintained in a way that benefits the long term health of the community very seriously. We will continue to work with the NRC until the decommissioning process is complete.

What will happen to the site? What will they do there?

NextEra Energy Duane Arnold is evaluating redevelopment opportunities at the site, but it would be premature to speculate about what decisions might be made. We will continue to evaluate potential redevelopment opportunities going forward.

What happens to the employees?

Our goal from the very beginning of this process has been to minimize the impact on our employees and their families. We continue to work with each and every team member to help them prepare for the eventual shutdown.

To support Duane Arnold Energy Center employees during the transition, NextEra Energy Resources has developed a comprehensive employee plan that includes an enhanced retirement program for eligible employees, placement in other jobs throughout the company, support services which include dealing with change, preparing for retirement, writing resumes, job searches and career fairs. NextEra Energy Resources also is partnering with Alliant Energy and other companies in the energy industry to identify opportunities for employees.

What does staffing look like in the months and years after shutdown?

The station will still need a group of team members to monitor the plant and provide security for several years after operations cease and throughout the decommissioning process.

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EXECUTIVE SUMMARY

The Duane Arnold Energy Center (DAEC) permanently shut down on August 10,2020, and the reactor fuel has been placed in the spent fuel pool. By letter dated August 27, 2020 (Accession No. ML20240A067), NextEra Energy Duane Arnold (NEDA) certified permanent cessation of power operations at the DAEC. By letter dated October 12, 2020 (ML20286A317), NEDA certified permanent defueling of the reactor at DAEC. Therefore, as specified in 10 CFR 50.82(a)(2), the 10 CFR Part 50 license for DAEC no longer authorizes operations of the reactor or emplacement or retention of fuel into the reactor vessel.

The contribution of dose to a member of the public most likely to be exposed from liquid and gaseous effluent releases was calculated using the Meteorological Information and Dose Assessment System (MIDAS) computer program in accordance with the ODAM. The calculated doses for gaseous and liquid effluent releases are less than the regulatory limits stated in Appendix I to 10 CFR 50 and in 40 CFR 190.

Supportive environmental data for the 2020 dose assessment can be found in the Duane Arnold Energy Center 2020 Annual Radiological Environmental Operating Report.

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REGULATORY LIMITS

Fission and Activation Gases

Dose Rate

- Less than 500 mrem/year to the whole body.
- Less than 3000 mrem/year to the skin.

Gamma Air Dose

- Less than or equal to 5 mrad/quarter.
- Less than or equal to 10 mrad/year.

Beta Air Dose

- Less than or equal to 10 mrad/quarter.
- Less than or equal to 20 mrad/year.

Airborne Particulates, Iodines and Tritium

Dose Rate

- Less than 1500 mrem/year.

Dose

- Less than or equal to 7.5 mrem/quarter to any organ.
- Less than or equal to 15 mrem/year to any organ.

Liquid Effluents

Dose

- Less than or equal to 1.5 mrem to the whole body during any calendar quarter.
- Less than or equal to 5 mrem to any organ during any calendar quarter.
- Less than or equal to 3 mrem to the whole body during any calendar year.
- Less than or equal to 10 mrem to any organ during any calendar year.

Concentration

- Liquid effluents released from the site to unrestricted areas shall not exceed ten times (10x) the concentrations listed in Appendix B, Table 2, Column 2 to 10 CFR 20.1001 – 20.2402.

40CFR190 and 10CFR72

Dose

- Less than or equal to 25 mrem annual whole-body dose.
- Less than or equal to 75 mrem annual thyroid dose.
- Less than or equal to 25 mrem annual dose to any other critical organ.

MAXIMUM PERMISSIBLE CONCENTRATIONS

Dose rates, rather than effluent concentrations, are used to calculate permissible release rates for gaseous effluents. The maximum permissible dose rates for gaseous releases are defined in Duane Arnold Offsite Dose Assessment Manual (ODAM) and the Defueled Offsite Dose Assessment Manual (DODAM). ODAM-DODAM Limiting Condition for Operation (OLCO) 6.2.2. Liquid effluent concentrations are limited per ODAM-DODAM OLCO 6.1.2 to ten times (10x) the concentration specified in 10CFR20 Appendix B, Table 2, Column 2.

AVERAGE ENERGY

The ODAM-DODAM limits dose rates at or beyond the site boundary due to the release of noble gases to less than or equal to 500 mrem per year to the total body and less than or equal to 3,000 mrem per year to the skin. Average energy is not used to determine dose to the public. Compliance with these limits is demonstrated based on dose calculations using measured isotopic concentrations of effluent streams and not based on gross count rate measuring systems.

Therefore, the average beta and gamma energies (E-BAR) for gaseous effluents as described in Regulatory Guide 1.21 "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," are not applicable.

MEASUREMENTS OF TOTAL RADIOACTIVITY

Gaseous Effluents

- Gaseous Effluents from the Offgas Stack, Reactor Building Vents, Turbine Building Vent and the Low Level Radwaste Storage and Processing Facility (LLRPSF) are continuously sampled for iodines and particulates. Sample media is changed weekly and analyzed by gamma spectroscopy. The gross alpha analyses are performed onsite. The particulate filters are composited on a quarterly basis and sent to a vendor for Sr-89, Sr-90, Fe-55 and Ni-63 analysis. Total error is calculated based on stack flow error, sample flow error, and analytical error.

- Noble gas grab samples of the same four release points are obtained monthly and analyzed by gamma spectroscopy. Total error is based on stack flow error, analytical error, and calculated sampling error.

- Tritium samples from all four release points are obtained quarterly and analyzed by liquid scintillation. Total error is based on stack flow error, analytical error, and calculated sampling error.

- A beta sensitive radiation detector provides continuous monitoring at each of the above described release points. For the year 2020, there were no instances where ODAM-DODAM required gaseous radiation monitoring or sampling systems were inoperable on an active release point for a period of 30 (contiguous) days or more. (ODAM-DODAM OLCO 6.2.1.1 A.2)

Liquid Effluents

- Service water systems are composite sampled once per week for gamma emitters. Portions of the weekly service water samples are composited for a monthly analysis for tritium and gross alpha. If there is a positive identification of reactor by-product radioactivity in these samples, Sr-89, Sr-90 and Fe-55 analyses are performed. Total error is based on the volume discharge error and analytical error.

- ODAM-DODAM defined "Clean Systems" are sampled prior to batch release or continuous release with composite sampling. Samples are analyzed for gamma emitters and tritium. If reactor by-product gamma emitters are identified, analyses for Sr-89, Sr-90 and Fe-55 are performed. "Clean Systems" include CST Containment Pit, Transformer Pit, Neutralizing Tank 1T022, FRAC tanks, and temporary mitigation of groundwater in a monitoring well.

- Beginning in November 2020, there were twenty radioactive batch releases of liquids from plant radwaste system using the ALARA filter enhancement. The primary isotope was tritium.

- The permanent groundwater mitigation system is designed to remove tritiated groundwater from the shallow aquifer. The composite sample is collected once per week and analyzed for gamma emitters and tritium. If reactor by-product gamma emitters are identified, analyses for Sr-89, Sr-90 and Fe-55 are performed. Total error is based on the volume discharge error and analytical error. For 2020, there were four continuous releases from the permanent GWPP mitigation system in which a plant by-product was identified above the lower level of detection. The four releases contained only tritium with no plant by-product gamma emitters identified.

- Temporary groundwater mitigation was performed during all four quarters of 2020 from select monitoring wells that indicated elevated tritium concentrations. For 2020, there were forty-three batch releases from the temporary mitigation system. All releases contained only tritium with no plant by-product gamma emitters identified.

- Continuous monitoring with gamma sensitive radiation detectors is provided for plant service water systems. For the year 2020, there were no instances where these liquid radiation monitoring systems were inoperable on an active release point for a period of 30 (contiguous) days or more. (ODAM-DODAM OLCO 6.1.1.1 A.2)

- Sewage effluent releases are sampled under the auspices of the Groundwater Protection Program. The sewage sample results from on-site laboratory are included in Attachment 1A. All other Groundwater Protection Program analyses and results can be found in the Duane Arnold Energy Center 2020 Annual Radiological Environmental Operating Report.

SUMMARY OF GASEOUS EFFLUENTS

There were no radioactive gaseous batch releases from the Duane Arnold Energy Center during this report period. All gaseous effluent releases were continuous and resulted in a small fraction of the 10 CFR 50, Appendix I dose limits.

For all release points, quarterly average gross alpha concentration of radioactivity measured less than 4.10E-09 µCi/cc.

There were no abnormal releases of gaseous effluents during the period.

Table 1A - Gaseous Effluents – Summation of All Releases

	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
Fission and Activation Gases						
1. Total Release	Ci	0.00E+00	6.38E+01	6.08E01	0.00E+00	1.60E+01
2. Average Release Rate for Period	µCi/sec	0.00E+00	8.11E+00	7.65E+00	0.00E+00	
3. Percent of Applicable Limit	%	*	*	*	*	
Iodines						
1. Total I-131	Ci	1.66E-06	2.55E-04	1.12E-05	3.45E-07	1.80E+01
2. Average Release Rate for Period	µCi/sec	2.11E-07	3.24E-05	1.41E-06	4.34E-08	
3. Percent of Applicable Limit	%	*	*	*	*	
Particulates						
1. Total Particulates w/ half-life >8 days	Ci	7.05E-06	6.22E-05	6.08E-05	3.63E-05	1.80E+01
2. Average Release Rate for Period	µCi/sec	8.97E-07	7.91E-06	7.65E-06	4.56E-06	
3. Percent of Applicable Limit	%	*	*	*	*	
Tritium						
1. Total Release	Ci	5.71E+00	8.06E+00	1.44E+00	1.42E+00	1.60E+01
2. Average Release Rate for Period	µCi/sec	7.26E-01	1.03E+00	1.82E-01	1.79E-01	
3. Percent of Applicable Limit	%	*	*	*	*	
Carbon-14						
1. Total Carbon-14	Ci	2.39E+00	2.06E+00	0.90E+00	0.00E+00	
2. Average Release Rate for Period	µCi/sec	3.07E-01	2.62E-01	1.13E-01	0.00E+00	
3. Percent of Applicable Limit	%	*	*	*	*	

* Applicable limits have been removed from the Technical Specifications. The comparison to ODAM limits is contained in the Radiological Impact on Man section of this report.

Table 1B - Gaseous Effluents by Quarter

ANNUAL RADIOACTIVE MATERIAL RELEASE REPORT (2020)					
GASEOUS EFFLUENTS BY CALENDAR QUARTER (Curies)					
Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission gases					
krypton-85	Ci	ND[1]	ND	ND	ND
krypton-85m	Ci	ND	9.26E-01	3.69E-01	ND
krypton-87	Ci	ND	7.64E-01	5.92E-01	ND
krypton-88	Ci	ND	8.68E-01	4.38E-01	ND
xenon-131m	Ci	ND	ND	ND	ND
xenon-133	Ci	ND	7.57E+00	5.53E+01	ND
xenon-133m	Ci	ND	ND	ND	ND
xenon-135	Ci	ND	3.75E+01	5.51E-01	ND
xenon-135m	Ci	ND	1.05E+01	1.03E+00	ND
xenon-138	Ci	ND	5.73E+00	2.48E+00	ND
argon-41	Ci	ND	3.25E-04	6.08E+01	ND
Total for period	Ci	**ND**	**6.37E+01**	**0.00E00**	**0.00E00**
2. Iodines					
iodine-131	Ci	1.66E-06	2.55E-04	1.12E-05	3.45E-07
iodine-133	Ci	8.59E-06	4.97E-05	4.02E-06	0.00E+00
iodine-135	Ci	ND	ND	ND	ND
Total for period	Ci	**1.03E-05**	**3.05E-04**	**1.53E-05**	**3.45E-07**
3. Particulates					
strontium-89	Ci	1.86E-06	1.24E-05	9.12E-06	4.59E-07
strontium-90	Ci	5.13E-07	1.67E-06	1.98E-08	ND
cesium-134	Ci	ND	ND	ND	ND
cesium-137	Ci	ND	ND	ND	ND
barium-lanthanum-140	Ci	ND	2.3E-06	1.08E-06	ND
chromium-51	Ci	ND	ND	ND	ND
cobalt-58	Ci	ND	ND	8.26E-08	3.27E-07
cobalt-60	Ci	ND	2.56E-06	6.24E-06	1.69E-05
manganese-54	Ci	2.40E-06	1.29E-05	1.73E-05	1.68E-05
iron-55	Ci	2.28E-06	3.04E-05	2.65E-05	ND
iron-59	Ci	ND	ND	ND	ND
nickel-63	Ci	ND	2.56E-08	7.88E-08	ND
zinc-65	Ci	ND	ND	4.55E-07	1.80E-06
zinc-69m	Ci	ND	ND	ND	ND
Total for period	Ci	**7.05E-06**	**6.22E-05**	**6.09E-05**	**3.63E-05**
4. Tritium	Ci	5.71E+00	8.06E+00	1.44E+00	1.42E+00
Tritium Total	Ci	**5.71E+00**	**8.06E+00**	**1.44E+00**	**1.42E+00**
5. Carbon-14	Ci	2.39E+00	2.06E+00	9.0E-01	0.00E+00
Carbon-14 Total	Ci	**2.39E+00**	**2.06E+00**	**9.0E-01**	**0.00E+00**

1. ND indicates the radionuclide was not identified in any samples using instrumentation that meets the lower limit of detection as required by the DAEC Offsite Dose Assessment Manual.

Table 1C - Gaseous Effluents by Release Point

ANNUAL RADIOACTIVE MATERIAL RELEASE REPORT (2020) GASEOUS EFFLUENTS BY RELEASE POINT (Curies)				
RELEASE POINT:	OFFGAS STACK	REACTOR BUILDING	TURBINE BUILDING	LLRPSF
RELEASE HEIGHT:	328 FEET	156 FEET	90 FEET	65 FEET
RELEASE MODE:	ELEVATED	WAKE SPLIT	WAKE SPLIT	WAKE SPLIT
argon-41	3.25E-04	ND[1]	ND	ND
barium-140	3.38E-06	ND	ND	ND
cesium-134	ND	ND	ND	ND
cesium-137	ND	ND	ND	ND
chromium-51	ND	ND	ND	ND
cerium-141	ND	ND	ND	ND
cobalt-58	ND	4.10E-07	ND	ND
cobalt-60	ND	2.53E-05	ND	4.00E-07
iodine-131	6.32E-05	1.43E-04	6.16E-05	ND
iodine-133	2.09E-05	2.48E-05	1.66E-05	ND
iron-55	3.45E-06	5.75E-05	ND	ND
iron-59	ND	ND	ND	ND
krypton-85	ND	ND	ND	ND
krypton-85m	1.30E+00	ND	ND	ND
krypton-87	1.36E+00	ND	ND	ND
krypton-88	1.31E+00	ND	ND	ND
manganese-54	1.79E-06	4.72E-05	ND	3.63E-07
nickel-63	ND	1.04E-07	ND	ND
strontium-89	1.26E-05	6.20E-06	4.44E-06	5.97E-07
strontium-90	2.20E-06	ND	ND	ND
tritium	2.60E+00	6.51E+00	7.51E+01	3.50E-02
xenon-131m	ND	ND	ND	ND
xenon-133	6.29E+01	ND	ND	ND
xenon-133m	ND	ND	ND	ND
xenon-135	1.30E+01	2.49E+00	1.95E-01	ND
xenon-135m	1.15E+01	ND	ND	ND
xenon-138	8.21E+00	ND	ND	ND
zinc-65	ND	9.04E-07	ND	1.35E-06
zinc-69m	ND	ND	ND	ND
carbon-14[2]	5.29E+00	-	-	-

1. ND means that the radionuclide was not identified in any samples using instrumentation that meets the lower limit of detection as required by the DAEC Offsite Dose Assessment Manual.
2. Carbon-14 release was estimated using methods of the EPRI document, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents"; Report 1021106, issued December 2010.

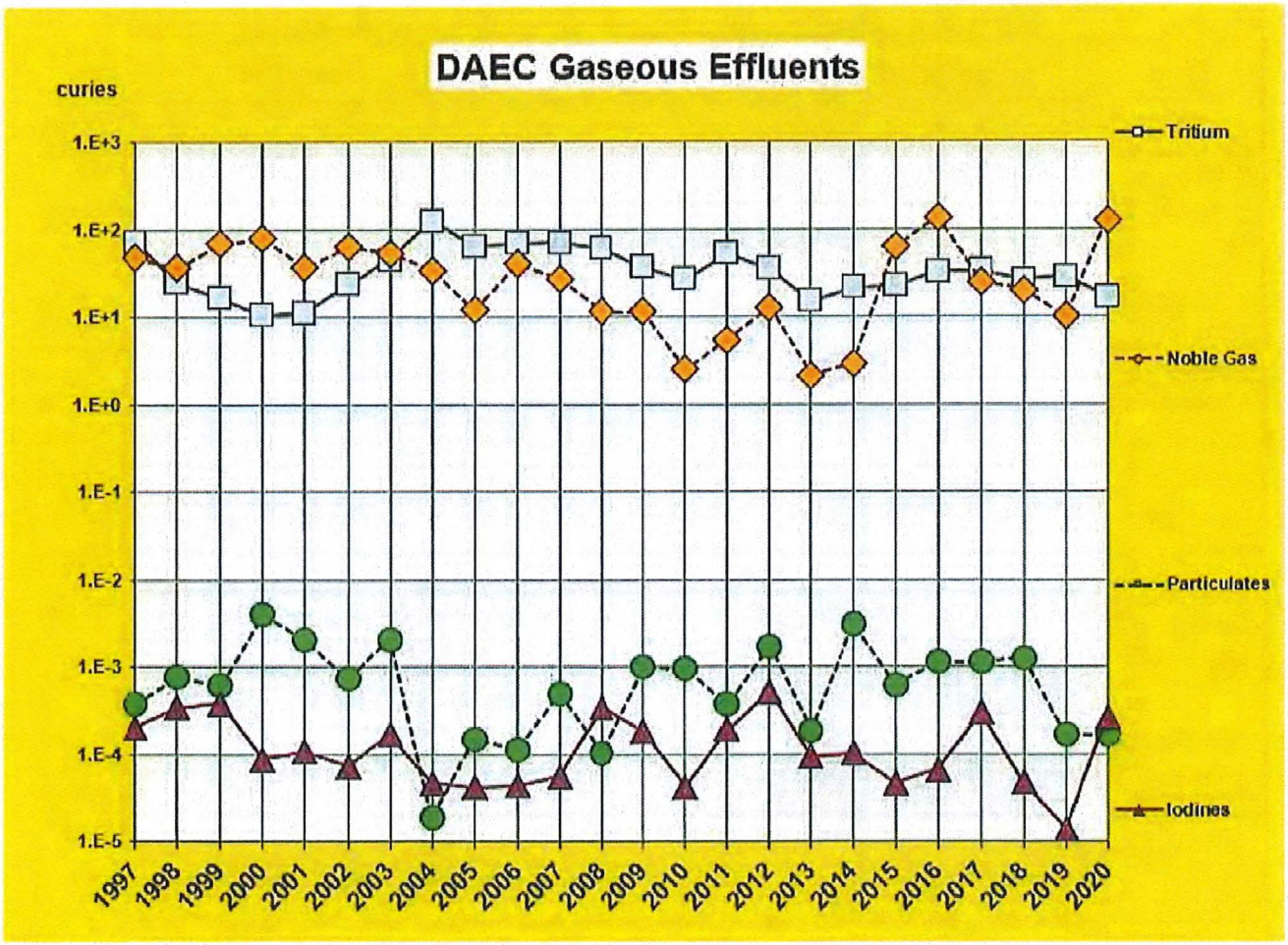
Estimated Release of Gaseous Carbon-14

The estimate of gaseous carbon-14 (C-14) released from the Duane Arnold Energy Center was derived using the EPRI document, "Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents", Report 1021106, issued December 2010. The site-specific source term for the DAEC was estimated using the proxy generation rate values from Table 3-1 and the actual 2020 power history for the site. Power production permanently ceased on August 10, 2020.

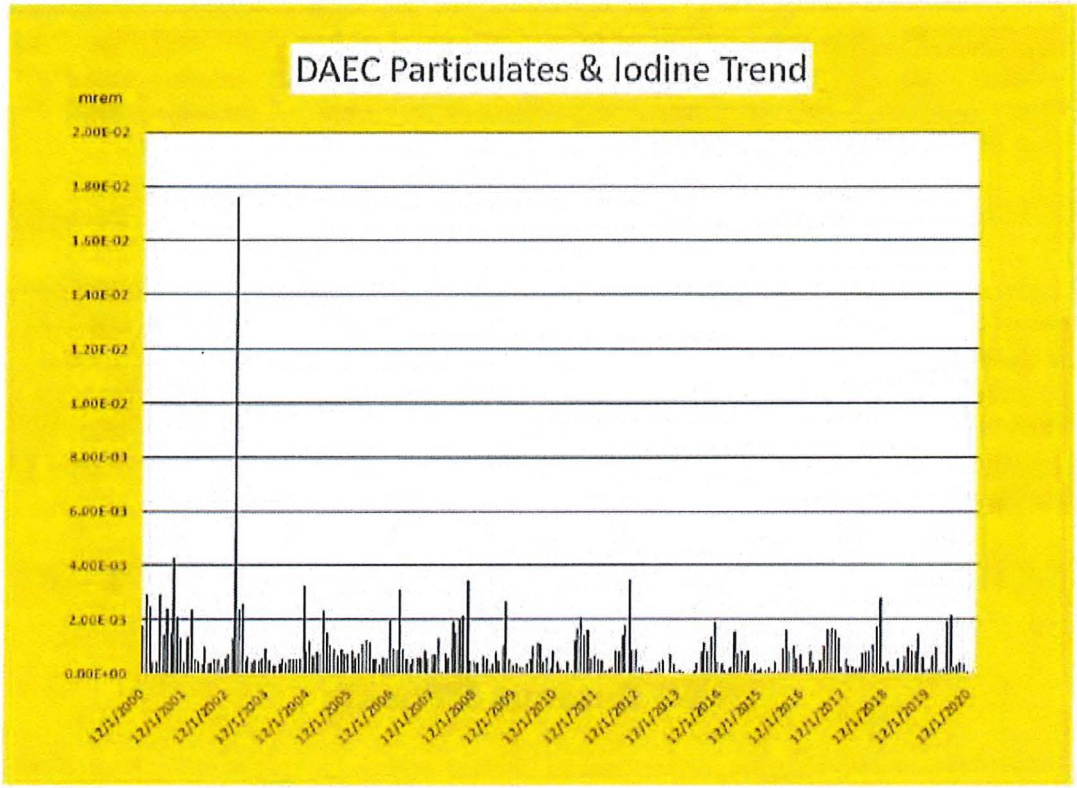
The total amount of C-14 released from the site in 2020 was estimated to be 5.29 curies.

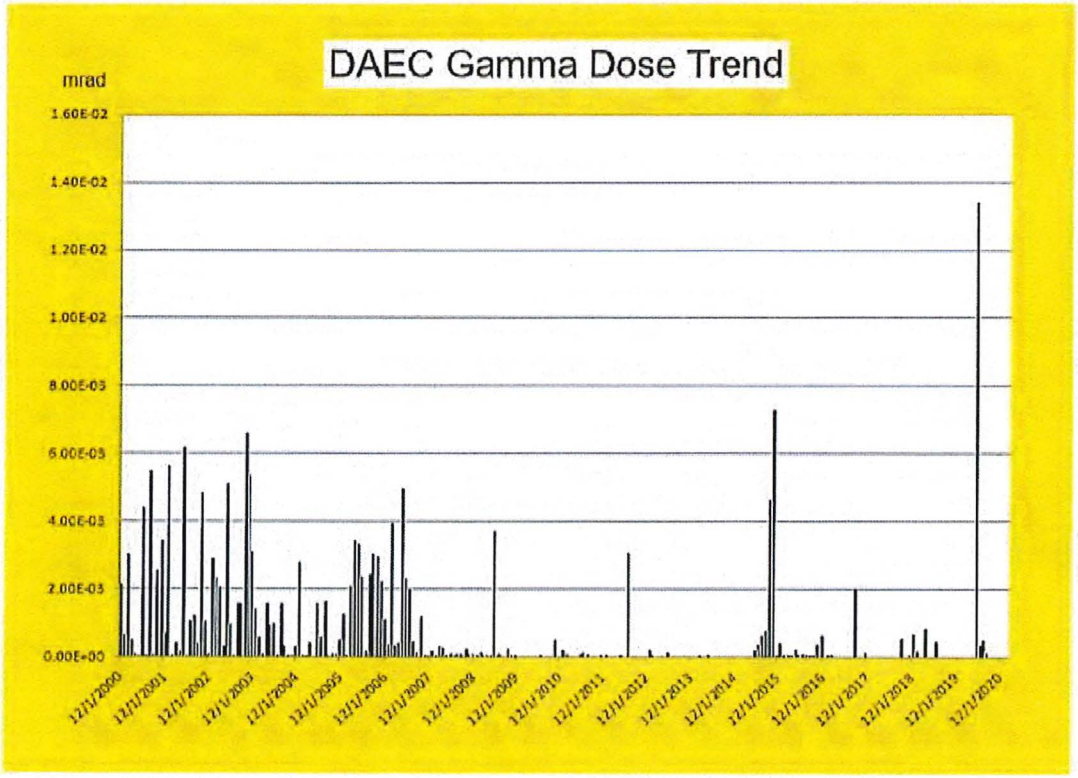
Using the dose calculation methodology from Regulatory Guide 1.109, the resultant maximally exposed receptor organ from C-14 is the bone of a child, located 1,760 meters towards the North. The dose is 2.14E-01 mrem (0.000214 rem/yr). This is a fraction of the 1 mrem annual whole-body dose received to the average US citizen from natural occurring carbon-14, primarily generated through cosmogenesis in the terrestrial biosphere. (Reference: National Council of Radiation Protection Report 94), Exposure of the Population in the United States and Canada from Natural Background Radiation.")

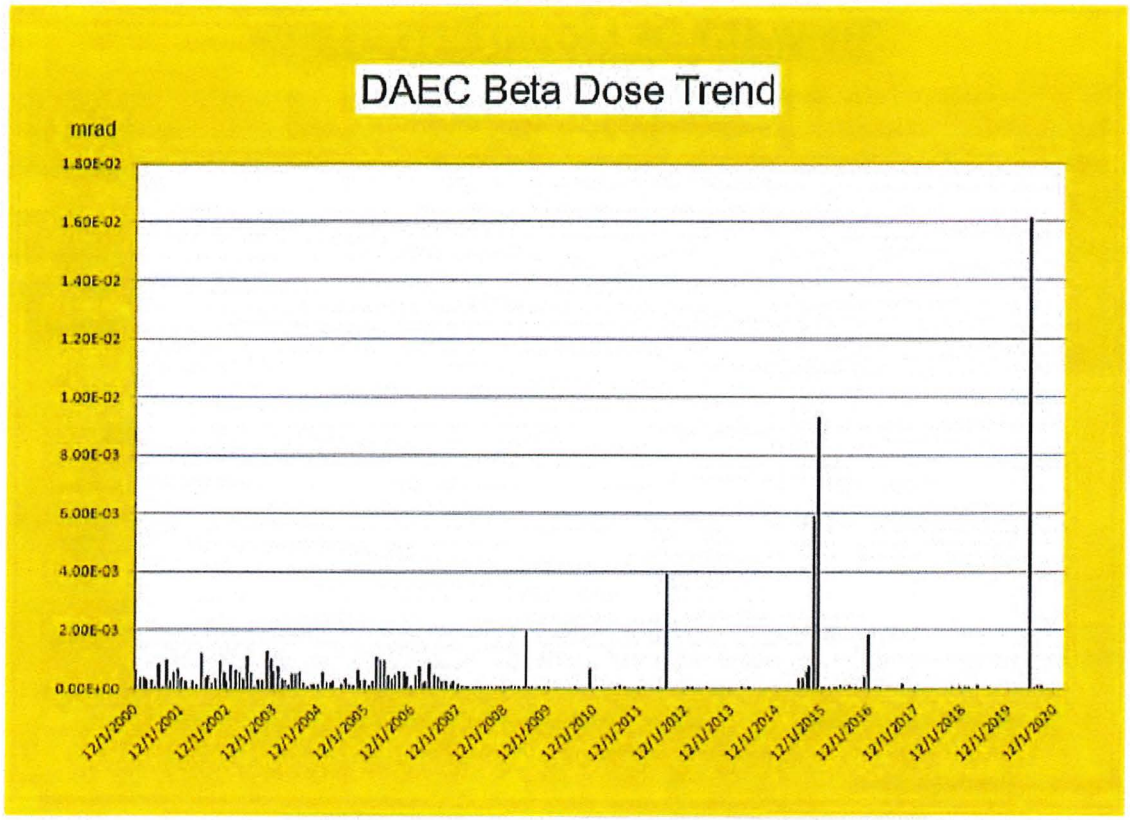
Gaseous Effluents Summary Trend in Curies Per Year Excluding Carbon-14



The following graphs show gaseous effluent dose trends for monthly particulate and iodine, monthly gamma, and monthly beta.







Comparative analysis of 2000-2020 gaseous effluent monthly data indicates the 2020 gaseous effluent release trends continue to be less than the 10 CFR 50 Appendix I limits.

SUMMARY OF LIQUID EFFLUENTS

Liquid effluent release in the form of service water from the facility was continuous during the period. No reactor by-product radionuclides were identified in samples from service water or sewage effluent. There were twenty liquid batch releases from the radioactive waste system and batch releases contained tritium, Manganese-54, Cobalt-60, and Cesium-137.

There were forty-seven liquid releases from groundwater mitigation. The identified only identified plant by-product released was tritium. As noted earlier, four continuous liquid releases were from groundwater mitigation system, and forty-three batch releases were from temporary groundwater mitigation system or a "Clean" system.

Table 2A - Liquid Effluents – Summation of All Releases

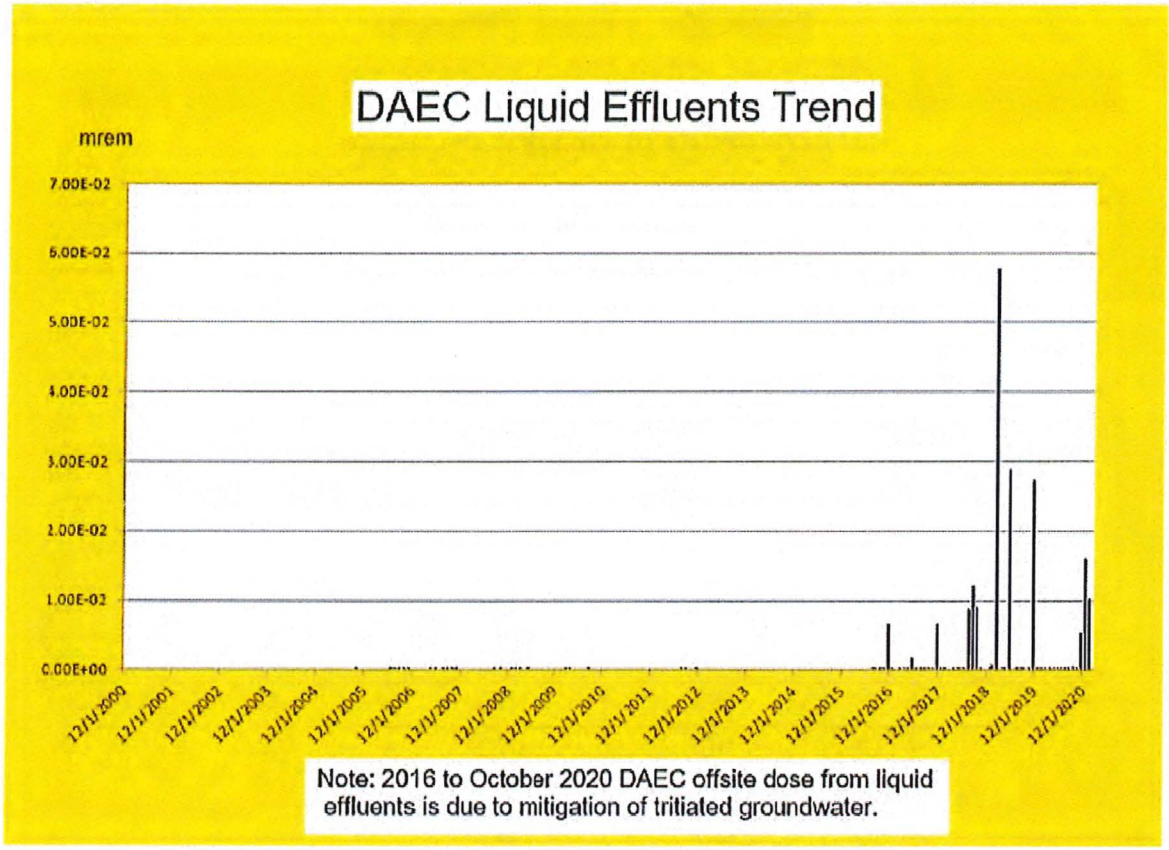
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
Fission and Activation Gases						
1. Total Release (not including Tritium, gases, alpha)	Ci	0.00E+00	0.00E+00	0.00E+00	8.03E-06	2.00E+01
2. Average Release Rate for Period	µCi/ml	0.00E+00	0.00E+00	0.00E+00	1.81E-11	
3. Percent of Applicable Limit	%	*	*	*	*	
Tritium						
1. Total Release	Ci	7.22E-03	2.64E-02	3.49E-02	3.89E+00	2.00E+01
2. Average Release Rate for Period	µCi/ml	1.70E-08	1.94E-08	2.41E-08	8.75E-06	
3. Percent of Applicable Limit	%	*	*	*	*	
Volume of Water Released (Prior To Dilution)	Liters	1.25E+06	2.25E+06	1.68E+06	3.64E+06	
Volume of Dilution Water Used During Period	Liters	4.25E+08	1.36E+09	1.45E+09	3.30E+09	

* Applicable limits have been removed from the Technical Specifications. The comparison to ODAM limits is contained in the Radiological Impact on Man section of this report.

Table 2B - Liquid Effluents

ANNUAL RADIOACTIVE MATERIAL RELEASE REPORT (2020) LIQUID EFFLUENTS (Curies)					
Nuclides Released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
strontium-89	Ci	ND[1]	ND	ND	ND
strontium-90	Ci	ND	ND	ND	ND
cesium-134	Ci	ND	ND	ND	ND
cesium-137	Ci	ND	ND	ND	6.16E-07
iodine-131	Ci	ND	ND	ND	ND
cobalt-58	Ci	ND	ND	ND	ND
cobalt-60	Ci	ND	ND	ND	3.31E-06
iron-55	Ci	ND	ND	ND	ND
iron-59	Ci	ND	ND	ND	ND
zinc-65	Ci	ND	ND	ND	ND
manganese-54	Ci	ND	ND	ND	4.10E-06
chromium-51	Ci	ND	ND	ND	ND
zirconium-niobium-95	Ci	ND	ND	ND	ND
molybdenum-99	Ci	ND	ND	ND	ND
technetium-99m	Ci	ND	ND	ND	ND
barium-lanthanum-140	Ci	ND	ND	ND	ND
cerium-141	Ci	ND	ND	ND	ND
other	Ci	ND	ND	ND	ND
tritium	Ci	7.22E-03	2.64E-02	3.49E-02	3.87E+00
xenon-133	Ci	ND	ND	ND	ND
xenon-135	Ci	ND	ND	ND	ND

1. ND means that the radionuclide was not identified in any samples using instrumentation that meets lower limit of detection as required by the DAEC Offsite Dose Assessment Manual.


DAEC Liquid Effluents Trend
mrem
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
12/1/2000
12/1/2001
12/1/2002
12/1/2003
12/1/2004
12/1/2005
12/1/2006
12/1/2007
12/1/2008
12/1/2009
12/1/2010
12/1/2011
12/1/2012
12/1/2013
12/1/2014
12/1/2015
12/1/2016
12/1/2017
12/1/2018
12/1/2019
12/1/2020
Note: 2016 to October 2020 DAEC offsite dose from liquid effluents is due to mitigation of tritiated groundwater.

SUMMARY OF RADIOACTIVE SOLID WASTE

A total of seven solid radioactive waste shipments occurred during 2020.

Five shipments of spent resin were made in 2020. Spent resin in poly liners were shipped for direct burial at Energy Solutions, located in Clive, Utah at their Containerized Waste Facility (CWF). All five shipments contained resin from the condensate system, and all were transported by highway.

Two shipment of Dry Active Waste (DAW) were shipped for processing and subsequent burial in 2020. This single shipment was sent to Energy Solution Bear Creek processing facility for sorting followed by shipping to Energy Solutions Clive, Utah facility for burial. The DAW was shipped by highway.

There were no shipments of liquid radwaste in 2020.

Shipments in 2020

Listed below are tables summarizing the Duane Arnold Energy Center's generation of Radioactive Solid Waste for the period of January 1, 2020 through December 31, 2020.

Shipments Made To Burial Facilities in 2020

WASTE TYPE	NO. SHIPMENTS	VOLUME (ft^3)	VOLUME (m^3)	ACTIVITY (curies)
Resin	5	659.7	18.68	155.93
DESTINATION	Energy Solutions, Containerized Waste Facility and Bulk Waste Facility Clive, Utah			

See Table 3A below for Major Nuclides

Shipments Made To Processing Facilities in 2020

WASTE TYPE	NO. SHIPMENTS	VOLUME (ft^3)	VOLUME (m^3)	ACTIVITY (curies)
Dry Active Waste	2	4,200	7.75	0.746
DESTINATION	Energy Solutions Bear Creek Facility in Oakridge TN The solid waste was subsequently delivered to Containerized Waste Facility and Bulk Waste Facility Clive, Utah.			

See Table 3B below for Major Nuclides

Total Solid Waste Disposition for 2020

WASTE	VOLUME (ft^3)	VOLUME (m^3)	ACTIVITY (curies)
Shipped	4,860	137.61	156.8
Buried	4,860	137.61	156.8

SOLIDIFICATION AGENT: None
MODE OF TRANSPORTATION: Exclusive-Use Vehicle (Trucks).
IRRADIATED COMPONENTS: There were no shipments of irradiated components or nuclear fuel in 2020.
See Table 3C below for Annual Summary of Major Nuclides

Waste Classification per 10 CFR 61	NUMBER OF SHIPMENTS IN 2020
A-Unstable	7
A-Stable	0
B	0
C	0

Site Historical Comparison

Year	Volume Buried(ft^3)	Activity (Ci)
2008	5.42E+03	134
2009	1.16E+04	58
2010	1.14E+04	23
2011	7.26E+03	324
2012	2.48E+04	58
2013	7.19E+03	52
2014	2.70E+04	33
2015	6.68E+03	48
2016	1.02E+03	43
2017	1.08E+04	156
2018	1.59E+04	115
2019	2.78E+03	171
2020	4.86E+03	157

Summary of Radioactive Solid Waste - Spent Resin

January 1, 2020 - December 31, 2020

Table 3A Spent Resin Major Nuclide Composition

Principle Nuclide	1st QTR (mCi)	2nd QTR (mCi)	3rd QTR (mCi)	4th QTR (mCi)	Total (mCi)	Percent Abundance
H-3	9.61E+00	5.07E+00	1.52E+01	2.07E+01	5.05E+01	0.032%
C-14	1.45E+01	7.65E+00	1.63E+01	1.35E+00	3.98E+01	0.025%
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Cr-51	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Mn-54	5.97E+03	3.17E+03	2.10E+03	1.69E+01	1.13E+04	7.219%
Fe-55	3.70E+04	1.95E+04	2.11E+04	1.10E+03	7.87E+04	50.465%
Co-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Co-58	3.22E+02	1.75E+02	1.09E+02	0.00E+00	6.06E+02	0.389%
Ni-59	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Fe-59	5.31E+01	2.94E+01	1.82E+01	0.00E+00	1.01E+02	0.065%
Co-60	4.73E+03	2.50E+03	3.37E+04	7.29E+03	4.82E+04	30.892%
Ni-63	2.39E+02	1.26E+02	1.36E+03	9.93E+01	1.82E+03	1.169%
Zn-65	7.99E+03	4.25E+03	2.64E+03	0.00E+00	1.49E+04	9.543%
Sr-89	1.40E+00	7.68E-01	4.77E-01	0.00E+00	2.65E+00	0.002%
Sr-90	6.90E-01	3.64E-01	3.98E+00	0.00E+00	5.03E+00	0.003%
Sr-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Nb-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Tc-99	8.63E+00	4.55E+00	1.06E+01	6.09E+00	2.98E+01	0.019%
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Sb-124	6.35E+00	3.46E+00	2.15E+00	0.00E+00	1.20E+01	0.008%
Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
I-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
I-129	1.69E-01	8.91E-02	2.28E+00	5.06E-02	2.58E+00	0.002%
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Cs-137	5.14E+01	2.71E+01	4.08E+01	6.67E+00	1.26E+02	0.081%
Ce-144	3.23E+01	1.72E+01	7.79E+01	7.32E+00	1.35E+02	0.086%
PU-238	0.00E+00	0.00E+00	0.00E+00	7.28E-02	7.28E-02	0.000%
Am-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Totals	5.64E+04	2.98E+04	6.11E+04	8.55E+03	1.56E+05	100.00%

Note: H-3, C-14, Tc-99 and I-129 are required to be manifested per 10 CFR 20, Appendix G.

H-3, Tc-99 and I-129 represent Minimum Detectable Activity (MDA) values
These three nuclides are calculated from uCi/cc on manifest by the material volume

Summary of Radioactive Solid Waste - Dry Active Waste

January 1, 2020 - December 31, 2020

Table 3B Dry Active Waste Major Nuclide Composition

Principle Nuclide	1st QTR (mCi)	2nd QTR (mCi)	3rd QTR (mCi)	4th QTR (mCi)	Total (mCi)	Percent Abundance
H-3	0.00E+00	3.01E-01	4.87E-01	0.00E+00	7.88E-01	0.106%
C-14	0.00E+00	2.90E-02	4.69E-02	0.00E+00	7.59E-02	0.010%
K-40	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Cr-51	0.00E+00	2.78E+00	4.50E+00	0.00E+00	7.28E+00	0.976%
Mn-54	0.00E+00	1.42E+01	2.30E+01	0.00E+00	3.72E+01	4.985%
Fe-55	0.00E+00	2.17E+02	3.51E+02	0.00E+00	5.68E+02	76.118%
Co-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Co-58	0.00E+00	6.30E-01	1.02E+00	0.00E+00	1.65E+00	0.221%
Ni-59	0.00E+00	1.26E-01	2.04E-01	0.00E+00	3.30E-01	0.044%
Fe-59	0.00E+00	8.39E-01	1.36E+00	0.00E+00	2.20E+00	0.295%
Co-60	0.00E+00	3.41E+01	5.52E+01	0.00E+00	8.93E+01	11.967%
Ni-63	0.00E+00	1.36E+01	2.21E+01	0.00E+00	3.57E+01	4.784%
Zn-65	0.00E+00	1.01E+00	1.64E+00	0.00E+00	2.65E+00	0.355%
Sr-89	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Sr-91	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Nb-95	0.00E+00	3.75E-02	6.07E-02	0.00E+00	9.82E-02	0.013%
Tc-99	0.00E+00	2.15E-02	3.49E-02	0.00E+00	5.64E-02	0.008%
Ag-110m	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Sn-113	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Sb-124	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Sb-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
I-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
I-129	0.00E+00	6.95E-03	1.12E-02	0.00E+00	1.82E-02	0.002%
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Cs-137	0.00E+00	1.33E-01	2.16E-01	0.00E+00	3.49E-01	0.047%
Ce-144	0.00E+00	1.95E-01	3.16E-01	0.00E+00	5.11E-01	0.068%
Pu-239	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Am-241	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.000%
Totals	0.00E+00	2.85E+02	4.61E+02	0.00E+00	7.46E+02	100.00%

Note: H-3, C-14, Tc-99 and I-129 are required to be manifested per 10 CFR 20, Appendix G.

H-3, Tc-99 and I-129 include Minimum Detectable Activity (MDA) values
These three nuclides are calculated from uCi/cc on manifest by the material volume

Summary of Radioactive Solid Waste - Annual Summary

January 1, 2020 - December 31, 2020

Table 3C Radwaste Annual Summary Major Nuclide Composition

Nuclide	Curies
H-3	5.13E+01
C-14	3.98E+01
K-40	0.00E+00
Cr-51	7.28E+00
Mn-54	1.13E+04
Fe-55	7.93E+04
Co-57	0.00E+00
Co-58	6.08E+02
Ni-59	3.30E-01
Fe-59	1.03E+02
Co-60	4.83E+04
Ni-63	1.86E+03
Zn-65	1.49E+04
Sr-89	2.65E+00
Sr-90	5.03E+00
Sr-91	0.00E+00
Zr-95	0.00E+00
Nb-95	9.82E-02
Tc-99	2.99E+01
Ag-110m	0.00E+00
Sn-113	0.00E+00
Sb-124	1.20E+01
Sb-125	0.00E+00
I-125	0.00E+00
I-129	2.60E+00
Cs-134	0.00E+00
Cs-137	1.26E+02
Ce-144	1.35E+02
Pu-238	7.28E-02
Am-241	0.00E+00
Total	**1.57E+02**

RADIOLOGICAL IMPACT ON MAN

The annual offsite radiation dose to a member of the public was determined by assessment of environmental dosimetry results, calculations based on monitored effluent releases, and estimates of gaseous carbon-14 releases.

Dose Contribution from Direct Radiation

Direct radiation dose from the operation of the DAEC was captured by TLDs placed at locations in the surrounding environment as described in the ODAM-DODAM. Pre-operational and 2020 TLD results were evaluated with a paired difference statistical test. The evaluation concluded that there were no significant differences in the TLD populations for the 0.5-mile, 1 mile and Control TLD populations. No measurable dose due to the operation of the DAEC was detected by environmental TLDs in 2020. In addition, compliance with 40 CFR 190 limits of 25 mrem whole body and 75 mrem thyroid is demonstrated in the Duane Arnold Energy Center 2020 Annual Radiological Environmental Operating Report, subsections "Ambient Radiation (TLDs)" and "ISFSI Facility Operations Monitoring".

Estimated Offsite Dose from Effluent Releases

The contribution of dose to a member of the public most likely to be exposed from liquid and gaseous effluent releases was calculated using the MIDAS computer program in accordance with the ODAM-DODAM. The calculation methods follow those prescribed by Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I".

Dose to members of the public from gaseous carbon-14 releases is calculated separately and is described below and on page 13.

Results of the MIDAS dose calculations are below:

1.) There were sixty-seven batch and continuous releases of radioactive material to liquid effluents in 2020. The maximum dose from tritiated liquid releases to a child's total body was 0.0000328 rem and maximum organ dose to a child's liver was 0.0000329 rem.

2.) The maximum gamma air dose from noble gases released was 0.0000157 rad located at 481 meters towards the South-Southeast from plant centerline.

3.) The maximum beta air dose from noble gases released was 0.0000181 rad at 481 meters towards the South-Southeast from the plant centerline.

4.) The whole-body dose equivalent to the hypothetical maximally exposed individual from noble gases was 0.0000053 rem at 805 meters towards the West from the plant centerline.

5.) The skin dose equivalent to the hypothetical maximally exposed individual (child) from noble gases was 0.0000096 rem at 805 meters towards the West from the plant centerline.

6.) The hypothetical maximally exposed organ due to airborne iodines and particulates with half-lives greater than eight days (excluding carbon-14) was 0.00000456 rem to the thyroid of a child at 805 meters towards the West from the centerline of the plant.

7.) The hypothetical maximally exposed organ due to airborne carbon-14 was 0.000214 rems to the bone of a child located 1,760 meters to the North from the centerline of the plant.

CONCLUSION

The contribution of dose to a member of the public most likely to be exposed from liquid and gaseous effluent releases was calculated using the MIDAS computer program in accordance with the ODAM-DODAM and site procedures. The calculated doses for gaseous and liquid effluent releases are below the regulatory limits stated in 10 CFR 50, Appendix I and in 40 CFR 190.

Estimated Maximum Offsite Individual Doses for 2020

Type	Age Group	Distance (meters)	Direction	Dose or Dose Equivalent (mrem)	Annual 10 CFR 50, Appendix I "Limit"
Direct Radiation (as measured by TLDs)				None	*
Liquid Releases					
Whole Body Dose	Child	D[1]	SE	0.0328 mrem	3 mrem
Organ Dose	Child - Liver	D[1]	SE	0.0329 mrem	10 mrem
Noble Gas					
Gamma Air Dose		481	SSE	0.0157 mrad	10 mrad
Beta Air Dose		481	SSE	0.0181 mrad	20 mrad
Whole Body	All	805	W	0.00530 mrem	5 mrem
Skin	Child	805	W	0.00960 mrem	15 mrem
Particulates & Iodines					
Organ Dose	Child – Thyroid	805	W	0.00456 mrem	15 mrem
Carbon 14					
Organ Dose	Child – Bone	1,760	N	0.214 mrem	15 mrem

* There is no Appendix I limit for direct radiation. Compliance with 40 CFR 190 limits of 25 mrem whole body and 75 mrem thyroid is demonstrated in the Duane Arnold Energy Center 2020 Annual Radiological Environmental Operating Report, subsections "Ambient Radiation (TLDs)" and "ISFSI Facility Operations Monitoring".

D[1] Receptor location is aquatic pathway at Cedar River. See ODAM-DODAM, Figure 3-2.

SUMMARY OF METEOROLOGICAL DATA

The following pages are a summation of meteorological data accumulated during the 2020 calendar year by the MIDAS software at the Duane Arnold Energy Center.

Greater than 90% data recovery was obtained for combined wind speed, delta temperature and wind direction. The table below summarizes 2020 data collection results:

Elevation and Sensors	Joint Recovery Valid Data
10-meter Wind Direction Wind Speed Delta Temp	100%
50-meter Wind Direction Wind Speed Delta Temp	99.3%

The following pages contain wind rose plots and stability class summary tables for the specified sensor heights (33 feet or 156 feet). Joint Frequency tables for each of the individual stability classes are maintained on site and are available upon request.

Stability Class Data 33'

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

			Total Period		All Hours
Period of Record =			01/01/2020 00:00 - 01/01/2021 00:00		
Elevation:	Speed:	WS33	Direction:	WD33	Lapse: DEL T

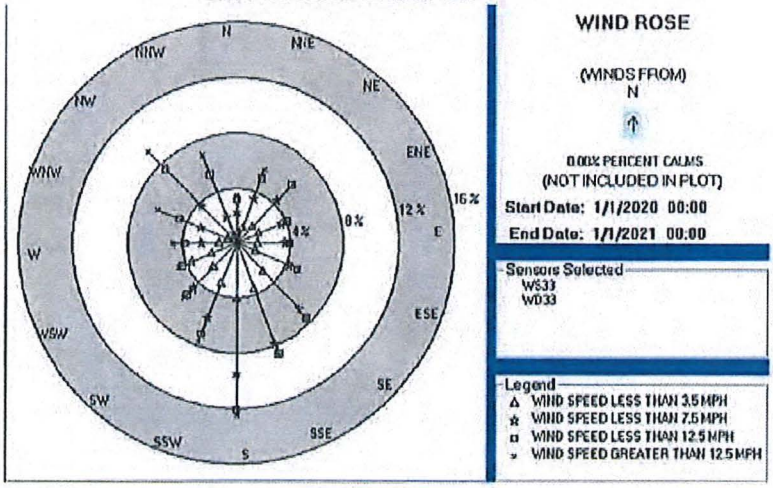
Stability Class: ALL Delta Temperature

Wind Speed (mph)

Wind Direction	1.1-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	>24.6	Total
N	53	122	81	16	1	1	274
NNE	83	190	140	47	3	1	464
NE	127	232	128	13	0	4	504
ENE	122	163	37	3	0	1	326
E	106	176	31	1	0	0	314
ESE	96	235	62	3	1	3	400
SE	212	329	65	0	0	2	608
SSE	283	351	63	1	2	5	705
S	326	465	209	34	1	2	1037
SSW	245	222	108	44	3	1	623
SW	188	185	55	15	1	4	448
WSW	155	129	62	17	7	0	370
W	99	108	110	40	25	7	389
WNW	64	181	148	93	47	5	538
NW	42	267	311	135	14	2	771
NNW	39	131	283	113	7	2	575
Total	2240	3486	1893	575	112	40	8346

Calm Hours not Included above for:	Total Period	All Hours	379
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	60
Number of Valid Hours for this Table	Total Period	All Hours	8346
Total Hours for the Period:			8785

Wind Rose Data 33'



Wind Rose (Direction From)

Stability Class Data 156'

Joint Frequency Distribution

Hours at Each Wind Speed and Direction

Period of Record = Total Period 01/01/2020 00:00 - 01/01/2021 00:00 All Hours

Elevation: Speed: WS156 Direction: WD156 Lapse: DEL T

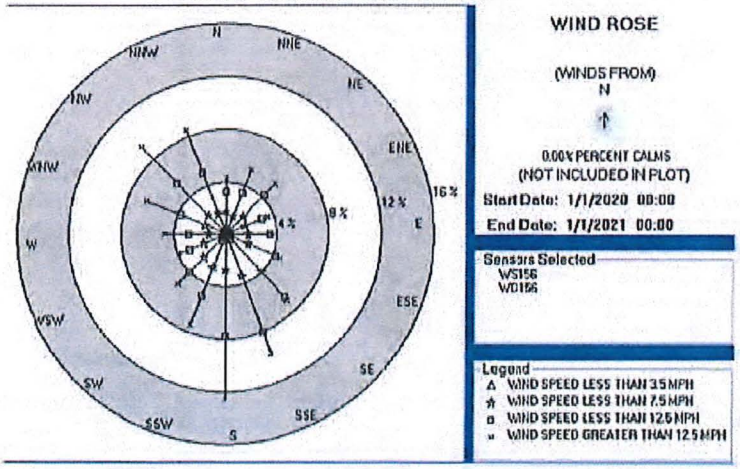
Stability Class: ALL Delta Temperature

Wind Speed (mph)

Wind Direction	1.1-3.5	3.6-7.5	7.6-12.5	12.6-18.5	18.6-24.5	> 24.6	Total
N	46	105	128	62	19	4	364
NNE	33	92	167	129	29	0	450
NE	31	132	196	100	11	0	470
ENE	23	121	120	39	1	0	304
E	31	121	144	28	1	0	325
ESE	33	137	198	36	3	0	407
SE	50	301	225	25	0	0	601
SSE	45	256	381	117	26	0	825
S	43	187	426	306	85	12	1059
SSW	51	185	195	130	46	24	631
SW	42	172	134	70	22	15	455
WSW	26	129	105	54	12	11	337
W	28	86	136	95	31	30	406
WNW	26	128	172	127	62	54	569
NW	27	145	290	224	83	16	785
NNW	30	115	288	223	54	6	716
Total	565	2412	3305	1765	485	172	8704

Calm Hours not Included above for:	Total Period	All Hours	21
Variable Direction Hours for:	Total Period	All Hours	0
Invalid Hours for:	Total Period	All Hours	60
Number of Valid Hours for this Table	Total Period	All Hours	8704
Total Hours for the Period:			8785

Wind Rose Data 156'



Wind Rose (Direction From)

SUMMARY OF GROUNDWATER PROTECTION INITIATIVE ISSUES

The Duane Arnold Energy Center has committed to the Nuclear Energy Institute's Industry Groundwater Protection Initiative - NEI 07-07. Per NEI 07-07, the following information is listed:

- Groundwater Protection Program (GWPP) samples were collected and analyzed in accordance with the requirements and guidance of the site procedures.

- The GWPP is a component of the Duane Arnold Energy Center's Radiological Environmental Monitoring Program (REMP). As such, REMP and GWPP sampling and analysis except for sewage effluent results can be found in the Duane Arnold Energy Center 2020 Annual Radiological Environmental Operating Report.

- Presented in Attachment 1 are only sewage effluent analysis lower level of detection results as determined by the site laboratory. No plant by-products were identified in sewage samples.

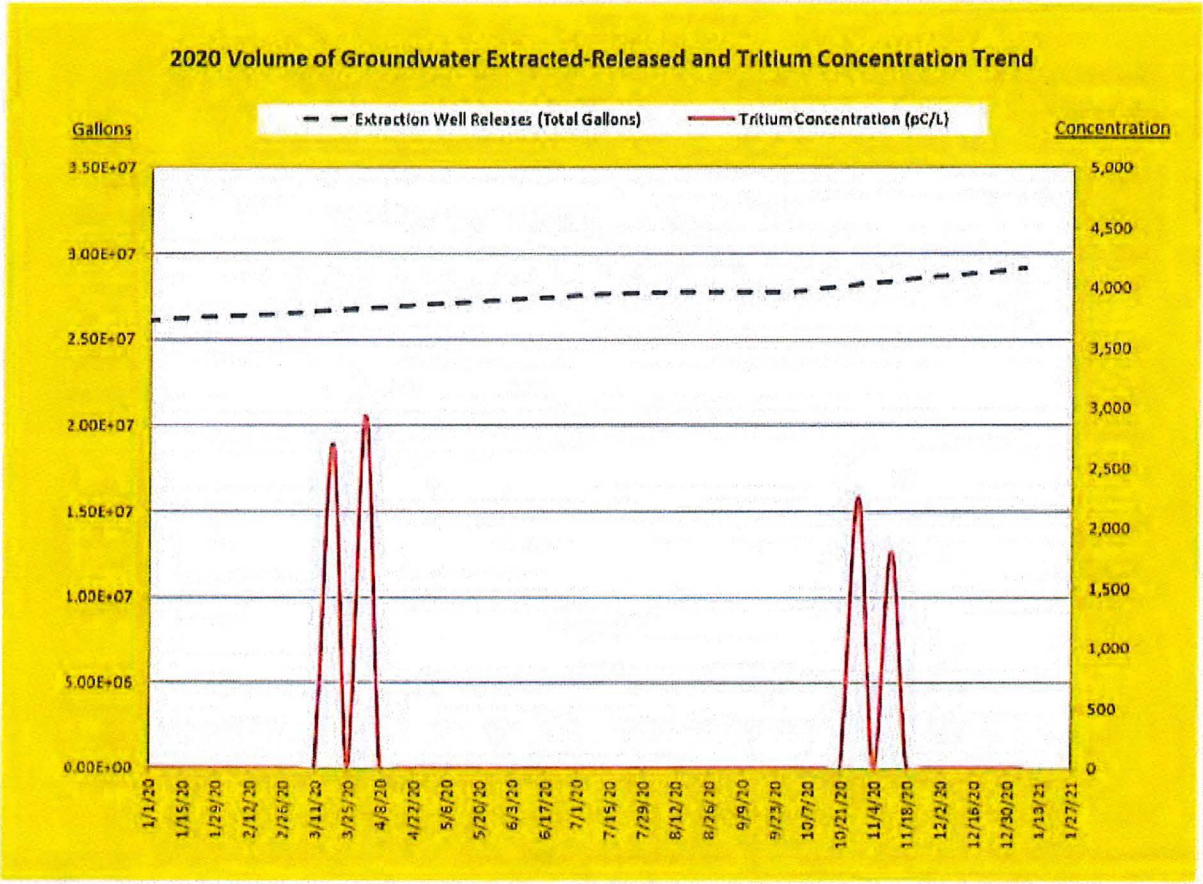
- Groundwater Protection Program details can be found in ODAM-DODAM, Table 6.3-2, Attachment 2, and sampling locations can be found in ODAM-DODAM, Table 5-1. Specifically, GWPP sample locations are identified by station number, GWPP station location, and sample type. A simplified map of environmental sample locations can be found in the ODAM-DODAM, Figure 5-1 and Figure 5-2.

- Analysis of GWPP results indicates a tritiated groundwater plume remains confined to the protected area and adjacent owner-controlled property at a depth 25 feet or less. Tritiated groundwater has not been identified outside the owner-controlled area. Tritium has not been identified in any drinking water well. In accordance with standards set forth in the ODAM-DODAM, tritiated groundwater is discharged and released as a liquid effluent.

- The Duane Arnold chemistry laboratory participates in Radiochemistry Cross Check Program with the firm Eckert & Ziegler Analytics from Atlanta, GA. The cross-check program results are available upon request.

- The vendor laboratory providing results from the Duane Arnold Energy Center's REMP and GWPP sampling is Environmental Inc. Midwest Laboratory of Northbrook, IL. The Environmental Inc. laboratory participates in several cross-check programs. These cross-check program results are presented in the 2020 Duane Arnold Energy Center Annual Radiological Environmental Operating Report or by request.

- The following graph shows the volume of groundwater released and tritium concentration trend for 2020. The data source is from the permanent groundwater mitigation system. The tritiated groundwater trend indicates a consistent absence of tritiated groundwater above 5,000 pCi/L for all of 2020. The tritiated groundwater spikes in March 2020 and October-November 2020 are due to equipment repairs and enhancements, which may have enabled temporary increase of tritiated groundwater followed by rapid decline once mitigation operations resumed.



Analysis: the variation in tritium concentration is a function of individual extraction well gallons per minute (GPM) of discharge, simultaneous operation, and the release point.

SUMMARY OF CHANGES TO THE OFFSITE DOSE ASSESSMENT MANUAL (ODAM)

Before implementation of the following described changes, a review was performed to validate that the levels of radioactive effluent control required by 10 CFR 20.1302, 40 CFR 190, 10 CFR 50.36a, and 10 CFR 50, Appendix I were not affected. The review also verified that the changes did not adversely impact the accuracy or reliability of effluent dose or set point calculations.

Revision 41 → Revision 42

- Revision 42 to the ODAM was approved/released on October 28, 2020.
- Page 5: Update acronyms and comments concerning DAEC's REMP program incorporates NEI 07-07 standards.
- Page 6: Update acronyms.
- Page 7: name change from "river" to "Cedar River".
- Page 8: document irrigation systems have not been identified downstream from DAEC. Name change from "river" to Cedar River".
- Page 9: ALARA achievement process for liquid releases.
- Page 12: remove strawberry and vegetable consumption statement.
- Page 13: name change from "river" to "Cedar River".
- Page 14: remove irrigated vegetable pathway comments.
- Page 15-16: update groundwater pathway description.
- Page 58: include new vegetation sample location at D-59
- Page 74: change to OSR 7.1.1.2 frequency from "24 hours" to "prior to release". Change to OSR 7.1.1.7 from "prior to release" to "92 Days". Change to OSR 7.1.1.8 from "prior to release" to "18 months".
- Page 129: update comments to section 8.1.1.e.
- Page 134: update comments to section 8.2.2.12.

SUMMARY OF CHANGES TO THE DE-FUELED OFFSITE DOSE ASSESSMENT MANUAL (DODAM)

ODAM Revision 42 → DODAM Revision 0

- Revision 0 to the DODAM was approved/released on April 14, 2021.
- Page 2: reference to section 3.3 removed.
- Page 5: description of cessation of operations.
- Page 7: update to section 2.1 for discharging liquid radiation waste.
- Page 18: remove section 3.3.
- Page 22: correction to time increment "*t* (yr)" to "*t* (hr)".
- Pages 24-26, 28-29, 34-36, 46, 48, 51, 63-64, and 68: grammatical spacing errors.
- Page 34: edit food pathway paragraph. Add "or, alternately" verbiage.
- Page 39: update figure 3.1 gaseous radioactive waste flow diagram.
- Page 40: update dose map and noble gas beta air dose distance.
- Page 53: update to table 5.1. Discontinue air samplers at D-3, D-6, D-7, and D-11. Discontinue D-15a soil sampling and D-16a soil and precipitation sampling.
- Page 54: update to table 5.1. Grammatical error D-31. Discontinue air sampling at D-40.
- Page 55: update table 5.1. Discontinue D-50 and D-63. Rename D-53, D-54, D-57, and D-58 as drinking water sources.
- Page 56: update table 5.1. Rename D-72 as drinking water source. Discontinue D-76, D-77, and D-81 precipitation sampling.
- Page 57: update table 5.1. Discontinue D-96, D-99, D-107a, D-108, D-109, D-110, and D-111.
- Page 58: update table 5.1. Discontinue D-112, D-113, D-114, D-115, D-116, D-118, D-127 precipitation, D-128 precipitation, D-130, D-133, and D135.

- Page 59: update table 5.1. Discontinue D-136, D-137, D-138, D-166, D-168, D-172.
- Page 60: edit "Functionality" and add the term "DODAM" to ACTIONS definition.
- Page 61: update definition of "Functional-Functionality".
- Page 62: edit to purpose section to clarify Defueled Offsite Dose Assessment Manual (DODAM) acronym.
- Page 63: edit to description section to remove "inoperable" and replace with "non-functional". Remove "MODE" and paragraph and replace.
- Page 65: remove "MODES" from OLCO 6.0.3.0.1 and OLCO 6.0.3.0.4. update OLCO 6.0.3.0.5 to include "non-functional" and "FUNCTIONALITY" terms.
- Page 66: include "non-functional" term and grammatical spacing edit. Remove "MODE" from OSR 7.0.3.0.4.
- Page 67: update table 6.1-1 section A to include terms "non-functional" and "FUNCTIONAL"
- Page 68: update note section to include terms "non-functional" and "FUNCTIONAL"
- Page 69: update table 6.1-1/7.1-1 to include "Functional" and update to table notation "c".
- Page 73: update table 7.1-2 grammatical spacing errors with table notations.
- Page 75: update table notations for grammatical spacing errors.
- Page 76: OCLO 6.1.3 paragraph grammatical spacing error.
- Page 78: include in section A.1 "non-functional" term instead of "inoperable".
- Page 80: section A.4 grammatical spacing error.
- Page 81: section OSR 7.1.5.1 grammatical spacing error.
- Page 82: OCLO 6.2.1.1 include "FUNCTIONAL" term and in section A. include "non-functional" term and section A.2 include "FUNCTIONAL" term.
- Page 83: section G and G.1 include "functional" term.

- Page 84: in NOTE section include "FUNCTIONAL" and "non-functional" terms.
- Page 85: under the table 6.2-1 title include "Functional" term in minim channels.
- Page 86: table notation for (b) include "FUNCTIONAL" and "non-functional" terms and grammatical spacing errors.
- Page 87: remove sections O 6.2.1.2 for off-gas system, table 6.2-2 and grammatical spacing error in section OCLO 6.2.2 subsection a.
- Page 88: remove reference in Frequency for post-treat rad. Monitor under OSR 7.2.2.2. and OSR 7.2.2.3. Remove sections OSR 7.2.2.5 and OSR 7.2.2.7.
- Page 89: remove table 7.2-2 surveillance requirements OSR 7.2.2.5 and OSR 7.2.2.7. Include section "A" as "Deleted". Grammatical spacing error in table notation (d).
- Page 90: table 7.2-2 table notation remove analysis time requirements for 50% increase in releases for post-treat noble gas monitor.
- Page 94: grammatical spacing error in 30-day frequency.
- Page 95: remove section O 6.2.5 and O 6.2.6 and include "timely" in B.1 paragraph.
- Page 100: update for REMP minimum number of sampling stations in table 6.3-1. Remove milk sampling.
- Page 101: update table 6.3-2 minimum number of groundwater sampling stations. Remove soil and precipitation sampling.
- Page 105: update radioactive liquid effluent instrumentation to include the "FUNCTIONAL" and "non-functional" terms.
- Page 106: grammatical spacing error in 5th paragraph.
- Page 107: under the Liquid Waste Treatment paragraph include "followed" term.
- Page 108: grammatical spacing errors.
- Page 109: grammatical spacing errors.
- Page 110: include the "FUNCTIONALITY", "FUNCTIONAL", and "non-functional" terms in paragraphs 1-3. Remove paragraph referencing two air injectors and off-gas post-treatment monitors.

- Page 111: remove reference to standby gas treatment system and section 6.2.5 and 7.2.5 for gaseous radwaste treatment. Include line space after paragraph 4 ending with "waste streams."

- Page 113: grammatical spacing error section 8.1.1.g.2

- Page 115: grammatical spacing error 8.2 Reporting Requirements.

- Page 119: remove 8.2.3.2 special reports referencing off-gas system. Add section "2. Deleted".

- Page 120: include "document" term in 8.3.a. Include "Decommissioning" in 8.3.b. Include "changed and" in 8.3.c.

- In Appendix A, remove dose transfer factors for radionuclides in effluent air. Pathways for cow milk for adult, teenager, child, and infant and goat milk for adult, teenager, child, and infant.

    - Remove pages 125-126, 132-133, 139-140, and 146-147.

- In Appendix C, remove pathway references to irrigated fresh leafy vegetables, irrigated stored vegetables, fruit, and grain, freshwater invertebrates, irrigated grass cow milk-cow meat, and irrigated stored forage cow milk-cow meat.

    - Remove pages 161-176, 189-204, 217-232, and 245-260

Revision:	34	35	36	37	38	39	40	41	42	DODAM-0
Date:	12/18/15	3/1/16	9/2/16	2/9/17	1/2/18	4/5/18	3/11/19	4/6/20	10/28/20	4/14/21

ATTACHMENT 1: SEWAGE EFFLUENT-DAEC LABORATORY

There were 53 sewage effluent samples collected in 2020. There were no plant by-products identified in the samples. The maximum value for the lower limit of detection (LLD) for environmental sample analysis are noted below and in the ODAM-DODAM, Table 6.3-3.

SEWAGE SAMPLES	
Activity	Maximum Value for the Lower Limit of Detection (pCi/L)
Gross Beta	4
Tritium	2,000[a] 3,000[b]
Mn-54	15
Fe-59	30
Co-58	15
Co-60	15
Zn-65	30
Zr-95	30
Nb-95	15
I-131	1[a] 15[b]
Cs-134	15
Cs-137	18
Ba-140	60
La-140	15
Other [c]	30
[a] Drinking water	
[b] Non-drinking water	
[c] Non-routine, plant by-products	