ADP CR3, LLC

Crystal River Nuclear Plant
2760 South Falkenburg Rd
Riverview, FL 33578
Docket 50-302
Docket 72-1035
Operating License No. DPR-72

ODCM

April 6, 2021
3F0421-02

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

Subject: Crystal River Unit 3 – 2020 Annual Radiological Environmental Operating Report

Dear Sir or Madam:

ADP CR3, LLC hereby provides the 2020 Annual Radiological Environmental Operating Report for Crystal River Unit 3 in accordance with the Offsite Dose Calculation Manual (ODCM). The data provided in the attached report is consistent with the objectives outlined in the ODCM and includes all radiological environmental samples taken during the report period from January 1, 2020 through December 31, 2020.

This letter contains no new regulatory commitments.

If you have any questions regarding this submittal, please contact Mr. Mark Van Sicklen, Licensing Manager, at (352) 436-5572.

Sincerely,

Phyllis A. Dixon
ISFSI Manager

PAD/mvs

Attachment 1: 2020 Annual Radiological Environmental Operating Report

cc: NMSS Project Manager
Regional Administrator, Region I

ADP CR3, LLC

DOCKET NUMBER 50-302 / 72-1035
LICENSE NUMBER DPR-72

ATTACHMENT 1

2020 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

2020

ADP CR3, LLC

CRYSTAL RIVER UNIT 3

TABLE OF CONTENTS

INTRODUCTION

This report is submitted as required by procedure CP-500: Special Actions and Reporting Requirements, Section 4.4.1.1, and the Offsite Dose Calculation Manual (ODCM).

The following information is required to be included in this report:

- Data Summaries
- Interpretations
- Unachievable LLDs
- An analysis of trends
- An assessment of any observed impact of plant operation on the environment

  NOTE: If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to correct it.

- Summarized and tabulated results of all radiological environmental samples taken during the report period, in the format of Radiological Assessment Branch Technical Position, Revision 1, November 1979.

  NOTE: If some results are not available for inclusion, the report shall note and explain the reason for the missing results. The missing results shall be submitted as soon as possible in a supplementary report.

- A summary description of the Radiological Environmental Monitoring Program.
- A map of all sampling locations keyed to a table giving distances and directions from the reactor.
- Land-use census results.
- Inter-laboratory Comparison Program results.
- A discussion of airborne sample station availability.
- Results of any unplanned release or spill of radioactive material that could have the potential to contaminate the groundwater as reported to maintain compliance with the groundwater protection initiative (NEI 07-07).

Additional Information

On February 5, 2013, Duke Energy decided to permanently retire Crystal River Unit 3. The decision was made due to the risk associated with repairing the containment building's delaminated concrete wall. The company placed the facility in a SAFSTOR status until Sept 30th, 2020. Beginning on October 1st 2020, the site radiological license was transferred from Duke Energy to ADP CR3, LLC and active decommissioning commenced. Also in 2020, CR3 received approval from the NRC to reduce the licensed area of the site to 884 acres as part of the Partial Site Release project. This had no effect on any REMP sample location or REMP sample frequency. Additionally, all spent nuclear fuel was transferred from the spent fuel pool to the onsite Independent Spent Fuel Storage Installation (ISFSI) for dry storage in January 2018 and most plant systems have been abandoned.

I. SUMMARY DESCRIPTION OF THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The analytical results of the Crystal River Unit 3 (CR-3) operational Radiological Environmental Monitoring Program (REMP) for 2020 are contained in this report. The operational program began on January 1, 1977 just prior to initial criticality, which was achieved on January 14, 1977.

Sampling of the facility environs is performed by the State of Florida Department of Health, Bureau of Radiation Control. The State also performs the required analyses, participates in the Interlaboratory Comparison Program, and performs the annual land-use census. Prior to 1990, the program was split between the Department of Health and the University of Florida.

Sample station locations are given in Table I-1 and Figures I-2, I-3, I-4, and I-5. Sample frequency and analysis type is shown on Table I-2. Figure I-1 illustrates the relevant exposure pathways. Regarding waterborne pathways, the groundwater area of the Crystal River site is too saline to be used as a source of drinking water, hence there is no credible drinking water intake pathway. Additionally, the Florida aquifer groundwater flows in a west-southwest direction across the site toward the Gulf of Mexico, and since the location of the site is along the coast, there is no downstream public impact regarding groundwater.

Except for air sample gross beta results and direct radiation measurements, most of the analytical results are below the lower limit of detection (LLD) of the sample. Sample LLDs are generally much lower than the required "a priori" LLD listed in the ODCM. When measurable results are reported, the values are also usually less than the required "a priori" LLD.

Trace levels of Cs-137 are still occasionally seen in vegetation samples due to past global fallout. The vegetation control sample station located in Orlando, Fl. is also experiencing similar Cs-137 deposition on the broad leaf sample media.

The results of the 2020 REMP samples have been compared to previous years' results. This comparison, in part illustrated by the trend graphs of Section IV, shows no evidence of consistent long-term increasing trends in any of the sample media. However, CR3 plant related radioactive material is occasionally quantified in sediment samples which are taken in the discharge canal near the liquid release discharge point. In general, these results verify the effectiveness of in-plant measures for controlling radioactive releases.

Trend graphs illustrate the mean measured concentration of a particular radionuclide for the year. When measurable results are not obtained, the highest sample LLD is plotted. LLD and measured values are plotted on the same line to best illustrate any trend.

Statistical summary pages are provided for each medium or pathway. Measured values are reported in terms of a mean and range. In addition, the number of measured values versus samples obtained is reported. For example, in the following entry;

15 (249/256)
(4 - 35)

the "All Indicator Locations" column would be interpreted as indicating a mean measured value of 15, with measured values ranging from 4 to 35. (249/256) means that out of 256 samples, 249 were measured values.

TABLE I-1

DUKE ENERGY FLORIDA, LLC - CR3 - 2020

SAMPLE STATION LOCATIONS

SAMPLE MEDIA	STATION ID	DIRECTION	APPROX. DISTANCE (Miles)
TLD – on-site	C60	N	0.88
	C61	NNE	0.92
	C62	NE	1.17
	C63	ENE	0.87
	C64	E	0.80
	C65	ESE	0.33
	C66	SE	0.36
	C67	SSE	0.33
	C68	S	0.27
	C69	SSW	0.31
	C41	SW	0.43
	C70	WSW	0.74
	C71	WNW	0.58
	C72	NW	0.30
	C73	NNW	0.74
	C27	W	0.41
TLD – off-site	C18	N	5.3
	C03	NNE	4.89
	C04	NE	5.95
	C74	ENE	5.13
	C75	E	3.99
	C76	ESE	5.61
	C08	SE	5.66
	C77	SSE	3.39
	C09	S	3.23
	C14G	W	2.0
	C01	NW	4.8
	C79	NNW	4.97
	C47-Control	ESE	78
	C07*	ESE	7.67
	C40*	E	3.48
	C46*	N	0.37

*TLDs not required by ODCM. Deployed at air sample locations.

TABLE I-1 (CONT'D)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

SAMPLE STATION LOCATIONS

SAMPLE MEDIA	STATION ID	DIRECTION	DISTANCE (Miles)
AIR	C07	ESE	7.7
	C18	N	5.3
	C40	E	3.5
	C41	SW	0.4
	C46	N	0.4
	C47-Control	ESE	78
SEAWATER	C14H	NW	0.1
	C14G	W	2.0
	C13-Control	WSW	4.6
GROUND WATER	C40-Control	E	3.6
SITE GROUND WATER	CR3-2	E	0.1
	CR3-4	SSE	0.086
	CR3-5	SSW	0.051
	CR3-6S	W	0.038
	CR3-6D	W	0.038
	CR3-7	WNW	0.060
	CR3-8	WNW	0.073
	CR3-9	NW	0.1
	CR3-10	NNE	0.1
DRINKING WATER	C07-Control	ESE	7.4
	C10-Control	ESE	6.0
	C18-Control	N	5.3
SHORELINE SEDIMENT	C09-Control	S	3.2
	C14H	NW	0.1
	C14M	W	1.2
	C14G	W	2.0
FISH & OYSTERS	C29	W	2.5
	C30-Control	WSW	3.4
BROAD LEAF VEGETATION	C48A	N	0.4
	C48B	ENE	0.9
	C47-Control	ESE	78
WATERMELON	C04	NE	6.0
CITRUS	C19	ENE	9.6

TABLE I-2

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

SAMPLING AND ANALYSIS PROGRAM

SAMPLE MEDIA	# OF STATIONS	FREQUENCY	ANALYSIS		LLD[1]
TLD	32*	Quarterly	γ Dose		---
Air Particulate	6	Weekly	Gross ß		0.01 pCi/m^3
		Quarterly	γ Spec :	Cs-134	0.05[e]
				Cs-137	0.06[e]
Seawater	3	Monthly	Tritium		2000[b] pCi/L
		Monthly	γ Spec :	Mn-54	15
				Fe-59	30
				Co-58	15
				Co-60	15
				Zn-65	30
				Zr-Nb-95	15[c]
				Cs-134	15
				Cs-137	18
				Ba-La-140	15[c]
Ground Water	1	Semiannual	Tritium		2000[b] pCi/L
		Semiannual	γ Spec :	[2]	[2]
Site Ground Water[6]	9	Quarterly	Tritium		2000[b] pCi/L
		Quarterly	γ Spec :	[2]	[2]
Drinking Water	3	Quarterly	Tritium		2000[b] pCi/L
		Quarterly	γ Spec :	[2]	[2]
Shoreline Sediment	4	Semiannual	γ Spec :	Cs-134	150 pCi/kg
				Cs-137	180

* Includes 3 stations which are not required by the ODCM
[1] The maximum "a priori" LLD listed in the ODCM
[2] Same as Seawater γ Spec
[6] Additional 2 stations reported that are not required by the ODCM
[b] LLD for drinking water. If no drinking water pathway exists, a value of 3000 pCi/L may be used
[c] The specified LLD is for an equilibrium mixture of parent and daughter nuclides which contain 15 pCi/L of the parent nuclide
[e] LLDs apply only to quarterly composite gamma spectral analysis, not to analyses of single particulate filters

TABLE I-2 (Cont'd)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

SAMPLING AND ANALYSIS PROGRAM

SAMPLE MEDIA	# OF STATIONS	FREQUENCY	ANALYSIS		LLD[1]
Carnivorous Fish and Oysters	2	Quarterly	γ Spec :	Mn-54	130 pCi/kg
				Fe-59	260
				Co-58	130
				Co-60	130
				Zn-65	260
				Cs-134	130
				Cs-137	150
Broad Leaf Vegetation	3	Monthly[3]	γ Spec :		
				Cs-134	60
				Cs-137	80
Watermelon	1	Annual[4]	γ Spec :	[5]	[5]
Citrus	1	Annual[4]	γ Spec :	[5]	[5]

[1] The maximum "a priori" LLD
[3] When available
[4] During harvest
[5] Same as broad leaf vegetation

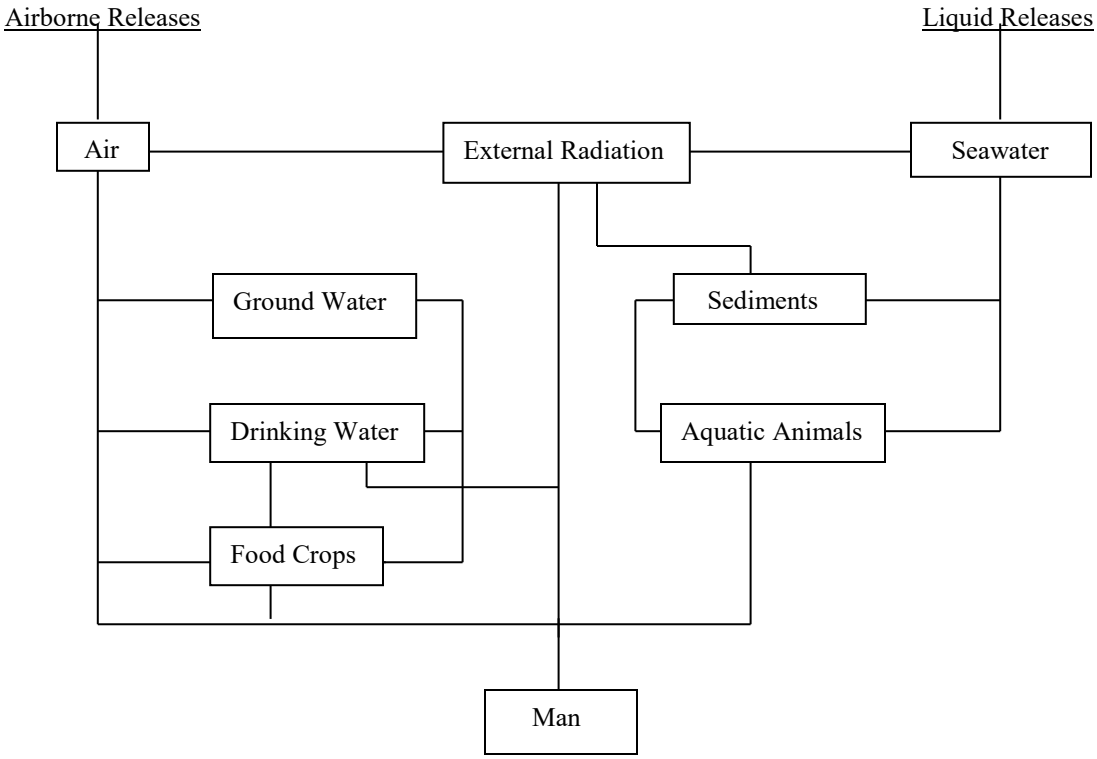


FIGURE I-1: Environmental Media and Exposure Pathways

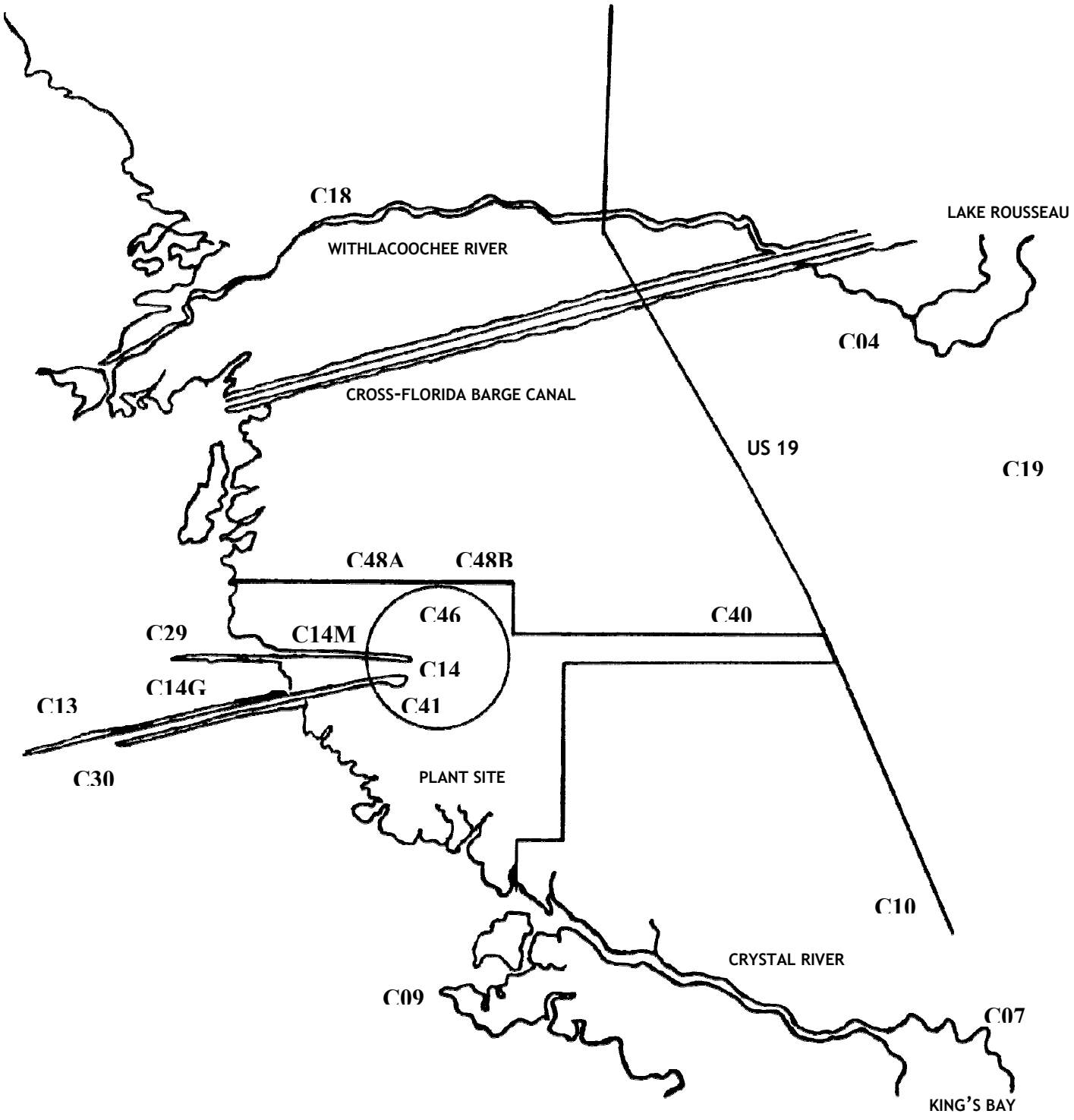


FIGURE I-2: Environmental Monitoring Sample Stations (non-TLDs)

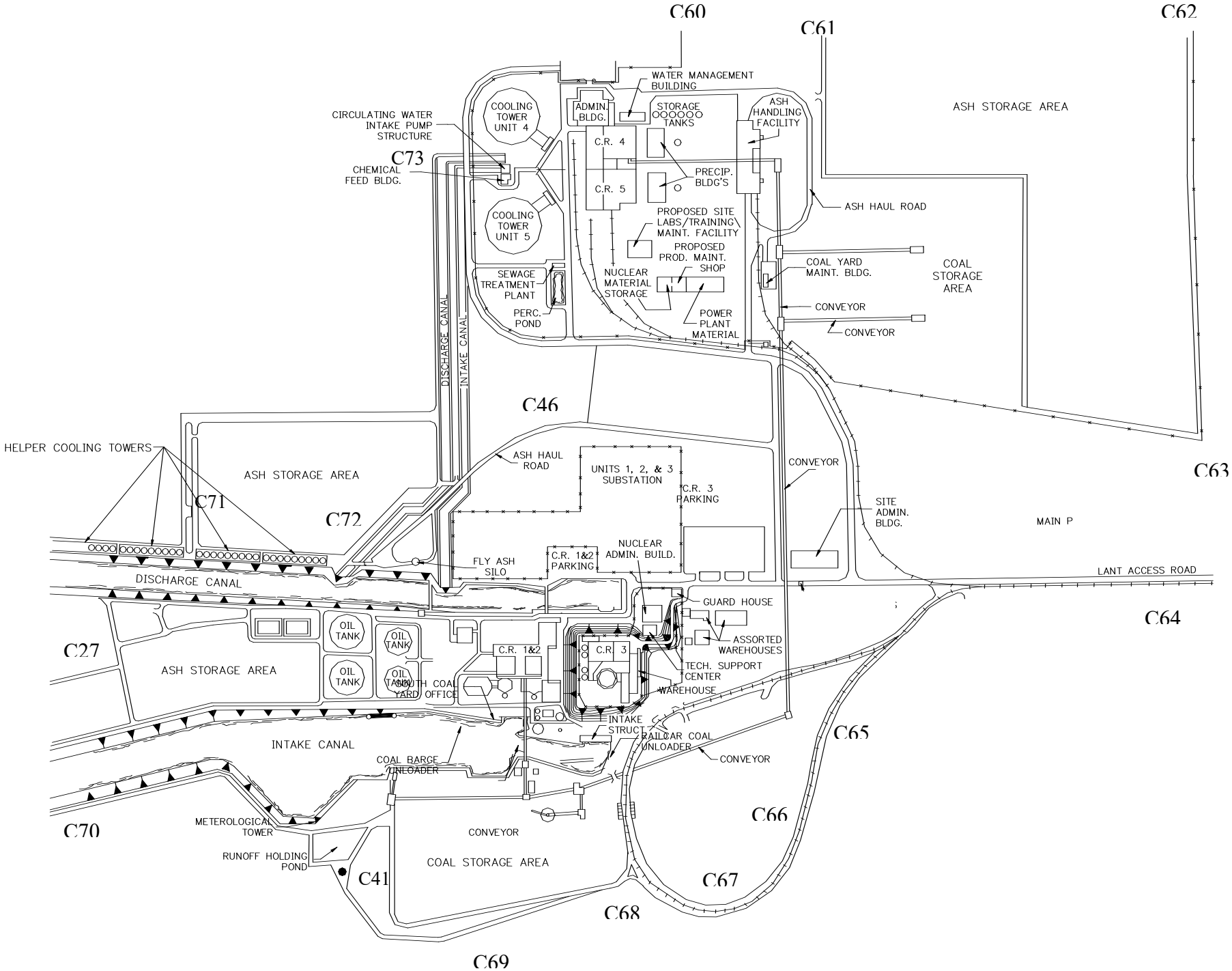


FIGURE I-3: Environmental Monitoring TLD Locations (on site)

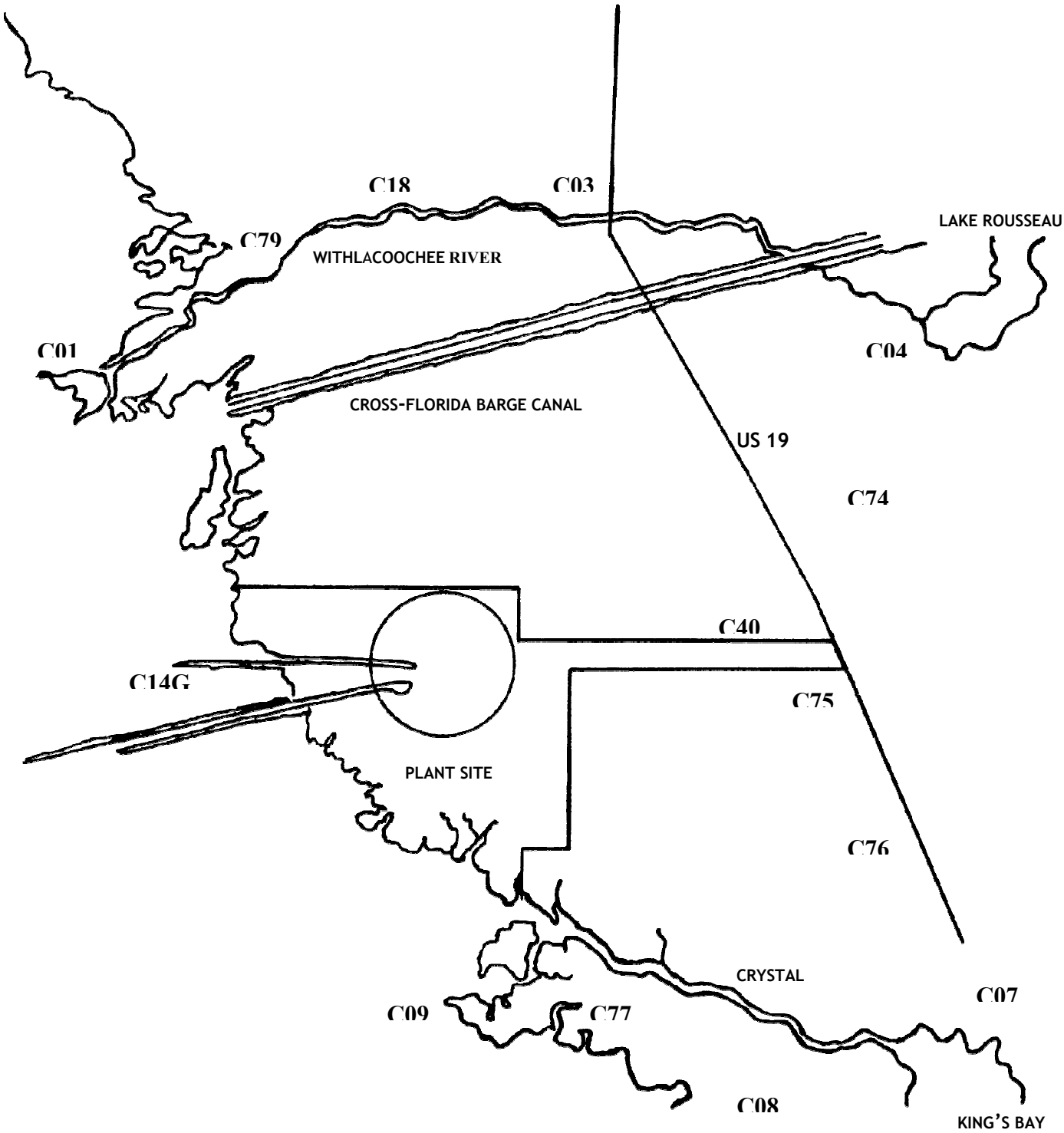
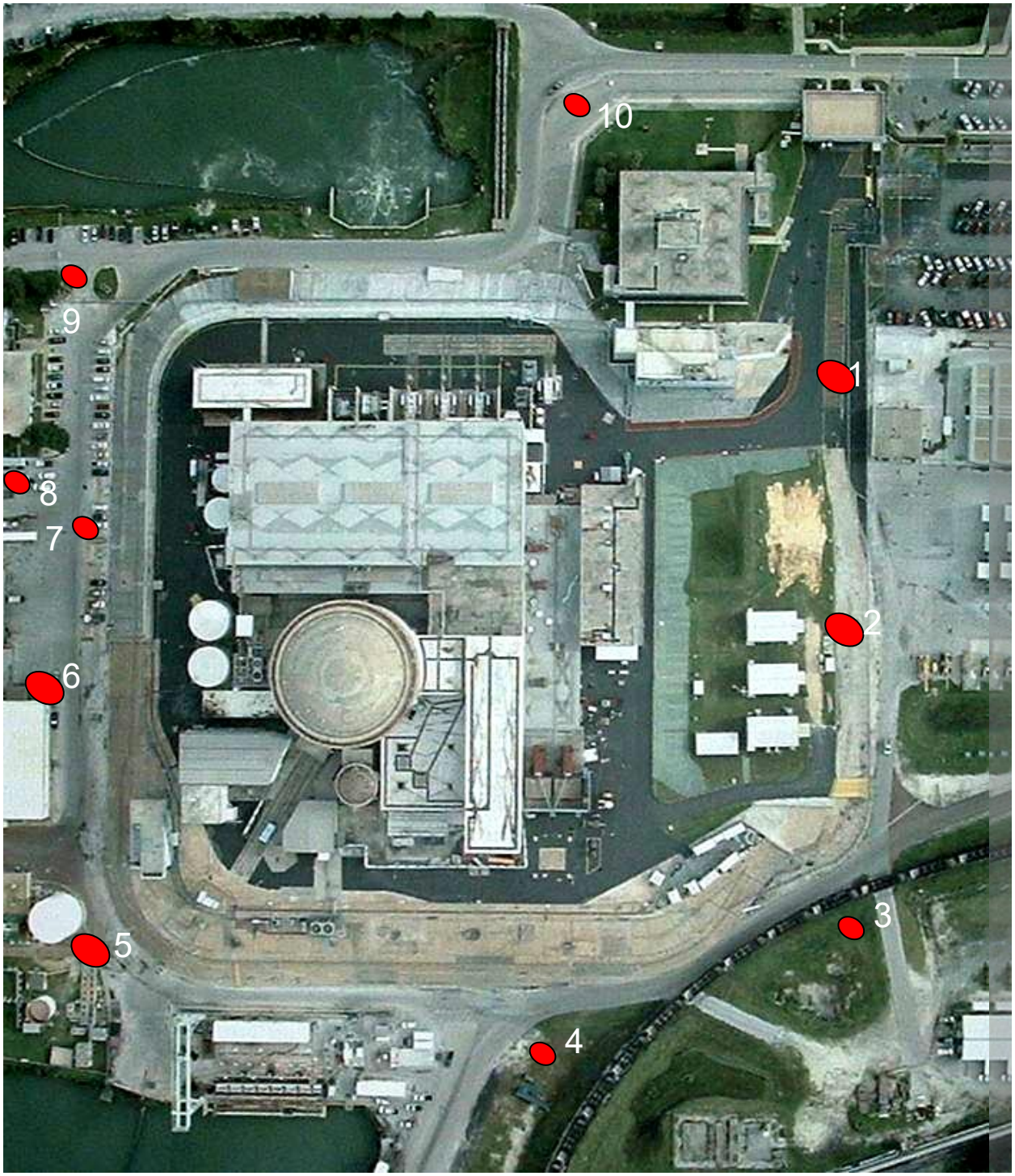


FIGURE I-4: Environmental Monitoring TLD Locations (off site)

Figure I-5: CR3 Groundwater Monitoring Well Locations
Deep Wells Are Also Installed at #'s 1, 3, 6



II. LAND-USE CENSUS

A 2020 land-use census was conducted in May and June. The purpose of the census is to identify the nearest residences, vegetable gardens, and potential milk-producing animals within a five-mile radius of the nuclear plant. The distance in miles and bearing in degrees for each receptor type in each of the sixteen sectors is summarized below. The garden in the ENE sector that was present in 2019 was not present in 2020. Otherwise, there were no changes from the prior 2019 land-use census.

SECTOR	NEAREST RESIDENCE	NEAREST GARDEN (A)	NEAREST MILK ANIMAL
N	4.5 @ 2º	*	*
NNE	4.6 @ 15º	*	*
NE	3.8 @ 54º	*	*
ENE	3.4 @ 57º	*	*
**E	2.4 @ 92º	*	*
ESE	4.2 @ 102º	*	*
SE	4.8 @ 133º	*	*
SSE	3.5 @ 149º	*	*
S	*	*	*
SSW	*	*	*
SW	*	*	*
WSW	*	*	*
W	*	*	*
WNW	*	*	*
NW	4.8 @ 321°	*	*
NNW	4.6 @ 339º	*	*

(A) - Only gardens with an estimated total area of 500 square feet, or more, and producing green leafy vegetables are considered.

* No suitable sites were located within 5 miles.
** Not a permanent resident but occupied intermittently by various DEP personal

III. FLORIDA DEPARTMENT OF HEALTH - INTERLABORATORY COMPARISON PROGRAM DATA

The EPA crosscheck program ceased operation at the end of 1998. To meet the requirements for a crosscheck program, the Florida Department of Health participates in the Department of Energy's Mixed-Analyte Performance Evaluation Program (MAPEP). For 2020, all results were within the indicated Acceptance Ranges, as shown below.

The following units are used for each of the four media:

Air Filters: Bq/sample
Soil: Bq/Kg
Vegetation: Bq/sample
Water: Bq/L

Analytical performance is based on historical analytical capabilities for individual analyte/matrix pairs.
Acceptable performance is designated by an "A".
Acceptable with warning is designated by a "W".
Performance which is not acceptable is designated by an "N".

MAPEP Results for February 2020:

Media	Nuclide	Result	% Bias	Acceptance Range	Flag
Air Filter	Cs-134	0.585	-2.5	0.420-0.780	A
Air Filter	Cs-137	0.766	4.2	0.515-0.956	A
Air Filter	Zn-65	1.380	16.9	0.83-1.53	A
Air Filter	Co-60	1.270	3.3	0.86-1.60	A
Air Filter	Mn-54	0.001	-	False Positive Test	A
Soil	Cs-134	1166.54	4.7	780-1448	A
Soil	Cs-137	1054.0	3.3	714-1326	A
Soil	Co-57	994.20	-7.2	750-1392	A
Soil	Co-60	0.87	-	False Positive Test	A
Soil	Mn-54	980.20	3.7	662-1229	A
Soil	Zn-65	804.80	7.2	526-976	A
Vegetation	Cs-134	3.664	-4.1	2.67-4.97	A
Vegetation	Cs-137	2.867	3.5	1.94-3.60	A
Vegetation	Co-57	-0.011	-	False Positive Test	A
Vegetation	Co-60	2.733	-2.0	1.95-3.63	A
Vegetation	Mn-54	4.867	6.3	3.21-5.95	A
Vegetation	Zn-65	3.983	5.1	2.65-4.93	A
Water	Cs-134	17.547	-5.2	13.0-24.1	A
Water	Cs-137	11.68	3.4	7.9-14.7	A
Water	Co-60	10.45	-1.4	7.4-13.8	A
Water	Mn-54	8.262	-1.6	5.9-10.9	A
Water	Zn-65	22.120	-0.4	15.5-28.9	A
Water	H-3	211.43	7.9	137-255	A

IV-A. AIRBORNE PATHWAY

Air samples are taken at five locations near the plant. The control location (station C-47) is 78 miles ESE of the plant, at the Department of Health, State Bureau of Radiation Control, in Orlando.

Table IV-A.1 provides a statistical summary of the analytical results for 318 gross beta samples.

Tables IV-A.2 and IV-A.3 provide the results for each weekly air sample.

In 2020, 318 particulate samples were analyzed for gross beta activity, and 317 had measurable activity above LLD. For the week of June 15th, location C41 only had a run time of 4.5 hours and the gross beta result was below the LLD. The average indicator concentration was 16 pCi/1000 m^3 with a range of 4 to 38 pCi/1000 m^3. In 2019 the average value was 18 pCi/1000 m^3. The average indicator concentration since 1996 has been in the range of 14 to 24 pCi/1000 m^3. The control location concentration for 2020 averaged 14 pCi/1000 m^3, with a range of 6 to 26 pCi/1000 m^3. The control location in 2019 averaged 17 pCi/1000 m^3. In 2020, location C18 (along with C7 and C40) had the highest yearly indicator concentration at 17 pCi/1000 m^3. C18, along with C7 and C41, was the highest location in 2019, with an average of 18 pCi/1000 m^3.

Quarterly composite data are summarized in Table IV-A.3. In 2020, measurable quantities of cesium were not identified in any particulate filter sample. The highest cesium LLD was 1.2 pCi/1000 m^3 for Cs-137, versus 1.1 pCi/1000 m^3 in 2019.

The 2019 airborne sample data is comparable with previous year's sample data with exception of samples collected in 2011 during the March and April time frame where airborne particulate and iodine samples were affected by the Fukushima earthquake and tsunami event that occurred on March 11, 2011. Those sample data were thoroughly discussed in the 2011 Annual Radiological Environmental Operating Report submitted for Crystal River Unit 3.

There were nine instances of an air sampler partial run time. They were identified during the routine weekly sample change-outs.

1. C41: 17-Feb-20 - Power outage. Estimated run time 130.6 out of 167.5 hours.
2. C41: 10-Mar-20 - Power outage. Estimated run time 141.2 out of 166 hours.
3. C41: 15-Jun-20 - No power. Estimated run time 4.5 out of 167.7 hours. Power restored later the same day. (Documented in CR3 NCR 02335601)
4. C46: 15-Jun-20: Power outage. Estimated run time 146.9 out of 169.6 hours.
5. C41: 19-Oct-20 – No power discovered on 12-Oct-20. Power restored 17-Oct-20 at 18:15. Ran 40 hours before collection. (Documented in CR3 NCR 2020000006)
6. C07: 26-Oct-20 – No power. Estimated run time 90 out of 168.3 hours. (Documented in CR3 NCR 2020000010)
7. C46: 7-Dec-20 – Pump not working. Estimated run time 117.2 out of 169 hours.
8. C47: 10-Dec-20 – No power. Estimated run time 158.9 out of 192.4 hours for the period 12/7 to 12/15. Power restored on 12/10/20. (Documented in CR3 NCR 2020000028)
9. C41: 21-Dec-20 – Power outage. Estimated run time 128.6 out of 143.5 hours.

The yearly percentages of missed (zero) or partial air samples (nine) was less than 3.4 % of the total indicator samples (265) collected.

TABLE IV-A.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIRBORNE PARTICULATES (pCi/1000m^3 for Gross ß, pCi/1000m^3 for γ Spec)	Gross ß 318	4.0	16 (259/260) (<1–38)	C18 5.3 miles North	17 (52/52) (7–33)	14 (52/52) (6–26)	0
	γ Spec 24						
	Cs-134	1.7	<LLD	--	--	<LLD	0
	Cs-137	1.5	<LLD	--	--	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

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TABLE IV-A.2

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/1000m^3 GROSS ß IN AIR

	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
07-Jan-20	20	19	17	13	17	18
14-Jan-20	9	13	14	10	12	12
21-Jan-20	17	17	20	17	16	15
27-Jan-20	21	23	15	24	21	14
03-Feb-20	19	20	15	14	13	16
10-Feb-20	20	22	22	19	12	17
17-Feb-20	10	12	9	9	9	6
25-Feb-20	12	18	11	10	9	8
03-Mar-20	16	17	14	12	12	12
10-Mar-20	10	11	15	14	12	10
16-Mar-20	13	13	18	13	12	6
23-Mar-20	14	14	19	11	10	13
30-Mar-20	22	22	20	15	14	20
Average:	**15**	**17**	**16**	**14**	**13**	**12**

TABLE IV-A.2 (Cont'd)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/1000m^3 GROSS ß IN AIR

	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
06-Apr-20	20	19	20	20	16	17
13-Apr-20	27	26	25	23	23	19
20-Apr-20	25	23	20	19	18	22
27-Apr-20	17	15	12	19	18	17
04-May-20	16	17	15	20	18	17
11-May-20	20	22	19	21	16	18
18-May-20	19	20	17	19	18	14
26-May-20	20	19	23	19	24	13
02-Jun-20	14	13	18	16	15	15
08-Jun-20	14	9	8	12	10	8
15-Jun-20	14	11	13		13	11
23-Jun-20	21	24	22	22	21	11
29-Jun-20	19	18	20	15	16	14
Average	**19**	**18**	**18**	**19**	**17**	**15**

TABLE IV-A.2 (Cont'd)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/1000m^3 GROSS ß IN AIR

	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
07-Jul-20	16	14	13	13	17	12
13-Jul-20	21	19	24	23	24	17
21-Jul-20	20	16	20	17	16	18
27-Jul-20	10	8	9	6	14	7
03-Aug-20	20	17	20	17	22	14
10-Aug-20	14	14	13	11	12	10
17-Aug-20	14	16	16	14	16	10
25-Aug-20	14	13	13	9	12	12
31-Aug-20	12	9	11	11	9	7
08-Sep-20	23	20	19	13	17	20
14-Sep-20	9	7	13	8	9	7
21-Sep-20	12	11	6	8	6	6
28-Sep-20	19	19	14	14	14	10
Average	**19**	**19**	**14**	**14**	**14**	**10**

TABLE IV-A.2 (Cont'd)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/1000m^3 GROSS ß IN AIR

	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
05-Oct-20	19	18	20	18	19	19
12-Oct-20	11	12	8	11	14	10
19-Oct-20	31	27	32	33	35	22
26-Oct-20	9	5	6	10	8	7
02-Nov-20	16	15	16	14	19	17
09-Nov-20	17	11	13	13	12	13
16-Nov-20	10	10	10	10	10	6
23-Nov-20	7	10	10	4	12	11
30-Nov-20	20	17	20	15	17	11
07-Dec-20	27	28	27	26	22	22
15-Dec-20	33	38	32	28	31	26
21-Dec-20	20	22	22	30	22	22
28-Dec-20	20	25	28	21	21	17
Average	**18**	**18**	**19**	**18**	**19**	**16**

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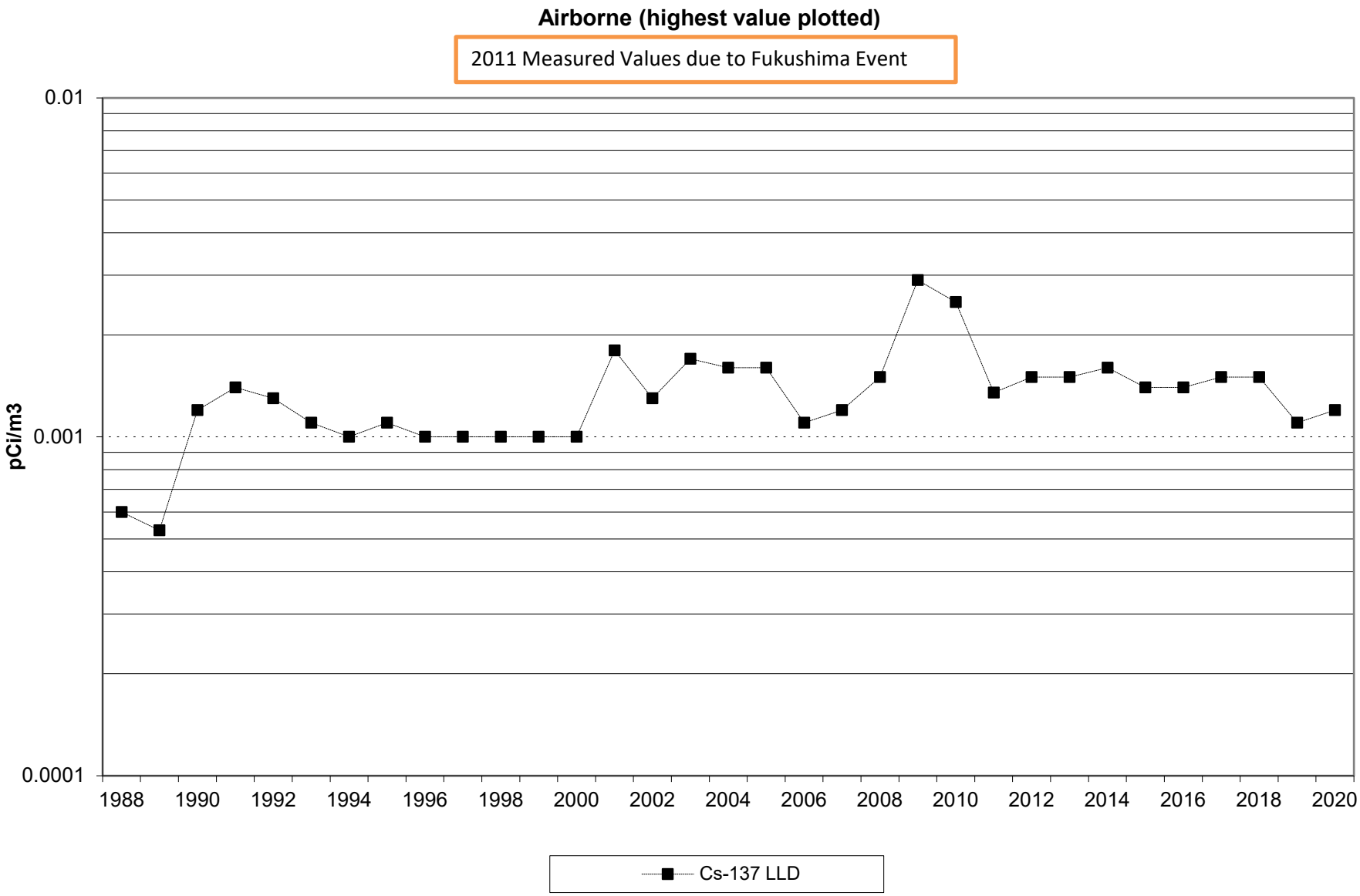
TABLE IV-A.3

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/1000m^3 γ EMITTERS IN QUARTERLY COMPOSITES OF AIR PARTICULATES

STATION	NUCLIDE	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
C07	Be-7	145	173	106	164
	K-40	<14	<12	<13	<16
	Cs-134	<1.3	<1.2	<1.3	<1.1
	Cs-137	<1	<1.2	<0.9	<0.9
C18	Be-7	133	152	118	147
	K-40	<22	<21	<26	<20
	Cs-134	<0.9	<1.1	<1.2	<0.9
	Cs-137	<0.9	<1.1	<0.9	<0.7
C40	Be-7	142	162	105	166
	K-40	<14	<21	<21	<13
	Cs-134	<1.3	<0.8	<0.9	<1.2
	Cs-137	<1	<0.8	<0.8	<0.9
C41	Be-7	132	155	94	134
	K-40	<23	<21	<18	<19
	Cs-134	<1	<1.5	<1	<1.1
	Cs-137	<0.9	<1.1	<0.7	<0.9
C46	Be-7	135	155	102	125
	K-40	<21	<22	<26	<17
	Cs-134	<1.2	<1.4	<1.1	<0.8
	Cs-137	<0.9	<1.1	<1.1	<0.8
C47	Be-7	132	151	117	159
	K-40	<17	<21	<15	<14
	Cs-134	<1.2	<1.1	<1.1	<1.2
	Cs-137	<0.9	<0.7	<0.9	<1


Airborne (highest value plotted)
2011 Measured Values due to Fukushima Event
0.01
0.001
0.0001
pCi/m3
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Cs-137 LLD

IV-B. DIRECT RADIATION

Direct radiation measurements (using TLDs) were taken at 31 locations surrounding the plant, and at one control location 78 miles from the site (C47). Of the 124 non-control quarterly TLDs, 121 were collected. Location C77 could not be collected during the first quarter as the siren pole was found removed during routine change-out (NCR 2309368). A new TLD was placed on an adjacent pole. The TLD at location C01 was not collected during the third and fourth quarters as it was found missing.

Table IV-B provides a statistical summary of the analytical results for 124 non-control TLDs sampled throughout the year.

Table IV-B.1 provides the results of the individual TLD measurements.

In 2020, the highest annual average on-site dose was 55 mrem at station C71 (WNW at 3600 feet). It was also the highest in 2019 at 56 mrem and in 2018 at 55 mrem. Station C71 was relocated in 1992 due to construction of the helper cooling towers on the former site. The new location has a higher background radiation level due to being closer to the storage pond for Units 4 & 5 fly ash, which produces a higher external radiation component than normal levels of natural background. The second highest average on-site dose was 43 mrem at station C65 (ESE at 1743 feet southeast of the coal rail loop). These were the same two locations with the highest onsite dose as in 2019.

The highest annual average off-site dose was 40 mrem at station C40 (east at 3.5 miles). This was also the same location which the highest recorded dose in 2019 38 mrem. The control station (C47) average annual dose was 32 mrem in 2020 versus 33 mrem in 2019. The average for all stations (except control) was 35 mrem for 2019 versus 36 mrem for 2018. Direct radiation results in 2020 are similar to previous results and do not show any indication of a trend.

The Independent Spent Fuel Storage Installation (ISFSI) was loaded with spent fuel beginning June 2017 and completed January 2018. Calculations performed prior to fuel movement into dry storage, derived a conservative dose rate at ~ 400 meters from the ISFSI pad of ~ 2.0e-4 mrem/h gamma plus neutron (Ref. N16-0003, Table 11-27). The gamma component contributes most of the dose. Greater than class C waste, stored at the ISFSI in May 2018, has a much lower gamma dose rate (Ref. N18-0002). The combined dose at 400 meters is ~ 0.4 mrem for 90 days of exposure. 90 days is the approximate exposure period for REMP TLDs, and 400 meters is the approximate nearest distance from the ISFIS pad (center) for any of the REMP TLDs (e.g. C65). A review of quarterly TLD results shows that normal quarter to quarter variation in dose is greater than the dose increment due to ISFSI. Likewise, four of the REMP TLDs (C65, C66, C67, and C68) most likely to be influenced by the ISFSI based show no discernable step change increases in annual dose over the period of 2018 through 2020 when compared to the period of 2014 through mid-2017.

TABLE IV-B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
DIRECT RADIATION (mrem/yr)	γ DOSE, 121	15	35 (121/121) (25 - 60)	C71 0.6 @ 296º	55 (4/4) (52 - 60)	32 (4/4) (29 - 36)	0

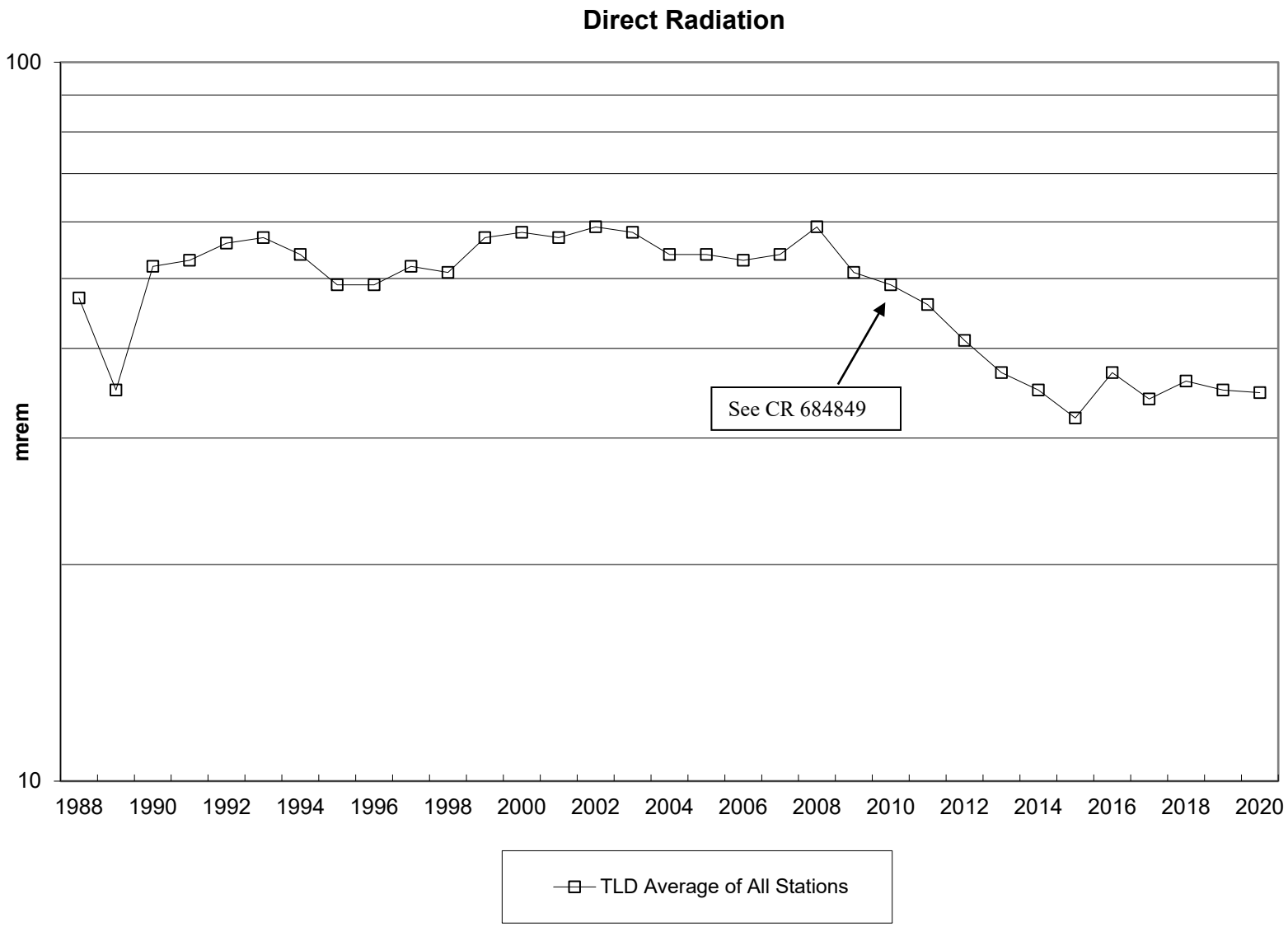
TABLE IV-B.1

DUKE ENERGY FLORIDA, LLC- CR-3 - 2020

Annual gamma (γ) Dose (mrem)

TLD STATION	Quarter	1	2	3	4
C01		32	28	**	**
C03		32	30	30	29
C04		32	29	31	28
C07*		32	27	29	29
C08		30	27	29	28
C09		32	27	29	29
C14G		38	34	36	32
C18		36	32	32	31
C27		47	41	42	40
C40*		44	38	41	38
C41		39	33	33	33
C46*		40	36	36	36
C47 (CONTROL)		36	31	29	30
C60		40	35	35	34
C61		43	37	39	39
C62		46	40	39	40
C63		41	38	40	39
C64		40	33	39	36
C65		48	39	42	43
C66		43	38	39	37
C67		36	39	40	38
C68		34	38	38	37
C69		39	39	41	37
C70		43	46	49	46
C71		52	53	60	54
C72		35	38	37	38
C73		32	35	38	34
C74		25	27	28	27
C75		32	34	36	34
C76		30	33	29	32
C77		**	27	28	25
C79		28	31	30	32

*TLDs not required by the ODCM.
** Missing


Direct Radiation
100
10
mrem
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
See CR 684849
TLD Average of All Stations

IV-C. WATERBORNE PATHWAY

To evaluate the waterborne pathway, samples are taken of seawater, ground water, drinking water, and shoreline sediment.

1. Monthly seawater grab samples are taken at two locations in the discharge canal (C14G and C14H) and at one control location (C13) near the mouth of the intake canal. In 2020, of twenty-four indicator samples, none had measurable tritium.

   Gamma spectral analysis was performed on all thirty-six samples, (including the 12 control samples at C13) and none of them showed measurable amounts of the gamma emitters of interest.

   Table IV-C.1 provides a statistical summary of the seawater tritium and gamma spectroscopy results.

   Table IV-C.1.a provides the results of the monthly samples.

2. Semiannual ground water samples are taken at one location, station C40, located approximately 3.5 miles east of CR-3. Gamma spectral and tritium analyses are performed. In 2020, all results were less than the detection limits. Since plant startup, all results, except for the results of one 1985 tritium analysis, have been less than LLD. The ODCM required sensitivity for measuring tritium in ground water is 2000 pCi/L. Analysis of ground water in the vicinity of CR-3 is done at a sensitivity of approximately 150 pCi/L for tritium and less than 10 pCi/L for select gamma emitters. The C40 groundwater sample is taken from pump #12.

   Table IV-C.2 provides a statistical summary of the groundwater tritium and gamma spectroscopy results.

   Table IV-C.2.a provides the results of the semi-annual samples.

3. Quarterly site ground water samples are taken at thirteen locations surrounding the perimeter of the CR-3 protected area (See Figure 1-5). Periodically five of these ground water wells have shown indications of very low levels of tritium on the west-southwest side of the plant. It is believed that this tritium is the result of a leak in the Station Drain Tank (SDT-1) to the settling pond discharge line that occurred in 1998. This discharge line has recently been leak tested and it is leak free. There are no other known leaking plant components.

   In 2020, one groundwater well - CR3-5 - continued to show tritium at very low concentrations above LLD, same as in 2019. Well 3-6D, which is just north of well CR3-5, showed 204 pCi/liter for the third quarter sample and less than LLD for the other three samples. Well CR3-5 had an average tritium concentration of 227 pCi/L with a range of 204 to 268 pCi/L based on all four 2020 quarterly samples. This compares to an average value of 240 pCi/l in 2019 and thus represents a slight decrease.

   Along with these wells, two other wells that are not presently part of the REMP program were sampled. They are on either side (north and south) of the plant settling ponds (percolation ponds) and are referred to as MWC-27 and MWC-IF2. Both wells did not show tritium concentrations above LLD levels in 2020, same as in 2019.

There have been no measurable amounts of gamma emitting radionuclides in any of these wells. There have also been no measurable amounts of hard-to-detect (HTD) radionuclides in any of these wells with exception of trace levels of gross alpha, which is expected, given the naturally occurring limestone strata that surrounds the Florida aquifer. As already noted, site ground water flows in a west-southwest direction toward the Gulf of Mexico. This flow was re-verified in 2017, after the ISFSI pad sub-surface construction was completed, with a new ground water flow study performed by a certified hydro-geologist as part of the NEI Ground Water Protection Initiative. In 2012 a previous groundwater flow study was performed to evaluate groundwater flow post installation of CR Units 4 & 5 clean air scrubber system. This scrubber system utilizes groundwater from the Florida aquifer. The flow studies confirmed that the groundwater flow, and direction of flow, has not been altered due to the installation and operation of the clean air scrubber system or the ISFSI pad.

It is noted that groundwater at the CR3 site is too saline for use as a potable water source, hence there is no drinking water uptake pathway at the Crystal River site.

Table IV-C.3. provides a statistical summary of the groundwater tritium and gamma spectroscopy results.

Table IV-C.3.a.1 provides the results of the quarterly samples.

4. Quarterly non-REMP required well samples at two locations were collected as discussed in item #3 above. These two wells are located on the north side and the south side of the site percolation ponds. The information is discussed above. Both of these wells showed no measurable amounts of any other radionuclides of interest. The tritium concentration in these wells, have decreased significantly due to a focused reduction in the number of discharges from the station drain tank (SDT-1) to the site settling ponds (percolation ponds) and are now less than the minimum detectable.

   Table IV-C.4 provides a statistical summary of the groundwater tritium and gamma spectroscopy results.

   Table IV-C.4.a. provides the results of the supplemental non-REMP required samples.

5. Quarterly drinking water samples are drawn from three locations: the Crystal River City Hall (C07), the Days Inn Motel (C10), and the Yankeetown City Well (C18). All samples were collected and analyzed for gamma emitters and tritium.

   In 2020, none of the samples yielded measurable activities of tritium or the required gamma emitters. The measurement sensitivity for drinking water samples is the same as those for ground water samples.

   Since the beginning of sampling, the drinking water samples have not had any other positive-measured radionuclides of interest detected.

   Table IV-C.5 provides a statistical summary of the drinking water tritium and gamma spectroscopy results.

   Table IV-C.5.a provides the results of the quarterly samples.

6. Semiannual shoreline sediment samples are taken at three indicator locations in the discharge canal (C14H, C14M, C14G) and one control location (C09) at Fort Island Gulf Beach. The plant discharge canal is the primary liquid effluent release pathway from CR-3. In 2020, all six samples showed Cs-137 below LLD and all other radionuclides were also below LLD. In 2018, one of the six samples showed Cs-137 above LLD levels (location C14M had 6±2 pCi/kg in the Aug 2018 sample). Last year in 2019, higher than usual Co-60 was detected in the three February 2019 samples – 67, 29 and 394 pCi/kg, for locations C14H, C14M and C14G, respectively. These locations all showed less than LLD when resampled in August 2019. Cs-137 results showed two of the three locations (C14M and C14G) with positive results in February (17 and 64 pCi/kg, respectively). For the August set of samples, only C14M showed Cs-137 above LLD at 13 pCi/Kg.

   In 2017, one of the six samples showed Cs-137 above LLD levels (location C14M had 23 pCi/kg Cs-137 in the Aug 2017 sample). None of the other samples showed CR3 licensed activity above LLD values. In 2016, one of the six samples had measurable amounts of Cs-137, at the same C14M location with a value of 21 pCi/kg. In 2015, three samples showed small concentrations of Cs-137.

The 2019 shoreline sediment results from the February samples were higher in Co-60 and Cs-137 than 2018 but the August set of samples were similar to 2018 results. There is not trend present. None of the samples taken at Fort Island Gulf Beach, the control location station C09, indicated measurable amounts of cobalt or cesium.

Table IV-C.6 provides a statistical summary of the shoreline sediment gamma spectroscopy results.

Table IV-C.6.a provides the results of the semi-annual samples.

7. There were no unmonitored spills or releases of radioactive material in 2020 that had the potential to contaminate the ground water per the guidelines of the Nuclear Energy Institute Ground Water Protection Initiative – Final Guidance Document 07-07. As such, there were no communiqués issued to state, local, or regulatory agencies.

   State and local governmental officials have been updated regarding the status of the groundwater monitoring program at the Crystal River site per the requirements of the NEI 07-07 Guidelines.

TABLE IV-C.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SEAWATER (pCi/L)	Tritium, 36	277	<LLD			<LLD	0
	γ Spec, 36						
	Mn-54	4	<LLD	--	--	<LLD	0
	Fe-59	8	<LLD	--	--	<LLD	0
	Co-58	4	<LLD	--	--	<LLD	0
	Co-60	4	<LLD	--	--	<LLD	0
	Zn-65	9	<LLD	--	--	<LLD	0
	Zr-Nb-95	7	<LLD	--	--	<LLD	0
	Cs-134	4	<LLD	--	--	<LLD	0
	Cs-137	4	<LLD	--	--	<LLD	0
	Ba-La-140	12	<LLD	--	--	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

TABLE IV-C.1.a
DUKE ENERGY FLORIDA, LLC- CR3 - 2020
pCi/L γ EMITTERS AND TRITIUM IN SEAWATER

STATION	MONTH	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zr-Nb-95	Cs-134	Cs-137	Ba-La-140
C13	JAN	<140	146±14	<3	<3	<6	<3	<6	<5	<3	<3	<7
	FEB	<146	171±17	<3	<3	<7	<3	<7	<5	<3	<3	<5
	MAR	<139	178±17	<3	<3	<6	<3	<7	<5	<3	<3	<9
	APR	<137	249±24	<3	<3	<6	<3	<7	<6	<3	<3	<12
	MAY	<136	205±20	<3	<4	<6	<3	<8	<6	<3	<4	<12
	JUN	<150	255±25	<3	<3	<7	<3	<6	<5	<3	<3	<4
	JUL	<139	210±21	<4	<3	<8	<3	<6	<6	<3	<4	<4
	AUG	<137	263±26	<3	<3	<7	<3	<7	<6	<3	<4	<4
	SEP	<139	260±26	<3	<3	<7	<4	<8	<6	<3	<3	<4
	OCT	<137	277±27	<4	<3	<8	<3	<8	<5	<4	<3	<4
	NOV	<135	266±26	<3	<3	<7	<3	<8	<6	<4	<4	<4
	DEC	<139	230±23	<3	<4	<8	<3	<8	<6	<3	<4	<4
C14G	JAN	<140	193±19	<4	<3	<6	<2	<7	<6	<3	<3	<5
	FEB	<138	194±19	<3	<3	<7	<3	<7	<6	<3	<4	<5
	MAR	<139	192±19	<3	<3	<6	<3	<7	<6	<3	<4	<11
	APR	<137	208±20	<3	<4	<7	<3	<7	<5	<3	<4	<11
	MAY	<136	163±16	<3	<3	<7	<4	<7	<6	<3	<3	<11
	JUN	<150	225±22	<3	<3	<7	<3	<8	<6	<3	<3	<4
	JUL	<139	214±21	<3	<3	<7	<3	<8	<5	<3	<3	<4
	AUG	<139	222±22	<4	<3	<6	<4	<7	<6	<3	<4	<4
	SEP	<139	209±20	<4	<3	<6	<4	<7	<6	<3	<4	<4
	OCT	<137	240±24	<4	<3	<7	<3	<7	<6	<4	<4	<4
	NOV	<135	223±22	<3	<3	<6	<4	<7	<6	<3	<4	<4
	DEC	<139	165±16	<3	<3	<7	<3	<8	<6	<3	<3	<4

TABLE IV-C.1a (CONT'D)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN SEAWATER

STATION	MONTH	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zr-Nb-95	Cs-134	Cs-137	Ba-La-140
C14H	JAN	<140	204±20	<4	<3	<7	<3	<8	<6	<3	<3	<6
	FEB	<138	188±18	<4	<4	<8	<4	<9	<7	<3	<5	<8
	MAR	<139	221±22	<3	<3	<6	<4	<6	<5	<3	<4	<12
	APR	<137	199±19	<3	<3	<7	<4	<7	<5	<3	<4	<10
	MAY	<138	157±15	<3	<3	<6	<3	<8	<6	<3	<3	<11
	JUN	<150	181±18	<3	<4	<7	<4	<7	<6	<4	<4	<4
	JUL	<139	249±24	<3	<3	<7	<4	<7	<5	<3	<3	<4
	AUG	<139	223±22	<3	<4	<7	<3	<8	<6	<3	<4	<4
	SEP	<139	151±15	<3	<3	<7	<4	<9	<6	<4	<4	<4
	OCT	<137	232±23	<3	<4	<8	<3	<7	<5	<3	<4	<4
	NOV	<135	260±26	<3	<4	<7	<3	<8	<6	<3	<4	<4
	DEC	<139	238±23	<4	<3	<7	<4	<8	<6	<4	<3	<4

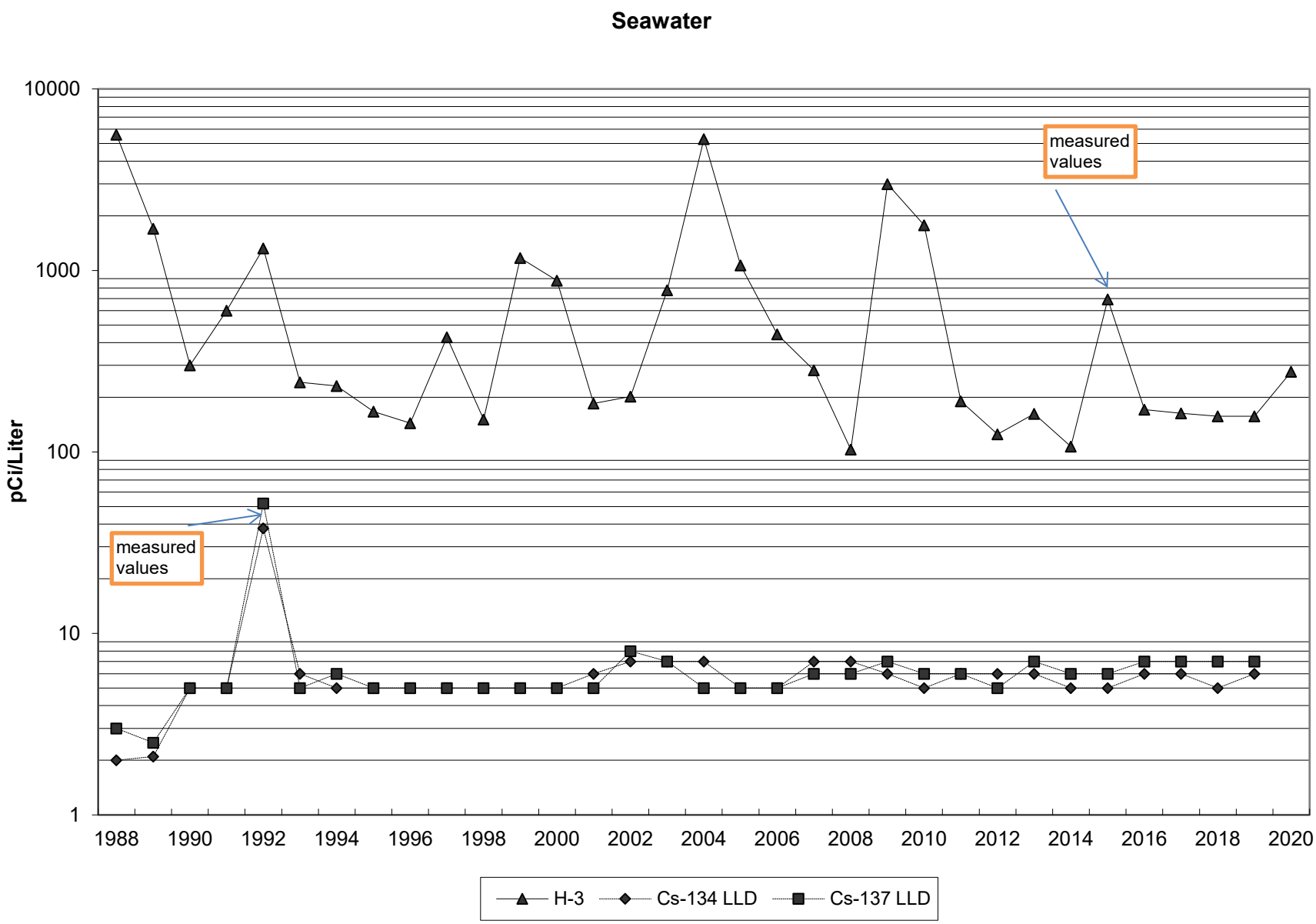

Seawater
10000
1000
100
10
1
pCi/Liter
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
measured values
measured values
H-3
Cs-134 LLD
Cs-137 LLD

TABLE IV-C.2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROUND WATER[2] (pCi/L)	Tritium, 2	141	<LLD	--	--	<LLD	0
	γ Spec, 2						
	Mn-54	4	<LLD	--	--	<LLD	0
	Fe-59	3	<LLD	--	--	<LLD	0
	Co-58	7	<LLD	--	--	<LLD	0
	Co-60	9	<LLD	--	--	<LLD	0
	Zn-65	6	<LLD	--	--	<LLD	0
	Zr-Nb-95	4	<LLD	--	--	<LLD	0
	Cs-134	4	<LLD	--	--	<LLD	0
	Cs-137	4	<LLD	--	--	<LLD	0
	Ba-La-140	13	<LLD	--	--	<LLD	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.
[2] There is no drinking water uptake pathway at the Crystal River site.

TABLE IV-C.2.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN GROUND WATER

STATION	NUCLIDE	FIRST HALF	SECOND HALF
C40	H-3	<141	<141
	Mn-54	<4	<3
	Fe-59	<7	<7
	Co-58	<4	<3
	Co-60	<3	<3
	Zn-65	<9	<7
	Zr-Nb-95	<6	<6
	Cs-134	<4	<4
	Cs-137	<4	<4
	Ba-La-140	<4	<4
	K-40	<38	<42

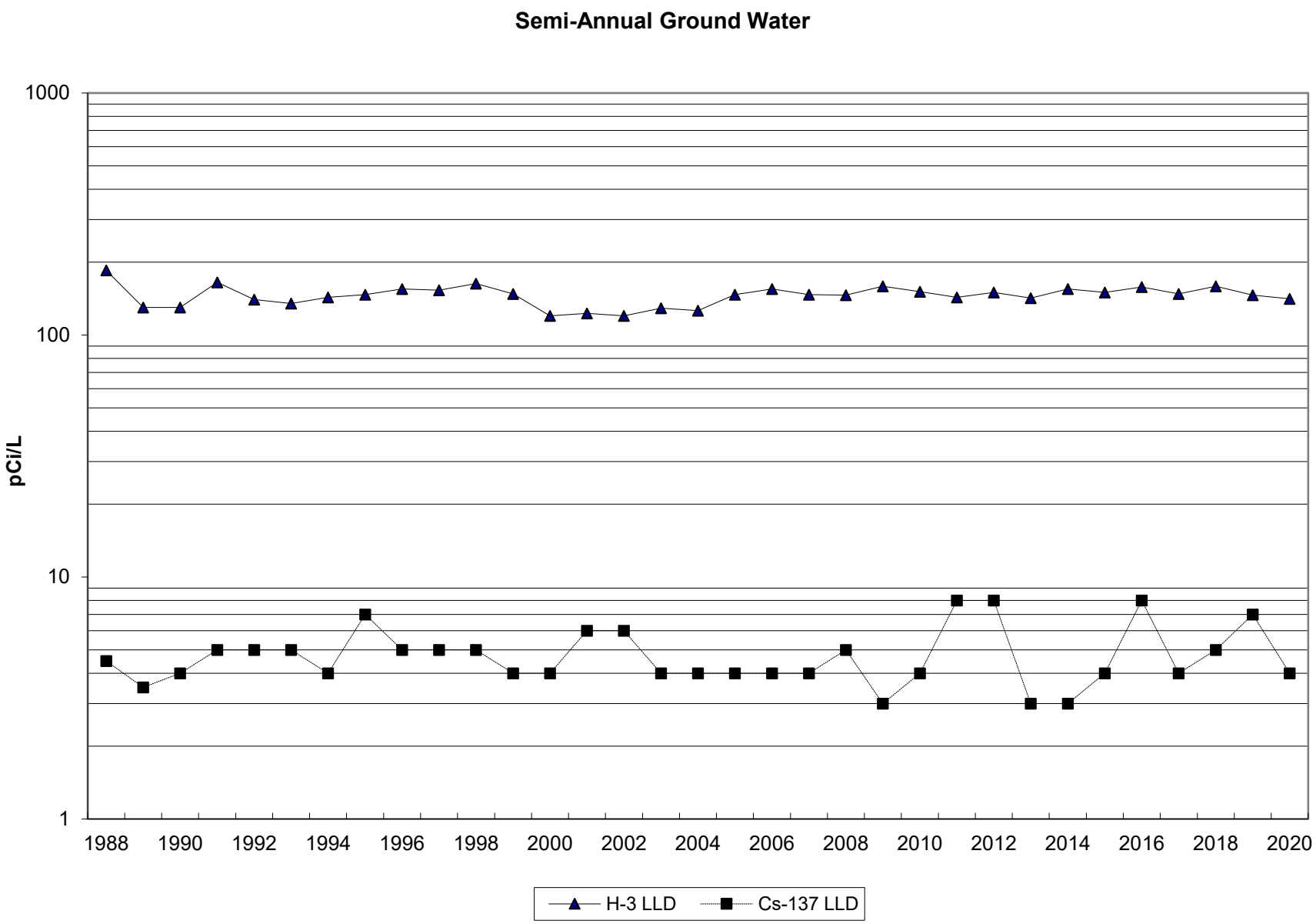

Semi-Annual Ground Water
1000
100
10
1
pCi/L
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
H-3 LLD
Cs-137 LLD

TABLE IV-C.3

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL (NUMBER)[2] OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
CR3 SITE GROUND WATER (pCi/L)	Tritium 52	146	223(5/52) (202-268)	CR3-5 0.051 mi.@225°	227(4/4) (202-268)	CR3-2 137(0/4) (LLD)	0
	γ Spec 52						
	Mn-54	7	<LLD	--	--	<LLD	0
	Fe-59	16	<LLD	--	--	<LLD	0
	Co-58	7	<LLD	--	--	<LLD	0
	Co-60	7	<LLD	--	--	<LLD	0
	Zn-65	19	<LLD	--	--	<LLD	0
	Zr-Nb-95	14	<LLD	--	--	<LLD	0
	Cs-134	6	<LLD	--	--	<LLD	0
	Cs-137	9	<LLD	--	--	<LLD	0
	Ba-La-140	28	<LLD	--	--	<LLD	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.
[2] Includes extra samples collected for data trending.

TABLE IV-C.3.a.1

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
CR3-1D	01-23	<139	<43	<3	<3	<7	<4	<7	<5	<3	<4	<5
	04-27	<145	<50	<4	<4	<7	<3	<9	<6	<3	<4	<12
	07-20	<139	<0	<4	<4	<7	<4	<7	<7	<4	<4	<4
	10-06	<137	<53	<3	<3	<7	<4	<10	<6	<4	<4	<4
CR3-1S	01-23	<139	<40	<3	<4	<7	<3	<8	<6	<3	<4	<5
	04-27	<145	<46	<3	<4	<7	<3	<8	<6	<4	<4	<12
	07-20	<137	<76	<4	<4	<7	<4	<9	<7	<4	<4	<6
	10-06	<137	<34	<3	<3	<6	<3	<9	<6	<4	<4	<4
CR3-2	01-23	<139	<43	<3	<3	<6	<3	<8	<6	<3	<4	<6
	04-27	<134	<47	<4	<4	<7	<4	<9	<6	<4	<4	<13
	07-20	<137	<83	<4	<4	<7	<5	<9	<7	<3	<4	<5
	10-06	<137	<51	<3	<4	<8	<4	<9	<7	<4	<5	<4

TABLE IV-C.3.a.1

DUKE ENERGY FLORIDA, LLC- CR3 – 2020

pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
CR3-3D	01-23	<146	<47	<3	<3	<7	<3	<7	<6	<3	<4	<6
	04-27	<136	<0	<3	<3	<7	<3	<8	<5	<3	<4	<7
	07-20	<137	<0	<4	<4	<9	<4	<10	<7	<4	<5	<8
	10-06	<137	<71	<4	<4	<7	<4	<8	<6	<4	<4	<7
CR3-3S	01-23	<139	<42	<3	<3	<7	<3	<6	<6	<3	<3	<5
	04-27	<134	<43	<3	<4	<7	<3	<8	<6	<3	<4	<7
	07-20	<137	<74	<4	<4	<8	<4	<9	<8	<4	<5	<7
	10-06	<137	<0	<5	<4	<9	<5	<11	<8	<4	<4	<8
CR3-4	01-23	<138	<47	<4	<4	<8	<4	<9	<6	<4	<4	<5
	04-27	<134	<52	<4	<4	<7	<4	<10	<7	<4	<4	<8
	07-20	<137	<69	<4	<4	<8	<4	<8	<7	<4	<4	<6
	10-06	<137	<73	<4	<5	<8	<4	<11	<8	<4	<5	<10

TABLE IV-C.3.a.1

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
CR3-5	01-23	204	<55	<4	<4	<7	<3	<9	<6	<4	<4	<6
	04-27	268	<61	<4	<4	<6	<4	<10	<7	<4	<4	<9
	07-20	202	<75	<5	<4	<7	<4	<8	<7	<4	<4	<7
	10-06	236	<67	<5	<5	<8	<4	<11	<7	<5	<4	<11
CR3-6S	01-23	<139	<105	<5	<6	<15	<6	<13	<10	<6	<7	<10
	04-27	<134	<53	<3	<4	<7	<3	<10	<6	<4	<4	<10
	07-20	<137	<46	<3	<4	<8	<3	<6	<5	<3	<3	<5
	10-06	<134	<0	<4	<4	<7	<4	<10	<8	<4	<4	<9
CR3-6D	01-23	<139	<82	<7	<7	<13	<6	<14	<10	<6	<5	<10
	04-27	<145	<0	<3	<4	<7	<3	<7	<7	<3	<3	<8
	07-20	204	46	<3	<4	<7	<4	<8	<6	<4	<4	<6
	10-06	<134	<0	<4	<4	<8	<4	<8	<7	<3	<4	<9

TABLE IV-C.3.a.1 (cont'd)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

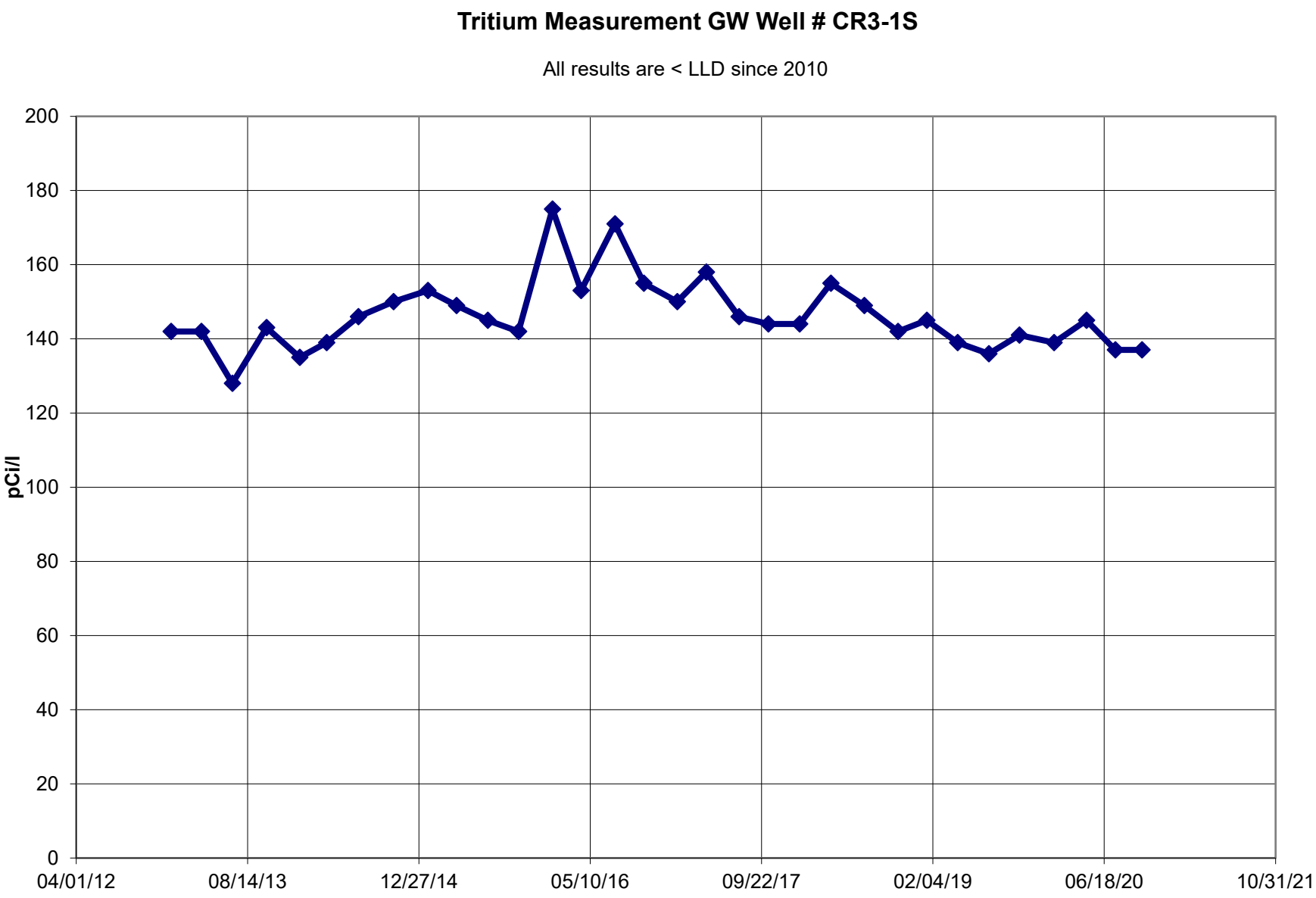
STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
CR3-7	01-23	<146	<71	<6	<5	<9	<7	<15	<11	<5	<7	<10
	04-27	<145	<94	<7	<7	<11	<6	<13	<11	<6	<7	<12
	07-20	<137	<0	<3	<3	<6	<4	<6	<7	<3	<4	<6
	10-06	<134	<67	<5	<4	<9	<4	<9	<7	<4	<4	<10
CR3-8	01-23	<139	<101	<7	<7	<16	<7	<14	<11	<6	<8	<12
	04-27	<145	<106	<7	<6	<14	<8	<15	<11	<6	<7	<11
	07-20	<142	<52	<4	<3	<8	<3	<8	<7	<4	<4	<6
	12-16	<139	<62	<5	<5	<8	<5	<15	<8	<5	<6	<5
CR3-9	01-23	<146	<117	<6	<7	<12	<6	<14	<10	<6	<6	<9
	04-27	<136	<0	<5	<5	<11	<7	<13	<11	<6	<6	<13
	07-20	<137	<54	<3	<3	<7	<3	<8	<6	<4	<4	<5
	12-16	<139	<59	<4	<4	<7	<3	<11	<7	<4	<5	<4

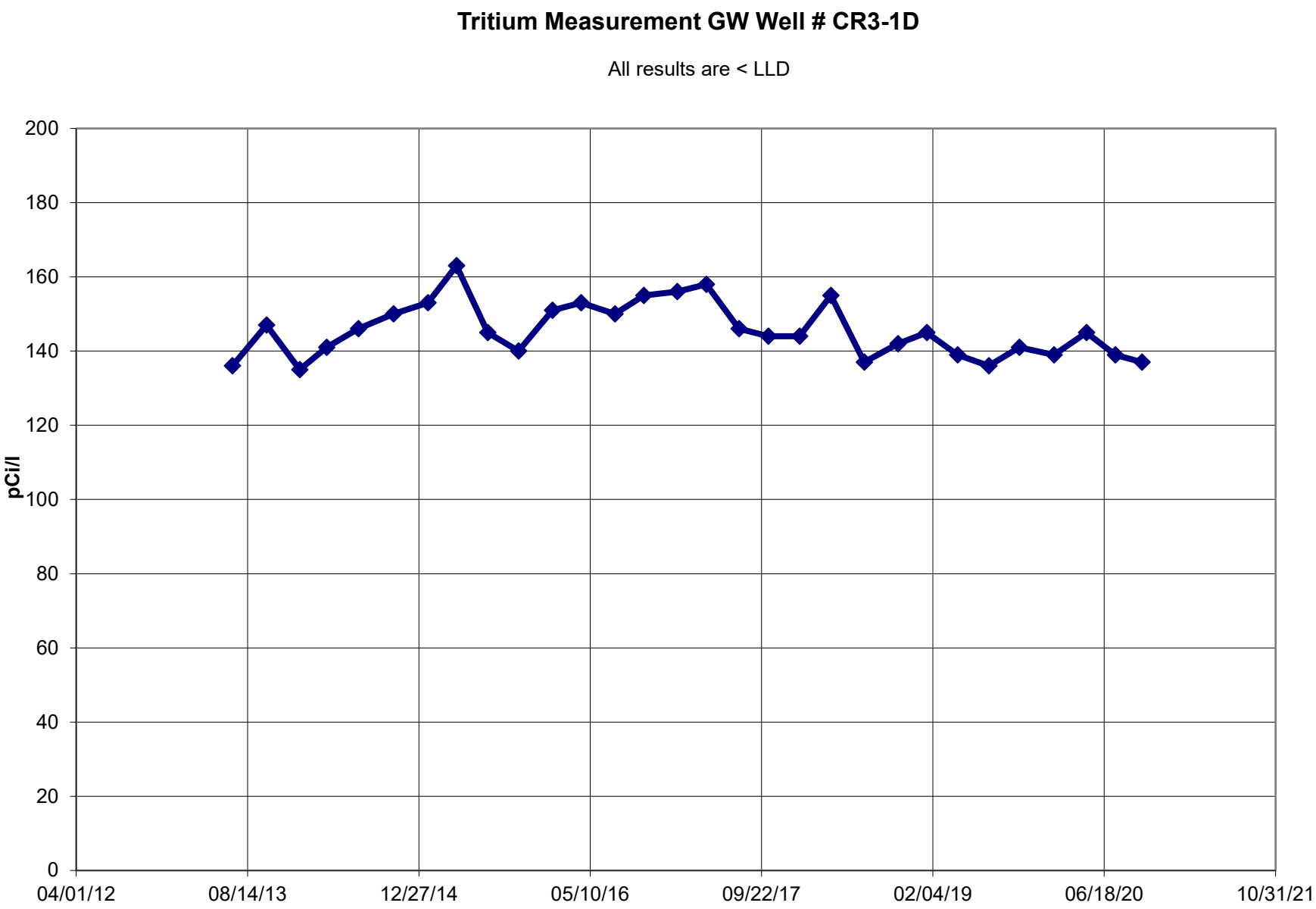
TABLE IV-C.3.a.1 (cont'd)

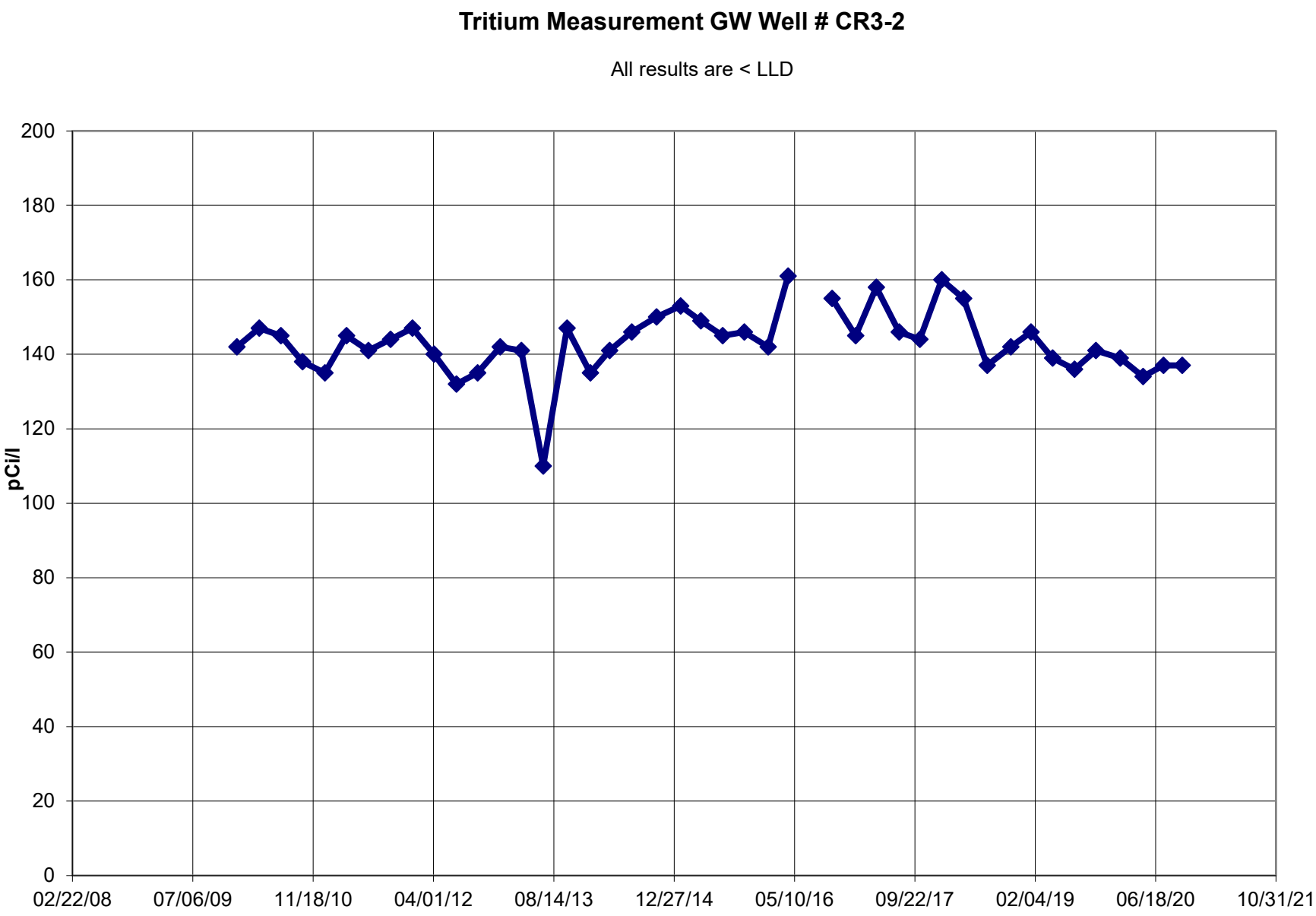
DUKE ENERGY FLORIDA, LLC- CR3 - 2020

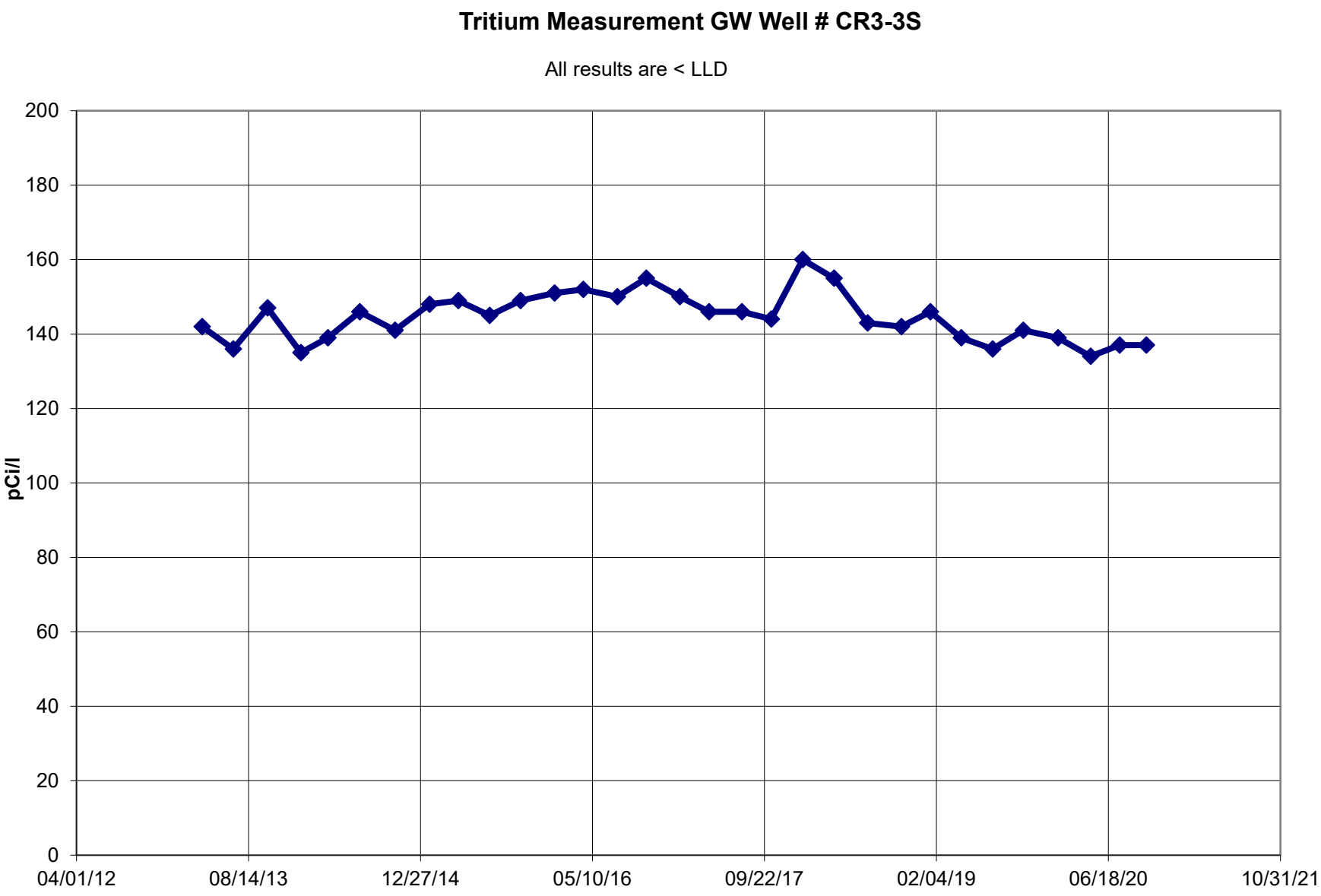
pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

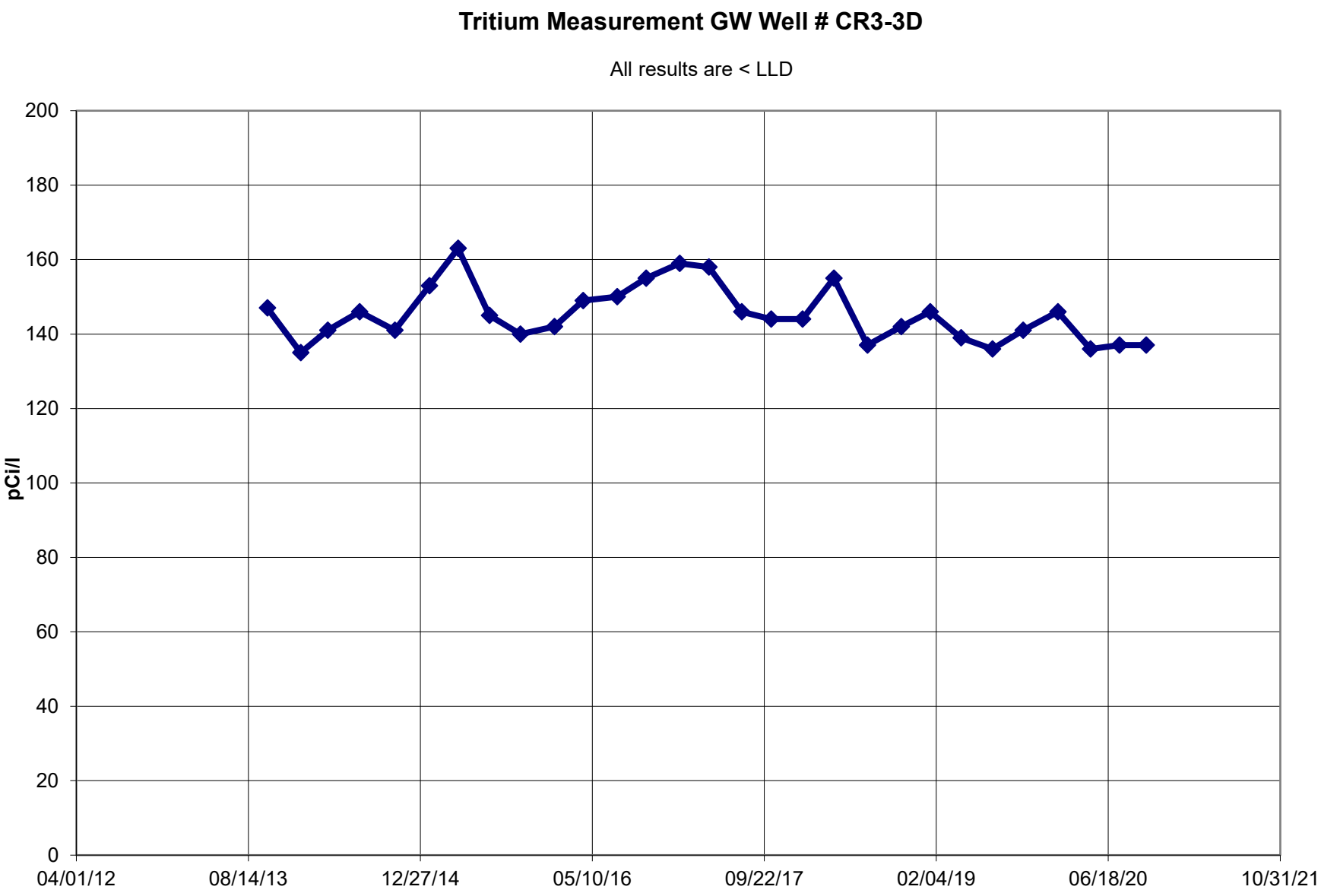
STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
CR3-10	01-23	<146	<44	<3	<4	<8	<3	<9	<6	<4	<4	<6
	04-27	<136	<47	<4	<4	<8	<4	<10	<7	<4	<4	<8
	07-20	<139	<76	<6	<7	<16	<7	<19	<14	<9	<9	<28
	12-16	<139	<48	<4	<4	<8	<4	<11	<7	<4	<5	<4

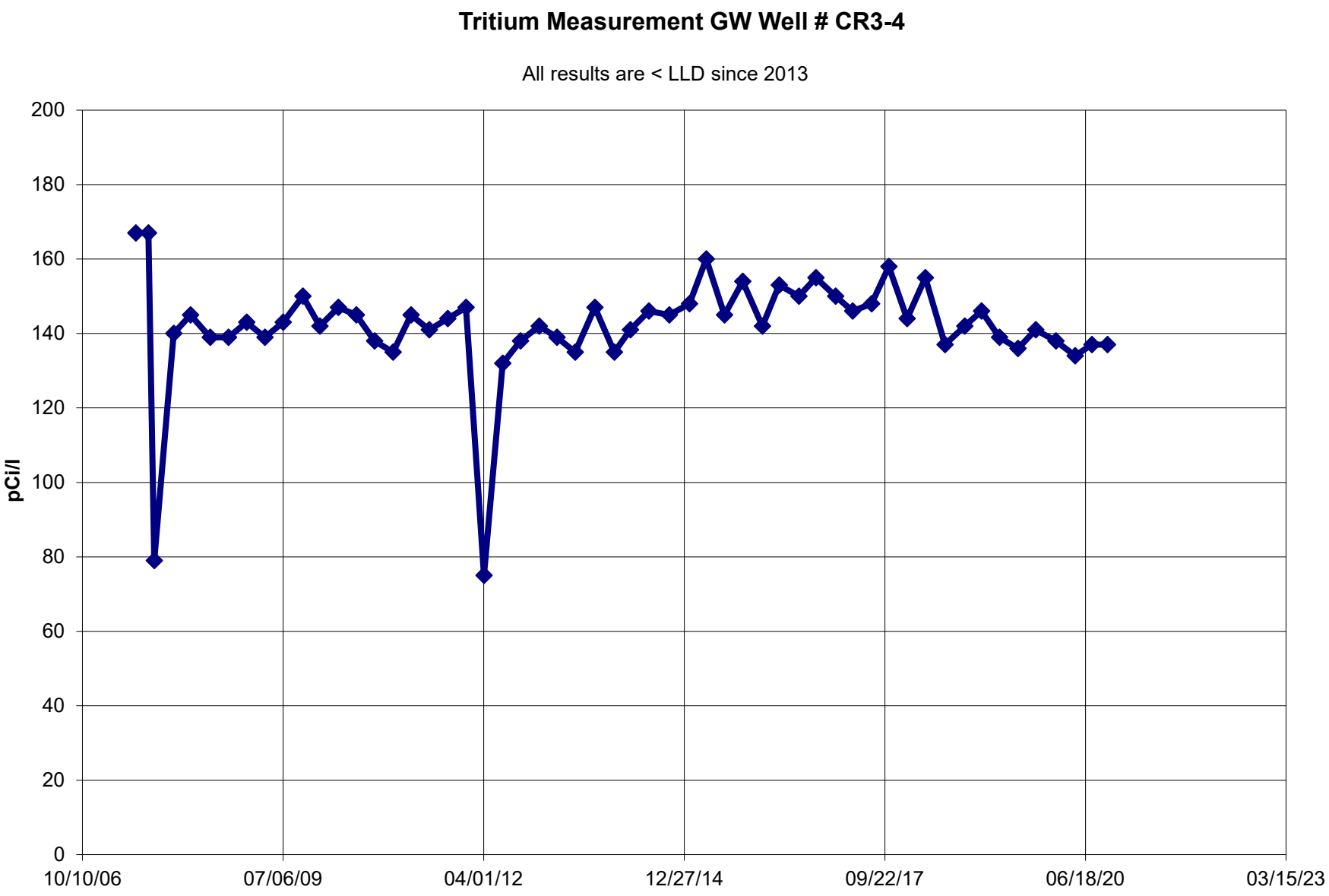

Tritium Measurement GW Well # CR3-1S
All results are < LLD since 2010
pCi/l
200
180
160
140
120
100
80
60
40
20
0
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20
10/31/21

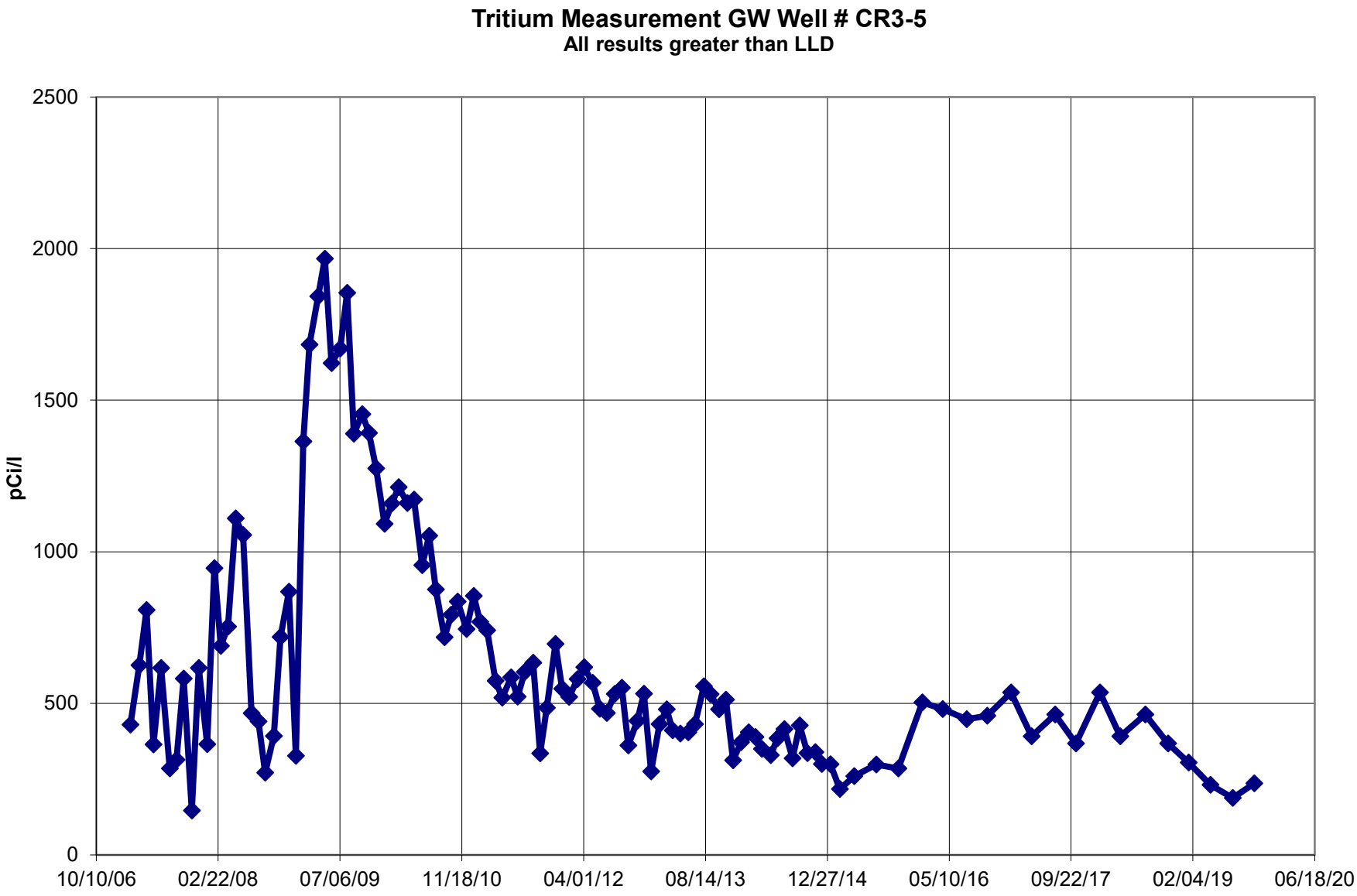

Tritium Measurement GW Well # CR3-1D
All results are < LLD
pCi/l
200
180
160
140
120
100
80
60
40
20
0
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20
10/31/21

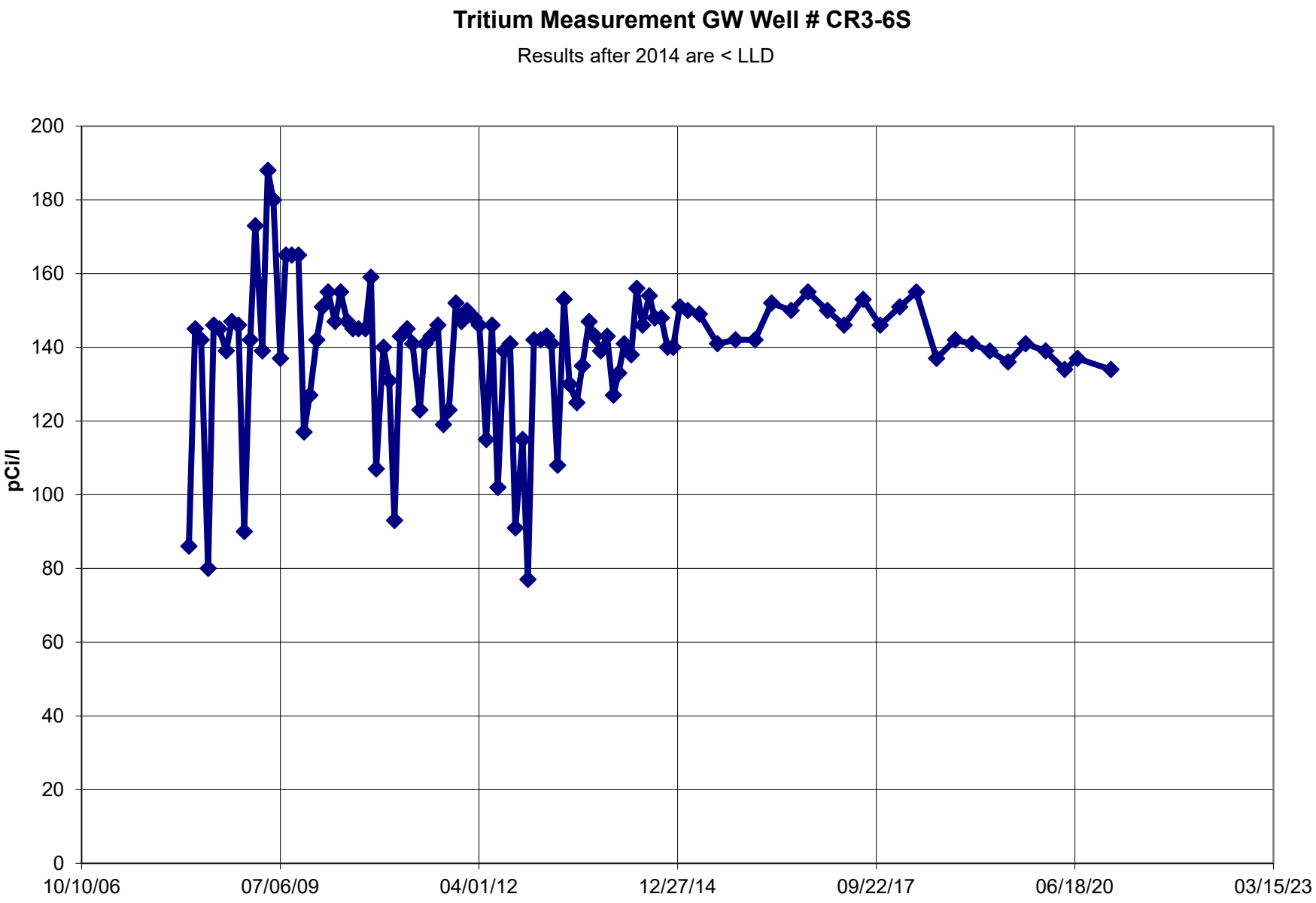

Tritium Measurement GW Well # CR3-2
All results are < LLD
pCi/l
200
180
160
140
120
100
80
60
40
20
0
02/22/08
07/06/09
11/18/10
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20
10/31/21

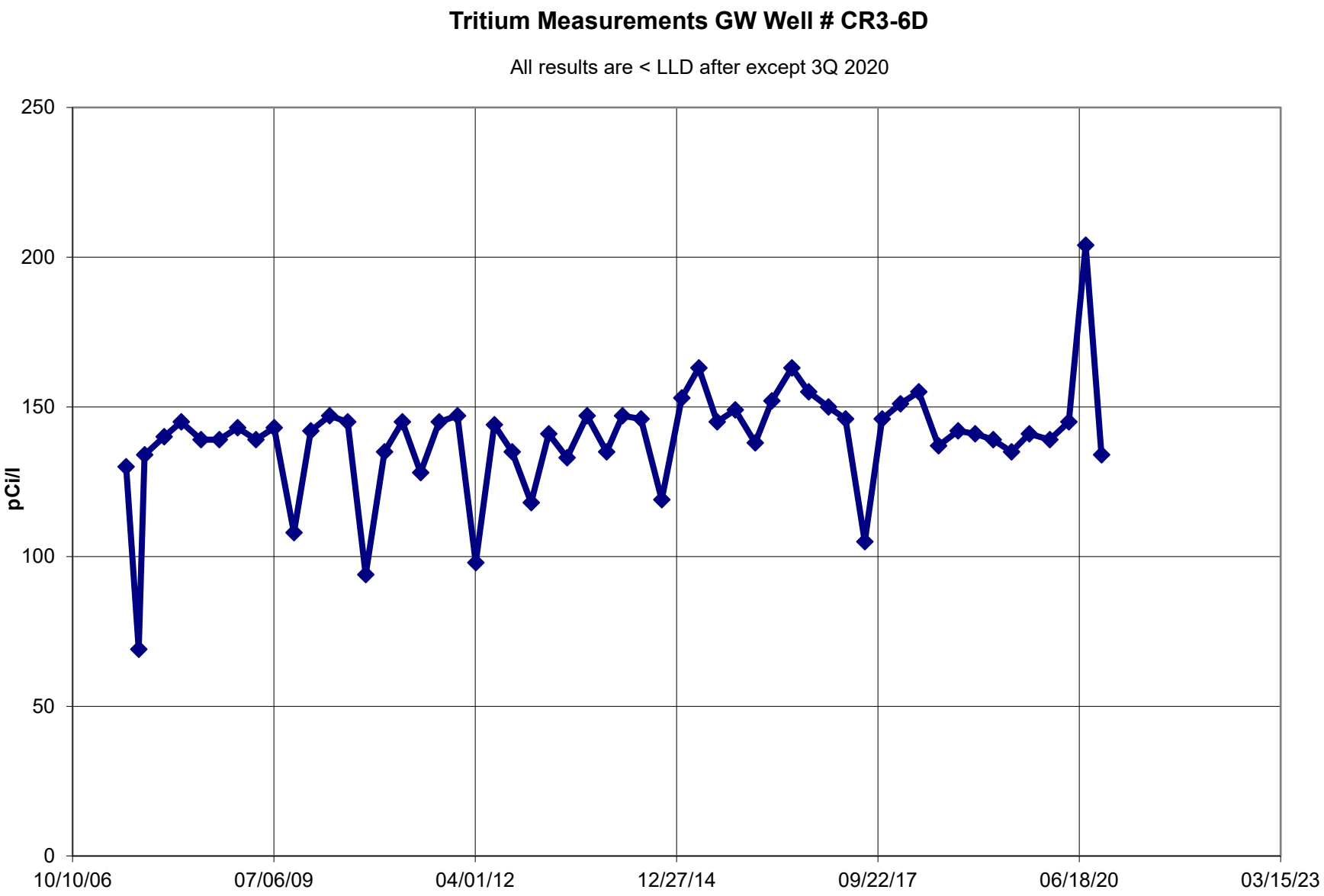

Tritium Measurement GW Well # CR3-3S
All results are < LLD
pCi/l
200
180
160
140
120
100
80
60
40
20
0
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20
10/31/21

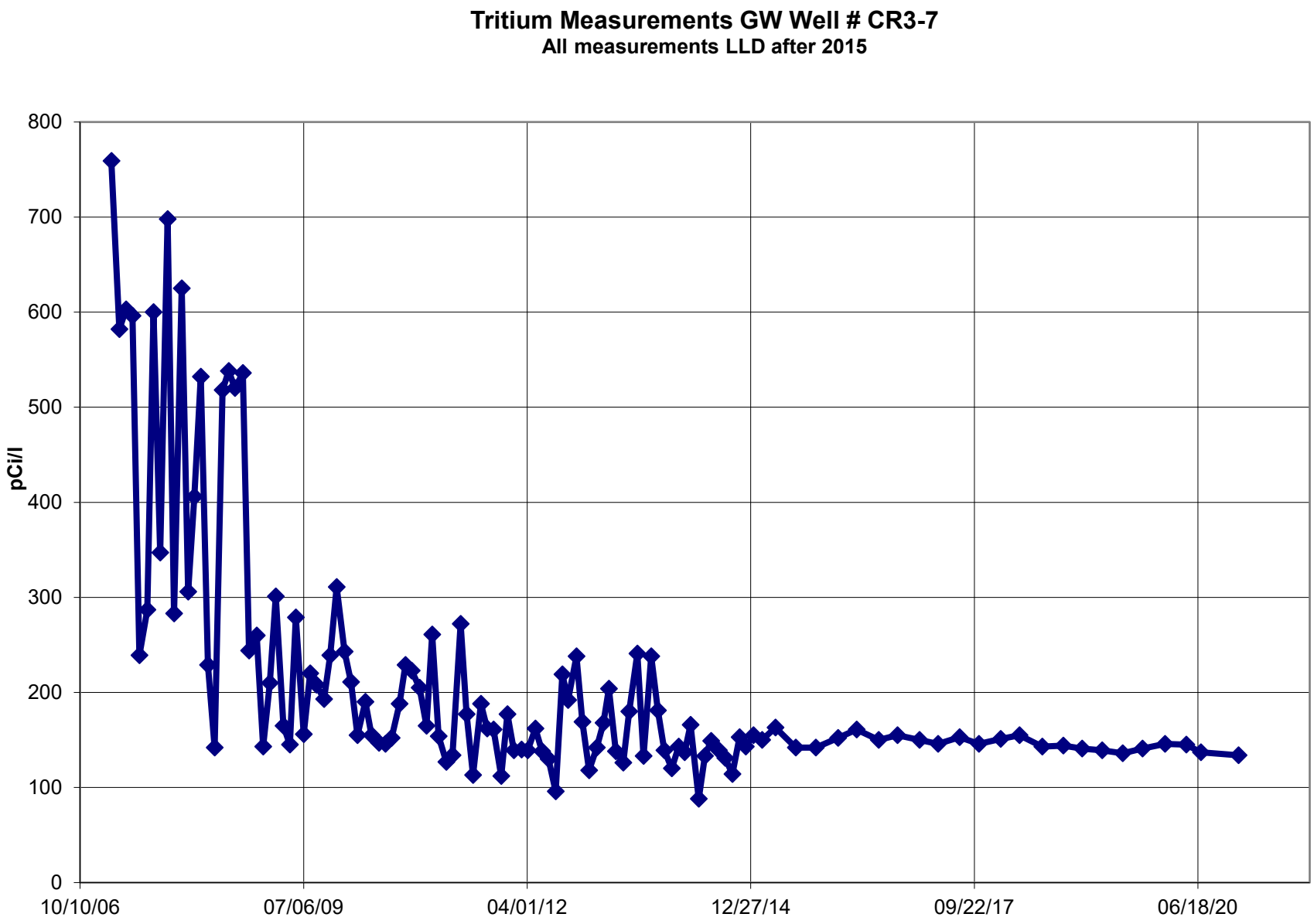

Tritium Measurement GW Well # CR3-3D
All results are < LLD
pCi/l
200
180
160
140
120
100
80
60
40
20
0
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20
10/31/21

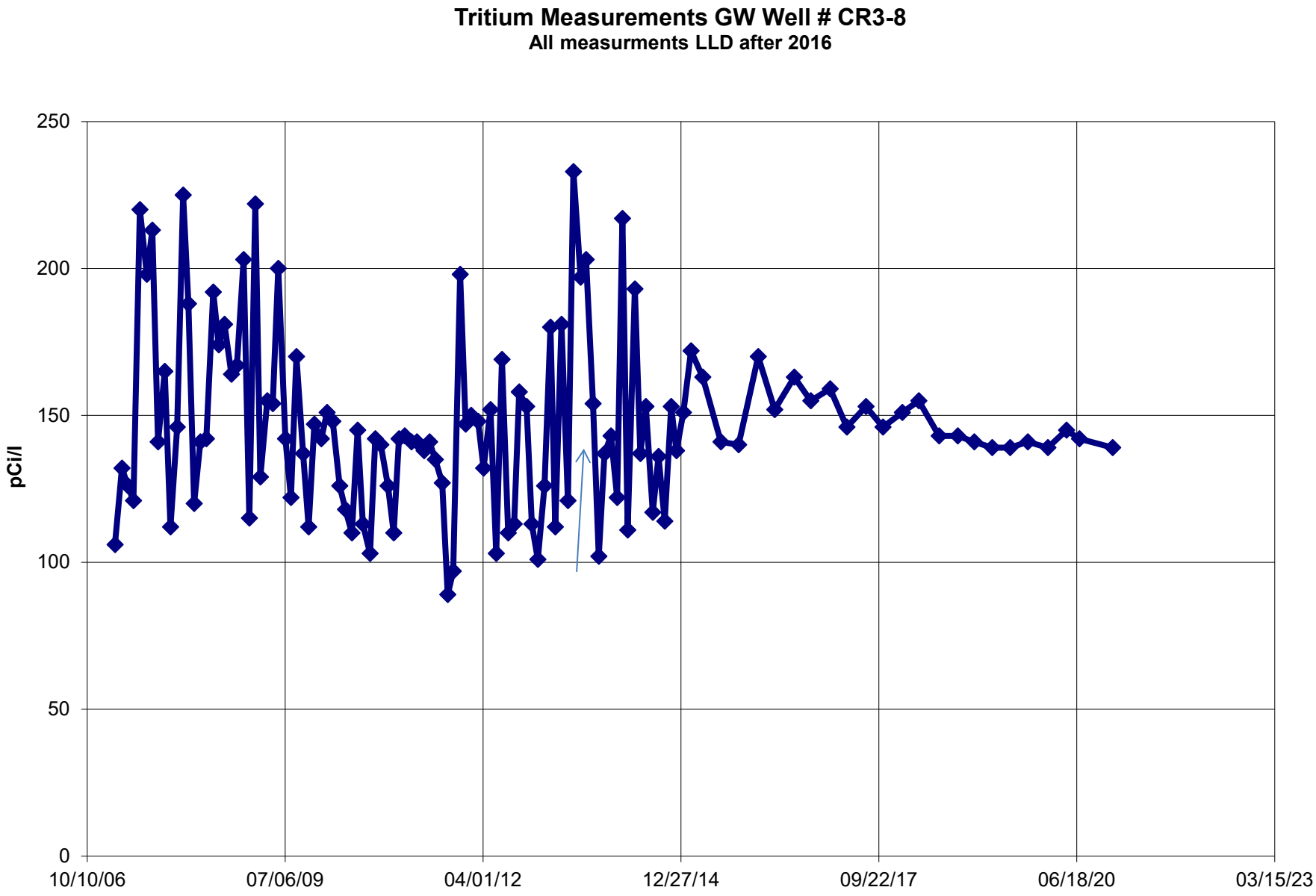

Tritium Measurement GW Well # CR3-4
All results are < LLD since 2013
pCi/l
200
180
160
140
120
100
80
60
40
20
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23

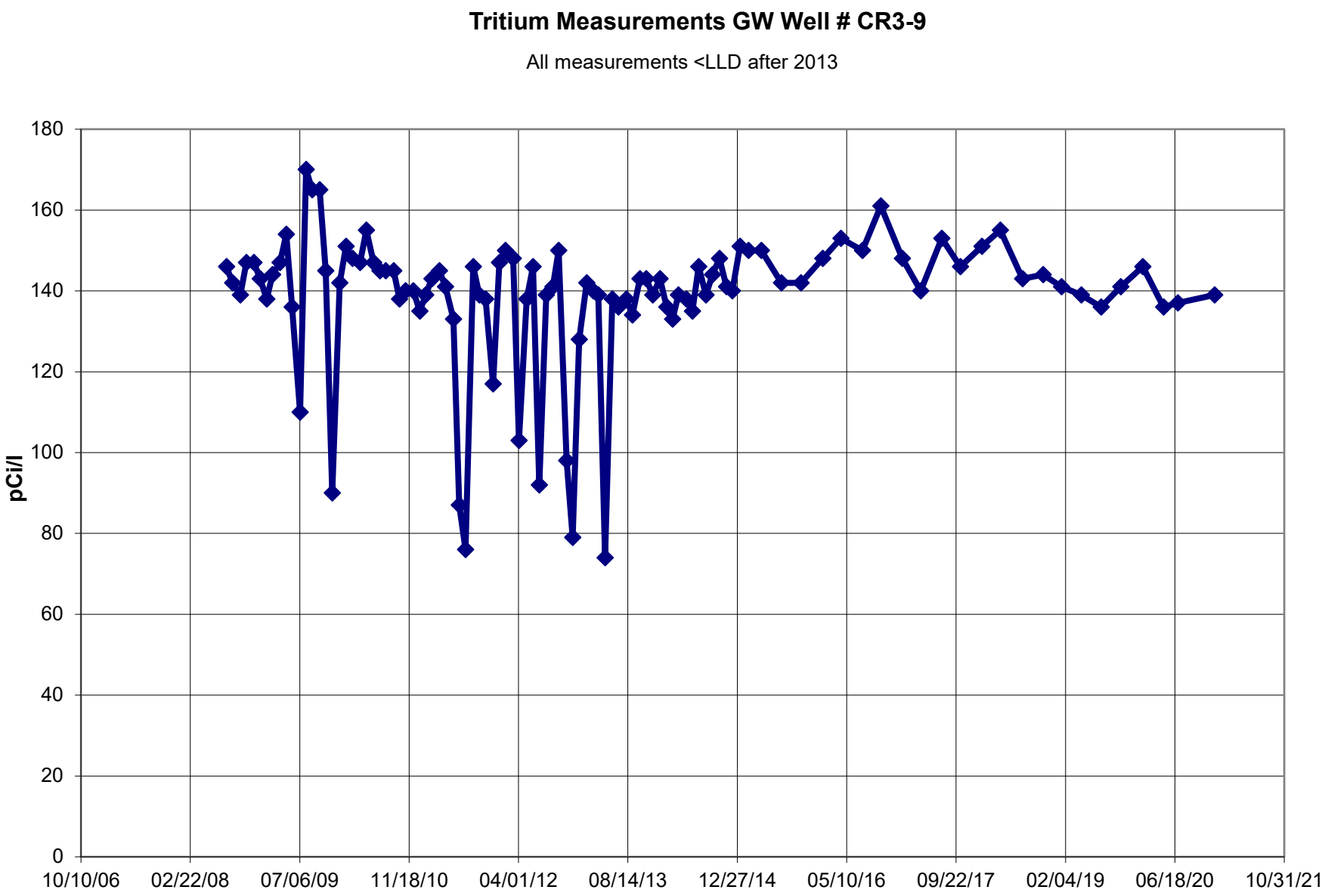

Tritium Measurement GW Well # CR3-5
All results greater than LLD
pCi/l
2500
2000
1500
1000
500
0
10/10/06
02/22/08
07/06/09
11/18/10
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20


Tritium Measurement GW Well # CR3-6S
Results after 2014 are < LLD
pCi/l
200
180
160
140
120
100
80
60
40
20
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23


Tritium Measurements GW Well # CR3-6D
All results are < LLD after except 3Q 2020
pCi/l
250
200
150
100
50
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23


Tritium Measurements GW Well # CR3-7
All measurements LLD after 2015
pCi/l
800
700
600
500
400
300
200
100
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20


Tritium Measurements GW Well # CR3-8
All measurments LLD after 2016
pCi/l
250
200
150
100
50
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23


Tritium Measurements GW Well # CR3-9
All measurements <LLD after 2013
pCi/l
180
160
140
120
100
80
60
40
20
0
10/10/06
02/22/08
07/06/09
11/18/10
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20
10/31/21

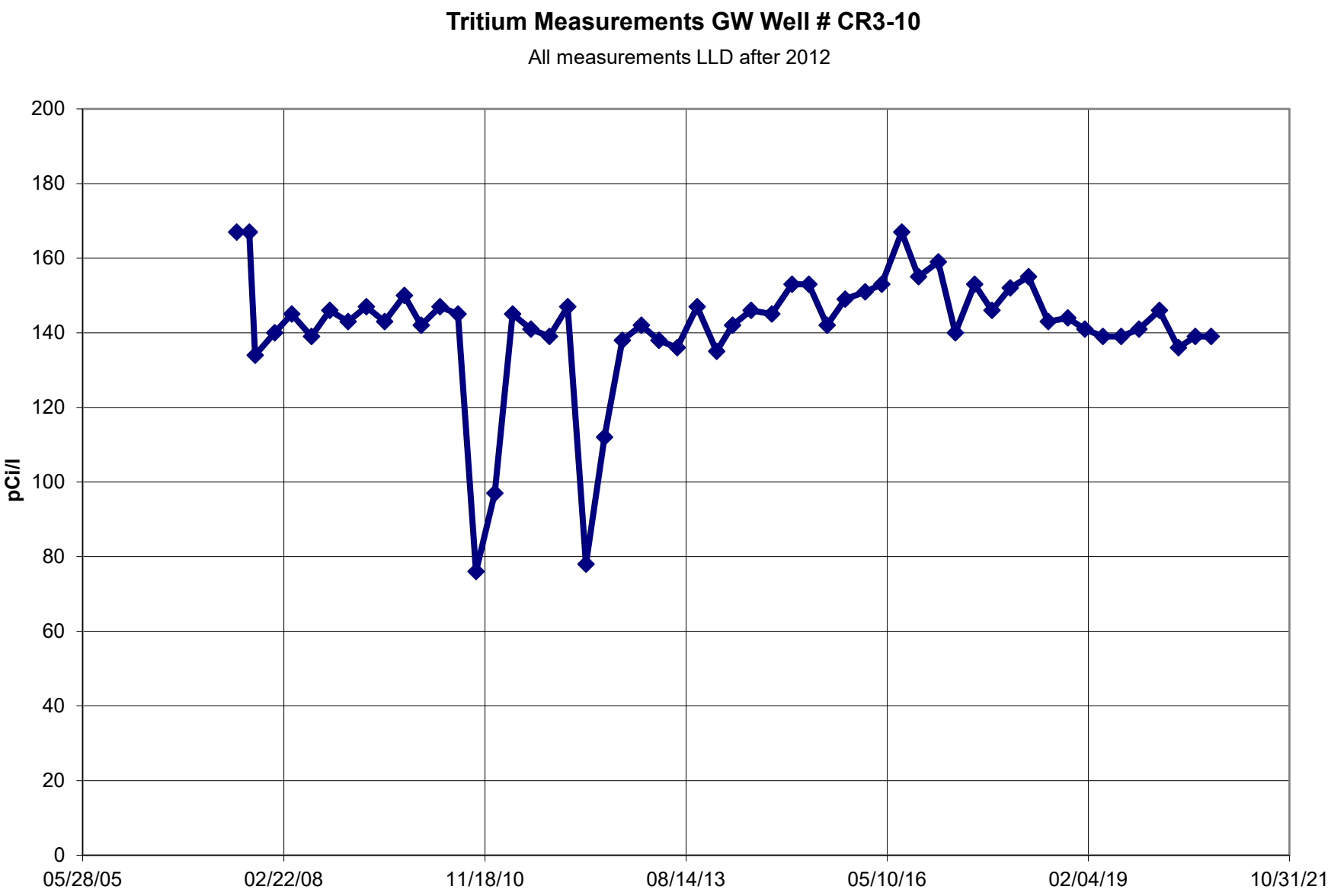

Tritium Measurements GW Well # CR3-10
All measurements LLD after 2012
pCi/l
200
180
160
140
120
100
80
60
40
20
0
05/28/05
02/22/08
11/18/10
08/14/13
05/10/16
02/04/19
10/31/21

TABLE IV-C.4

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
*CR3 SITE GROUND WATER (pCi/L)	Tritium 8	146	<LLD	MWC-27 0.30 mi.@266°	(0/4) (<LLD)	CR3-2 (<LLD)	0
	γ Spec 8						
	Mn-54	4	<LLD	-	-	<LLD	0
	Fe-59	8	<LLD	-	-	<LLD	0
	Co-58	4	<LLD	-	-	<LLD	0
	Co-60	4	<LLD	-	-	<LLD	0
	Zn-65	11	<LLD	-	-	<LLD	0
	Zr-Nb-95	8	<LLD	-	-	<LLD	0
	Cs-134	5	<LLD	-	-	<LLD	0
	Cs-137	5	<LLD	-	-	<LLD	0
	Ba-La-140	8	<LLD	-	-	<LLD	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.
* Non-REMP required samples

TABLE IV-C.4.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER (SUPPLEMENTAL DATA)

STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
MWC-27*	01-23	<146	137	<4	<4	<7	<3	<8	<7	<4	<4	<5
	04-27	<136	176	<4	<4	<8	<3	<10	<6	<4	<4	<8
	07-20	<139	182	<4	<4	<7	<4	<11	<8	<5	<5	<4
	12-16	<137	198	<4	<4	<8	<4	<11	<6	<5	<4	<5

*= These wells are not officially included in the REMP and are located on either side (north and south) of the site percolation ponds.

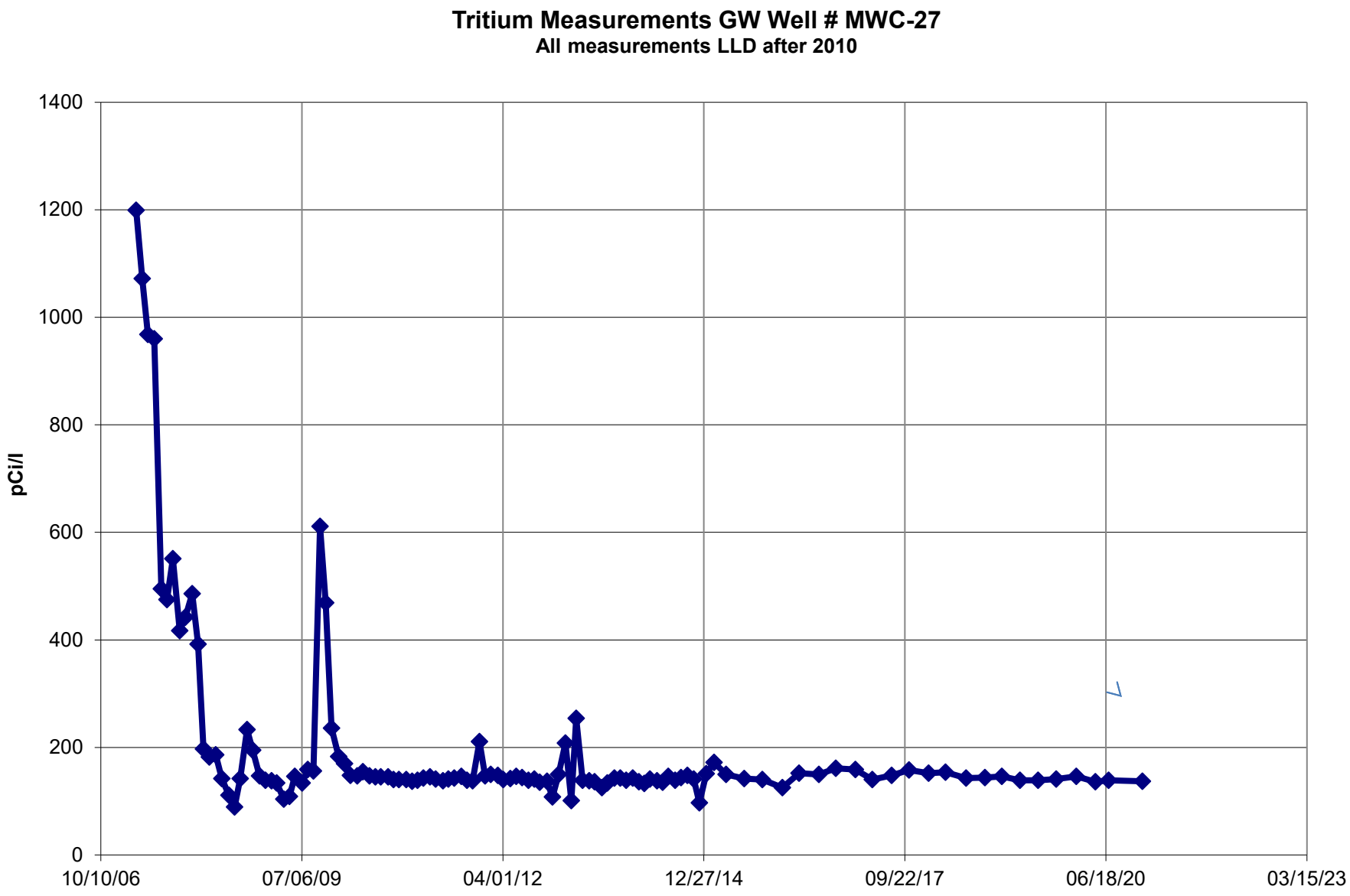
TABLE IV-C.4.a (cont'd)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER (SUPPLEMENTAL DATA)

STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
MWC-IF2*	01-23	<139	<49	<4	<4	<7	<3	<9	<6	<4	<4	<6
	04-27	<136	<52	<4	<3	<7	<3	<8	<7	<4	<4	<7
	07-20	<137	<51	<3	<3	<8	<3	<9	<6	<4	<4	<5
	12-16	<139	<54	<4	<4	<8	<4	<10	<7	<4	<5	<4

* These wells are not officially included in the REMP and are located on either side (north and south) of the site percolation ponds.


Tritium Measurements GW Well # MWC-27
All measurements LLD after 2010
pCi/l
1400
1200
1000
800
600
400
200
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23

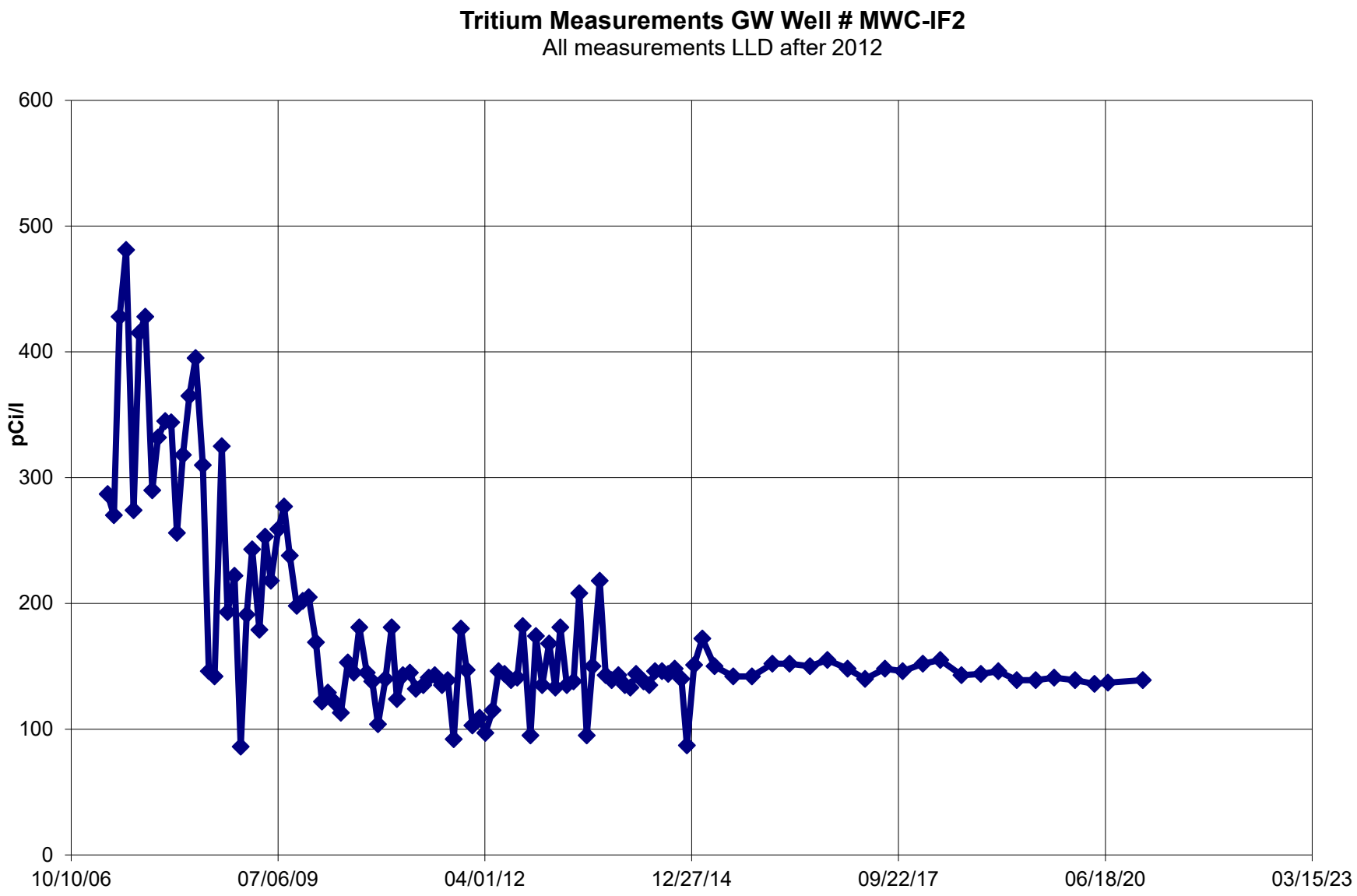

Tritium Measurements GW Well # MWC-IF2
All measurements LLD after 2012
pCi/l
600
500
400
300
200
100
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23

TABLE IV-C.5

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
DRINKING WATER (pCi/L)	Tritium 12	146	<LLD	-	-	<LLD	0
	γ Spec 12						
	Mn-54	6	<LLD	-	-	<LLD	0
	Fe-59	13	<LLD	-	-	<LLD	0
	Co-58	6	<LLD	-	-	<LLD	0
	Co-60	5	<LLD	-	-	<LLD	0
	Zn-65	13	<LLD	-	-	<LLD	0
	Zr-Nb-95	10	<LLD	-	-	<LLD	0
	Cs-134	5	<LLD	-	-	<LLD	0
	Cs-137	7	<LLD	-	-	<LLD	0
	Ba-La-140	11	<LLD	-	-	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

TABLE IV-C.5.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/L γ EMITTERS AND TRITIUM IN DRINKING WATER

STATION	DATE	H-3	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Zn-Nb-95	Cs-134	Cs-137	Ba-La-140
C07	01-09	<140	<5	<6	<13	<5	<10	<8	<8	<5	<6	<9
	04-13	<136	<3	<4	<7	<3	<8	<5	<4	<3	<3	<11
	07-13	<139	<4	<4	<7	<4	<9	<7	<5	<4	<5	<8
	10-06	<134	<3	<3	<6	<4	<9	<6	<4	<3	<4	<4
C10	01-09	<140	<5	<6	<13	<5	<13	<10	<10	<5	<6	<10
	04-13	<136	<3	<3	<7	<3	<7	<6	<4	<3	<3	<11
	07-13	<139	<3	<3	<6	<3	<8	<6	<4	<3	<3	<4
	10-06	<134	<3	<3	<6	<3	<7	<5	<4	<3	<4	<4
C18	01-09	<146	<6	<6	<11	<5	<13	<10	<11	<5	<7	<9
	04-13	<136	<3	<3	<5	<3	<7	<6	<3	<3	<3	<11
	07-13	<139	<3	<4	<7	<3	<7	<6	<4	<3	<3	<4
	10-06	<134	<4	<3	<6	<3	<6	<5	<4	<3	<3	<4

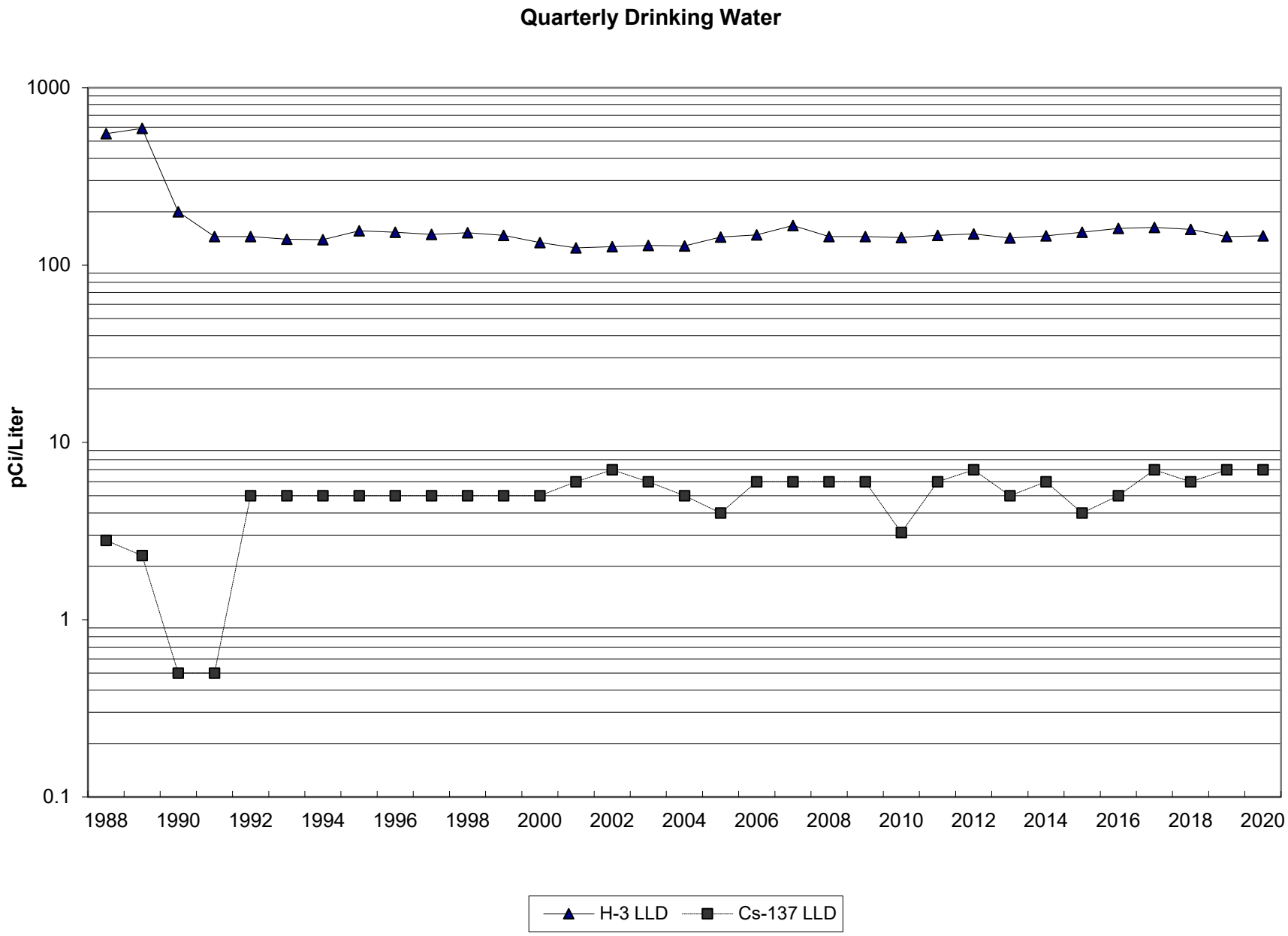

Quarterly Drinking Water
pCi/Liter
1000
100
10
1
0.1
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
H-3 LLD
Cs-137 LLD

TABLE IV-C.6

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SHORELINE SEDIMENT	γ Spec 8						
(pCi/kg)	Cs-134	19	LLD	—	—	<LLD	0
	Cs-137	19	LLD	—	---	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

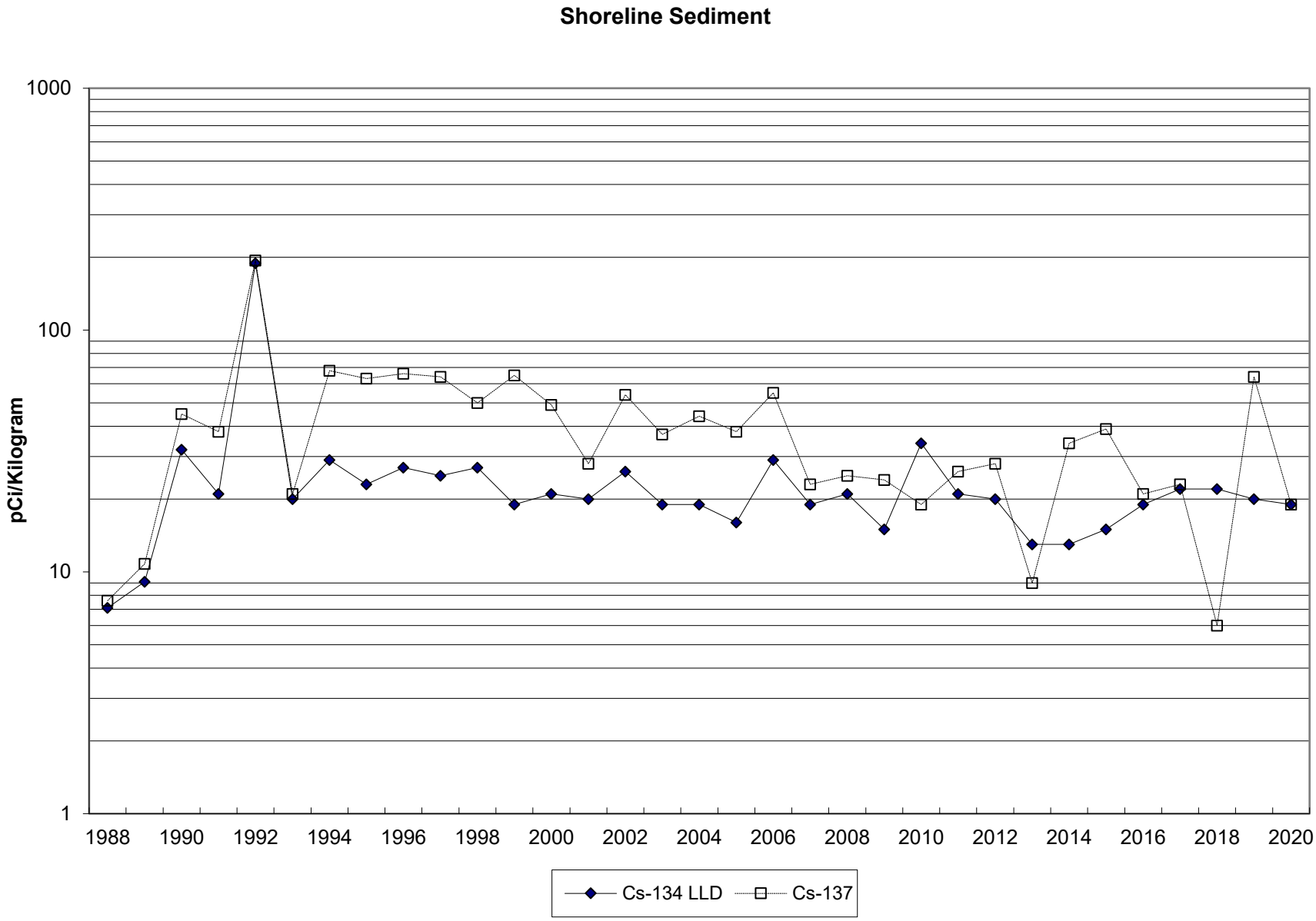
TABLE IV-C.6.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/kg γ EMITTERS IN SHORELINE SEDIMENT

STATION	PERIOD	Co-58	Co-60	Cs-134	Cs-137	K-40	Ra-226
C09	First Half	<9	<9	<8	<10	132±32	329±76
	Second Half	<9	<9	<8	<8	484±46	<289
C14H	First Half	<17	<15	<17	<16	1300±78	2510±176
	Second Half	<19	<17	<19	<19	338±58	1810±179
C14M	First Half	<17	<16	<13	<15	361±55	1620±146
	Second Half	<12	<12	<10	<12	807±78	<276
C14G	First Half	<9	<8	<10	<10	238±28	1040±87
	Second Half	<12	<12	<13	<14	187±40	1130±126

C09 is the control station at Ft. Island Beach. C14H, C14M, & C14G are discharge canal stations.


Shoreline Sediment
1000
100
10
1
pCi/Kilogram
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Cs-134 LLD
Cs-137

IV-D. INGESTION PATHWAY

To evaluate the ingestion pathway, samples are taken of fish, oysters, broad leaf vegetation, citrus, milk and watermelon.

1. Quarterly carnivorous fish samples were taken at two locations: C29 at the end of the discharge canal, and C30, the control location, near the mouth of the intake canal. The fish sample for C30 was not available in the first quarter.

   In 2020, none of the required radionuclides were found in measurable quantities. The highest Cs-137 LLD for stations C29 and C30 was 29 pCi/kg. Naturally occurring K-40 was quantified in all eight samples at an average concentration of 2,393 pCi/kg.

   In 2019, none of the required radionuclides were found in measurable quantities.

   In 2018, none of the required radionuclides were found in measurable quantities.

   In 2017, none of the required radionuclides were found in measurable quantities.

   In 2016, none of the required radionuclides were found in measurable quantities.

   In 2015, none of the required radionuclides were found in measurable quantities.

   In 2014, none of the required radionuclides were found in measurable quantities.

   In 2013, none of the radionuclides of interest were identified in measurable quantities.

   In 2012, none of the radionuclides of interest were identified in measurable quantities.

   Table IV-D.1 provides a statistical summary of the carnivorous fish gamma spectroscopy results.

   Table IV-D.1.a provides the results of the quarterly samples.

2. Quarterly oyster samples were taken at the same locations as fish samples, C29 and C30.

   In 2020, none of the required radionuclides were found in measurable quantities.

   In 2019, none of the required radionuclides were found in measurable quantities.

   In 2018, none of the required radionuclides were found in measurable quantities.

   In 2017, none of the required radionuclides were found in measurable quantities.

   In 2016, none of the required radionuclides were found in measurable quantities.

   In 2015, none of the required radionuclides were found in measurable quantities.

   In 2014, none of the required radionuclides were found in measurable quantities. Additionally, silver-110m was found in one sample at location C29 with a concentration of 35 pCi/kg.

   In 2013, none of the required radionuclides were found in measurable quantities. Additionally, silver-110m was not quantified in any sample.

   Table IV-D.2 provides a statistical summary of the oyster gamma spectroscopy results.

   Table IV-D.2.a provides the results of the quarterly samples.

3. Monthly broad leaf vegetation samples were taken at two indicator locations, C48A and C48B, and one control location, C47.

   In 2020, 12 out of the 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 51 pCi/kg and a range of 10 to 116 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137 in 10 of 12 samples ranging from 16 to 336 pCi/kg. These results are similar to those in 2019.

   In 2019, 11 out of the 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 52 pCi/kg and a range of 6 to 329 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137 in 7 of 12 samples ranging from 13 to 154 pCi/kg. These results are similar to those in 2018.

   In 2018, 13 out of 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 27 pCi/kg and a range of 13 to 48 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 12 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 111 pCi/kg and a range of 38 to 184 pCi/kg. These results are similar to those in 2017.

   In 2017, 12 out of 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 30 pCi/kg and a range of 17 to 66 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 10 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 99 pCi/kg and a range of 19 to 186 pCi/kg. These results are similar to those in 2016.

   In 2016, 13 out of 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 46 pCi/kg and a range of 11 to 179 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 10 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 73 pCi/kg and a range of 10 to 174 pCi/kg. These results are similar to those in 2015.

   In 2015, fourteen of twenty four indicator samples had measurable amounts of cesium-137 with an average concentration of 50 pCi/kg and a range of 12 to 105 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 11 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 67 pCi/kg and a range of 15 to 150 pCi/kg. The Cs-137 values are similar in concentration as compared to samples collected in 2014 which experienced radionuclide deposition as a result of the Fukushima earthquake event in 2011 and are not a result of the operation of CR3.

   In 2014, sixteen of twenty four indicator samples had measurable amounts of Cs-137 with an average concentration of 53 pCi/kg and a range of 4 to 159 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 10 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 43 pCi/kg and a range of 17 to 71 pCi/kg. The Cs-137 values are similar in concentration as compared to samples collected in 2013 which experienced radionuclide deposition as a result of the Fukushima earthquake event in 2011 and are not a result of the operation of CR3.

   In 2013, fifteen of twenty four indicator samples had measurable amounts of Cs-137 with an average concentration of 75 pCi/kg and a range of 5 to 147 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In twelve of twelve control station samples there were measurable amounts of cesium-137 at an average concentration of 86 pCi/kg and a range of 14 to 258 pCi/kg. The Cs-137 values are similar in concentration as compared to samples collected in 2012 which experienced radionuclide deposition as a result of the Fukushima earthquake event and are not a result of the operation of CR3.

4. In 2020 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample. There were also four milk samples collected in 2020, all at location C28. Location C28 is about 20 miles SSE of the plant. All showed less than LLD for Cs-134 and Cs-137. Milk samples are not required per the ODCM.

   In 2019 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample. There were also three milk samples collected in 2019, all at location C28. Location C28 is about 20 miles SSE of the plant. All showed less than LLD for Cs-134 and Cs-137. Milk samples are not required per the ODCM.

   In 2018 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample.

   In 2017 the State was unable to locate a watermelon field at location C04 or anywhere in the vicinity of C04. This is documented in plant condition report 2192486. Also, only one citrus sample was collected versus the usual two samples. It showed above MDA levels of Cs-137 at 9 pCi/kg with an uncertainty of 2 pCi/kg. It was collected at location C19 which is 9.6 miles ENE of CR3. This reported value is less than the MDA of 11 pCi/kg reported in 2016 and is likely due to natural background.

   In 2016 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample.

   In 2015 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus samples with exception of Cs-137 at a concentration of 9 pCi/kg. It is not unusual to periodically see Cs-137 in citrus samples due to widespread deposition of Cs-137 from fallout due to past weapons testing and more recent from the Fukushima earthquake and tsunami event that occurred in 2011.

   In 2014 watermelon samples were collected at station C04. None of the required radionuclides were found in measurable quantities. Citrus samples (oranges and grapefruit) were collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus samples with exception of Cs-137 (in grapefruit) at a concentration of 4 pCi/kg. It is not unusual to periodically see Cs-137 in citrus samples due to widespread deposition of Cs-137 from fallout due to past weapons testing and more recent from the Fukushima earthquake and tsunami event that occurred in 2011.

   Table IV-D.4 provides a statistical summary of the watermelon and citrus gamma spectroscopy results.
   Table IV-D.4.a provides the results of the semi-annual samples.

TABLE IV-D.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
CARNIVOROUS	γ Spec 8						
FISH							
(pCi/kg)	Mn-54	27	<LLD	-	-	<LLD	0
	Fe-59	47	<LLD	-	-	<LLD	0
	Co-58	28	<LLD	-	-	<LLD	0
	Co-60	27	<LLD	-	-	<LLD	0
	Zn-65	56	<LLD	-	-	<LLD	0
	Cs-134	27	<LLD	-	-	<LLD	0
	Cs-137	29	<LLD	-	-	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

TABLE IV-D.1.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/kg γ EMITTERS IN CARNIVOROUS FISH

STATION	QUARTER	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	K-40
C29	1	<27	<28	<47	<24	<53	<27	<29	2470±192
	2	<20	<17	<39	<19	<41	<18	<21	2960±180
	3	<24	<23	<43	<27	<52	<24	<21	2820±203
	4	<18	<21	<41	<21	<48	<21	<23	2510±171
C30	1	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
	2	<21	<23	<45	<23	<56	<18	<24	2770±204
	3	<19	<20	<42	<16	<43	<22	<21	2480±172
	4	<20	<16	<40	<17	<50	<20	<25	2840±182

(1) Unable to catch 1st quarter fish. Attempts made on 26-Feb-20, 27-Feb-20, 28-Feb-20, 6-Mar-20.

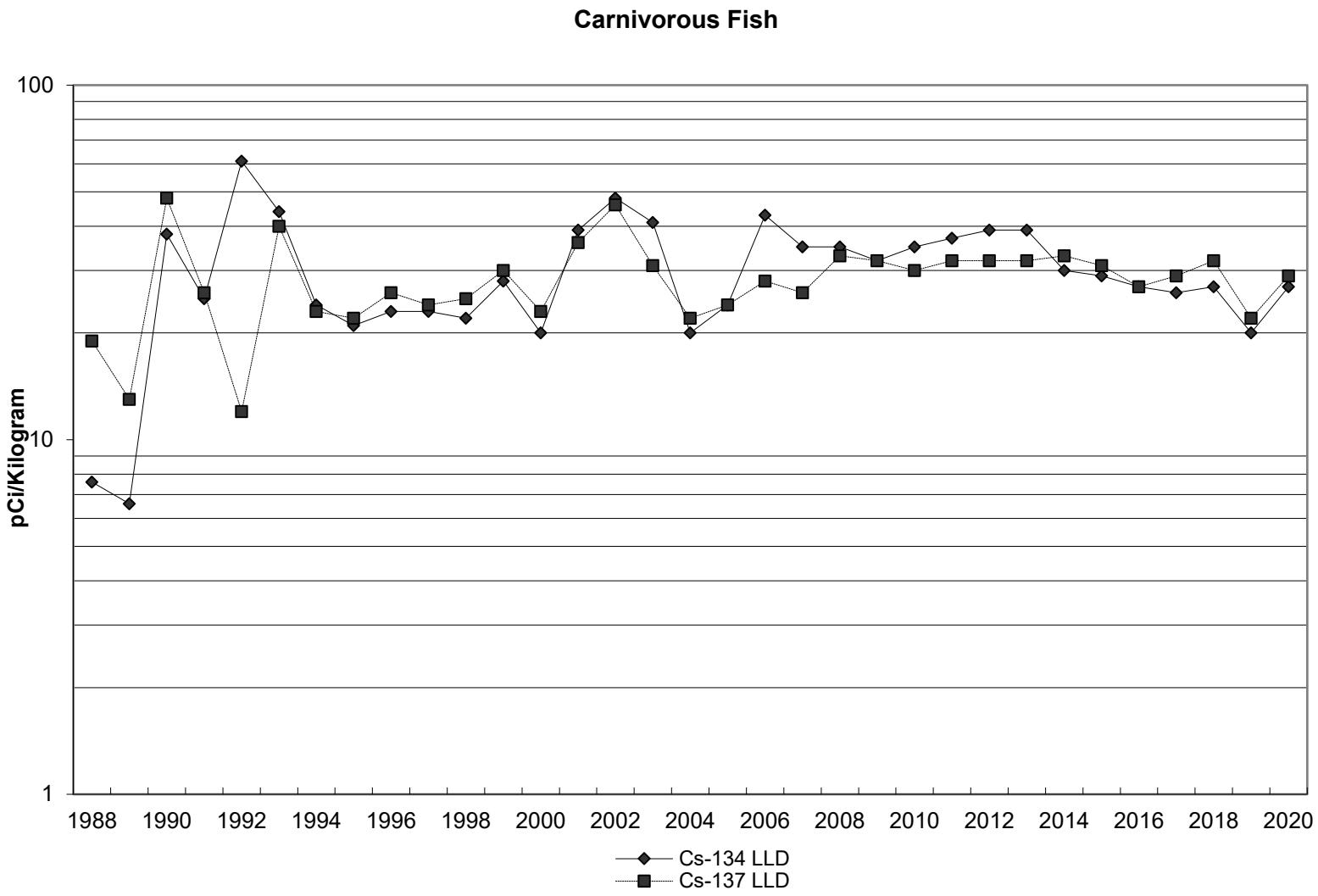

Carnivorous Fish
100
10
1
pCi/Kilogram
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Cs-134 LLD
Cs-137 LLD

TABLE IV-D.2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
OYSTERS (pCi/kg)	γ Spec 8						
	Mn-54	22	<LLD	-	-	<LLD	0
	Fe-59	80	<LLD	-	-	<LLD	0
	Co-58	30	<LLD	-	-	<LLD	0
	Co-60	25	<LLD	-	-	<LLD	0
	Zn-65	57	<LLD	-	-	<LLD	0
	Cs-134	21	<LLD	-	-	<LLD	0
	Cs-137	21	<LLD	-	-	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

TABLE IV-D.2.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/kg γ EMITTERS IN OYSTERS

STATION	QUARTER	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137	K-40
C29	1	<19	<31	<56	<25	<57	<20	<17	1110±130
	2	<22	<30	<80	<21	<40	<17	<20	1260±135
	3	<20	<26	<61	<20	<40	<19	<21	777±142
	4	<20	<22	<51	<16	<41	<17	<18	721±123
C30	1	<16	<20	<41	<15	<31	<17	<17	867±87
	2	<20	<25	<48	<16	<36	<17	<17	798±88
	3	<21	<26	<58	<21	<42	<19	<21	943±102
	4	<19	<24	<47	<21	<50	<21	<19	1250±123

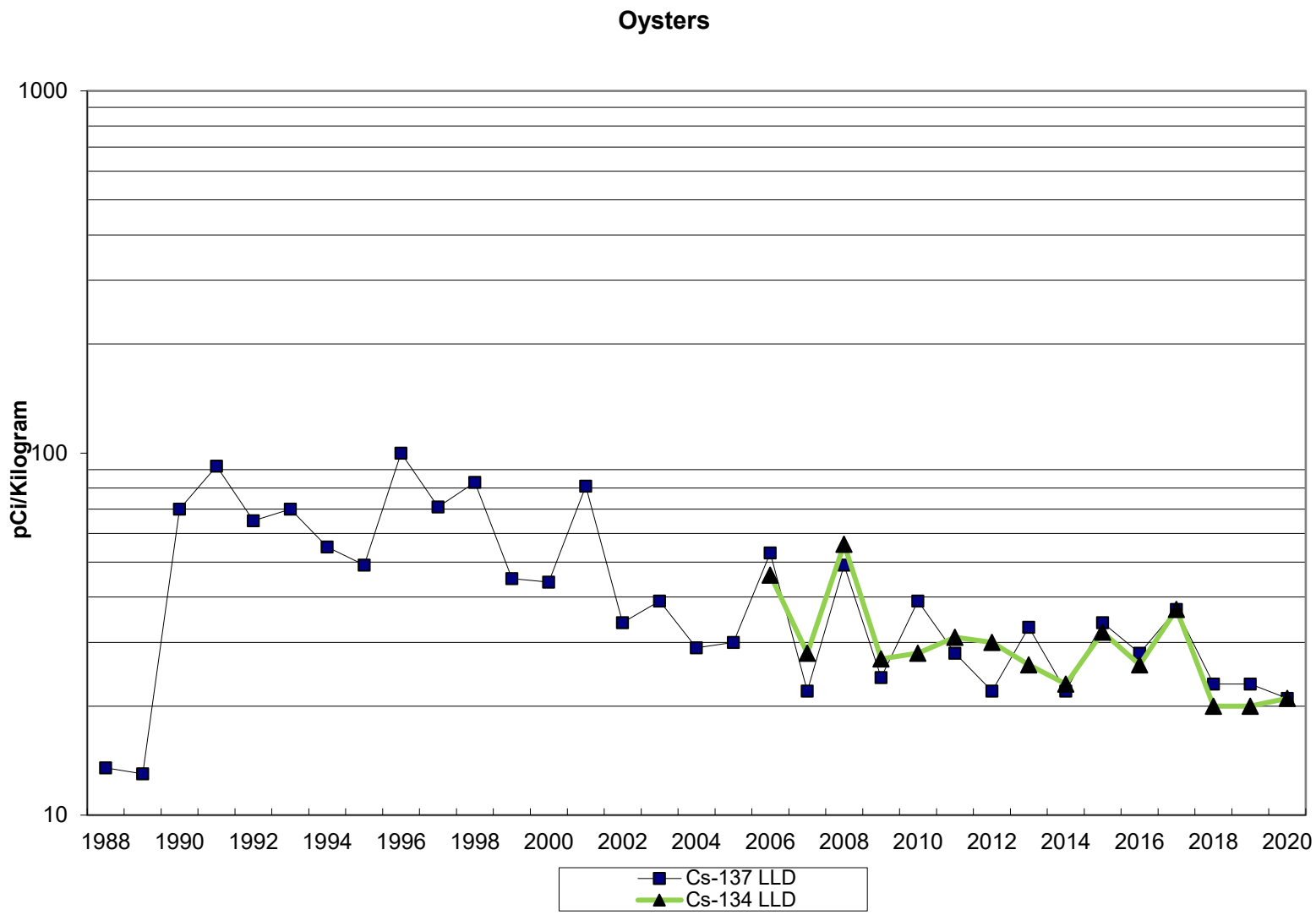

Oysters
1000
100
10
pCi/Kilogram
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
Cs-137 LLD
Cs-134 LLD

TABLE IV-D.3

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
BROAD LEAF VEGETATION (pCi/kg)	γ Spec 36						
	Cs-134	15	<LLD	_	_	<LLD	0
	Cs-137[2]	26	51 (12/24) (10-116)	C48B 0.9 @ 73º	55(11/12) (18-116)	150 (10/12) (16-336)	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

[2] The elevated Cs-137 values are not associated with the operation of CR3 and are a direct result of the Fukushima earthquake and tsunami event that occurred in 2011.

TABLE IV-D.3.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/kg OF γ EMITTERS IN BROAD LEAF VEGETATION

STATION	MONTH	Cs-134	Cs-137	K-40
C47	JAN	<10	16±3	3280±143
	FEB	<10	167±8	1660±91
	MAR	<13	<22	2350±156
	APR	<13	<26	2260±154
	MAY	<14	336±15	2250±144
	JUN	<10	109±8	1620±112
	JUL	<9	84±6	2580±129
	AUG	<10	50±5	2560±129
	SEP	<11	232±10	2590±137
	OCT	<15	83±8	2160±131
	NOV	<11	202±10	3480±159
	DEC	<14	223±12	1920±135
C48A	JAN	<13	<21	1900±150
	FEB	<11	<16	3200±171
	MAR	<12	<16	3840±195
	APR	<13	10±4	3360±177
	MAY	<14	<19	3860±196
	JUN	<9	<10	2390±119
	JUL	<10	<14	3470±172
	AUG	<10	<12	3110±142
	SEP	<12	<11	2840±148
	OCT	<10	<11	3230±148
	NOV	<11	<13	2950±150
	DEC	<10	<12	2490±123

TABLE IV-D.3.a (CONT'D)

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/kg OF γ EMITTERS IN BROAD LEAF VEGETATION

STATION	MONTH	Cs-134	Cs-137	K-40
C48B	JAN	<15	82±9	830±108
	FEB	<14	18±5	1660±126
	MAR	<14	18±5	2340±155
	APR	<10	66±7	2200±133
	MAY	<11	116±8	1650±117
	JUN	<13	24±5	1710±132
	JUL	<11	31±5	1670±121
	AUG	<8	37±4	2050±110
	SEP	<11	77±7	1360±90
	OCT	<10	66±6	1040±75
	NOV	<9	68±5	1200±71
	DEC	<9	<13	1230±95

The elevated Cs-137 values are a direct result of the Fukushima earthquake and tsunami event that occurred in 2011 and legacy weapons testing fallout and are not associated with CR-3 operation.

Broad Leaf Vegetation

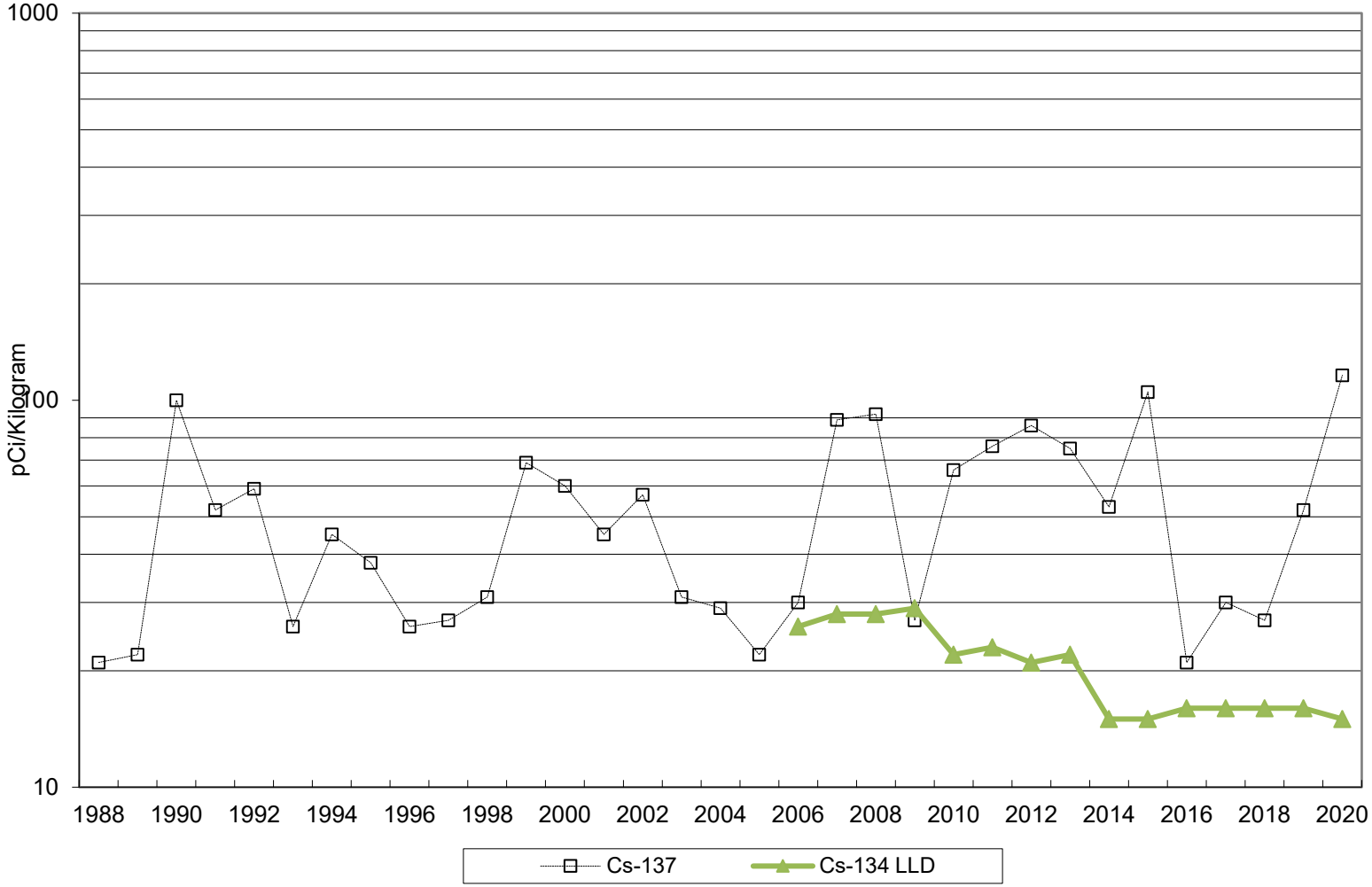


TABLE IV-D.4

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2020**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
WATERMELON (pCi/kg)	γ Spec 1						
	Cs-134	4	<LLD			None	0
	Cs-137	4	<LLD	C04	NE (6.0 miles)	None	0
CITRUS (pCi/kg)	γ Spec 1						
	Cs-134	7	<LLD	_	_	None	0
	Cs-137	10	<LLD	C19	ENE (9.6 miles)	None	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-9 of the CR-3 ODCM.

TABLE IV-D.4.a

DUKE ENERGY FLORIDA, LLC- CR3 - 2020

pCi/kg OF γ EMITTERS IN WATERMELON AND CITRUS

STATION	MONTH	Cs-134	Cs-137	K-40
C04 – Watermelon	June	<4	<4	1050±50
C19 – Citrus	February	<7	<10	1530±92