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MEASURED THERMAL AND FAST NEUTRON FLUENCE RATES ATR CYCLES 171A IR TMIST 3B Revision 1 4/21/23 thru 6/19/23

B. J. Walker and M. A. Reichenberger

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ATR CYCLE 171A
Revision 1
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This report contains the thermal (2200 m/s) and fast (E>1MeV) neutron fluence rate data for ATR Cycle 171A which were measured by the Radiation Measurements Laboratory (RML) as requested by the Power Reactor Programs (ATR Experiments) Radiation Measurements Work Order.

This report contains fluence rate values corresponding to the particular elevations (relative to the 80-ft. core elevation) where the measurements were taken. The data in this report consists of (1) a table of the ATR power history and distribution, (2) a listing of the calculated thermal and fast neutron fluence rates, and (3) plots of calculated both the thermal and fast neutron fluence rates.

The fluence rates reported are for the average power levels given in the table of power history and distribution.

During the irradiation of Cycle 152A, the RML performed additional flux measurements to assess core reconfiguration issues. Measurements using cadmium covered as well as bare neutron monitors in the Southwest, Southeast, and H positions of the Center lobe were performed to determine the division in neutron energy between epithermal and thermal neutrons. This is defined as the resonance correction defined in this report. It is used to quantify both thermal and fast neutron flux. For more information please refer to letter, “RADIATION MEASUREMENTS LABORATORY MEASUREMENTS OF IN CORE ATR PHYSICS TESTING DURING CYCLE 152A” dated January 24, 2013, to Casey Stengel from C. C. Jensen. The measured values documented in RML Procedure, “ACMM-3600, Flux Monitoring,” will be used indefinitely until further measurements supersede the current values.

DEFINITIONS OF REPORTED INFORMATION

ON PRINTED PAGES

1. CYCLE: The identification code given to a specific period of operation of the ATR for which the data in this report applies.

2. POSITION: The identification code given to a specific location in the ATR core area where neutron monitors were located and for which the data associated with the code apply. The letter code identifies the lobe and the number code identifies a monitor position.

3. MONITOR ID: The identification code given to a specific neutron monitor holder. The code is stamped on the holder. The letter code identifies the type of holder and the number is unique to allow tracking of the neutron monitors and their data.

4. EFPD: The acronym for, "Effective Full Power Days" which is the effective number of days the ATR operated at the average total core power level of the cycle. This value is obtained from the ATR power history and distribution.

5. AVERAGE MW: The average power level (in megawatts) at which the ATR lobe operated during the cycle. The values used for NW, NE, C, SW, and SE lobes are obtained from the ATR power history and distribution. The values used for the other lobes and core positions are determined as follows:

$$N = (NE + NW + C)/3$$
$$E = (NE + SE + C)/3$$
$$S = (SE + SW + C)/3$$
$$W = (NW + SW + C)/3$$

A1 through A8 = C
A9 = NE
A10 = SE
A11 = SW
A12 = NW

B1 or B2 = NE	I21 = NE	B9 = N
B3 or B4 = SE	I22 = SE	B10 = E
B5 or B6 = SW	I23 = SW	B11 = S
B7 or B8 = NW	I24 = NW	B12 = W

6. DATE: The calendar dates corresponding to the outage and operating time of the cycle. These dates include the forced outage time associated with the cycle as well as the operating time.

7. ELEVATION: The vertical position associated with the neutron fluence rate

measurement value relative to the 80 ft. elevation of the ATR core. The elevation values are in inches and negative values are below the 80 ft. elevation (commonly referred to as centerline). The elevation values are established based on a 35.25" offset from the top of the wire to the core centerline with a 4.5" offset for the wirescanner fixturing.

An evaluation of the elevation tolerances is listed as follows:

Known Tolerances:

Holder Fabrication	+ 0.11 inch
Cutting the Monitor Wire to Length	+ 0.10 inch
Wire Alignment in the Holder	+ 0.13 inch
Mounting the Wire to the Scanner	+ 0.13 inch
Scanning Control	+ 0.01 inch
Scanner Home Positioning	+ 0.06 inch

Estimated Tolerances:

4.5" Wirescanner Fixture Offset	+ 0.25 inch
Stackup of the Safety Rod Components	± 0.33 inch
Position of the Safety Rod Relative to 80 ft. during Operation	± 0.75 inch*
Total Tolerance:	**± 1.87 inch**

These elevation tolerances include only what are from random errors. Systematic errors or biases may also occur due to information input. However, procedural controls are used to minimize this information input error.

*This estimate does not include variations due to thermal and hydraulic effects.

8. "THERMAL": The equivalent 2200 m/s (0.025 eV) neutron fluence rate assuming a Maxwellian distribution for the thermalized neutrons at 20.44C. The fluence rate is determined from the Co-59 (n,γ) Co-60 reaction rate assuming a 37 barn 2200 m/s cross section for the reaction. Corrections for the epithermal reaction rate are made based on cadmium ratio measurements at each position of the fluence rate measurement. All fluence rate values are in units of neutrons per sqcm per second.

9. "FAST": The equivalent >1 MeV fission neutron energy fluence rate assuming a pure U-235 fission spectrum neutron energy distribution. The fluence rate is determined from the Ni-58(n,p)Co-58 reaction rate assuming a 0.092 barn fission spectrum averaged cross section for the reaction and a fission spectrum fraction of 0.692 for >1 MeV neutrons. Corrections for the burnout of the Co-58 isomers are made based on the measured 2200

m/s fluence rate, the exposure duration and the burnout cross sections of the isomers [1650 barns (71 days), 1.7 E+5 barns (9.1 hours)] at each position of the fluence rate measurement.

10. CENTERLINE FLU. RATE: The neutron fluence rate at the elevation assignment nearest to the ATR core centerline elevation (0.0).

11. AVG. MAX. FLU. RATE: The average of the highest three adjacent values.

12. MAX. FLU. RATE/MW (AVG.): The average maximum fluence rate divided by the average power level (MW) of the lobe or position.

13. K FACTOR: The conversion factor determined from the neutron monitor activity for converting the net count rate at each elevation to the absolute reaction product (^{60}Co or ^{58}Co) radioactivity per unit mass of the monitor material (d/s/mg).

14. RESONANCE CORRECTION: The fractional correction factor used to correct the Co-59 (n,γ) Co-60 reaction rate for the epithermal neutron response at the position where the neutron monitor was located during irradiation. This correction factor was determined from cobalt "cadmium ratio" measurements at the same spatial location for the monitor geometry and atom density.

15. C/L BURNOUT CORRECTION: The correction factor for the burnout (transmutation) of the reaction products (Co-60, Co-58, Co-58m) of the neutron monitors during the cycle irradiation at the centerline fluence rate elevation. The burnout correction factors for other elevation assignments will vary (nonlinearly) depending on the "thermal" neutron fluence rates and cycle durations.

16. BACKGROUND (counts/sec.): The wire scanner detector background environment counting rate at the time the neutron monitor wires were scanned.

17. CHECK SOURCE (counts/sec.)
    Date Hour: The wire scanner detector check source count rate on the day the neutron monitor wires were scanned. The check source is a radioactive (^{60}Co) cobalt-aluminum wire mounted in a fixture which reproducibly positions it over the detector collimator. This check source is used to test counting functions (gain and stability) of the scanner counting system. The count rate is corrected for background and decay corrected to 08/30/08, 12:00.

ON PLOTS

18. REACTOR: Identification of the reactor with which the data are associated (normally ATR).

19. CYCLE POWER: The total megawatt days of power produced during the reactor cycle. This value is normally obtained from the ATR power history and distribution information supplied by PRP.

20. MATERIAL: The element name of the neutron monitor material. The "thermal" neutron monitor material is normally an alloy (CoAl) of cobalt (Co) and aluminum (Al) where the weight percent is given preceding the percent (%) symbol.

21. EXPERIMENT: The identification code given to the experiment located in the loop. This information is provided by PRP.

ADDITIONAL INFORMATION

Cycle 171A was the first operating cycle at ATR following the 6th core internals changeout. Following this 2-year long outages, the condition of the canal wirescanner that is used to measure the activity of Ni and Co/Al wires was suspect due to high traffic in the region of the canal where the wirescanner resides and the extended outage.

Before conducting the measurement of the activated Ni and Co/Al wires, the drive-motor of the scanning bed was jammed. Furthermore, the gain and offset of the shaping amplifier and analog to digital converter were respectively set to different values than how they were left following the cycle 170A flux wire measurements. These items were troubleshot and resolved before measurement of flux wires for 171A began.

The existing software to operate the wire-scanning bed does not provide instruction on the proper analysis of the amplifier gain settings. During the measurements, it was discovered that the software *assumes* that the energy calibration of the NaI detector is both linear and constant between the three peaks of interest,

- 811 keV – Co-58,
- 1173 keV – Co-60,
- 1333 keV – Co-60,

and that the spacing between these peaks does not change. However, it was observed that the assumed spacing between peaks was not appropriate and that the software was *incorrectly* integrating the area under the Co-60 peaks. This under-integration likely led to significant under-reporting of the thermal neutron fluence rates reported herein. The determination of the fast fluence-rate also requires correction based on thermal fluence and is therefore also suspect.

This inconsistency was not identified until the final wire was being measured. The present process requires that a wire segment from each wire be extracted and taken back to RML. Therefore, it was not possible to re-measure any wires. It is therefore recommended to disregard the absolute value of the following results. However, relative comparisons (between irradiation locations and along the axis of the core) should still be valid.

POWER HISTORY AND DISTRIBUTION
CYCLE 171 A
4/21/23
TO
6/19/23

	NW	NE	C	SW	SE	TOT MW
MWD	1094	1037	1125	1366	1257	587
EFPD	55.12					
MWD/44 = EFF. TE.	24.86	23.57	25.57	31.05	28.57	
EFF. TE. / EFPD = PF	.451	.428	.464	.563	.518	
MWD/EFPD = AVG. POWER (MW)	19.85	18.81	20.41	24.78	22.80	
TOTAL MWD/EFPD = AVERAGE FULL POWER (MW)	106.66					

THE FOLLOWING POWER HISTORY WAS USED FOR FLUENCE RATE DETERMINATIONS.

Days	Power (MW)	Power Factor (P.F.)
0.9	1.50	0.01
3.21	0	0
55.1	104.97	1
57	0	0

ATR NEUTRON MONITOR RESULTS

CYCLE: 171A POSITION: I-10 MONITOR ID: IR-59
EFPD: 55.1 AVERAGE MW: NA DATE: 04/21/23 to 06/19/23

ELEVATION from core CL (inches)	"THERMAL" 2200 m/s CO (n/cm**2/sec)	"FAST" >1 MeV NI (n/cm**2/sec)
-30.73	9.76E+12	3.65E+11
-29.75	1.14E+13	4.26E+11
-29.75	1.14E+13	4.26E+11
-28.75	1.34E+13	4.82E+11
-27.75	1.51E+13	5.30E+11
-26.75	1.72E+13	5.93E+11
-25.75	1.83E+13	7.13E+11
-24.75	2.01E+13	7.28E+11
-23.75	2.18E+13	7.99E+11
-22.75	2.36E+13	8.34E+11
-21.75	2.50E+13	8.60E+11
-20.75	2.61E+13	9.53E+11
-19.75	2.71E+13	9.72E+11
-18.75	2.77E+13	1.05E+12
-17.75	2.86E+13	1.05E+12
-16.75	2.98E+13	1.15E+12
-15.75	3.05E+13	1.07E+12
-14.75	3.11E+13	1.16E+12
-13.75	3.16E+13	1.17E+12
-12.75	3.31E+13	1.19E+12
-11.75	3.32E+13	1.13E+12
-10.75	3.40E+13	1.19E+12
-9.75	3.36E+13	1.26E+12
-8.75	3.33E+13	1.20E+12
-7.75	3.35E+13	1.21E+12
-6.75	3.42E+13	1.18E+12
-5.75	3.36E+13	1.17E+12
-4.75	3.36E+13	1.24E+12
-3.75	3.35E+13	1.13E+12
-2.75	3.21E+13	1.15E+12
-1.75	3.26E+13	1.16E+12
-0.75	3.08E+13	1.09E+12
0.25	3.02E+13	1.11E+12
1.25	3.01E+13	1.03E+12
2.25	2.97E+13	1.01E+12
3.25	2.84E+13	9.31E+11
4.25	2.74E+13	8.75E+11
5.25	2.60E+13	9.31E+11
6.25	2.46E+13	8.15E+11
7.25	2.32E+13	8.11E+11
8.25	2.16E+13	7.47E+11
9.25	1.93E+13	6.71E+11
10.25	1.81E+13	6.21E+11
11.25	1.61E+13	5.76E+11
12.25	1.37E+13	4.81E+11
13.25	1.19E+13	4.19E+11
14.25	9.80E+12	4.10E+11
CENTER LINE FLU. RATE	3.02E+13	1.11E+12
AVG. MAX. FLU. RATE	3.38E+13	1.22E+12
MAX. FLU. RATE/MW (AVG.)	NA	NA
K FACTOR	268.32	2762.81
RESONANCE CORRECTION	0.98	NA
C/L. BURNOUT CORRECTION	1.000	1.189
BACKGROUND (COUNTS/SEC.)	1.26	1.26
CHECK SOURCE (COUNTS/SEC.)		
07/27/23 09:00	3406.	3406.

ATR NEUTRON MONITOR RESULTS

CYCLE: 171A POSITION: I-10 MONITOR ID: IR-60
EFPD: 55.1 AVERAGE MW: NA DATE: 04/21/23 to 06/19/23

ELEVATION from core CL (inches)	"THERMAL" 2200 m/s CO (n/cm**2/sec)	"FAST" >1 MeV NI (n/cm**2/sec)
-30.73	6.01E+12	2.13E+11
-29.75	7.05E+12	2.30E+11
-29.75	7.05E+12	2.30E+11
-28.75	8.38E+12	2.65E+11
-27.75	9.70E+12	3.33E+11
-26.75	1.07E+13	3.37E+11
-25.75	1.18E+13	3.45E+11
-24.75	1.28E+13	4.07E+11
-23.75	1.34E+13	4.78E+11
-22.75	1.46E+13	4.57E+11
-21.75	1.53E+13	4.84E+11
-20.75	1.63E+13	5.20E+11
-19.75	1.68E+13	5.62E+11
-18.75	1.80E+13	5.63E+11
-17.75	1.83E+13	6.01E+11
-16.75	1.90E+13	5.75E+11
-15.75	1.93E+13	6.22E+11
-14.75	1.99E+13	5.96E+11
-13.75	2.01E+13	6.61E+11
-12.75	2.05E+13	6.81E+11
-11.75	2.06E+13	6.66E+11
-10.75	2.09E+13	6.99E+11
-9.75	2.14E+13	6.92E+11
-8.75	2.15E+13	6.95E+11
-7.75	2.12E+13	6.65E+11
-6.75	2.15E+13	6.88E+11
-5.75	2.05E+13	6.83E+11
-4.75	2.09E+13	6.71E+11
-3.75	2.11E+13	6.47E+11
-2.75	2.03E+13	6.49E+11
-1.75	1.96E+13	6.34E+11
-0.75	1.93E+13	6.21E+11
0.25	1.91E+13	6.41E+11
1.25	1.89E+13	6.04E+11
2.25	1.85E+13	5.36E+11
3.25	1.76E+13	5.38E+11
4.25	1.65E+13	5.06E+11
5.25	1.58E+13	5.00E+11
6.25	1.54E+13	4.52E+11
7.25	1.44E+13	4.22E+11
8.25	1.38E+13	4.30E+11
9.25	1.25E+13	3.95E+11
10.25	1.13E+13	3.57E+11
11.25	1.03E+13	2.98E+11
12.25	8.96E+12	2.75E+11
13.25	8.08E+12	2.86E+11
14.25	6.70E+12	2.49E+11
CENTER LINE FLU. RATE	1.91E+13	6.41E+11
AVG. MAX. FLU. RATE	2.14E+13	6.95E+11
MAX. FLU. RATE/MW (AVG.)	NA	NA
K FACTOR	264.82	2727.97
RESONANCE CORRECTION	0.98	NA
C/L. BURNOUT CORRECTION	1.000	1.119
BACKGROUND (COUNTS/SEC.)	1.43	1.43
CHECK SOURCE (COUNTS/SEC.)		
07/31/23 09:05	3433.	3433.

ATR NEUTRON MONITOR RESULTS

CYCLE: 171A POSITION: I-13 MONITOR ID: IR-61
EFPD: 55.1 AVERAGE MW: NA DATE: 04/21/23 to 06/19/23

ELEVATION from core CL (inches)	"THERMAL" 2200 m/s CO (n/cm**2/sec)	"FAST" >1 MeV NI (n/cm**2/sec)
-30.73	1.24E+13	5.85E+11
-29.75	1.48E+13	7.32E+11
-29.75	1.48E+13	7.32E+11
-28.75	1.79E+13	8.73E+11
-27.75	2.08E+13	1.00E+12
-26.75	2.31E+13	1.08E+12
-25.75	2.56E+13	1.20E+12
-24.75	2.83E+13	1.33E+12
-23.75	3.03E+13	1.44E+12
-22.75	3.23E+13	1.59E+12
-21.75	3.39E+13	1.70E+12
-20.75	3.60E+13	1.80E+12
-19.75	3.79E+13	1.87E+12
-18.75	4.03E+13	1.96E+12
-17.75	4.17E+13	2.07E+12
-16.75	4.30E+13	2.18E+12
-15.75	4.44E+13	2.16E+12
-14.75	4.57E+13	2.25E+12
-13.75	4.65E+13	2.32E+12
-12.75	4.75E+13	2.30E+12
-11.75	4.81E+13	2.38E+12
-10.75	4.85E+13	2.45E+12
-9.75	4.86E+13	2.41E+12
-8.75	4.87E+13	2.48E+12
-7.75	4.83E+13	2.50E+12
-6.75	4.81E+13	2.37E+12
-5.75	4.89E+13	2.33E+12
-4.75	4.81E+13	2.37E+12
-3.75	4.75E+13	2.31E+12
-2.75	4.70E+13	2.17E+12
-1.75	4.59E+13	2.21E+12
-0.75	4.53E+13	2.08E+12
0.25	4.41E+13	2.09E+12
1.25	4.30E+13	1.95E+12
2.25	4.12E+13	1.98E+12
3.25	3.98E+13	1.94E+12
4.25	3.83E+13	1.86E+12
5.25	3.67E+13	1.81E+12
6.25	3.40E+13	1.68E+12
7.25	3.21E+13	1.62E+12
8.25	2.94E+13	1.49E+12
9.25	2.73E+13	1.35E+12
10.25	2.44E+13	1.25E+12
11.25	2.24E+13	1.12E+12
12.25	1.93E+13	9.85E+11
13.25	1.61E+13	8.77E+11
14.25	1.40E+13	7.92E+11

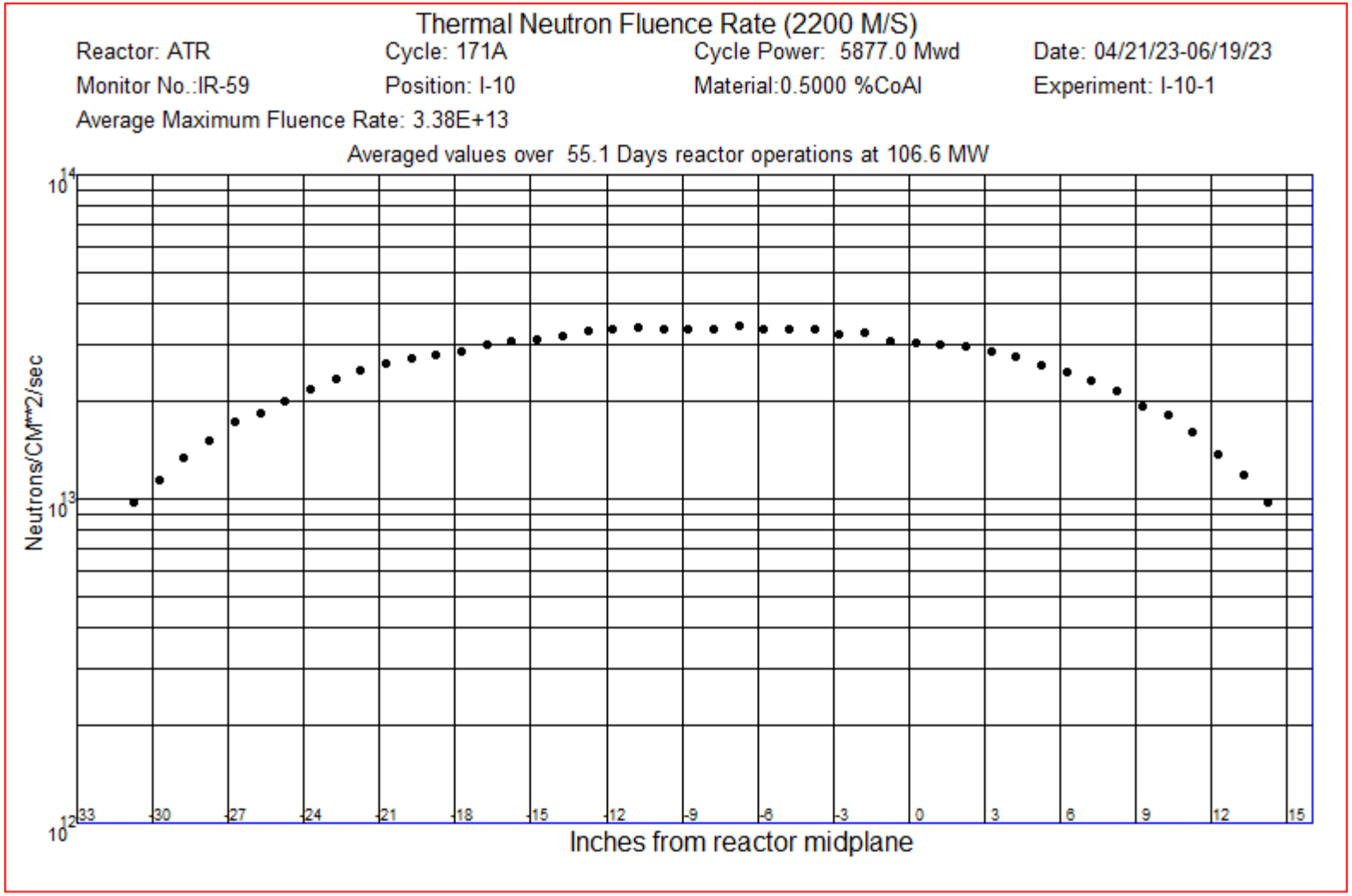
CENTER LINE FLU. RATE	4.41E+13	2.09E+12
AVG. MAX. FLU. RATE	4.86E+13	2.46E+12
MAX. FLU. RATE/MW (AVG.)	NA	NA
K FACTOR	268.36	2702.26
RESONANCE CORRECTION	0.98	NA
C/L. BURNOUT CORRECTION	1.000	1.276
BACKGROUND (COUNTS/SEC.)	1.55	1.55
CHECK SOURCE (COUNTS/SEC.)		
07/27/23 09:00	3406.	3406.

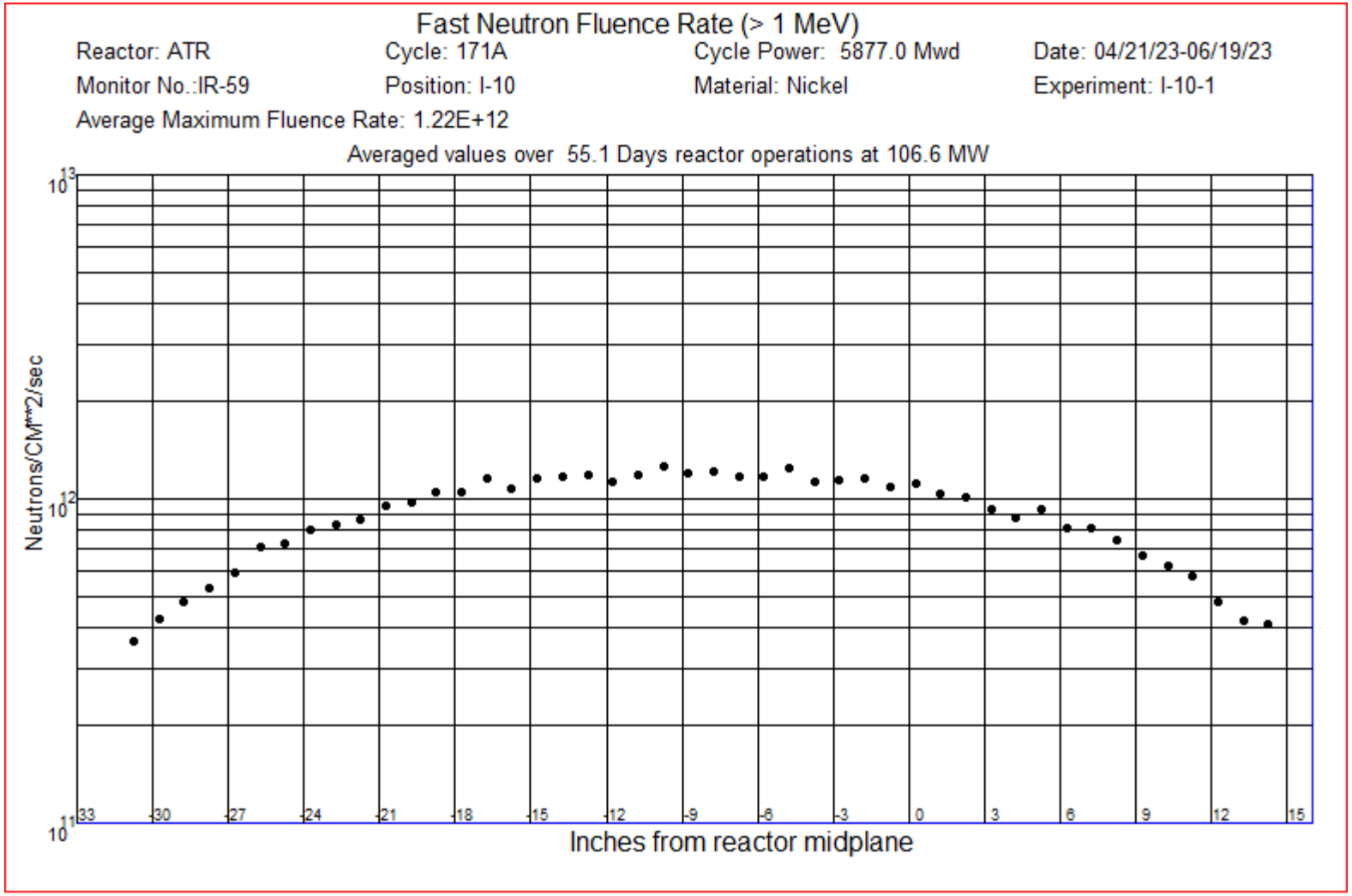
ATR NEUTRON MONITOR RESULTS

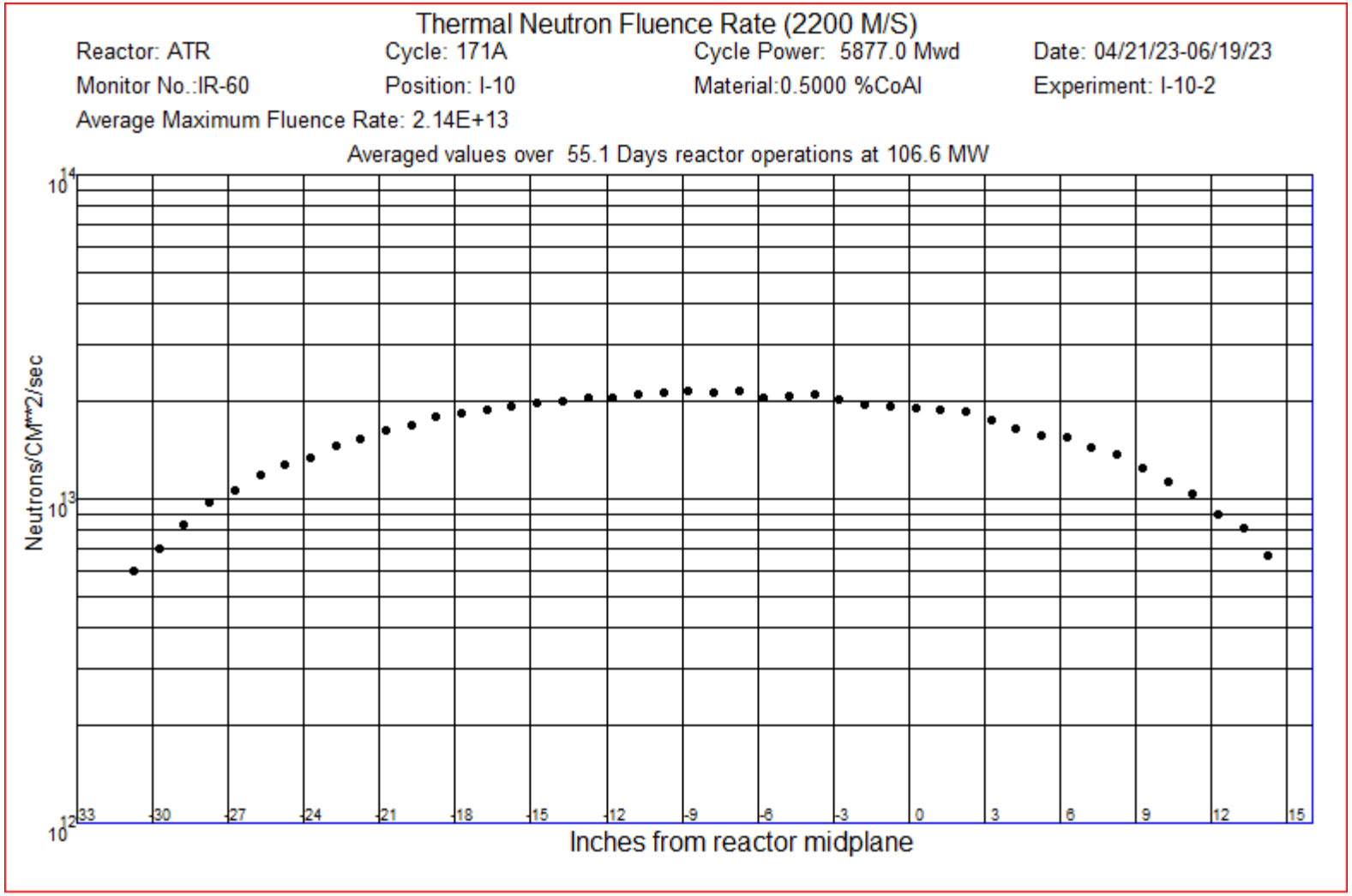
CYCLE: 171A POSITION: I-13 MONITOR ID: IR-62
EFPD: 55.1 AVERAGE MW: NA DATE: 04/21/23 to 06/19/23

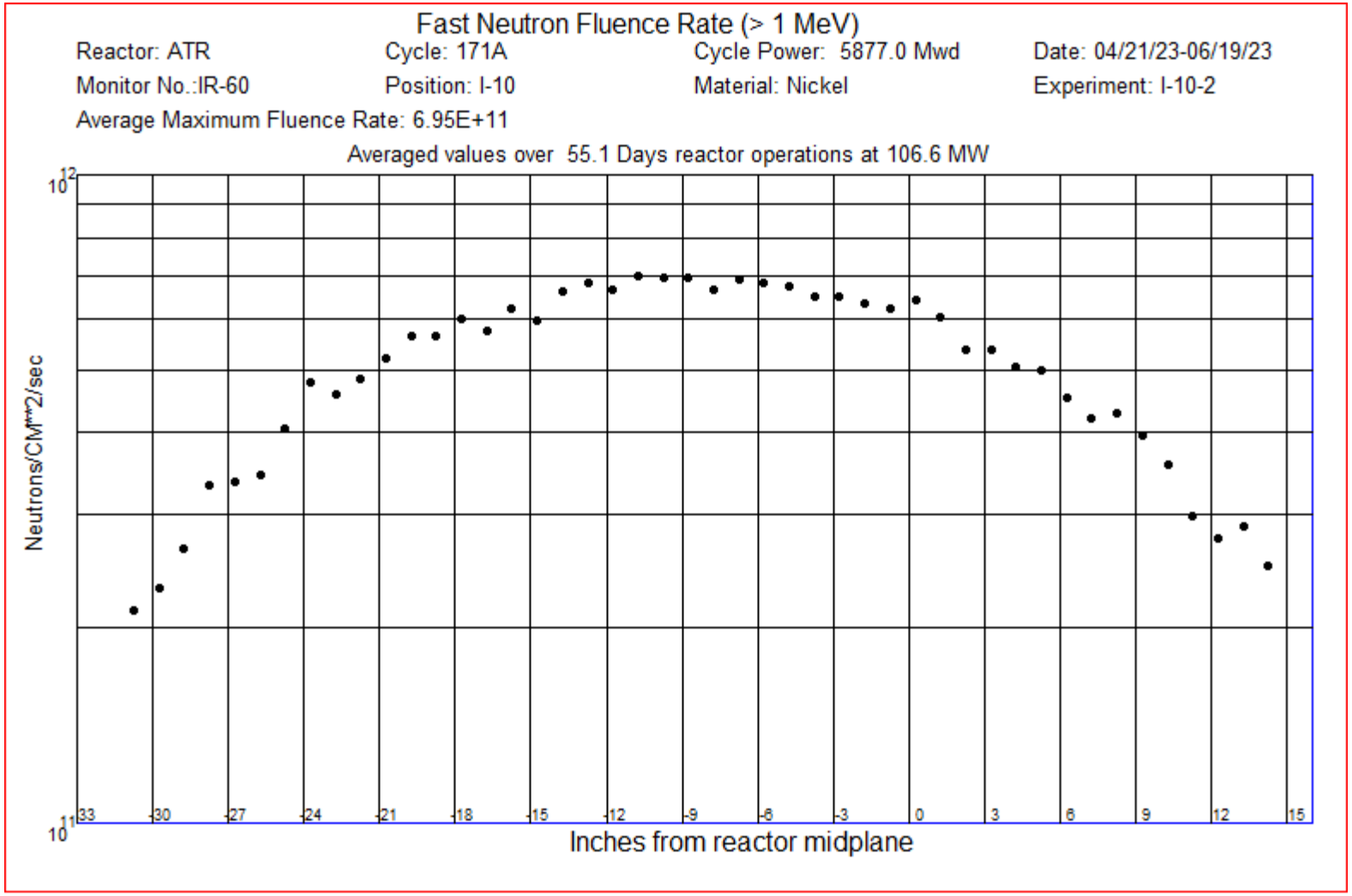
ELEVATION from core CL (inches)	"THERMAL" 2200 m/s CO (n/cm**2/sec)	"FAST" >1 MeV NI (n/cm**2/sec)
-30.73	8.01E+12	3.29E+11
-29.75	9.65E+12	4.20E+11
-29.75	9.65E+12	4.20E+11
-28.75	1.11E+13	4.66E+11
-27.75	1.31E+13	5.49E+11
-26.75	1.46E+13	5.84E+11
-25.75	1.63E+13	7.01E+11
-24.75	1.83E+13	7.39E+11
-23.75	1.98E+13	7.58E+11
-22.75	2.10E+13	8.16E+11
-21.75	2.23E+13	8.22E+11
-20.75	2.39E+13	9.44E+11
-19.75	2.49E+13	9.40E+11
-18.75	2.63E+13	9.94E+11
-17.75	2.72E+13	9.99E+11
-16.75	2.76E+13	1.08E+12
-15.75	2.87E+13	1.12E+12
-14.75	3.00E+13	1.17E+12
-13.75	3.02E+13	1.16E+12
-12.75	3.07E+13	1.22E+12
-11.75	3.14E+13	1.22E+12
-10.75	3.15E+13	1.25E+12
-9.75	3.20E+13	1.23E+12
-8.75	3.23E+13	1.26E+12
-7.75	3.25E+13	1.27E+12
-6.75	3.26E+13	1.24E+12
-5.75	3.27E+13	1.29E+12
-4.75	3.17E+13	1.23E+12
-3.75	3.24E+13	1.15E+12
-2.75	3.18E+13	1.20E+12
-1.75	3.13E+13	1.15E+12
-0.75	3.05E+13	1.17E+12
0.25	3.04E+13	1.14E+12
1.25	2.89E+13	1.09E+12
2.25	2.85E+13	1.09E+12
3.25	2.76E+13	9.87E+11
4.25	2.63E+13	1.01E+12
5.25	2.52E+13	9.21E+11
6.25	2.38E+13	8.22E+11
7.25	2.20E+13	8.08E+11
8.25	2.12E+13	7.83E+11
9.25	1.93E+13	6.60E+11
10.25	1.75E+13	6.61E+11
11.25	1.60E+13	5.93E+11
12.25	1.44E+13	5.47E+11
13.25	1.21E+13	4.24E+11
14.25	1.07E+13	3.82E+11

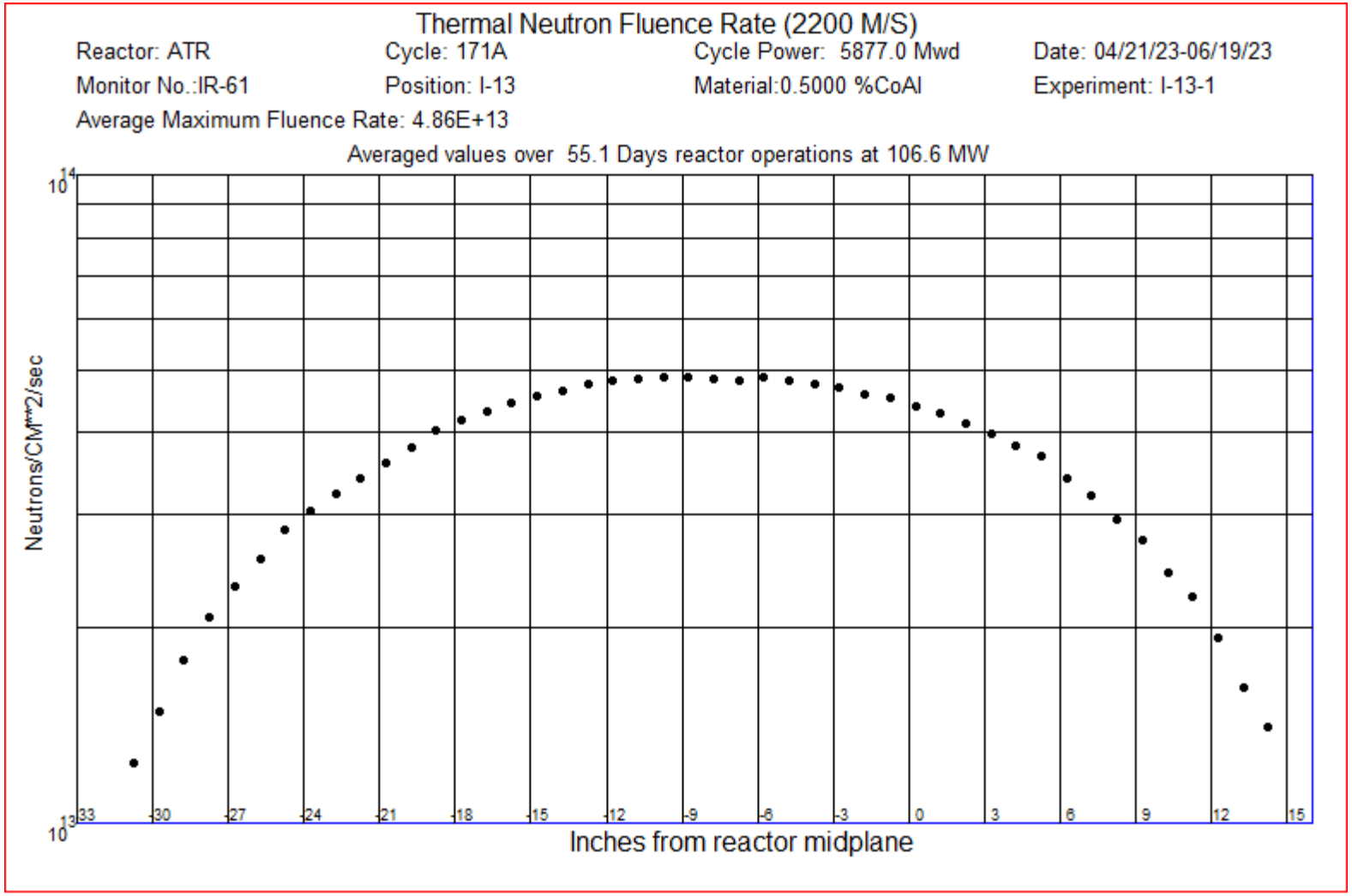
CENTER LINE FLU. RATE	3.04E+13	1.14E+12
AVG. MAX. FLU. RATE	3.26E+13	1.27E+12
MAX. FLU. RATE/MW (AVG.)	NA	NA
K FACTOR	273.82	2679.34
RESONANCE CORRECTION	0.98	NA
C/L. BURNOUT CORRECTION	1.000	1.190
BACKGROUND (COUNTS/SEC.)	1.36	1.36
CHECK SOURCE (COUNTS/SEC.)		
07/31/23 09:05	3433.	3433.

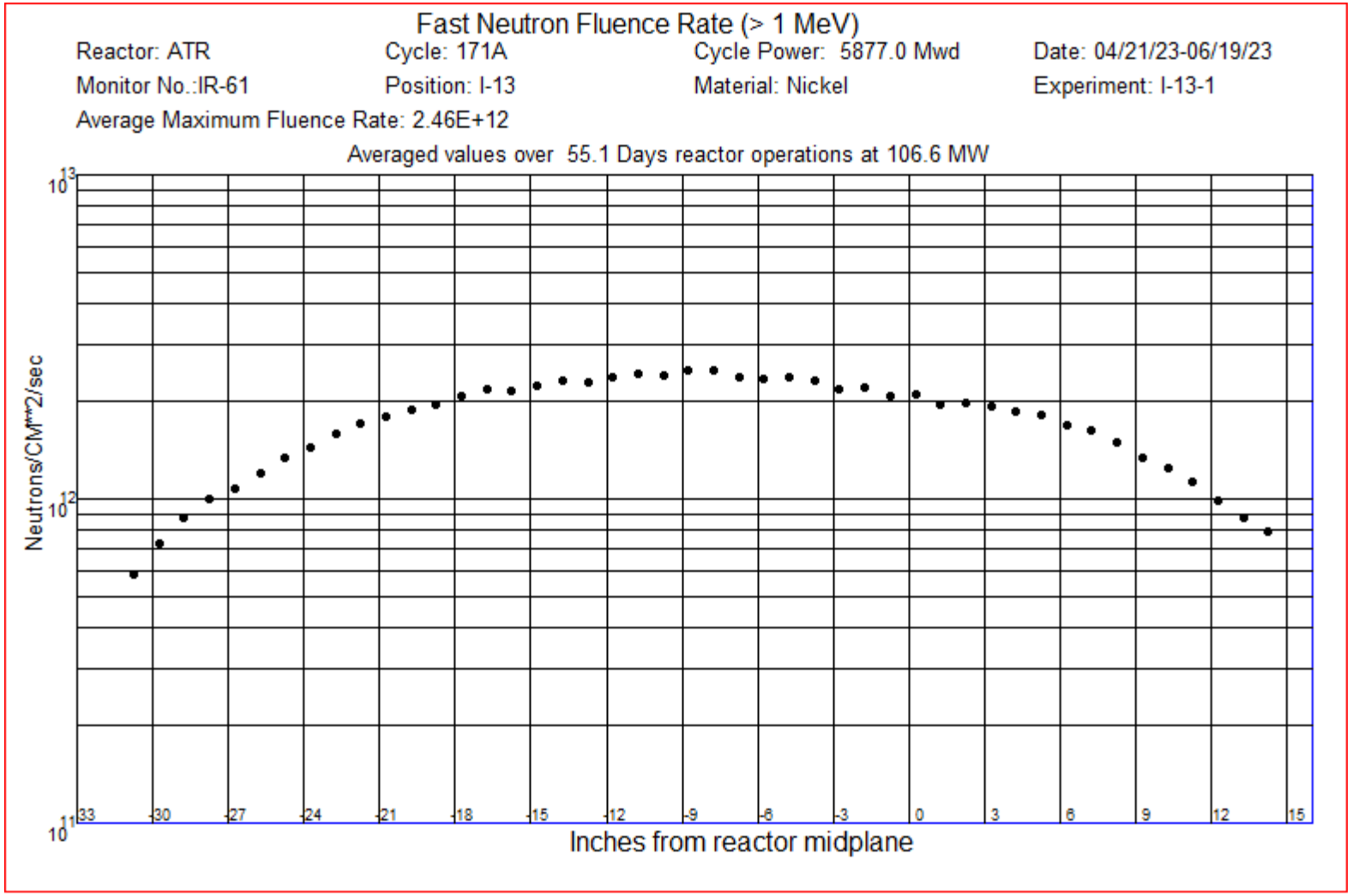

Thermal Neutron Fluence Rate (2200 M/S)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-59
Position: I-10
Material:0.5000 %CoAl
Experiment: I-10-1
Average Maximum Fluence Rate: 3.38E+13
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^14
10^13
10^12
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane

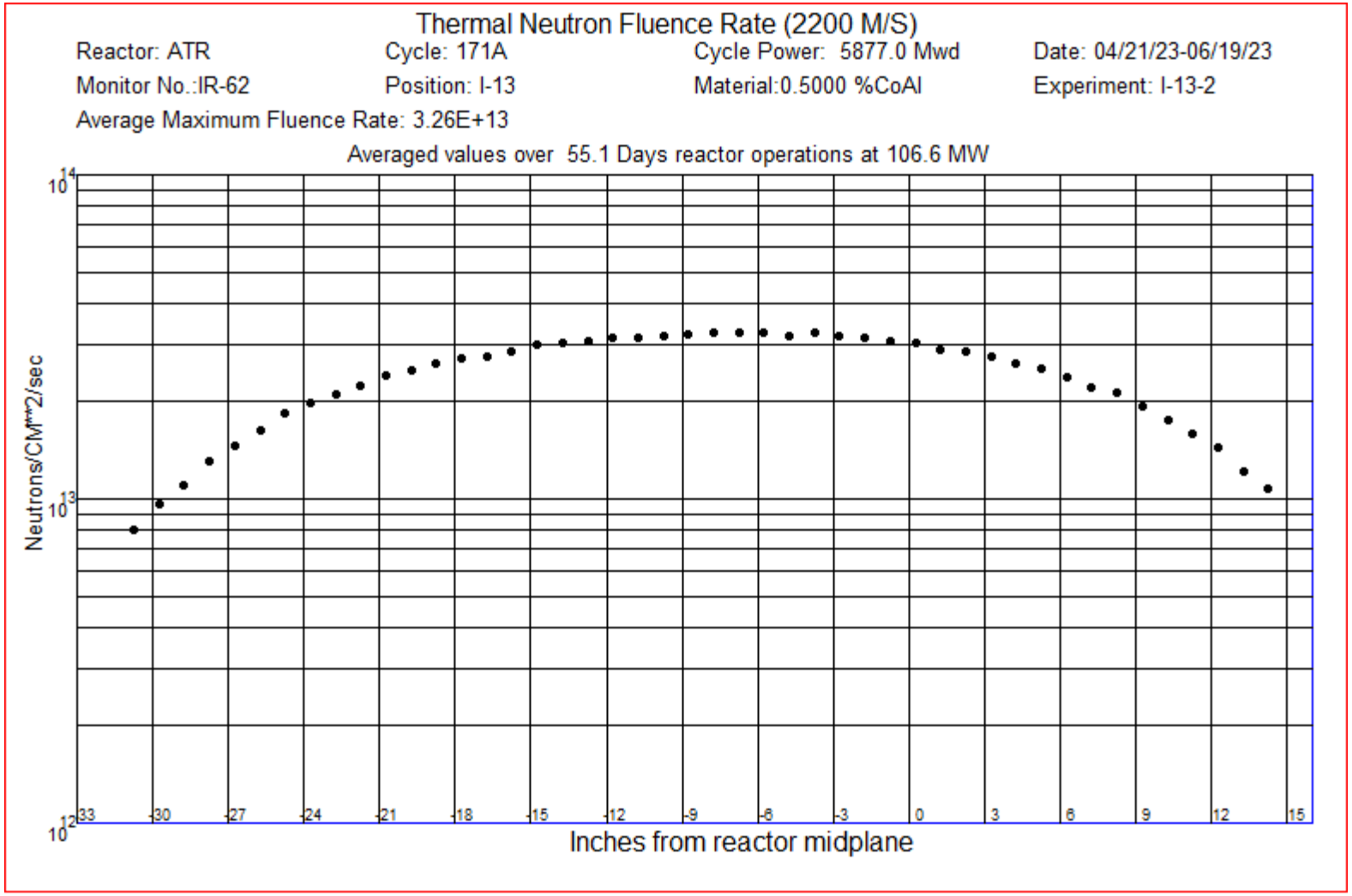

Fast Neutron Fluence Rate (> 1 MeV)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-59
Position: I-10
Material: Nickel
Experiment: I-10-1
Average Maximum Fluence Rate: 1.22E+12
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^13
10^12
10^11
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane

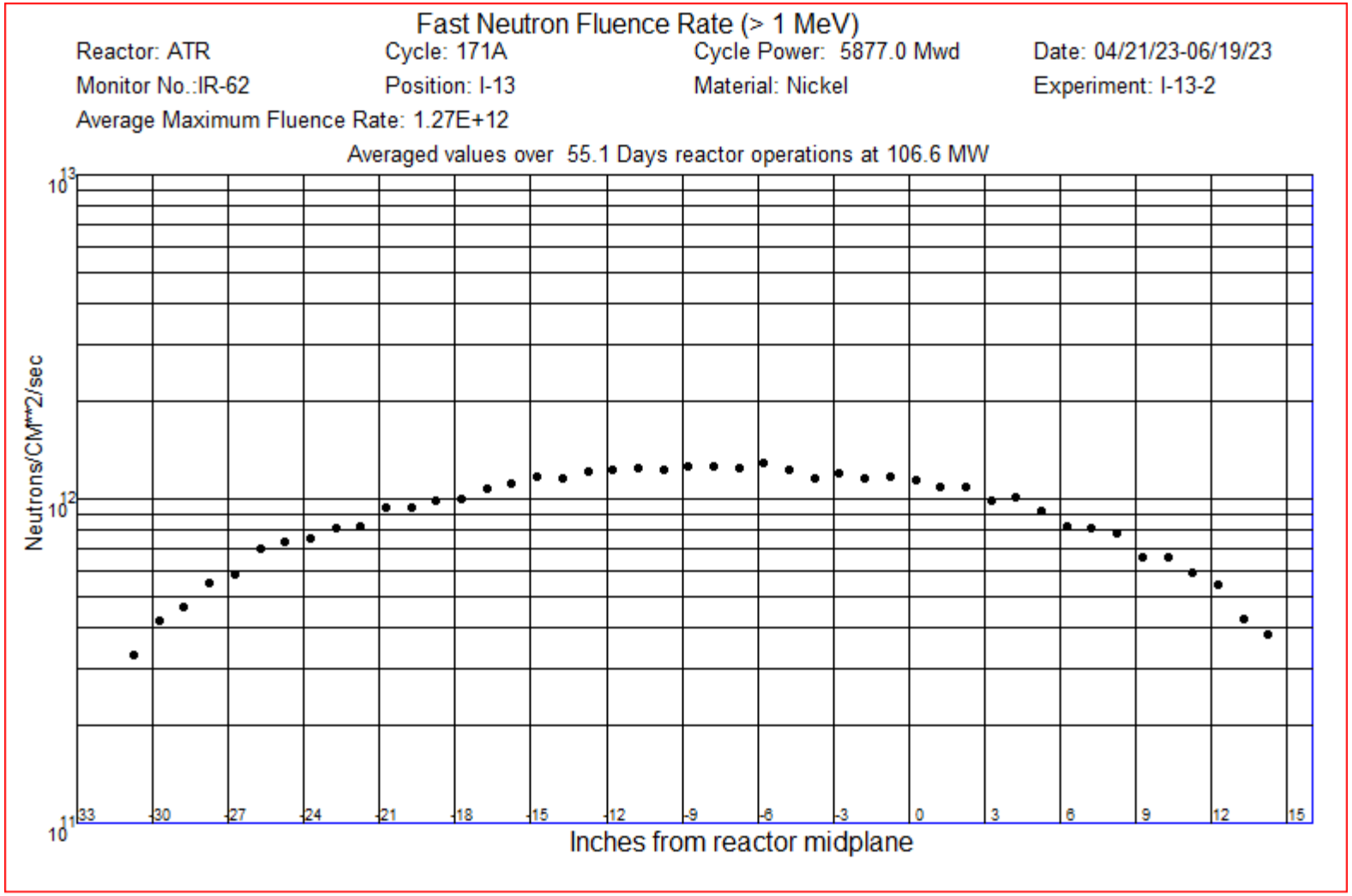

Thermal Neutron Fluence Rate (2200 M/S)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-60
Position: I-10
Material:0.5000 %CoAl
Experiment: I-10-2
Average Maximum Fluence Rate: 2.14E+13
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^14
10^13
10^12
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane


Fast Neutron Fluence Rate (> 1 MeV)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-60
Position: I-10
Material: Nickel
Experiment: I-10-2
Average Maximum Fluence Rate: 6.95E+11
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^12
10^11
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane


Thermal Neutron Fluence Rate (2200 M/S)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-61
Position: I-13
Material:0.5000 %CoAl
Experiment: I-13-1
Average Maximum Fluence Rate: 4.86E+13
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^14
10^13
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane


Fast Neutron Fluence Rate (> 1 MeV)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-61
Position: I-13
Material: Nickel
Experiment: I-13-1
Average Maximum Fluence Rate: 2.46E+12
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^13
10^12
10^11
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane


Thermal Neutron Fluence Rate (2200 M/S)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-62
Position: I-13
Material:0.5000 %CoAl
Experiment: I-13-2
Average Maximum Fluence Rate: 3.26E+13
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^14
10^13
10^12
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane


Fast Neutron Fluence Rate (> 1 MeV)
Reactor: ATR
Cycle: 171A
Cycle Power: 5877.0 Mwd
Date: 04/21/23-06/19/23
Monitor No.:IR-62
Position: I-13
Material: Nickel
Experiment: I-13-2
Average Maximum Fluence Rate: 1.27E+12
Averaged values over 55.1 Days reactor operations at 106.6 MW
Neutrons/CM**2/sec
10^13
10^12
10^11
-33
-30
-27
-24
-21
-18
-15
-12
-9
-6
-3
0
3
6
9
12
15
Inches from reactor midplane