SOUTHERN CALIFORNIA EDISON COMPANY

2021

TRANSMISSION LINE CIRCUIT AVAILABILITY PERFORMANCE REPORT

April 1, 2022

TABLE OF CONTENTS

2021 Availability Performance Report

I INTRODUCTION

The 2021 Southern California Edison (SCE) Transmission Line Circuit Availability Performance report provides the California Independent System Operator Corporation (CAISO), system availability performance measurements between January 1, 2021 and December 31, 2021. This report is submitted to comply with the maintenance reporting requirements outlined in the California Public Utilities Code and the Transmission Control Agreement.

At the SCE Company, the ISO transmission system is comprised of SCE owned transmission line circuits of 500 kV, 230 kV, 115 kV and 69 kV voltage class that were placed under the operational control of the ISO on or after April 1, 1998. The 2021 performances are monitored through the use of Performance Control Charts, which include three indices: Annual Average Forced Outage Frequency of all Transmission Line Circuits, Annual Average Accumulated Forced Outage Duration of only Transmission Line Circuits with Forced Outages, and Annual Proportion of Transmission Line Circuits with No Forced Outages. Shifts in performance are identified using a set of tests, which can be used to validate changes observed on the control charts. SCE provided the ISO historical information that was used as a base line for control chart limits that were created to establish the availability measurement system used to measure the annual performance of all transmission line circuits in a voltage class and also establish the availability measure target for all transmission line circuits in a voltage class.

The following attachments are made part of this report:

- Control Chart for Mean Outage Frequency of all Transmission Line Circuits, Control Chart for Mean Accumulated Outage Duration of only Transmission Line Circuits with Forced Outages, and Proportion Control Chart for Transmission Line Circuits with No Forced Outages for each voltage class.

- Summary Outage Data

II APPROACH TO AVAILABILITY PERFORMANCE ANALYSIS

Forced outages of each SCE circuit of different voltage class were summarized and rolled-up from 2021 forced outage (raw) data. Performance Control Charts for each voltage class were developed utilizing a statistical program called "Bootstrap Re-sampling Method". The treatment of Bootstrap procedures is taken directly from Section 4.2.2.2 of the ISO Transmission Maintenance Standards. The Performance Control Charts that were developed are:

1. 500 kV Voltage Class
    - Mean Outage Frequency of all transmission line circuits
    - Mean Accumulated Outage Duration of only transmission line circuits with forced outages
    - Proportion of transmission line circuits with no forced outages
2. 230 kV Voltage Class
    - Mean Outage Frequency of all transmission line circuits
    - Mean Accumulated Outage Duration of only transmission line circuits with forced outages
    - Proportion of transmission line circuits with no forced outages
3. 115 kV Voltage Class
    - Mean Outage Frequency of all transmission line circuits
    - Mean Accumulated Outage Duration of only transmission line circuits with forced outages
    - Proportion of transmission line circuits with no forced outages
4. 69 kV Voltage Class
    - Mean Outage Frequency of all transmission line circuits
    - Mean Accumulated Outage Duration of only transmission line circuits with forced outages
    - Proportion of transmission line circuits with no forced outages

All 2021 events and forced outages that were excluded from the calculation of the Availability Measures and Availability Measure Targets are:

1. Scheduled outages that are scheduled, reviewed, and approved by the ISO in accordance with the Transmission Control Agreement.
2. Forced outages which were caused by events outside the PTO's system including those outages that originate in other TO systems, other electric systems, and other customer's equipment.
3. Forced Outages due to earthquakes.

4. Outages classified as “Not a Forced Outage” in the Maintenance Procedures.

Multiple momentary forced outages on the same transmission line circuit in the span of one (1) minute were treated as one (1) outage, and when the operation of the transmission line circuit is restored following a forced outage and transmission line circuit remains in operation for a period that exceeds one (1) minute, and was followed by another forced outage, the outage frequency was counted as two (2) forced outages. Duration’s of individual forced outages, which exceeded 4320 minutes, were capped at 4320 minutes.

All forced outages in SCE’s detailed forced outage data file for year 2021 were rounded up to the nearest full minute before being summed with the other detailed forced outages and rolled up into the summary data. Basic statistical methodology was applied to this data and the annual average (mean) forced outage frequency of all transmission line circuits and annual average (mean) accumulated forced outage duration of only transmission line circuits with forced outages in its voltage class per year was calculated. The number of transmission line circuits with forced outage frequency per year was also tabulated. The tabulated statistics shows the number of transmission line circuits in its voltage class with no forced outages per year and the number of transmission line circuits in its voltage class with forced outages per year in an ascending order. The proportion of transmission line circuits with no forced outages per year (percentage in “Discussion of Results” section) was also calculated for each voltage class.

The calculated transmission line circuit performance indices were plotted on the Performance Control Charts for comparison and tested for short term changes, for detection of shift up on averages or shift to a lower level, and either a trend of continuous increase or decrease in the average values. The Performance Control Charts also assess the changes in performance during an intermediate period.

Power system events are monitored, recorded and posted by the Grid Control Center. When an interruption or forced outage occurs, personnel from Power Delivery Business Line (PDBL) are actively engaged in tasks that identify and mitigate the interruption or forced outage. Initial or preliminary data is submitted; utilizing the Energy Management System and a PC based system (Lotus Notes Log) to record station log information. This includes the cause of forced outages or interruptions and corresponding cause codes. Cause code software is utilized and is installed in all switching centers. Following the initial entry of data, interruption/forced outage data is reviewed and validated by supervision to ensure accuracy of data input.

III PERFORMANCE INDICATIONS

Performance Indications provided by control charts were tested. Four tests have been selected to enable identification of exceptional performance in an individual year, shifts in long term performance, and trends in longer-term performance. The four (4) tests were applied to the three (3) indices for each voltage class and the results are as follows:

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
500 kV Annual Forced Outage Frequency	1	Value is above the UCL			Test Not Triggered
		Value is below the LCL when LCL>0	X		
	2	v1 or more consecutive values above the CL			Test Triggered
		v2 or more consecutive values below the CL	X		
	3	2 out of 3 values above the UWL			Test Triggered
		2 out of 3 values below the LWL	X		
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
500 kV Annual Forced Outage Duration	1	Value is above the UCL			Test Not Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Not Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
500 kV Annual Proportion of Transmission Line Circuits With no Forced Outages	1	Value is above the UCL			Test Not Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL	X		Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Not Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
230 kV Annual Forced Outage Frequency	1	Value is above the UCL			Test Triggered
		Value is below the LCL when LCL>0	X		
	2	v1 or more consecutive values above the CL			Test Triggered
		v2 or more consecutive values below the CL	X		
	3	2 out of 3 values above the UWL			Test Triggered
		2 out of 3 values below the LWL	X		
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
230 kV Annual Forced Outage Duration's	1	Value is above the UCL			Test Not Triggered
		Value is below the LCL when LCL>0	X		
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Not Triggered
		2 out of 3 values below the LWL	X		
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
230 kV Annual Proportion of Transmission Line Circuits With no Forced Outages	1	Value is above the UCL	X		Test Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL	X		Test Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL	X		Test Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
115 kV Annual Forced Outage Frequency	1	Value is above the UCL			Test Not Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Not Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
115 kV Annual Forced Outage Duration	1	Value is above the UCL			Test Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Not Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
115 kV Annual Proportion of Transmission Line Circuits With no Forced Outages	1	Value is above the UCL	X		Test Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL	X		Test Not Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
69 kV Annual Forced Outage Frequency	1	Value is above the UCL			Test Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
69 kV Annual Forced Outage Duration	1	Value is above the UCL			Test Not Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Not Triggered
		2 out of 3 values below the LWL			
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

CONTROL CHART TYPE	TEST		Performance Status Indicated by test results		
	NUMBER	RESULTS	IMPROVEMENT	DEGRADATION	COMMENT
69 kV Annual Proportion of Transmission Line Circuits With no Forced Outages	1	Value is above the UCL			Test Not Triggered
		Value is below the LCL when LCL>0			
	2	v1 or more consecutive values above the CL			Test Not Triggered
		v2 or more consecutive values below the CL			
	3	2 out of 3 values above the UWL			Test Triggered
		2 out of 3 values below the LWL		X	
	4	6 consecutive values increasing			Test Not Triggered
		6 consecutive values decreasing			

IV DISCUSSION OF RESULTS

In accordance with Maintenance Procedure 2 under Section 2.3.6 SCE captured the first fourteen calendar years of valid Summary Outage data while under ISO Operational Control and used only that data to calculate the Control Chart limits. The first fourteen calendar years of valid Summary Outage data obtained by SCE for only those years while under ISO Operational Control were used in their entirety to establish the Control Chart limits regardless of whether any of the yearly data within the first ten of those fourteen calendar years of valid data triggered any tests. The ten Control Chart annual points from 1998 through 2007 were not used to see if tests were triggered. Only valid Summary Outage data for years 2009 through 2021 were tested for compliance using the testing criteria described in Section 4.2.3 of Appendix C of the TCA. Although tests were triggered in the 2009 and 2021 timeframe all the data was used to calculate the control limits because none of the tests were triggered significantly. Valid data is defined as Transmission Line Circuit forced outage data provided by SCE to the ISO, verified by the ISO, and does not skew the Control Chart limits.

500 kV System

The 500 kV voltage class triggered test 1, 2 and 3 in improvement on the frequency index, due to a reduction in weather caused outages and maintenance

The 500 kV voltage class did not trigger any test on the duration indices.

The 500 kV voltage class triggered test 2 improvement on the proportion index.

230 kV System

The 230 kV voltage class triggered test 1, 2 and 3 in improvement on the frequency index.

Improvement due to the infrastructure replacement program and routine maintenance.

The 230 kV voltage class triggered test 1 and 3 in improvement on the duration indices.

The 230 kV voltage class triggered test 1, 2 and 3 in improvement on the proportion index.

Improvement due to upgrades to line equipment.

115 kV System

The 115 kV voltage class did not trigger any test on the frequency index.

The 115 kV voltage class did not trigger any test on the duration indices.

The 115 kV voltage class triggered test 1 and 3 in improvement on the proportion index.

69 kV System

The 69 kV voltage class did not trigger any test on the frequency index.

The 69 kV voltage class did not trigger any test taken on the duration indices.

The 69 kV voltage class triggered test 3 in degradation on the proportion index, while this test show degradation on the 69 kV class it should be noted that this may not be statistically valid as there are only four lines in this class within the SCE company.

500 kV Voltage Class

- Outage Frequency - The historical average Control Limit (CL) between 2003 and 2021 on SCE 500 kV transmission line circuits under the operational control of the ISO is 1.459 outages per year. In 2021 the outage frequency average was 0.5625 outages per year, which is below the historical average. The range of expected performance for the 500 kV voltage class is:

    1. Upper Control Limit (UCL) = 2.605
    2. Upper Warning Limit (UWL) = 2.232
    3. Lower Warning Limit (LWL) = 0.805
    4. Lower Control Limit (LCL) = 0.577

- Outage Duration - The historical average (CL) between 2003 and 2021 on SCE 500 kV transmission line circuits under the operational control of the ISO is 1561.65 minutes per year. In 2021, the outage duration is an accumulated average of 386.63 minutes per year, which is below the historical average. The range of expected performance for the 500 kV voltage class is:

    1. Upper Control Limit (UCL) = 3749.94 min
    2. Upper Warning Limit (UWL) = 2977.54 min
    3. Lower Warning Limit (LWL) = 592.59 min
    4. Lower Control Limit (LCL) = 363.88 min

- Proportion - The historical average percentage (CL) between 2003 and 2021 on SCE 500 kV transmission line circuits under the operational control of ISO is 43.1%. In 2021, the average percentage for transmission line circuits that experienced no forced outages is 56.25 %, which is above the historical average. The range of expected performance for the 500 kV voltage class is:

    1. Upper Control Limit (UCL) = 69.3 %
    2. Upper Warning Limit (UWL) = 60.8 %
    3. Lower Warning Limit (LWL) = 21.7 %
    4. Lower Control Limit (LCL) = 14.0%

230 kV Voltage Class

- Outage Frequency - The historical average (CL) between 2003 and 2021 on SCE 230 kV transmission line circuits under the operational control of the ISO is 1.786 outages per year. In 2021, the outage frequency has an average of 0.5625 outages per year, which is below the historical average. The range of expected performance for the 230 kV voltage class is:
    1. Upper Control Limit (UCL) = 2.415
    2. Upper Warning Limit (UWL) = 2.213
    3. Lower Warning Limit (LWL) = 1.405
    4. Lower Control Limit (LCL) = 1.260

- Outage Duration - The historical average (CL) between 2003 and 2021 on SCE 230 kV transmission line circuits under the operational control of the ISO is 1645.22 minutes per year. In 2021, the outage duration accumulated average was 192.94 minutes per year, which is below the historical average. The range of expected performance for the 230 kV voltage class is:
    1. Upper Control Limit (UCL) = 2470.02 min
    2. Upper Warning Limit (UWL) = 2210.19 min
    3. Lower Warning Limit (LWL) = 1177.36 min
    4. Lower Control Limit (LCL) = 1010.21 min

- Proportion - The historical average percentage (CL) between 2003 and 2021 on SCE 230 kV transmission line circuits under the operational control of ISO is 37.6 %. In 2021, the average percentage for transmission line circuits that experienced no forced outages was 72.92%, which is above the historical average. The range of expected performance for the 230 kV voltage class is:
    1. Upper Control Limit (UCL) = 49.5 %
    2. Upper Warning Limit (UWL) = 45.9 %
    3. Lower Warning Limit (LWL) = 29.3 %
    4. Lower Control Limit (LCL) = 25.7 %

115 kV Voltage Class

- Outage Frequency - The historical average (CL) between 2003 and 2021 on SCE 115 kV transmission line circuits under the operational control of the ISO is 3.477 outages per year. In 2021 the outage frequency average was 2.3077 outages per year, which is below the historical average. The range of expected performance for the 115 kV voltage class is:
    1. Upper Control Limit (UCL) = 5.844
    2. Upper Warning Limit (UWL) = 5.070
    3. Lower Warning Limit (LWL) = 2.093
    4. Lower Control Limit (LCL) = 1.637

- Outage Duration - The historical average (CL) between 2003 and 2021 on SCE 115 kV transmission line circuits under the operational control of the ISO is 1416.21 minutes per year. In 2021, the outage duration accumulated average was 319.08 minutes per year, which is below the historical average. The range of expected performance for the 115 kV voltage class is:
    1. Upper Control Limit (UCL) = 3155.32 min
    2. Upper Warning Limit (UWL) = 2552.26 min
    3. Lower Warning Limit (LWL) = 614.44 min
    4. Lower Control Limit (LCL) = 405.06 min

- Proportion - The historical average percentage (CL) between 2003 and 2021 on SCE 115 kV transmission line circuits under the operational control of ISO is 23.1 %. In 2021, the average percentage for transmission line circuits that experienced no forced outages was 53.85 %, which is above the historical average. The range of expected performance for the 115 kV voltage class is:
    1. Upper Control Limit (UCL) = 46.1%
    2. Upper Warning Limit (UWL) = 38.1 %
    3. Lower Warning Limit (LWL) = 6.1 %
    4. Lower Control Limit (LCL) = 0.9 %

69 kV Voltage Class

- Outage Frequency - The historical average (CL) between 2003 and 2021 on SCE 69 kV transmission line circuits under the operational control of the ISO is 5.051 outages per year. In 2021, the outage frequency average was 6.5 outages per year, which is above the historical average. The range of expected performance for the 69 kV voltage class is:
    1. Upper Control Limit (UCL) = 7.557
    2. Upper Warning Limit (UWL) = 6.757
    3. Lower Warning Limit (LWL) = 3.527
    4. Lower Control Limit (LCL) = 2.980

- Outage Duration - The historical average (CL) between 2003 and 2021 on SCE 69 kV transmission line circuits under the operational control of the ISO is 2490.54 minutes per year. In 2021, the outage duration mean accumulated average was 1934.25 minutes per year, which is below the historical average. The range of expected performance for the 69 kV voltage class is:
    1. Upper Control Limit (UCL) = 4072.13 min
    2. Upper Warning Limit (UWL) = 3544.99 min
    3. Lower Warning Limit (LWL) = 1599.89 min
    4. Lower Control Limit (LCL) = 1301.04 min

- Proportion - The historical average percentage (CL) between 2003 and 2021 on SCE 69 kV transmission line circuits under the operational control of the ISO is 13.5 %. In 2021, the average percentage for transmission line circuits that experienced no forced outages was 0.00 %, which is below the historical average. The range of expected performance for the 69 kV voltage class is:
    1. Upper Control Limit (UCL) = 32.1 %
    2. Upper Warning Limit (UWL) = 25.4 %
    3. Lower Warning limit (LWL) = 0.07 %
    4. Lower Control Limit (LCL) = 0.0 %

To achieve future results similar to this year's pattern and to promote the enhancement of availability SCE has in place the following Maintenance activities:

- Infrastructure replacement of transmission equipment
- Additional pole replacements
- Replacement of substation equipment

V SUMMARY OUTAGE DATA

500 kV Voltage Class

Transmission Owner	Transmission Line ID	Volt Class	Year	Annual Outage Frequency	Annual Outage Duration Min.
SCE	71	500	2021	1	28
SCE	72	500	2021	1	830
SCE	79	500	2021	0	0
SCE	81	500	2021	1	4
SCE	83	500	2021	1	327
SCE	104	500	2021	0	0
SCE	106	500	2021	0	0
SCE	112	500	2021	0	0
SCE	116	500	2021	0	0
SCE	117	500	2021	0	0
SCE	121	500	2021	2	60
SCE	126	500	2021	2	254
SCE	127	500	2021	1	47
SCE	129	500	2021	1	3
SCE	132	500	2021	0	0
SCE	134	500	2021	1	33
SCE	135	500	2021	0	0
SCE	194	500	2021	0	0
SCE	390	500	2021	1	809
SCE	942	500	2021	0	0
SCE	943	500	2021	0	0
SCE	945	500	2021	2	4689
SCE	958	500	2021	0	0
SCE	959	500	2021	0	0
SCE	1895	500	2021	2	4682
SCE	1896	500	2021	0	0
SCE	1905	500	2021	0	0
SCE	1906	500	2021	1	545
SCE	1907	500	2021	1	61
SCE	1908	500	2021	0	0
SCE	1910	500	2021	0	0
SCE	1914	500	2021	0	0

230 kV Voltage Class

Transmission Owner	Transmission Line ID	Volt Class	Year	Annual Outage Frequency	Annual Outage Duration Min.
SCE	35	230	2021	1	22
SCE	38	230	2021	1	184
SCE	39	230	2021	2	294
SCE	96	230	2021	0	0
SCE	174	230	2021	0	0
SCE	175	230	2021	0	0
SCE	185	230	2021	0	0
SCE	187	230	2021	1	1
SCE	188	230	2021	0	0
SCE	195	230	2021	1	223
SCE	196	230	2021	1	28
SCE	213	230	2021	0	0
SCE	216	230	2021	0	0
SCE	217	230	2021	0	0
SCE	219	230	2021	0	0
SCE	226	230	2021	0	0
SCE	289	230	2021	1	128
SCE	290	230	2021	0	0
SCE	299	230	2021	1	188
SCE	306	230	2021	2	192
SCE	337	230	2021	0	0
SCE	338	230	2021	0	0
SCE	369	230	2021	0	0
SCE	378	230	2021	0	0
SCE	397	230	2021	0	0
SCE	449	230	2021	2	4
SCE	461	230	2021	0	0
SCE	464	230	2021	0	0
SCE	465	230	2021	0	0
SCE	470	230	2021	0	0
SCE	471	230	2021	2	670
SCE	474	230	2021	0	0
SCE	475	230	2021	0	0
SCE	483	230	2021	0	0
SCE	488	230	2021	0	0
SCE	490	230	2021	0	0
SCE	513	230	2021	0	0
SCE	514	230	2021	0	0
SCE	515	230	2021	0	0
SCE	517	230	2021	0	0
SCE	521	230	2021	0	0
SCE	526	230	2021	1	329
SCE	545	230	2021	0	0
SCE	577	230	2021	0	0
SCE	592	230	2021	0	0

SCE	594	230	2021	0	0
SCE	599	230	2021	0	0
SCE	601	230	2021	0	0
SCE	602	230	2021	1	1017
SCE	609	230	2021	0	0
SCE	611	230	2021	0	0
SCE	624	230	2021	0	0
SCE	638	230	2021	0	0
SCE	654	230	2021	5	21
SCE	655	230	2021	1	1237
SCE	657	230	2021	1	1
SCE	659	230	2021	0	0
SCE	664	230	2021	0	0
SCE	665	230	2021	1	977
SCE	667	230	2021	0	0
SCE	669	230	2021	1	7
SCE	677	230	2021	1	78
SCE	689	230	2021	0	0
SCE	690	230	2021	0	0
SCE	701	230	2021	1	46
SCE	707	230	2021	0	0
SCE	708	230	2021	2	1809
SCE	709	230	2021	0	0
SCE	729	230	2021	0	0
SCE	731	230	2021	0	0
SCE	755	230	2021	0	0
SCE	763	230	2021	3	2797
SCE	766	230	2021	0	0
SCE	770	230	2021	1	4320
SCE	771	230	2021	0	0
SCE	775	230	2021	0	0
SCE	776	230	2021	0	0
SCE	778	230	2021	0	0
SCE	785	230	2021	0	0
SCE	845	230	2021	0	0
SCE	880	230	2021	0	0
SCE	881	230	2021	0	0
SCE	920	230	2021	0	0
SCE	926	230	2021	0	0
SCE	946	230	2021	0	0
SCE	972	230	2021	0	0
SCE	973	230	2021	0	0
SCE	974	230	2021	1	213
SCE	981	230	2021	1	351
SCE	982	230	2021	0	0
SCE	999	230	2021	0	0
SCE	1038	230	2021	0	0
SCE	1046	230	2021	2	273
SCE	1050	230	2021	0	0
SCE	1058	230	2021	0	0
SCE	1062	230	2021	0	0

SCE	1063	230	2021	0	0
SCE	1073	230	2021	0	0
SCE	1079	230	2021	0	0
SCE	1082	230	2021	1	4
SCE	1083	230	2021	3	3
SCE	1091	230	2021	1	23
SCE	1093	230	2021	0	0
SCE	1108	230	2021	0	0
SCE	1124	230	2021	1	1004
SCE	1125	230	2021	0	0
SCE	1135	230	2021	0	0
SCE	1188	230	2021	0	0
SCE	1189	230	2021	0	0
SCE	1242	230	2021	0	0
SCE	1277	230	2021	0	0
SCE	1478	230	2021	0	0
SCE	1479	230	2021	0	0
SCE	1480	230	2021	0	0
SCE	1481	230	2021	0	0
SCE	1483	230	2021	0	0
SCE	1495	230	2021	4	8506
SCE	1591	230	2021	0	0
SCE	1594	230	2021	0	0
SCE	1607	230	2021	0	0
SCE	1618	230	2021	0	0
SCE	1710	230	2021	1	62
SCE	1813	230	2021	0	0
SCE	1897	230	2021	0	0
SCE	1898	230	2021	0	0
SCE	1899	230	2021	0	0
SCE	1900	230	2021	0	0
SCE	1901	230	2021	0	0
SCE	1903	230	2021	0	0
SCE	1925	230	2021	3	1109
SCE	1969	230	2021	0	0
SCE	1984	230	2021	3	725
SCE	4320	230	2021	0	0
SCE	4406	230	2021	0	0
SCE	4540	230	2021	0	0
SCE	4676	230	2021	0	0
SCE	4677	230	2021	1	19
SCE	6644	230	2021	0	0
SCE	6866	230	2021	0	0
SCE	7239	230	2021	0	0
SCE	7240	230	2021	1	11
SCE	7241	230	2021	3	189
SCE	8214	230	2021	8	117
SCE	8342	230	2021	13	601

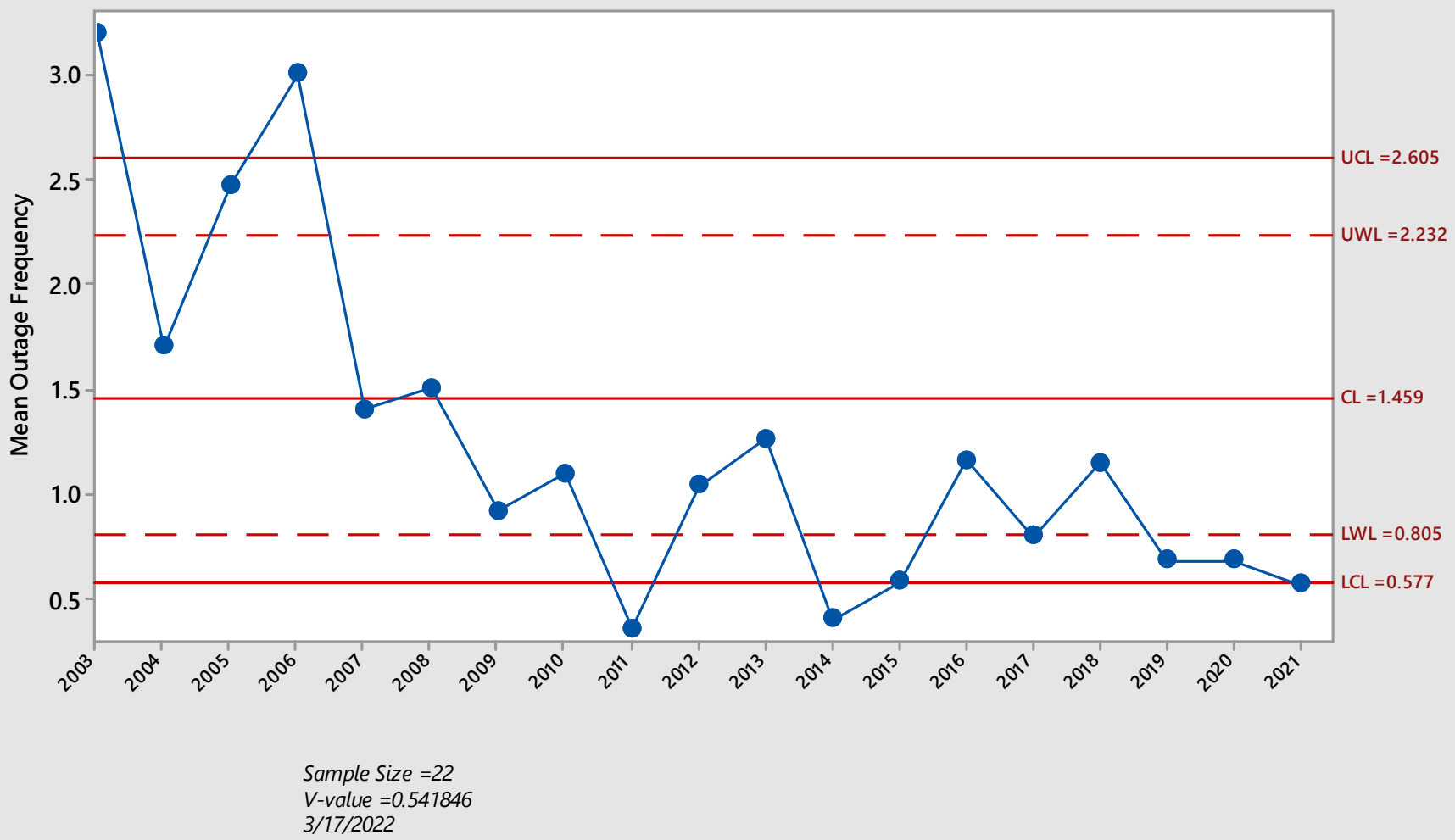
115 kV Voltage Class

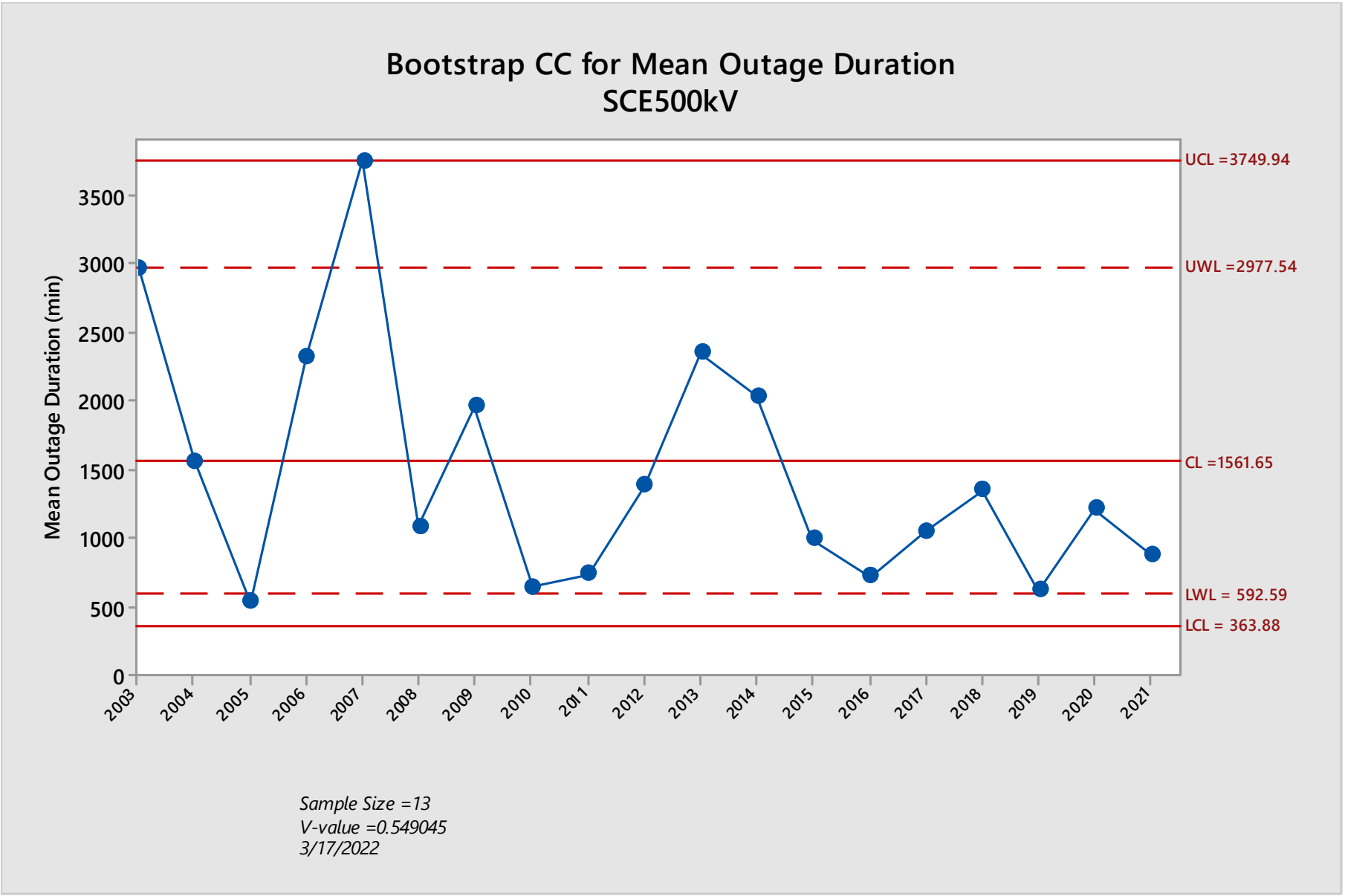
Transmission Owner	Transmission Line ID	Volt Class	Year	Annual Outage Frequency	Annual Outage Duration Min.
SCE	180	115	2021	4	1269
SCE	199	115	2021	0	0
SCE	200	115	2021	0	0
SCE	560	115	2021	4	263
SCE	561	115	2021	0	0
SCE	948	115	2021	1	235
SCE	949	115	2021	0	0
SCE	1064	115	2021	3	497
SCE	1118	115	2021	0	0
SCE	1363	115	2021	0	0
SCE	75165	115	2021	0	0
SCE	77245	115	2021	13	1862
SCE	77246	115	2021	5	22

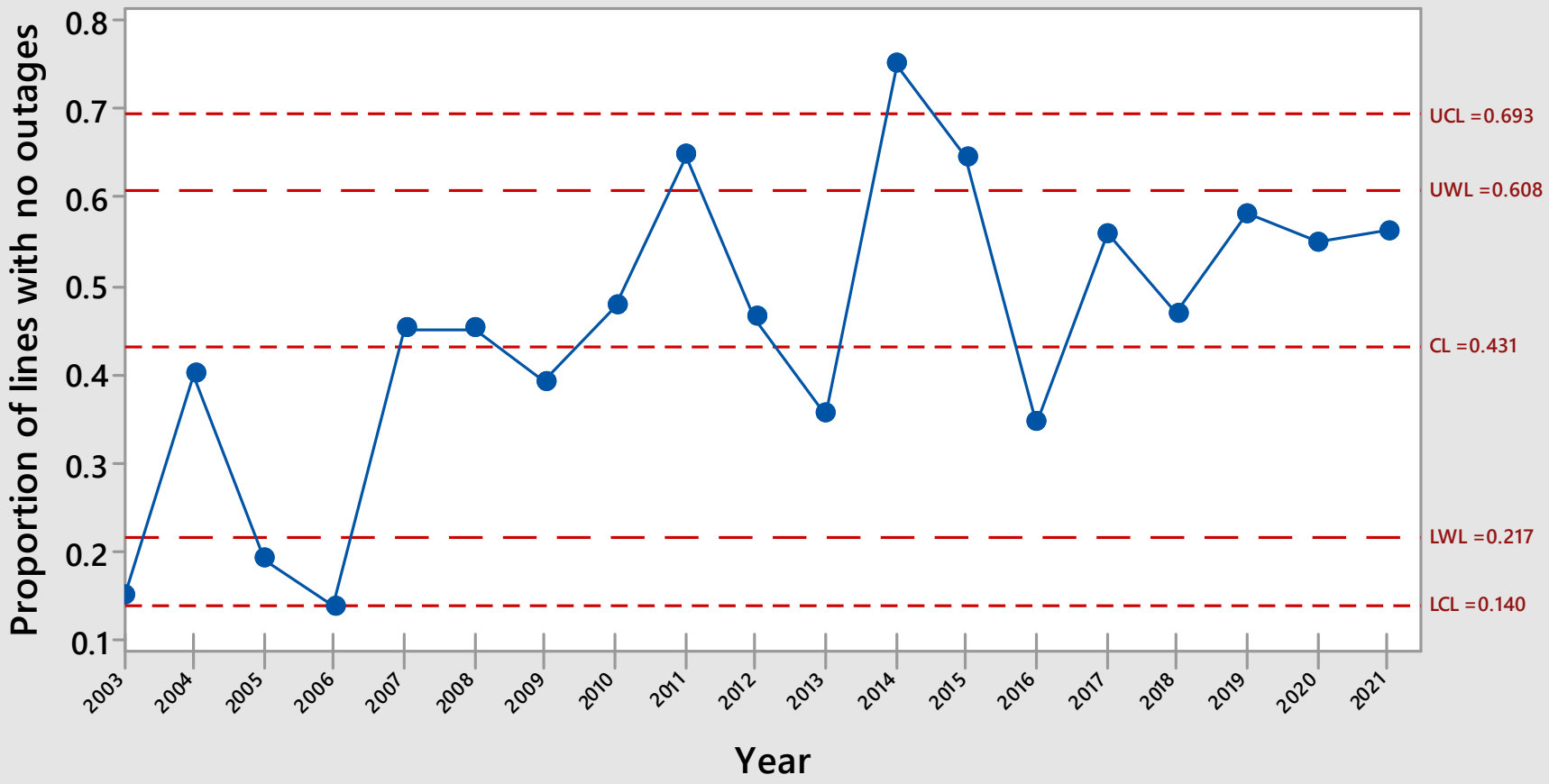
69 kV Voltage Class

Transmission Owner	Transmission Line ID	Volt Class	Year	Annual Outage Frequency	Annual Outage Duration Min.
SCE	285	69	2021	3	2748
SCE	827	69	2021	7	2579
SCE	76337	69	2021	7	616
SCE	76438	69	2021	9	1794

VI CONTROL CHARTS


Bootstrap CC for Mean Outage Frequency
SCE500kV
Mean Outage Frequency
3.0
2.5
2.0
1.5
1.0
0.5
UCL =2.605
UWL =2.232
CL =1.459
LWL =0.805
LCL =0.577
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Sample Size =22
V-value =0.541846
3/17/2022

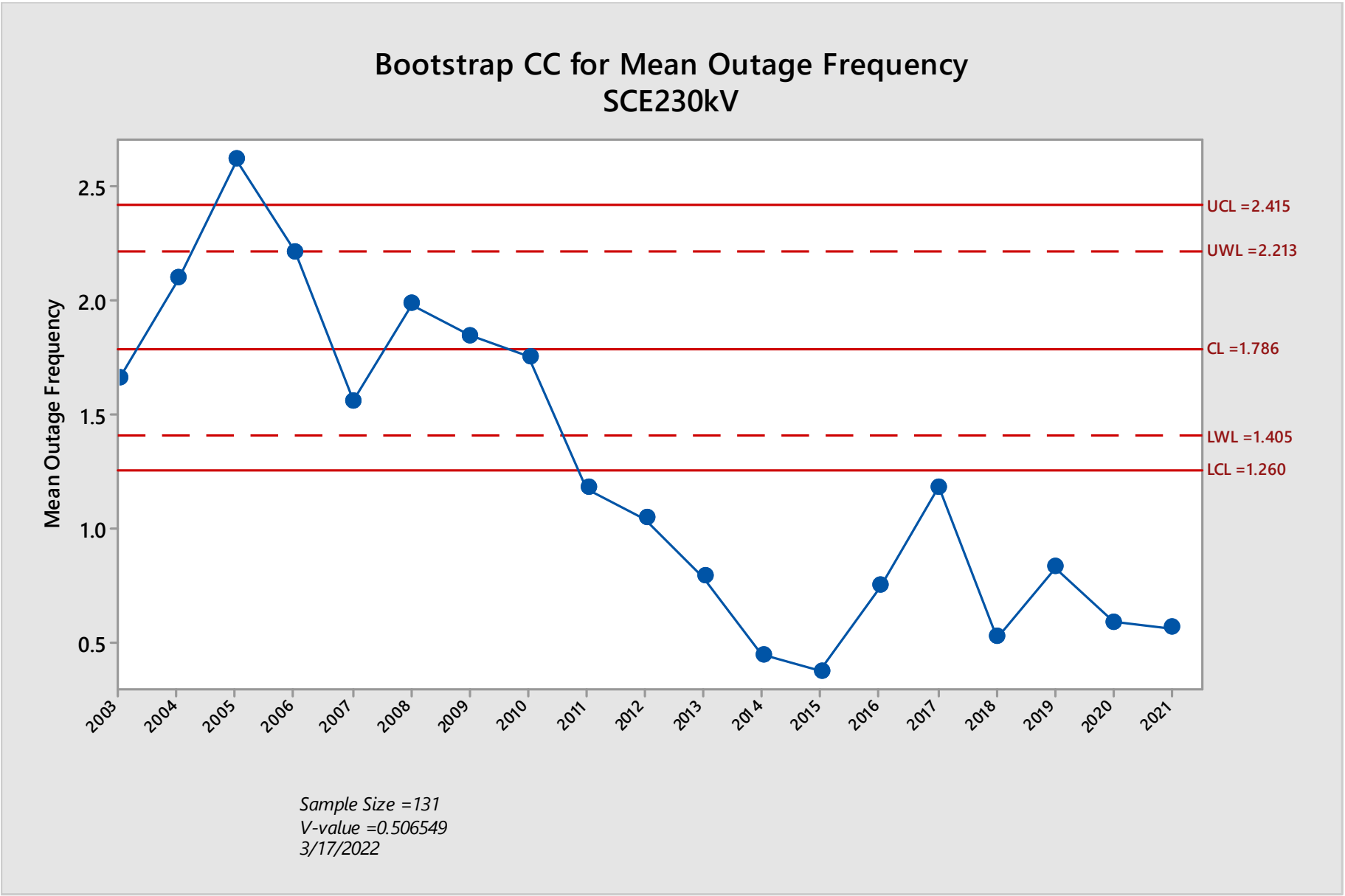

Bootstrap CC for Mean Outage Duration
SCE500kV
Mean Outage Duration (min)
0
500
1000
1500
2000
2500
3000
3500
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
UCL =3749.94
UWL =2977.54
CL =1561.65
LWL = 592.59
LCL = 363.88
Sample Size =13
V-value =0.549045
3/17/2022

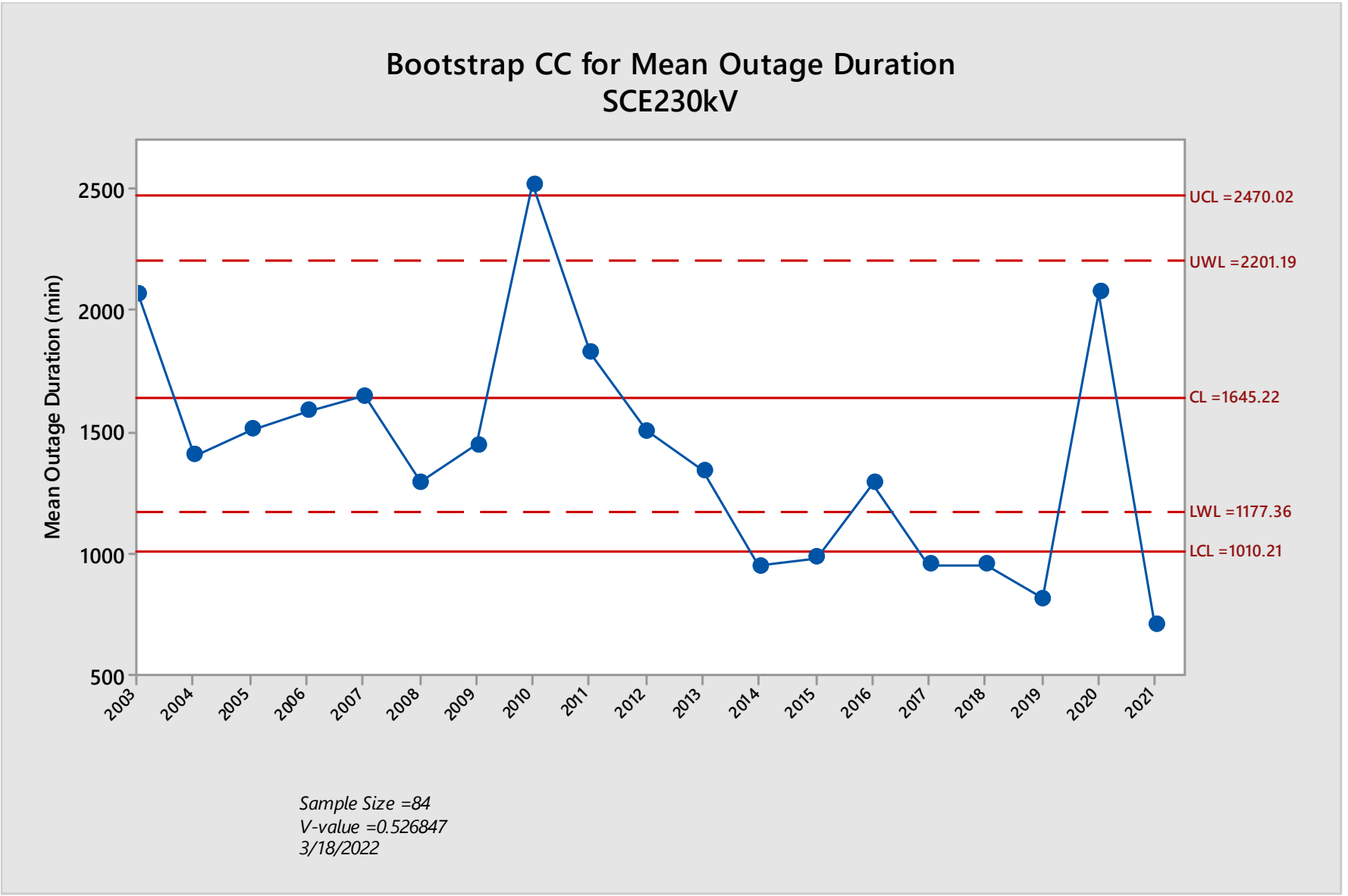


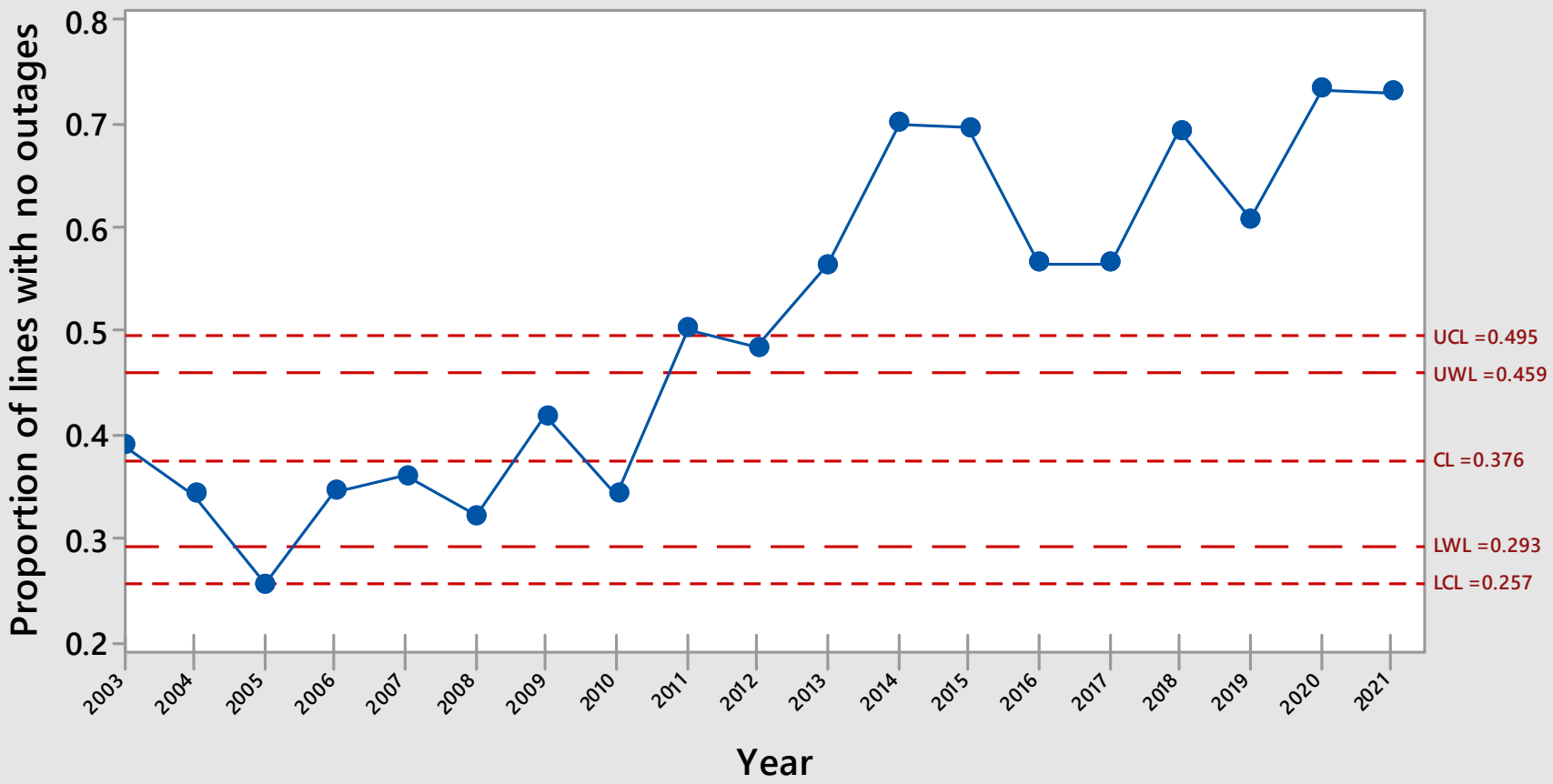
V_Value =0.618

Median number of Active Lines =25

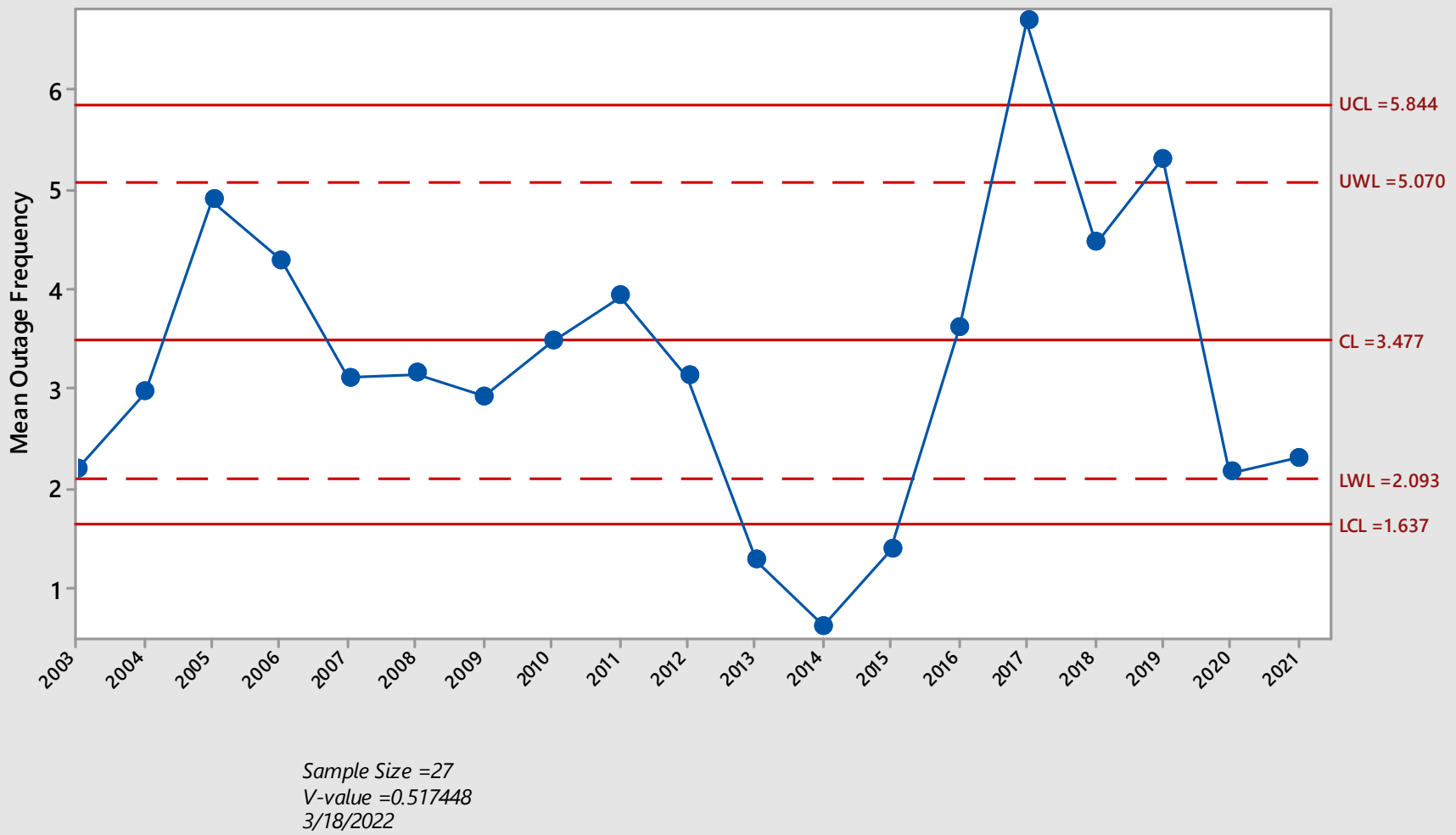
3/17/2022

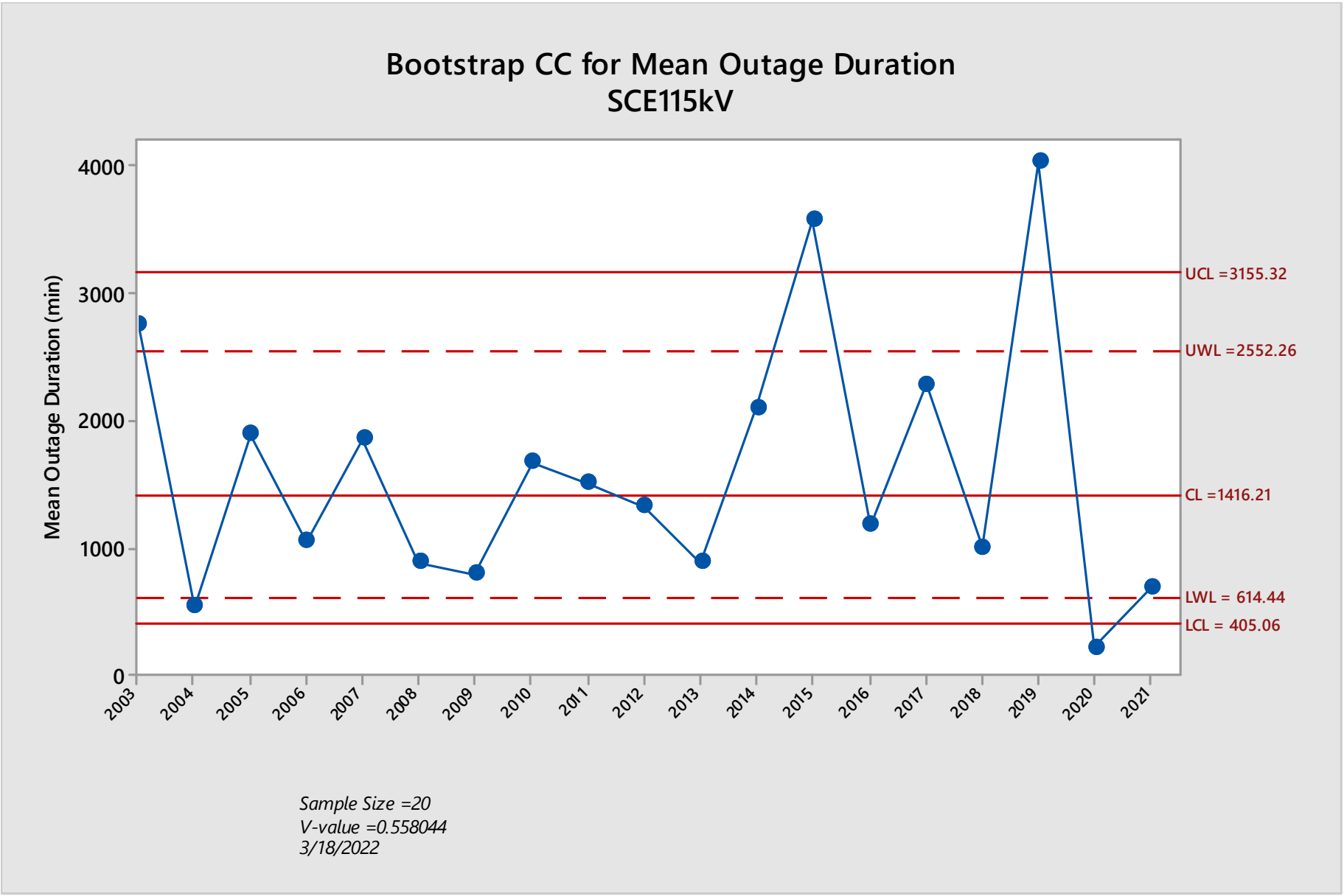

Bootstrap CC for Mean Outage Frequency
SCE230kV
Mean Outage Frequency
2.5
2.0
1.5
1.0
0.5
UCL =2.415
UWL =2.213
CL =1.786
LWL =1.405
LCL =1.260
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Sample Size =131
V-value =0.506549
3/17/2022

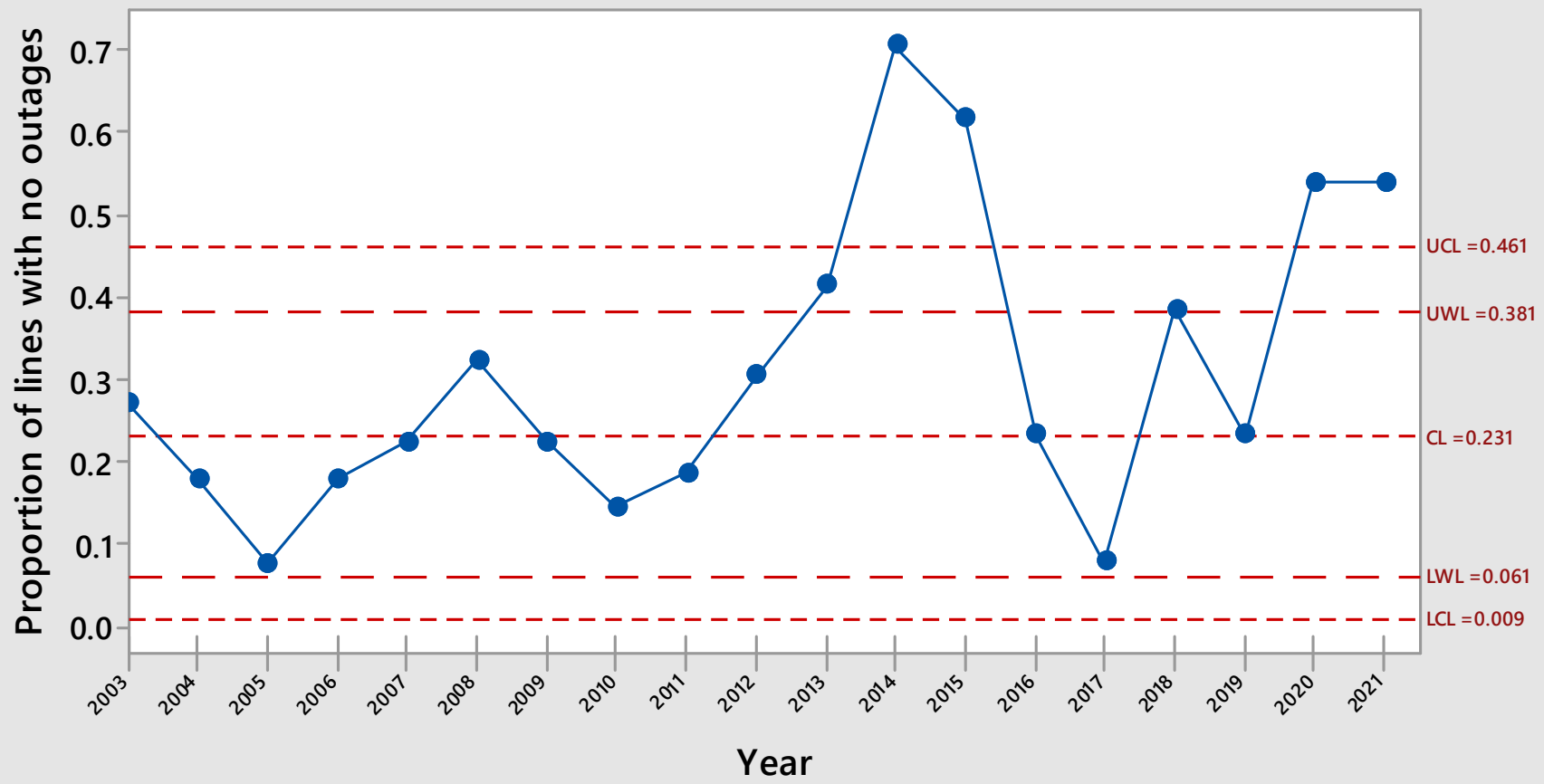

Bootstrap CC for Mean Outage Duration
SCE230kV
Mean Outage Duration (min)
2500
2000
1500
1000
500
UCL =2470.02
UWL =2201.19
CL =1645.22
LWL =1177.36
LCL =1010.21
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Sample Size =84
V-value =0.526847
3/18/2022



Median number of Active Lines =131
V-Value = 0.5000
3/18/2022


Bootstrap CC for Mean Outage Frequency
SCE115kV
Mean Outage Frequency
6
5
4
3
2
1
UCL =5.844
UWL =5.070
CL =3.477
LWL =2.093
LCL =1.637
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Sample Size =27
V-value =0.517448
3/18/2022

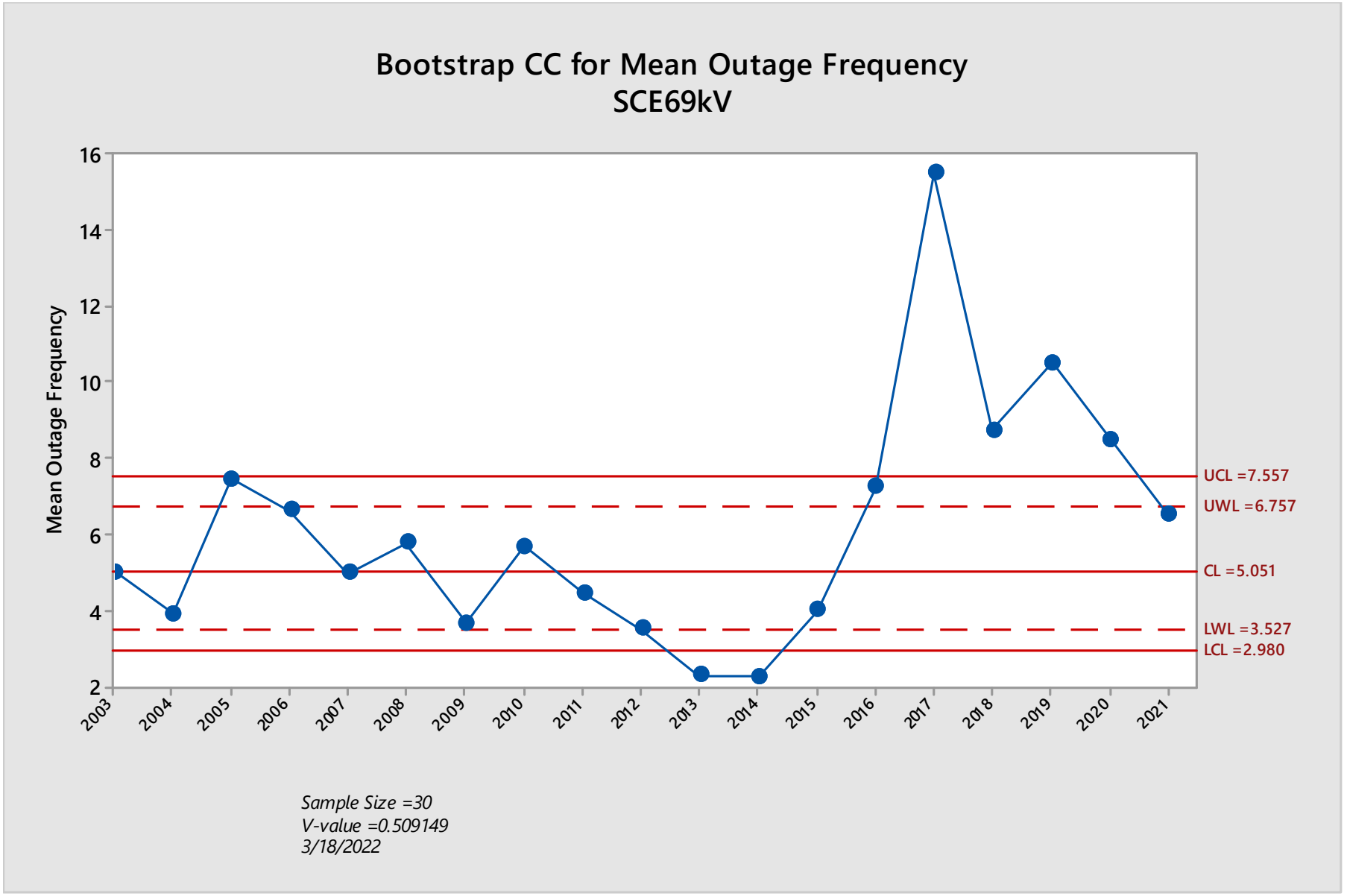

Bootstrap CC for Mean Outage Duration
SCE115kV
Mean Outage Duration (min)
4000
3000
2000
1000
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
UCL =3155.32
UWL =2552.26
CL =1416.21
LWL = 614.44
LCL = 405.06
Sample Size =20
V-value =0.558044
3/18/2022

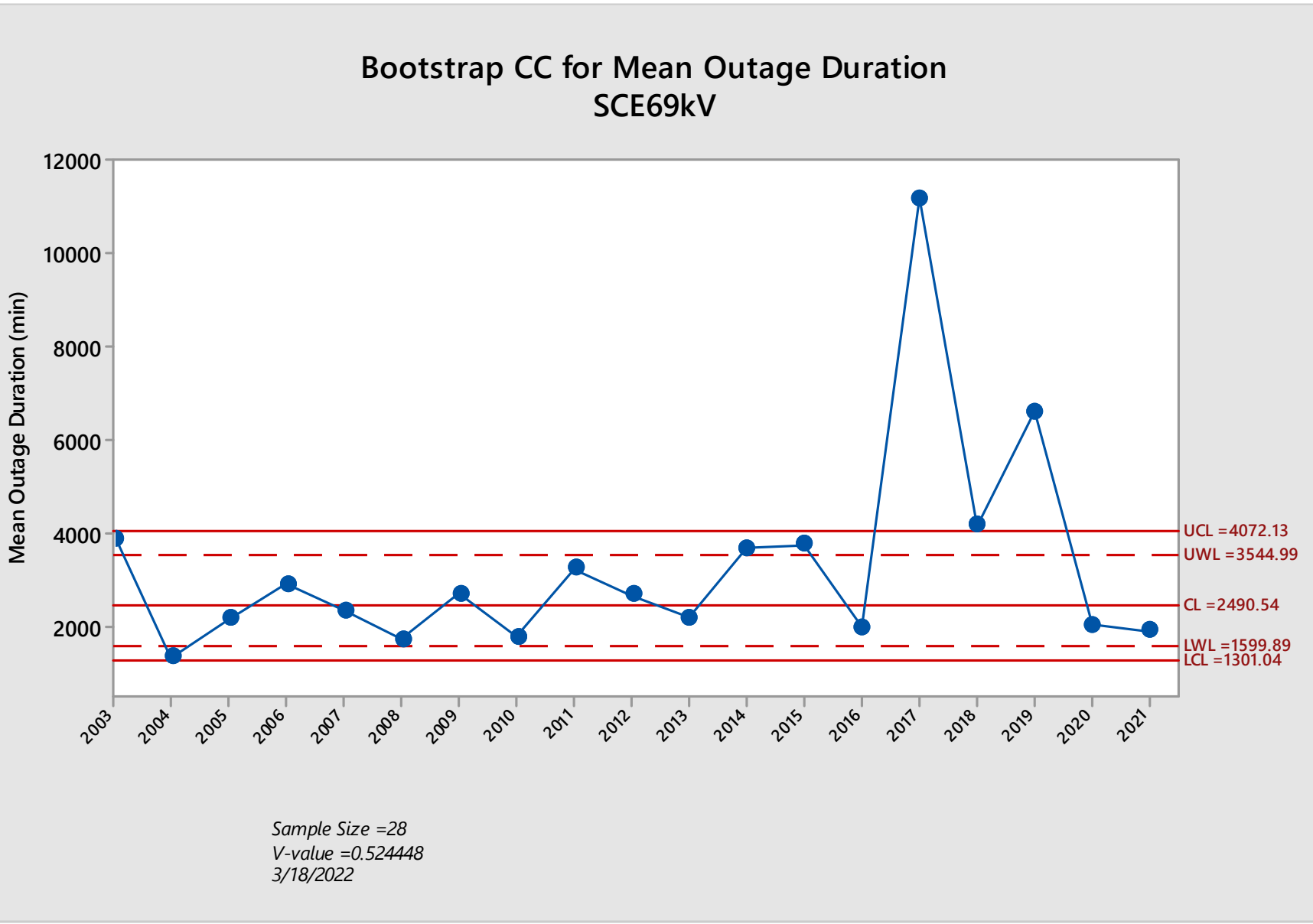


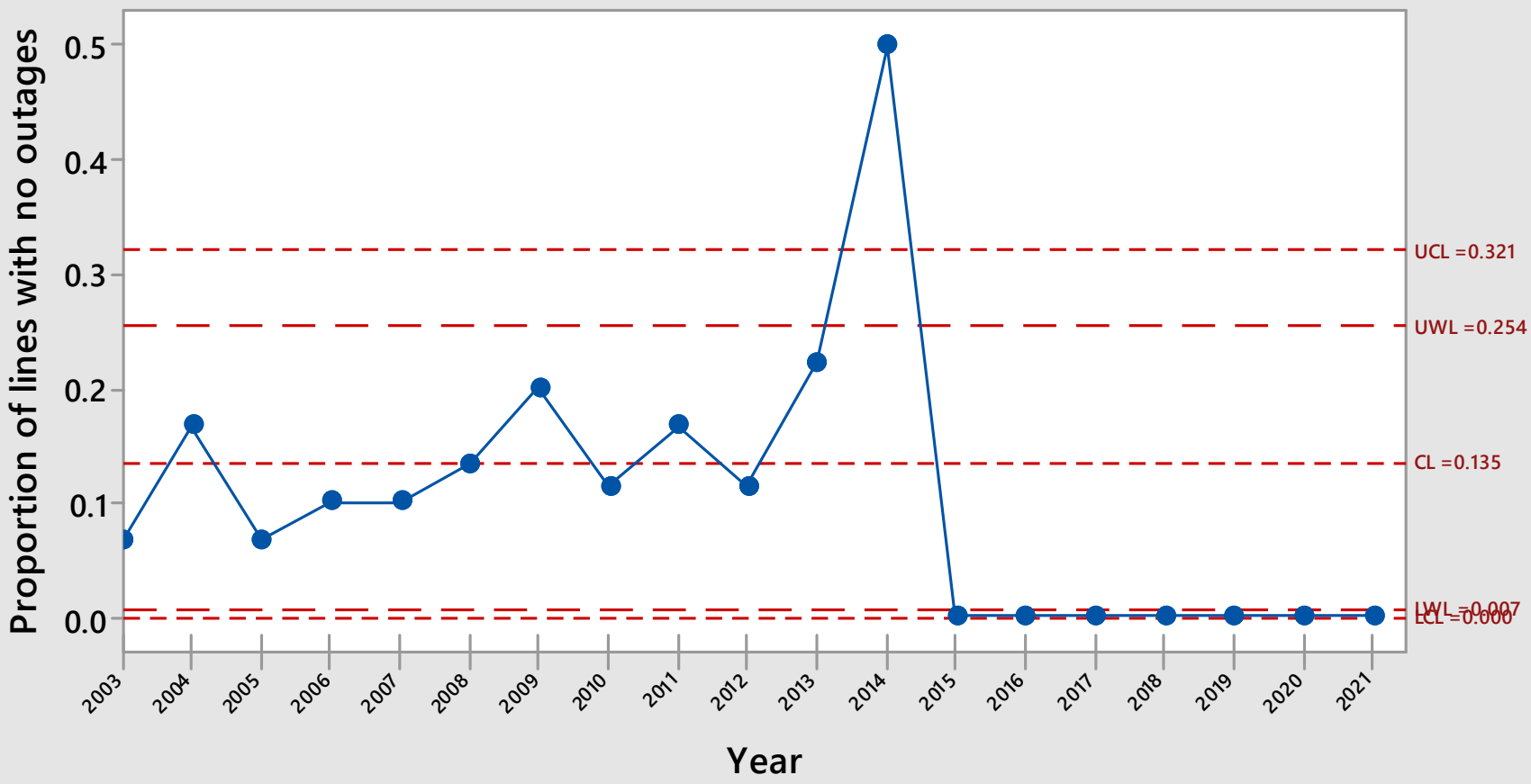
V_Value =0.385

Median number of Active Lines =27

3/18/2022


Bootstrap CC for Mean Outage Frequency
SCE69kV
Mean Outage Frequency
16
14
12
10
8
6
4
2
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
UCL =7.557
UWL =6.757
CL =5.051
LWL =3.527
LCL =2.980
Sample Size =30
V-value =0.509149
3/18/2022


Bootstrap CC for Mean Outage Duration
SCE69kV
Mean Outage Duration (min)
12000
10000
8000
6000
4000
2000
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
UCL =4072.13
UWL =3544.99
CL =2490.54
LWL =1599.89
LCL =1301.04
Sample Size =28
V-value =0.524448
3/18/2022



V_Value =0.616

Median number of Active Lines =30

3/21/2022