



# **SOUTHERN CALIFORNIA EDISON COMPANY**

**2022**

## **TRANSMISSION LINE CIRCUIT AVAILABILITY PERFORMANCE REPORT**

**April 1, 2023**

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## 2022 Availability Performance Report

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# **2021 Availability Performance Report**

## **I INTRODUCTION**

The 2022 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, 2022 and December 31, 2022. 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 2022 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 2022 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 2022 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			
	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			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			
	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
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 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 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		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
69 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
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 2022 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 2022 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 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 did not trigger any test 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 did not trigger any test 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 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 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 2022 on SCE 500 kV transmission line circuits under the operational control of the ISO is 1.371 outages per year. In 2022 the outage frequency average was 0.5151 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) = 2.509
  2. Upper Warning Limit (UWL) = 2.127
  3. Lower Warning Limit (LWL) = 0.727
  4. Lower Control Limit (LCL) = 0.518
- Outage Duration - The historical average (CL) between 2003 and 2022 on SCE 500 kV transmission line circuits under the operational control of the ISO is 1574.98 minutes per year. In 2022, the outage duration is an accumulated average of 2664.83 minutes per year, which is above the historical average. The range of expected performance for the 500 kV voltage class is:
  1. Upper Control Limit (UCL) = 3739.75 min
  2. Upper Warning Limit (UWL) = 2981.14 min
  3. Lower Warning Limit (LWL) = 598.82 min
  4. Lower Control Limit (LCL) = 352.69 min
- Proportion - The historical average percentage (CL) between 2003 and 2022 on SCE 500 kV transmission line circuits under the operational control of ISO is 44.6%. In 2022, the average percentage for transmission line circuits that experienced no forced outages is 63.63 %, which is above the historical average. The range of expected performance for the 500 kV voltage class is:
  1. Upper Control Limit (UCL) = 69.5 %
  2. Upper Warning Limit (UWL) = 61.4 %
  3. Lower Warning Limit (LWL) = 24.6 %
  4. Lower Control Limit (LCL) = 17.2%

## 230 kV Voltage Class

- Outage Frequency - The historical average (CL) between 2003 and 2022 on SCE 230 kV transmission line circuits under the operational control of the ISO is 1.690 outages per year. In 2022, the outage frequency has an average of 0.8255 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) = 2.311
  2. Upper Warning Limit (UWL) = 2.112
  3. Lower Warning Limit (LWL) = 1.309
  4. Lower Control Limit (LCL) = 1.162
- Outage Duration - The historical average (CL) between 2003 and 2022 on SCE 230 kV transmission line circuits under the operational control of the ISO is 1638.49 minutes per year. In 2022, the outage duration accumulated average was 1510.02 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) = 2487.11 min
  2. Upper Warning Limit (UWL) = 2209.71 min
  3. Lower Warning Limit (LWL) = 1159.03 min
  4. Lower Control Limit (LCL) = 991.13 min
- Proportion - The historical average percentage (CL) between 2003 and 2022 on SCE 230 kV transmission line circuits under the operational control of ISO is 40.3%. In 2022 the average percentage for transmission line circuits that experienced no forced outages was 64.43%, which is above the historical average. The range of expected performance for the 230 kV voltage class is:
  1. Upper Control Limit (UCL) = 52.3%
  2. Upper Warning Limit (UWL) = 48.7 %
  3. Lower Warning Limit (LWL) = 31.9 %
  4. Lower Control Limit (LCL) = 28.3 %

## 115 kV Voltage Class

- Outage Frequency - The historical average (CL) between 2003 and 2022 on SCE 115 kV transmission line circuits under the operational control of the ISO is 3.426 outages per year. In 2022 the outage frequency average was 3.2307 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) = 5.819
  2. Upper Warning Limit (UWL) = 5.037
  3. Lower Warning Limit (LWL) = 2.041
  4. Lower Control Limit (LCL) = 1.593
- Outage Duration - The historical average (CL) between 2003 and 2022 on SCE 115 kV transmission line circuits under the operational control of the ISO is 1385.29 minutes per year. In 2022, the outage duration accumulated average was 957.5 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) = 3184.06 min
  2. Upper Warning Limit (UWL) = 2537.18 min
  3. Lower Warning Limit (LWL) = 588.46 min
  4. Lower Control Limit (LCL) = 387.55 min
- Proportion - The historical average percentage (CL) between 2003 and 2022 on SCE 115 kV transmission line circuits under the operational control of ISO is 23.1 %. In 2022, the average percentage for transmission line circuits that experienced no forced outages was 23.08 %, which is below 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 2022 on SCE 69 kV transmission line circuits under the operational control of the ISO is 5.050 outages per year. In 2022, the outage frequency average was 5 outages 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) = 7.560
  2. Upper Warning Limit (UWL) = 6.747
  3. Lower Warning Limit (LWL) = 3.547
  4. Lower Control Limit (LCL) = 2.983
  
- Outage Duration - The historical average (CL) between 2003 and 2022 on SCE 69 kV transmission line circuits under the operational control of the ISO is 2491.85 minutes per year. In 2022, the outage duration mean accumulated average was 3155 minutes 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) = 4085.11 min
  2. Upper Warning Limit (UWL) = 3562.73 min
  3. Lower Warning Limit (LWL) = 1593.08 min
  4. Lower Control Limit (LCL) = 1301.32 min
  
- Proportion - The historical average percentage (CL) between 2003 and 2022 on SCE 69 kV transmission line circuits under the operational control of the ISO is 13.4 %. In 2022, 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) = 31.9 %
  2. Upper Warning Limit (UWL) = 25.2 %
  3. Lower Warning limit (LWL) = 0.6 %
  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	2022	1	32
SCE	72	500	2022	0	0
SCE	79	500	2022	0	0
SCE	81	500	2022	1	1350
SCE	83	500	2022	2	8640
SCE	104	500	2022	0	0
SCE	106	500	2022	0	0
SCE	112	500	2022	0	0
SCE	116	500	2022	0	0
SCE	117	500	2022	0	0
SCE	121	500	2022	0	0
SCE	126	500	2022	0	0
SCE	127	500	2022	1	3595
SCE	129	500	2022	0	0
SCE	132	500	2022	0	0
SCE	134	500	2022	0	0
SCE	135	500	2022	0	0
SCE	299	500	2022	1	699
SCE	942	500	2022	0	0
SCE	943	500	2022	1	299
SCE	945	500	2022	2	471
SCE	958	500	2022	1	4320
SCE	959	500	2022	0	0
SCE	1895	500	2022	1	4320
SCE	1896	500	2022	0	0
SCE	1905	500	2022	0	0
SCE	1906	500	2022	1	655
SCE	1907	500	2022	0	0
SCE	1908	500	2022	0	0
SCE	1910	500	2022	0	0
SCE	1914	500	2022	0	0
SCE	1966	500	2022	2	3862
SCE	1967	500	2022	3	3735



230 kV Voltage Class

Transmission Owner	Transmission Line ID	Volt Class	Year	Annual Outage Frequency	Annual Outage Duration Min.
SCE	35	230	2022	1	3
SCE	36	230	2022	0	0
SCE	37	230	2022	0	0
SCE	38	230	2022	0	0
SCE	39	230	2022	0	0
SCE	96	230	2022	0	0
SCE	127	230	2022	1	1
SCE	174	230	2022	0	0
SCE	175	230	2022	1	164
SCE	185	230	2022	0	0
SCE	187	230	2022	0	0
SCE	188	230	2022	0	0
SCE	194	230	2022	1	278
SCE	195	230	2022	0	0
SCE	196	230	2022	0	0
SCE	213	230	2022	0	0
SCE	216	230	2022	1	137
SCE	217	230	2022	0	0
SCE	219	230	2022	1	21
SCE	226	230	2022	0	0
SCE	289	230	2022	0	0
SCE	290	230	2022	0	0
SCE	306	230	2022	0	0
SCE	337	230	2022	1	757
SCE	338	230	2022	0	0
SCE	369	230	2022	2	8640
SCE	378	230	2022	2	5602
SCE	397	230	2022	0	0
SCE	449	230	2022	0	0
SCE	461	230	2022	0	0
SCE	464	230	2022	0	0
SCE	465	230	2022	0	0
SCE	470	230	2022	0	0
SCE	471	230	2022	1	30
SCE	474	230	2022	0	0
SCE	475	230	2022	0	0
SCE	483	230	2022	0	0
SCE	488	230	2022	0	0

SCE	490	230	2022	0	0
SCE	513	230	2022	0	0
SCE	514	230	2022	0	0
SCE	515	230	2022	0	0
SCE	517	230	2022	2	7852
SCE	521	230	2022	0	0
SCE	526	230	2022	0	0
SCE	545	230	2022	1	204
SCE	577	230	2022	0	0
SCE	592	230	2022	0	0
SCE	594	230	2022	0	0
SCE	599	230	2022	0	0
SCE	601	230	2022	0	0
SCE	602	230	2022	1	3
SCE	609	230	2022	0	0
SCE	611	230	2022	0	0
SCE	624	230	2022	3	3241
SCE	637	230	2022	0	0
SCE	638	230	2022	0	0
SCE	654	230	2022	9	9
SCE	655	230	2022	0	0
SCE	657	230	2022	9	9
SCE	659	230	2022	0	0
SCE	664	230	2022	0	0
SCE	665	230	2022	2	7908
SCE	667	230	2022	5	14148
SCE	669	230	2022	2	297
SCE	677	230	2022	0	0
SCE	689	230	2022	1	221
SCE	690	230	2022	0	0
SCE	701	230	2022	0	0
SCE	707	230	2022	0	0
SCE	708	230	2022	3	4332
SCE	729	230	2022	1	612
SCE	731	230	2022	1	94
SCE	755	230	2022	0	0
SCE	763	230	2022	0	0
SCE	770	230	2022	2	4467
SCE	771	230	2022	1	1
SCE	775	230	2022	0	0
SCE	776	230	2022	0	0
SCE	778	230	2022	0	0

SCE	785	230	2022	0	0
SCE	845	230	2022	0	0
SCE	880	230	2022	1	22
SCE	881	230	2022	1	16
SCE	920	230	2022	1	328
SCE	926	230	2022	0	0
SCE	946	230	2022	0	0
SCE	972	230	2022	0	0
SCE	973	230	2022	0	0
SCE	974	230	2022	0	0
SCE	981	230	2022	1	511
SCE	982	230	2022	0	0
SCE	999	230	2022	1	208
SCE	1038	230	2022	0	0
SCE	1046	230	2022	5	533
SCE	1050	230	2022	0	0
SCE	1058	230	2022	4	1039
SCE	1062	230	2022	1	531
SCE	1063	230	2022	0	0
SCE	1073	230	2022	0	0
SCE	1082	230	2022	9	5311
SCE	1083	230	2022	3	4
SCE	1091	230	2022	0	0
SCE	1093	230	2022	0	0
SCE	1108	230	2022	0	0
SCE	1124	230	2022	1	656
SCE	1125	230	2022	0	0
SCE	1135	230	2022	0	0
SCE	1188	230	2022	1	23
SCE	1189	230	2022	1	24
SCE	1242	230	2022	0	0
SCE	1277	230	2022	0	0
SCE	1478	230	2022	0	0
SCE	1479	230	2022	1	514
SCE	1480	230	2022	0	0
SCE	1481	230	2022	0	0
SCE	1483	230	2022	0	0
SCE	1495	230	2022	0	0
SCE	1591	230	2022	0	0
SCE	1594	230	2022	0	0
SCE	1607	230	2022	1	564
SCE	1618	230	2022	0	0

SCE	1709	230	2022	0	0
SCE	1710	230	2022	0	0
SCE	1813	230	2022	1	737
SCE	1897	230	2022	0	0
SCE	1898	230	2022	0	0
SCE	1899	230	2022	1	4320
SCE	1900	230	2022	1	555
SCE	1901	230	2022	0	0
SCE	1903	230	2022	0	0
SCE	1925	230	2022	1	19
SCE	1951	230	2022	0	0
SCE	1968	230	2022	0	0
SCE	1969	230	2022	0	0
SCE	1989	230	2022	0	0
SCE	4320	230	2022	1	1017
SCE	4406	230	2022	5	3209
SCE	4488	230	2022	0	0
SCE	4489	230	2022	0	0
SCE	4540	230	2022	0	0
SCE	4676	230	2022	1	85
SCE	4677	230	2022	0	0
SCE	6644	230	2022	3	3
SCE	7239	230	2022	1	13
SCE	7240	230	2022	1	6
SCE	7241	230	2022	1	441
SCE	8214	230	2022	5	8
SCE	8342	230	2022	14	303

115 kV Voltage Class

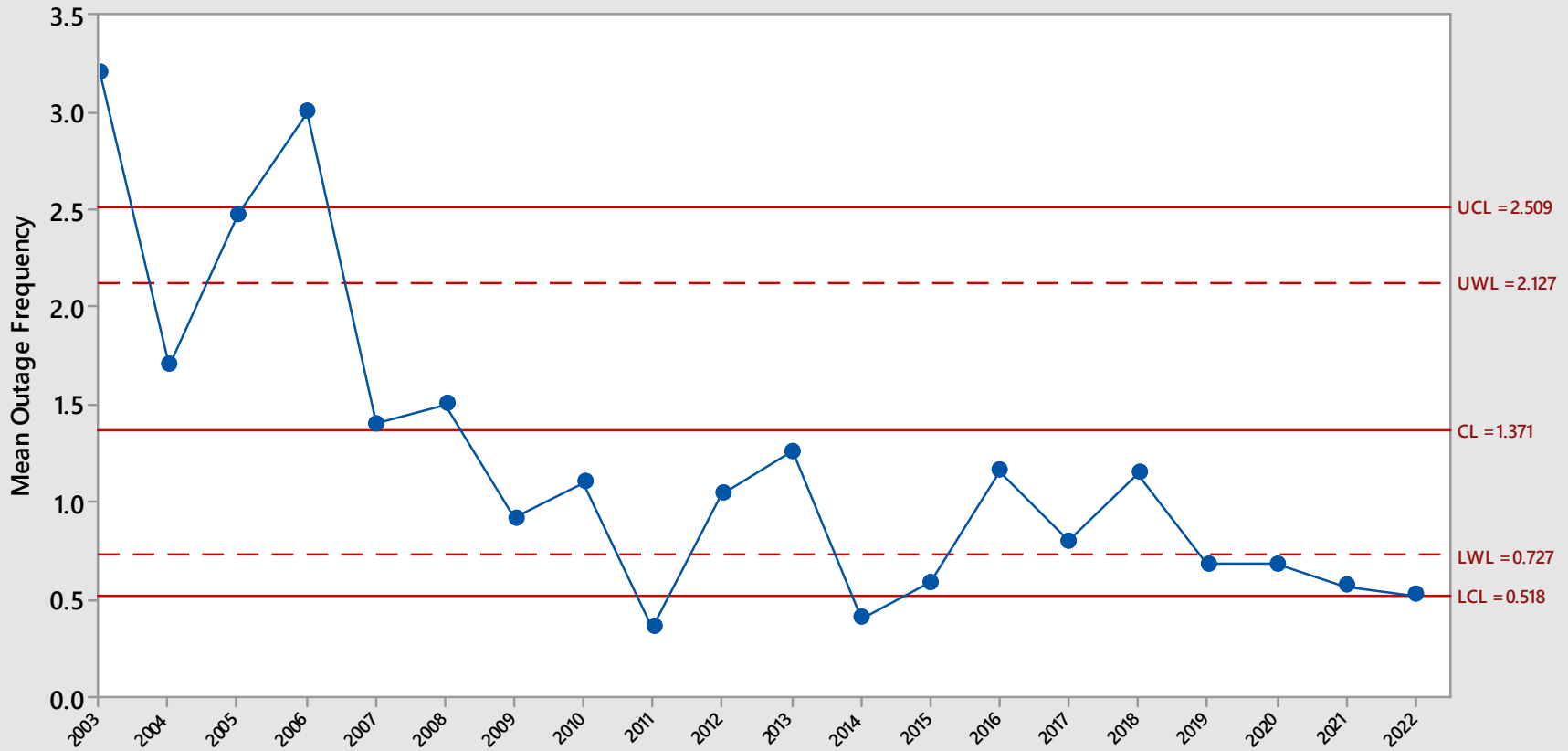
<b>Transmission Owner</b>	<b>Transmission Line ID</b>	<b>Volt Class</b>	<b>Year</b>	<b>Annual Outage Frequency</b>	<b>Annual Outage Duration Min.</b>
SCE	180	115	2022	3	113
SCE	199	115	2022	1	1383
SCE	200	115	2022	0	0
SCE	560	115	2022	2	1440
SCE	561	115	2022	1	1439
SCE	948	115	2022	2	1061
SCE	949	115	2022	1	2
SCE	1064	115	2022	2	28
SCE	1118	115	2022	0	0
SCE	1363	115	2022	0	0
SCE	75165	115	2022	4	363
SCE	77245	115	2022	17	2434
SCE	77246	115	2022	9	1312

69 kV Voltage Class

<b>Transmission Owner</b>	<b>Transmission Line ID</b>	<b>Volt Class</b>	<b>Year</b>	<b>Annual Outage Frequency</b>	<b>Annual Outage Duration Min.</b>
SCE	180	115	2022	3	113
SCE	199	115	2022	1	1383
SCE	200	115	2022	0	0
SCE	560	115	2022	2	1440
SCE	561	115	2022	1	1439
SCE	948	115	2022	2	1061
SCE	949	115	2022	1	2
SCE	1064	115	2022	2	28
SCE	1118	115	2022	0	0
SCE	1363	115	2022	0	0
SCE	75165	115	2022	4	363
SCE	77245	115	2022	17	2434
SCE	77246	115	2022	9	1312

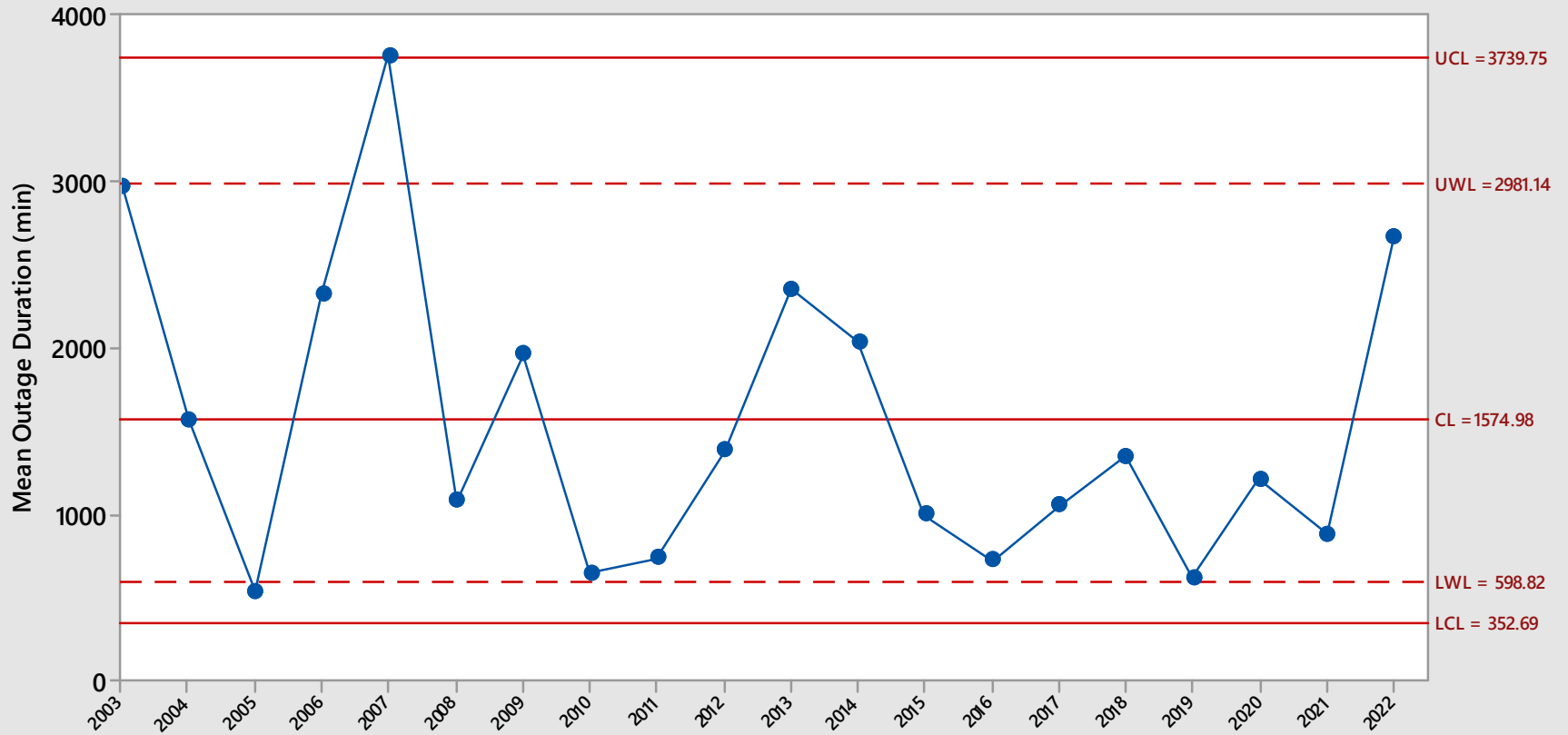
## **VI CONTROL CHARTS**

### Bootstrap CC for Mean Outage Frequency SCE500kV



Sample Size = 22  
V-value = 0.538246  
3/13/2023

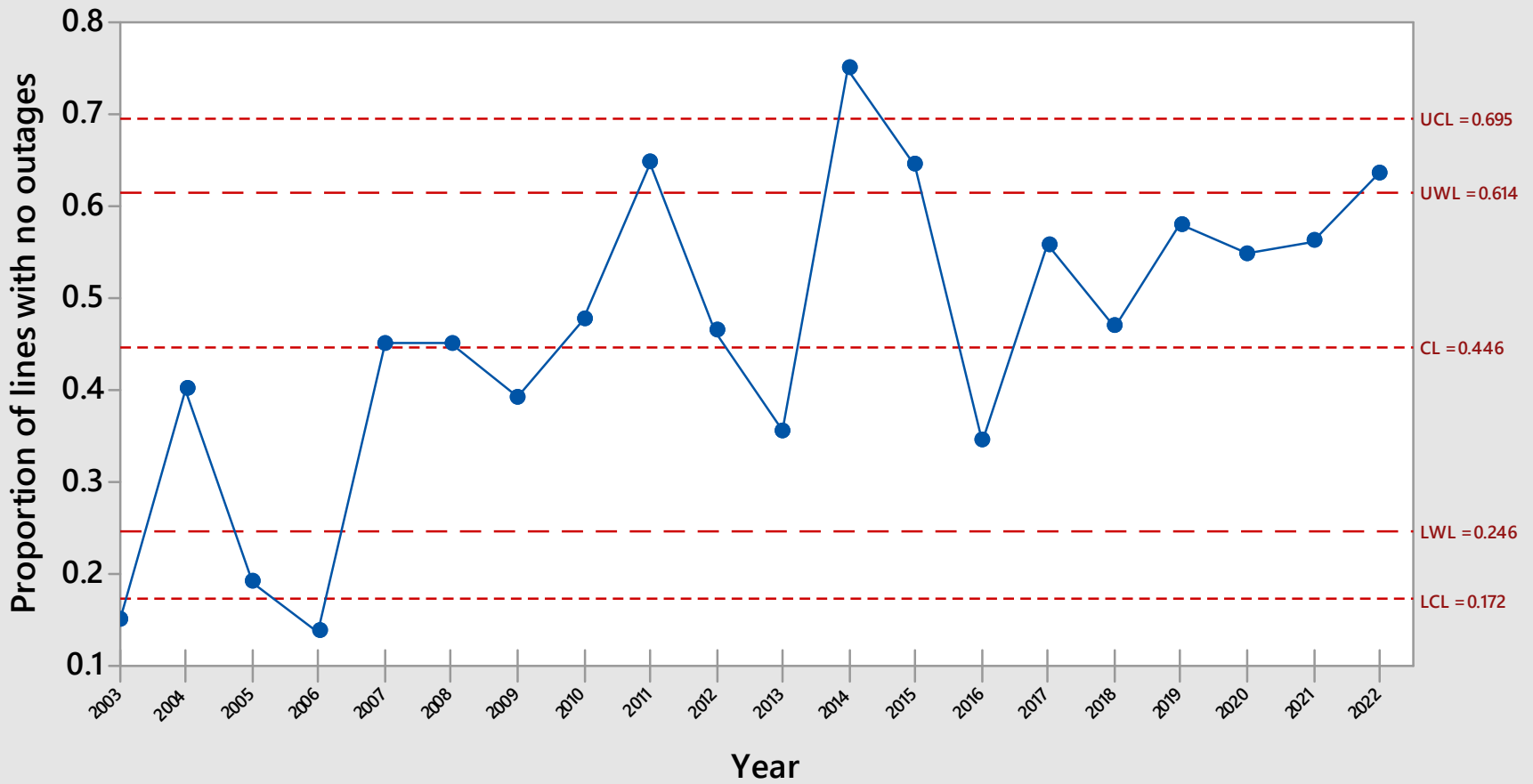
### Bootstrap CC for Mean Outage Duration SCE500kV



Sample Size = 13  
V-value = 0.552845  
3/13/2023

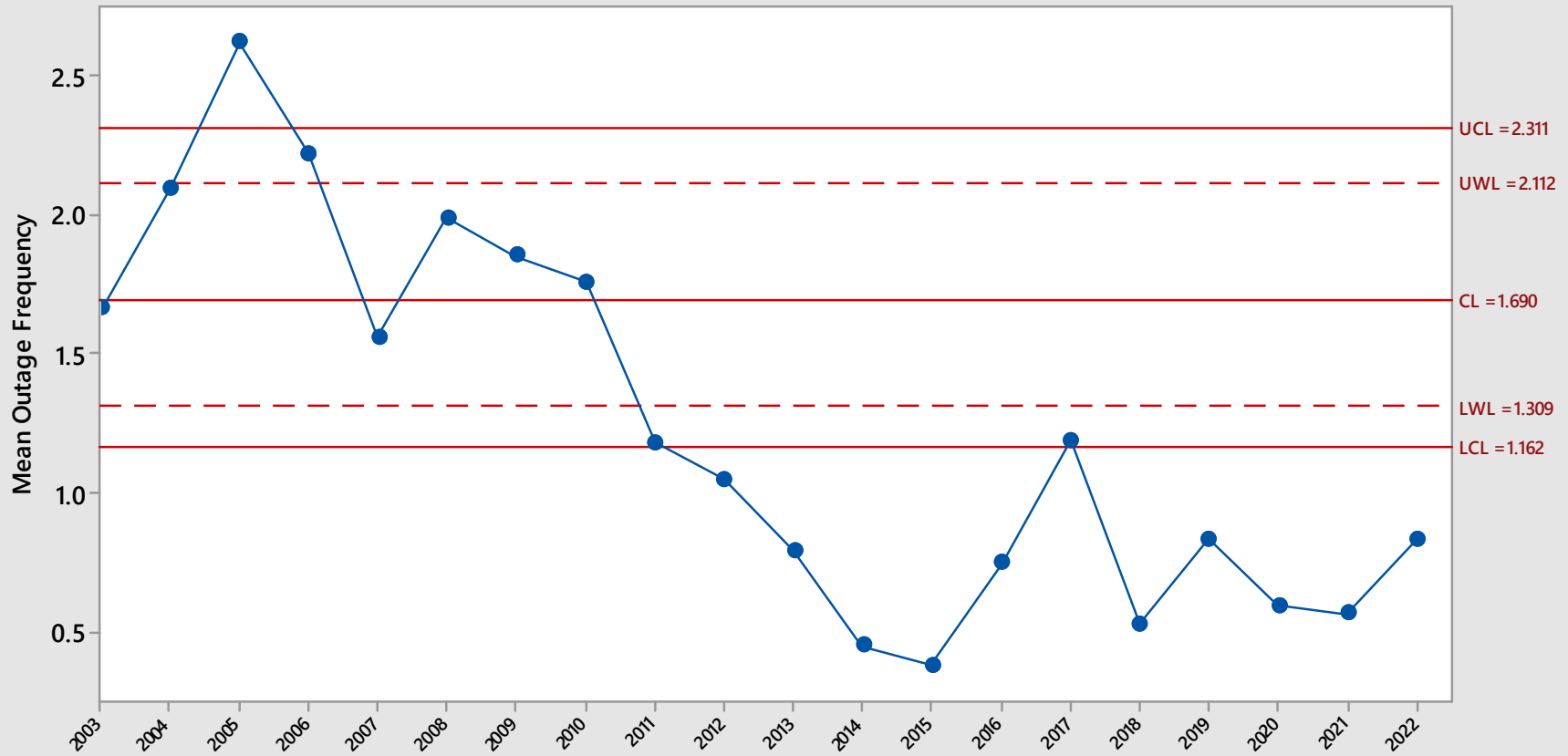


### Proportion Control Chart SCE500kV



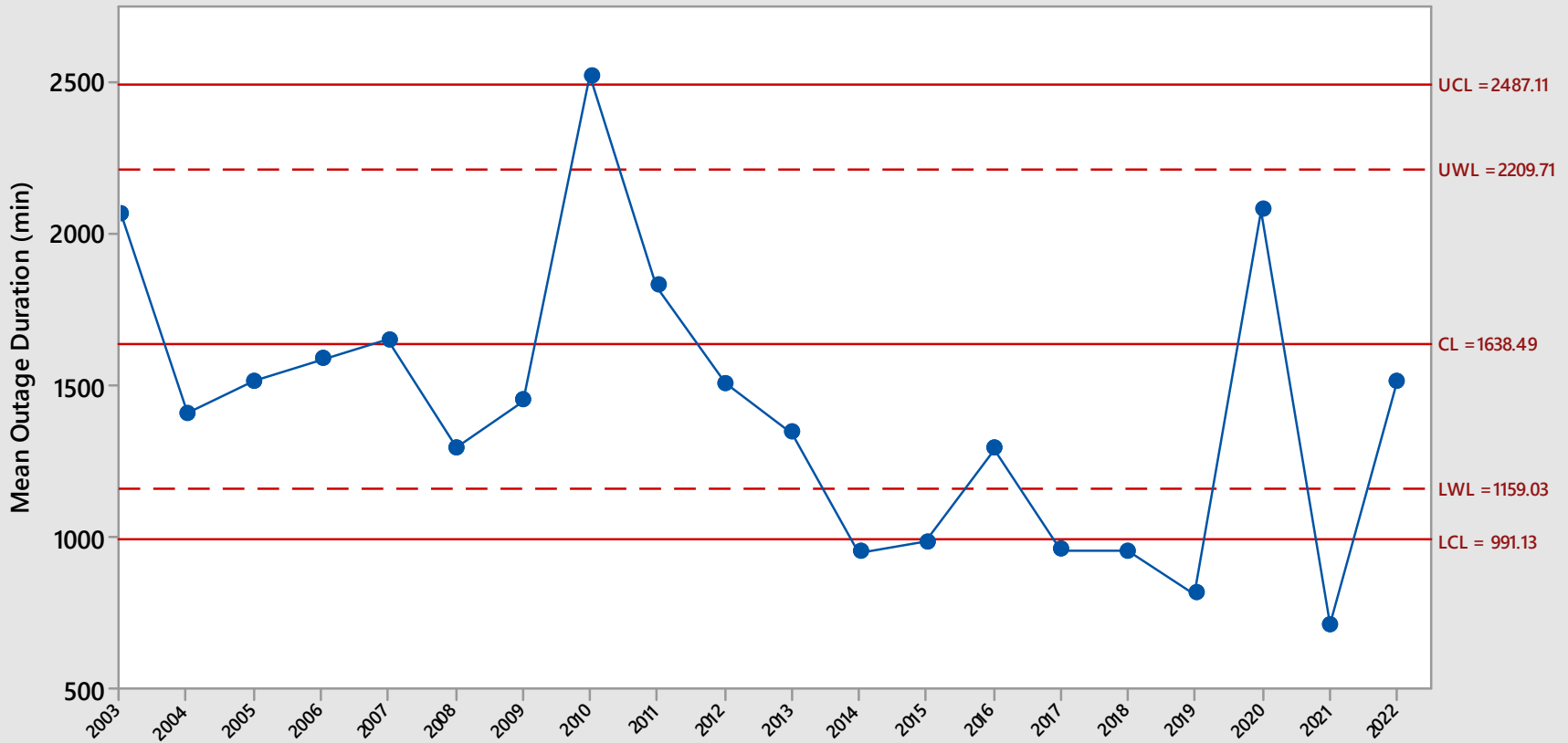
*V\_Value = 0.357*  
*Median number of Active Lines = 28*  
 3/13/2023

### Bootstrap CC for Mean Outage Frequency SCE230kV



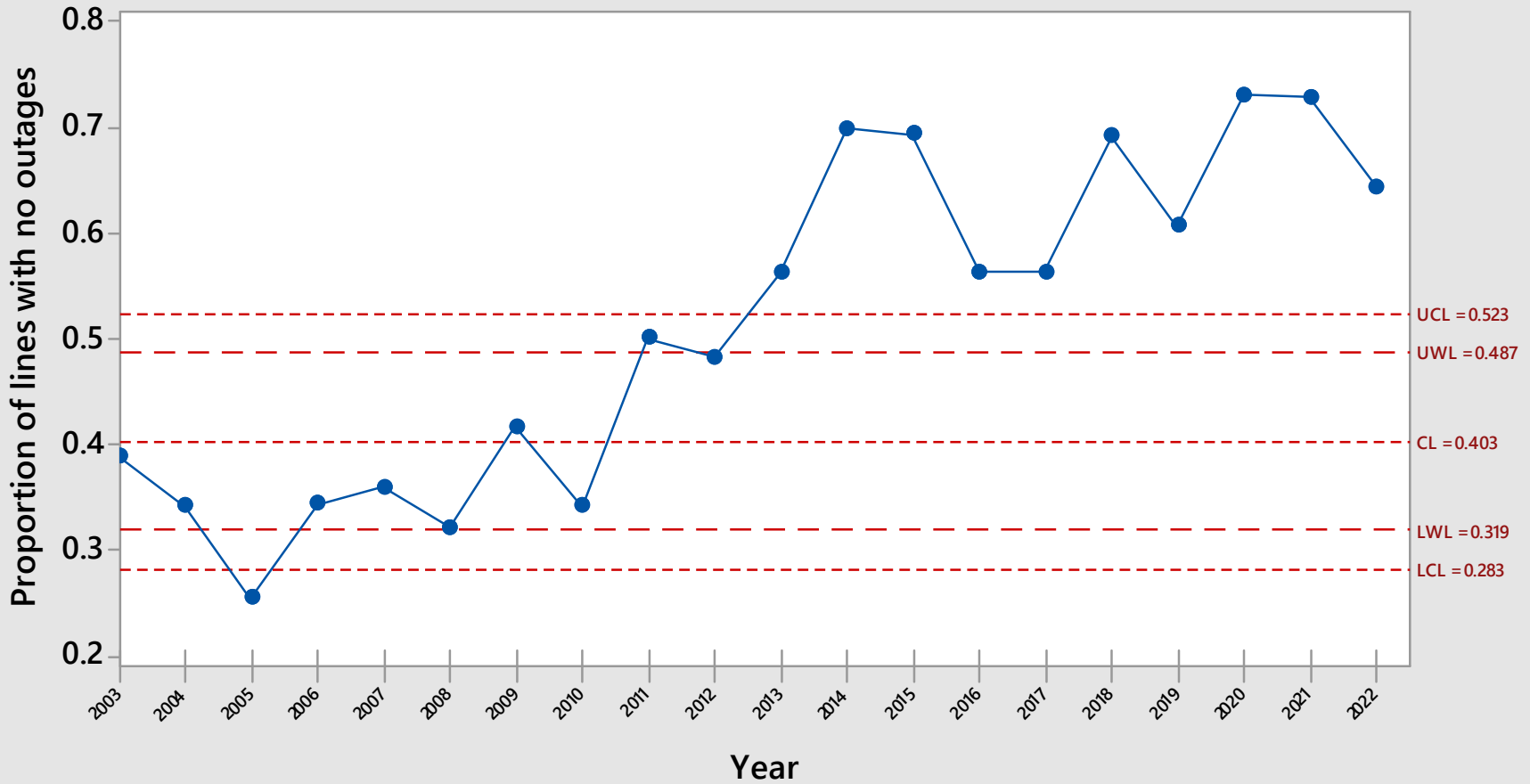
Sample Size = 131  
 V-value = 0.518348  
 3/12/2023

### Bootstrap CC for Mean Outage Duration SCE230kV



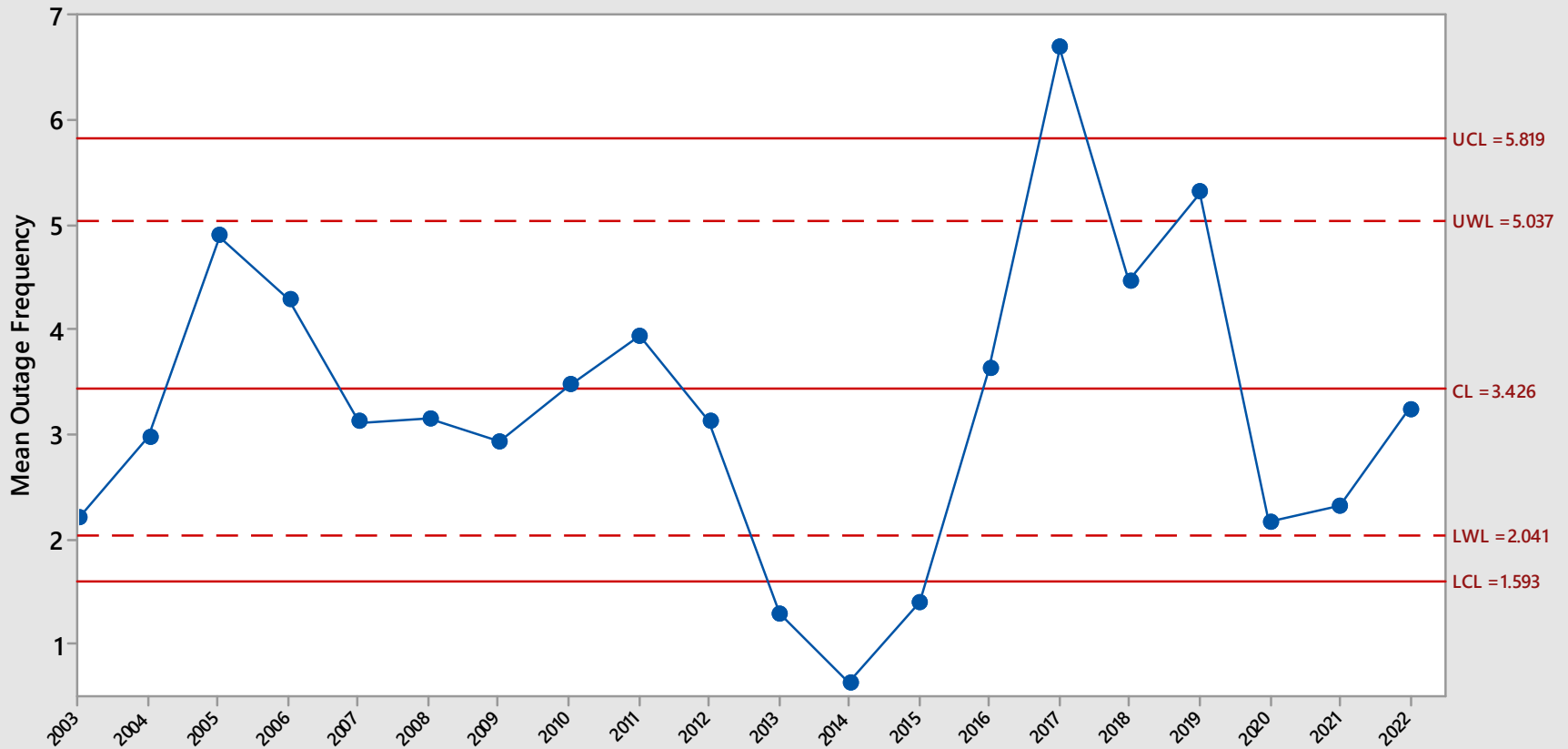
Sample Size = 82  
V-value = 0.523848  
3/12/2023

### Proportion Control Chart SCE230kV



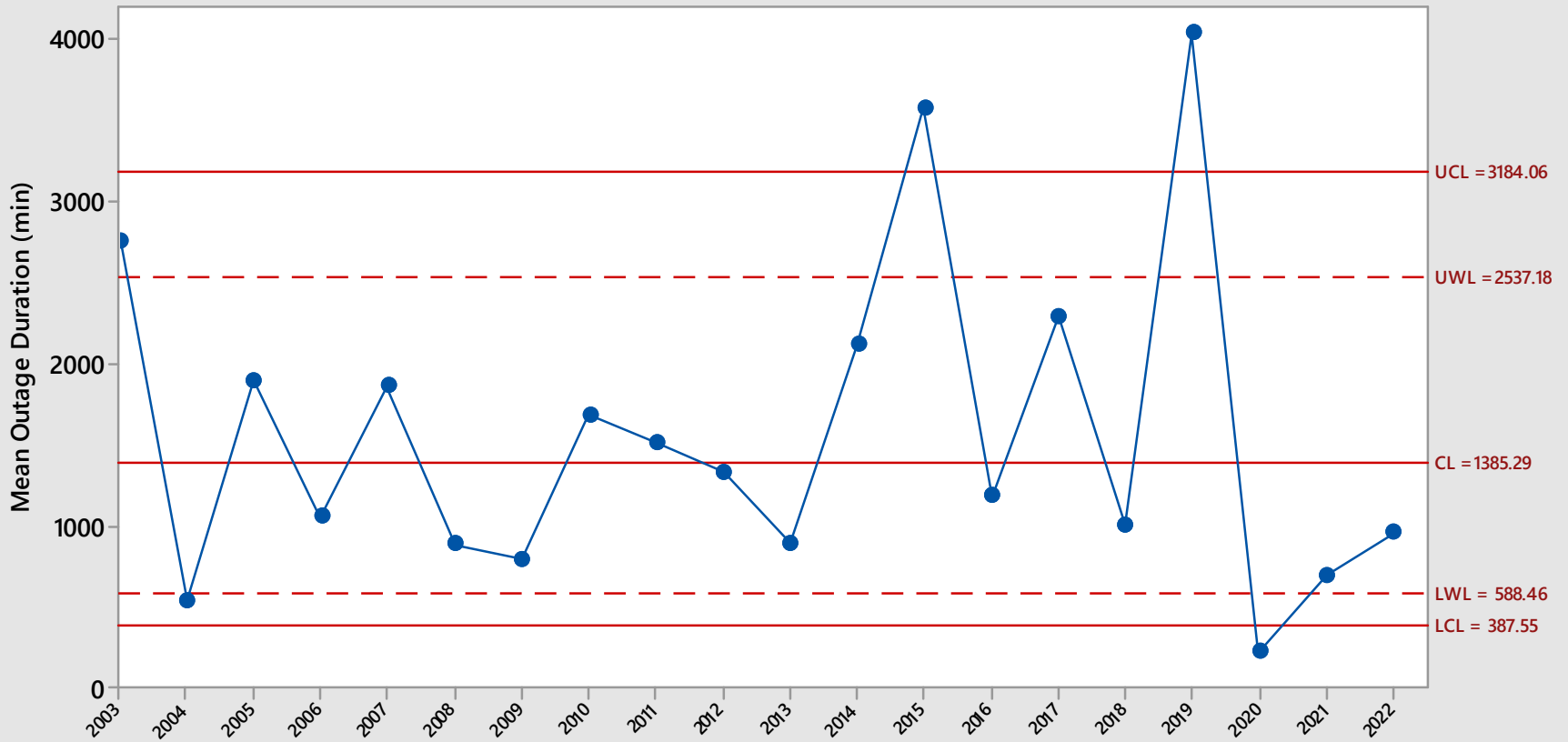
Median number of Active Lines = 131  
 V-Value = 0.5000  
 3/12/2023

### Bootstrap CC for Mean Outage Frequency SCE115kV



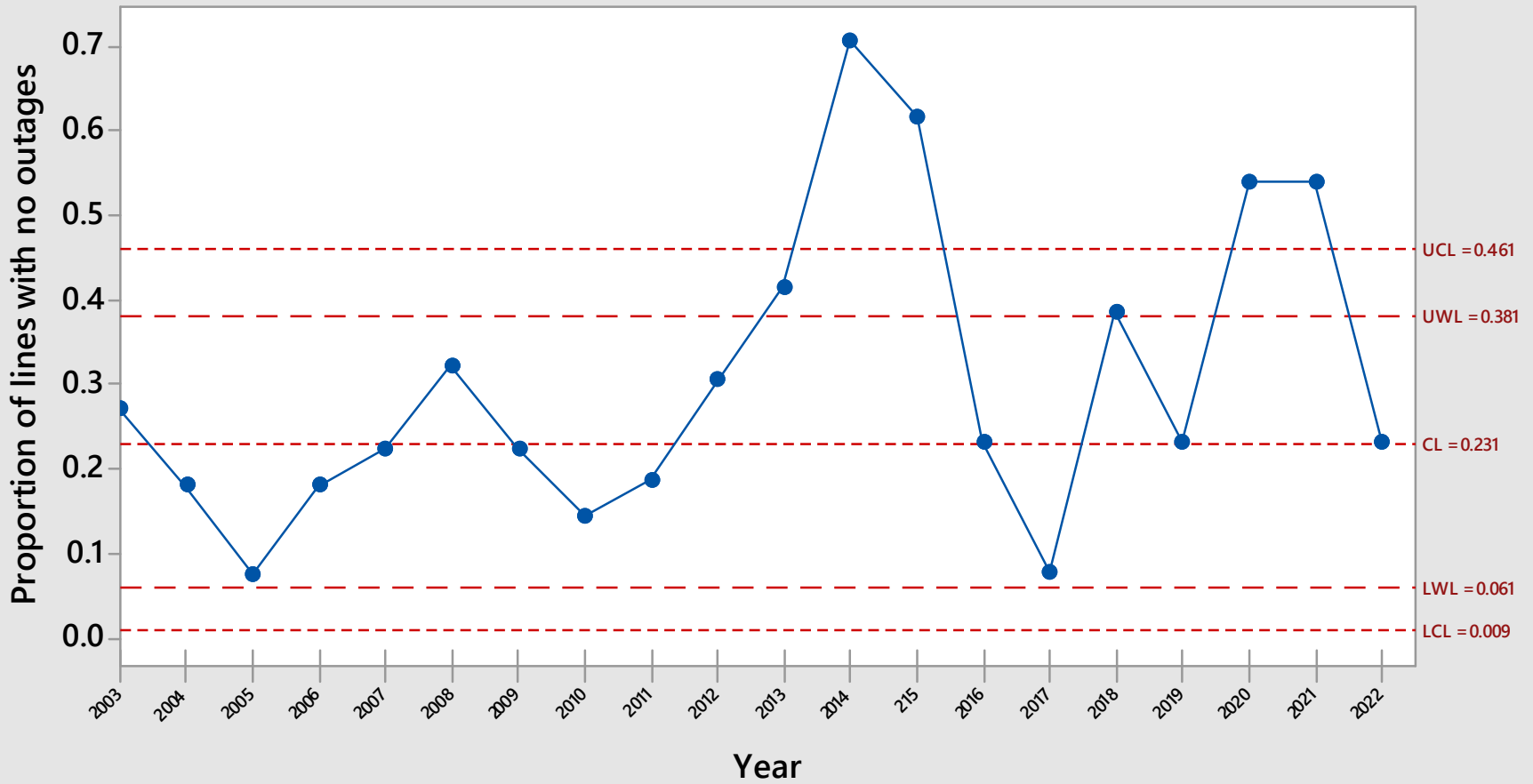
Sample Size = 27  
V-value = 0.521048  
3/12/2023

### Bootstrap CC for Mean Outage Duration SCE115kV



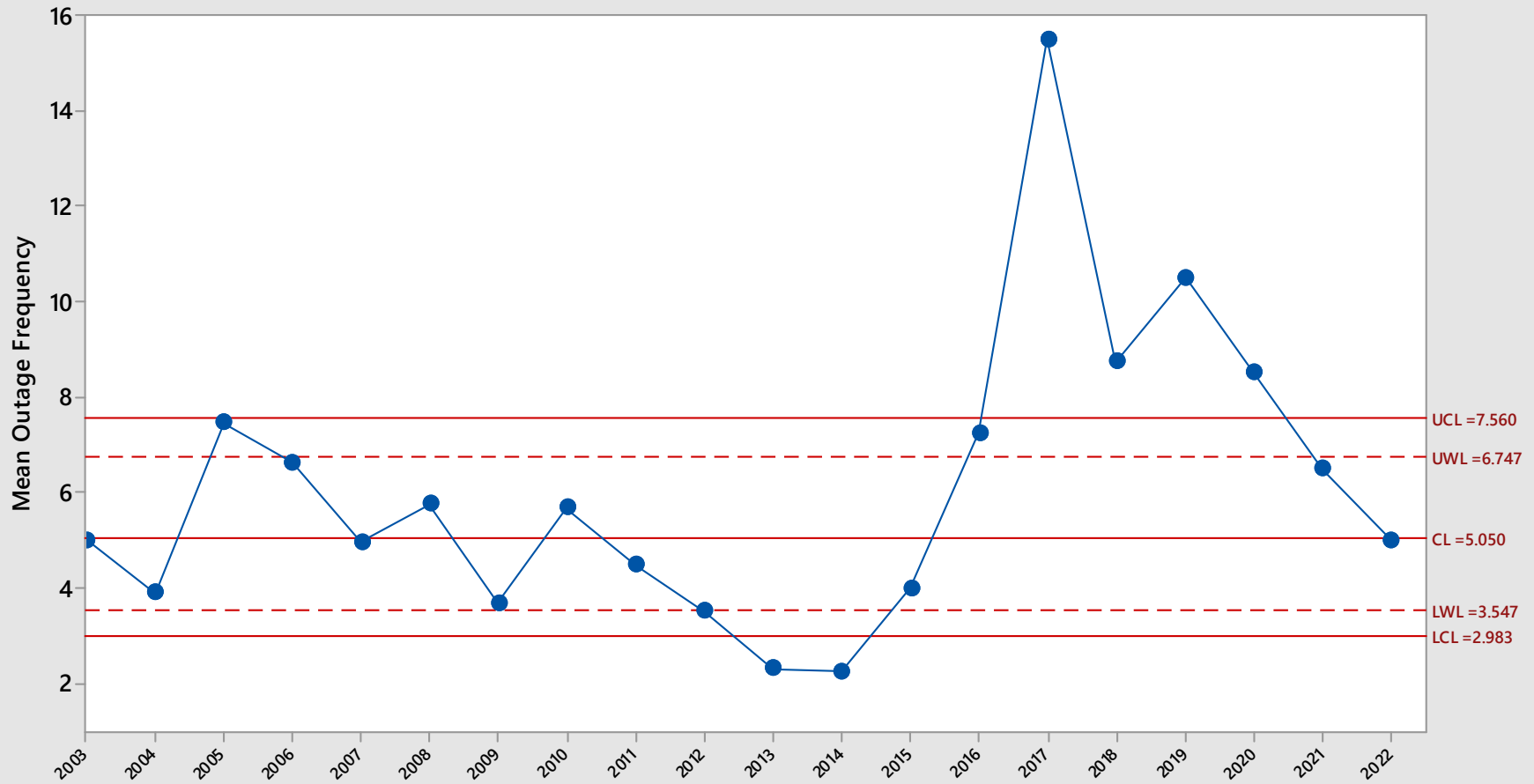
*Sample Size = 19*  
*V-value = 0.550645*  
*3/12/2023*

### Proportion Control Chart SCE115kV



*V\_Value = 0.385*  
*Median number of Active Lines = 27*  
*3/12/2023*

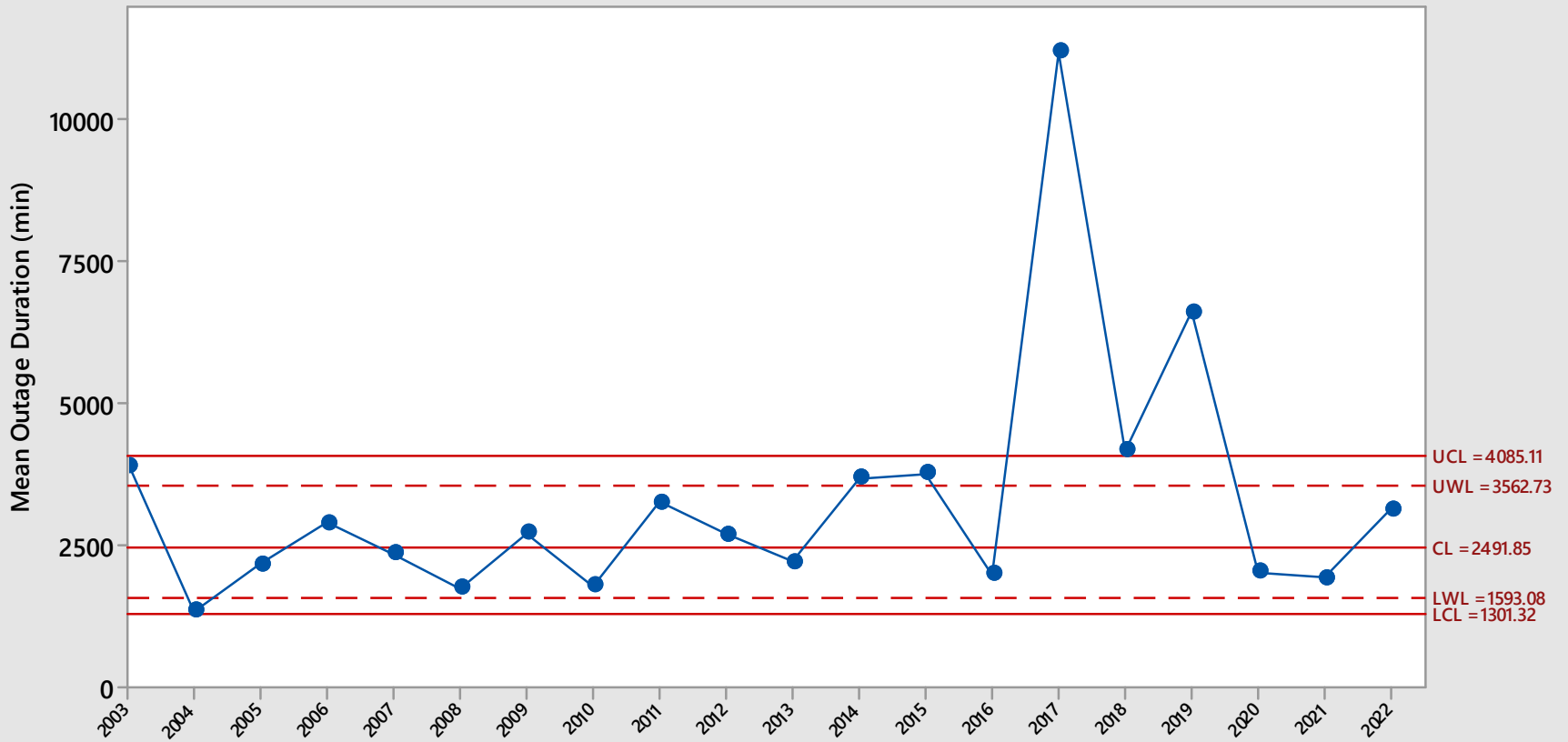
### Bootstrap CC for Mean Outage Frequency SCE69kV



Sample Size =30  
V-value =0.525747  
3/27/2023

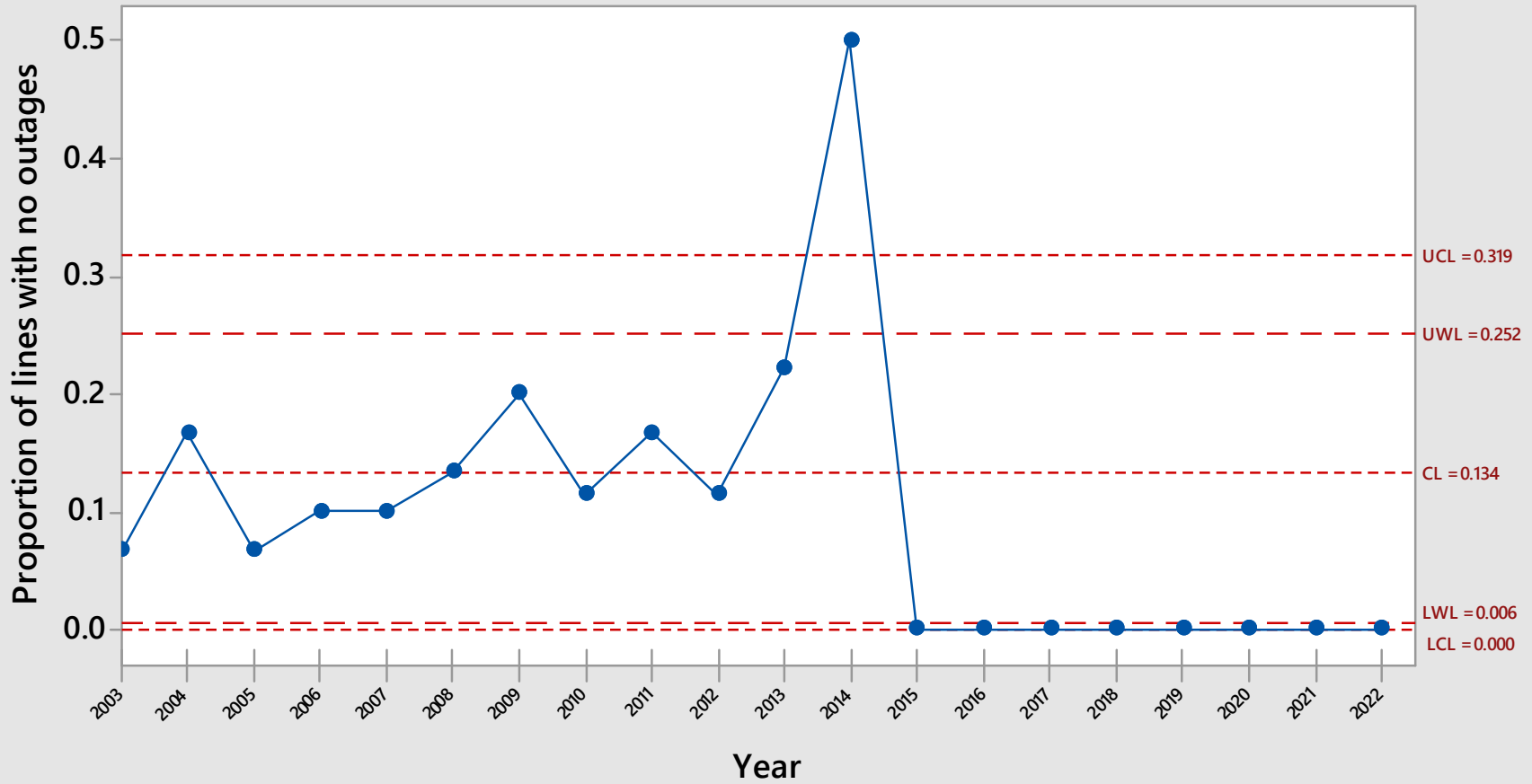


### Bootstrap CC for Mean Outage Duration SCE69kV



Sample Size = 27  
 V-value = 0.519548  
 3/12/2023

### Proportion Control Chart SCE69kV



V\_Value = 0.626  
Median number of Active Lines = 30  
3/12/2023