San Diego Gas & Electric
Annual Transmission Availability Report - 2022

To

California Independent System Operator

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Prepared by SDG&E Grid Operation Services

Contents

I. EXECUTIVE SUMMARY

This Availability Performance report, submitted to the CAISO, summarizes the 2022 San Diego Gas & Electric's transmission Availability Measure performance and fulfills the annual reporting requirement under the CAISO Transmission Maintenance Standards (Appendix C of the CAISO Transmission Control Agreement (TCA), Section 4.3 Availability Report).

The annual Transmission Availability Report (TAR) is based on SDG&E's Forced Outage records and only considers the Availability Measure performance of SDG&E's transmission circuits that are under the operational control of CAISO.

SDG&E's transmission system performance is monitored using control charts for each voltage class (69 kV, 138 kV, 230 kV, and 500 kV). As the CAISO Transmission Maintenance Standards do not have a 138 kV voltage class, all performance measurements for SDG&E's 138 kV voltage level are placed in the CAISO's 115 kV voltage class. Control charts are statistically based graphs which illustrate both an expected range of performance on historical data, and discrete measures of recent performance. Three performance indices are plotted in the charts to measure SDG&E's transmission Availability. These indices are (1) the annual average forced outage frequency for all transmission circuits, (2) the annual average accumulated forced outage duration only for those circuits with forced outages, and (3) the annual proportion of circuits with no forced outages.

Four predetermined statistical tests are used to assess shifts in annual performance and trends in longer-term performance. SDG&E provided CAISO its forced outage data that were used to establish the baseline for the control chart limits in this report.

In 2022, there was no performance test that triggered in degradation for SDG&E. Eighteen tests were triggered in improvement.

II. AVAILABILITY PERFORMANCE ANALYSIS

Having a reliable transmission system requires that the availability of individual transmission facilities is maintained. Each transmission facility has inherent levels of achievable availability and reliability. Short of making capital improvements or additions, an individual facility cannot operate above these inherent levels. It is possible, however, for performance to degrade to a lower level. This can occur from improper operation and/or improper or ineffective maintenance. From this background, the CAISO in collaboration with stakeholders developed transmission maintenance standards.

This report considers the performance of SDG&E's transmission circuits that are under the operational control of CAISO. SDG&E's forced outage data from its outage database was submitted to CAISO. These forced outage data was compared with SDG&E's forced outage information at CAISO (from CAISO's WebOMS system). The data validation was done in accordance with CAISO's Transmission Maintenance Procedure No 5. Transmission outages classified as "Not a Forced Outage" in the procedure are excluded. Moreover, SDG&E's forced outages that were de-energized for fire and other public safety reasons were also excluded. Transmission outages that lasted more than three days are capped at 72 hours so that excessively long forced outages do not skew the data. Forced outages in the database were rounded up to the nearest full minute.

The Availability performance of SDG&E is monitored using control charts. Annual performance indices reflecting annual Availability performance are then plotted on these control charts. The indices below are calculated using basic statistical methodology as outlined in section 4 of the TCA, Appendix C.

- Index 1: Annual Average Forced Outage (IMS) Frequency for All Transmission Line Circuits.
- Index 2: Annual Average Accumulated Forced Outage (IMS) Duration for those Transmission Line Circuits with Forced Outages (IMS).
- Index 3: Annual Proportion of Transmission Line Circuits with No Forced Outages (IMS).

Section 2.3.6 of CAISO Transmission Maintenance Procedure 2, dated 4/13/18, provides guidance on the outage data that should be included in calculating the control chart limits. In addition, the TMCC approved a change in 2014 to the valid Summary outage data used to initially establish the control chart limits. As a result, the 2022 control charts were generated using forced outage data from 2003 to 2012

(10 years) regardless if any points triggered a test. This established the initial control chart limits. In addition, valid summary outage data from 2013 to present were included in the outage data for calculating the control chart limits provided the point didn't trigger a test. The control charts show 20 years of data, 2003 to 2022.

The statistical chart limits, which are upper and lower control limits (UCL and LCL, respectively) and upper and lower warning limits (UWL and LWL, respectively), are calculated either using so-called "bootstrap" resampling procedures (Indices 1 and 2) or using exact determinations of limits for the proportion chart (Index 3). The Center Control Line (CL) represents the average annual historical performance for a period prior to the current calendar year. The UCL and LCL define a range of expected performance extending above and below the CL. Collectively, the CL, UCL, LCL, UWL and LWL provide reference values for use in evaluating performance.

The four tests have been selected to enable identification of exceptional performance in an individual calendar year, shifts in longer-term performance, and trends in longer-term performance.

Test 1 Control Limit Test: The index value for the current calendar year falls outside the UCL (Upper Control Limit) or LCL (Lower Control Limit).

Test 2 Center Line Test: At least v1 consecutive annual index values fall above the CL (Center Line) or v2 consecutive annual index values fall below the CL. The actual values of v1 and v2 will be outputted from the bootstrap resampling procedures. The choices for v1 and v2 are designed to keep the probability of these events less than one percent. (Refer to Table 1 of Appendix C of the TCA for values of v1 and v2).

Test 3 Warning Limit Test: At least two out of three consecutive annual index values fall outside the UWL or LWL on the same side of the CL.

Test 4 Trend Test: Six or more values are consecutively increasing or consecutively decreasing.

Therefore, Test 1 is designed to detect a short-term change or jump in the average level. Tests 2 and 4 are looking for long-term changes. Test 2 will detect a shift up in averages or a shift to a lower level. Test 4 is designed to detect either a trend of continuous increase in the average values or continuous decrease. Test 3 is designed to assess changes in performance during an intermediate period of three calendar

years. If Test 3 is satisfied, the evidence is of a decline (or increase) in Availability over a three-calendar year period.

The four tests will assist the CAISO and SDG&E in assessing the Availability performance of the transmission system for each voltage class.

III. SDG&E TRANSMISSION SYSTEM PERFORMANCE

The 2022 average forced outage frequency, average accumulated forced outage duration for lines experiencing forced outages, and the annual proportion of transmission lines that experienced outages are calculated as shown in Table 1 below. The values are calculated using forced outage data of SDG&E's transmission lines that are under the control of CAISO.

Table 1: 2022 Performance Indices

						FREQUENCY METRIC	**DURATION METRIC**	**PROPORTION METRIC**
VOLT CLASS (kV)	No. of Ckts	No. of outages	No. of outaged lines	No. of non-outaged lines	Total duration (min)	Frequency per Ckt	Duration per Ckt	Ratio of Non-outaged lines to Total lines
						Total no. of Outages /Total no. of Ckts	Total Duration / No. of Ckts Outaged	No. non-outaged ckts / Total no. of Ckts
69	143	60	43	100	24130	0.41958042	561.16279070	0.699300699
115	32	9	8	24	5167	0.28125	645.87500000	0.75
230	38	9	6	32	421	0.236842105	70.16666667	0.842105263
500	5	2	1	4	1575	0.4	1575.000	0.8

* Note: *Duration/circuit are based only on those circuits experiencing forced outages each year.*

To determine the availability performance of SDG&E's transmission system, the four tests (i.e. the Control Limit Test, the Center Line Test, the Warning Limit Test, and the Trend Test) were performed to each control chart type in all voltage classes.

If none of these tests indicate a change has occurred, test is not triggered (NT), performance shall be considered stable and consistent with past performance. If one or more of these tests indicates a change, test is triggered (T), Availability performance shall be considered as improved (green **T**) or degraded (red **T**).

Table 4.2.1 of CAISO Transmission Control Agreement (TCA), Appendix C provides performance status indications (improvement or degradation) for the result of the control chart tests.

The following table was used in determining if any of the triggered four tests previously mention was triggered as an improvement or degradation.

Table 4.2.1 Performance Indications Provided by Control Chart Tests

Control Chart Type	Test		Performance Status Indicated by Test Results	
	Number	Results	Improvement	Degradation
Annual Average Forced Outage[IMS] Frequency	1	value is above the UCL		X
		value is below the LCL when LCL>0	X	
	2	v1 or more consecutive values above the CL		X
		v2 or more consecutive values below the CL	X	
	3	2 out of 3 values above the UWL		X
		2 out of 3 values below the LWL	X	
	4	6 consecutive values increasing		X
		6 consecutive values decreasing	X	
Annual Average Accumulated Forced Outage[IMS] Duration	1	value is above the UCL		X
		value is below the LCL when LCL>0	X	
	2	v1 or more consecutive values above the CL		X
		v2 or more consecutive values below the CL	X	
	3	2 out of 3 values above the UWL		X
		2 out of 3 values below the LWL	X	
	4	6 consecutive values increasing		X
		6 consecutive values decreasing	X	
Annual Proportion of Transmission Line Circuits with No Forced Outages[IMS]	1	value is above the UCL	X	
		value is below the LCL when LCL>0		X
	2	v1 or more consecutive values above the CL	X	
		v2 or more consecutive values below the CL		X
	3	2 out of 3 values above the UWL	X	
		2 out of 3 values below the LWL		X
	4	6 consecutively increasing values	X	
		6 consecutively decreasing values		X

Results of applying the four tests are summarized in the Table 2 below.

Table 2: 2022 Performance Tests Results

Voltage Class	Monitored Index	Test 1	Test 2	Test 3	Test 4
		Control Limit	Center Line	Warning Limit	Trend
		Not Triggered /Triggered (NT/T)	Not Triggered /Triggered (NT/T)	Not Triggered /Triggered (NT/T)	Not Triggered /Triggered (NT/T)
69 kV	Forced Outage Frequency	T	T	T	NT
	Duration	T	NT	T	NT
	Proportion	T	NT	T	NT
115 kV	Forced Outage Frequency	T	T	T	NT
	Duration	NT	T	NT	NT
	Proportion	NT	NT	T	NT
230 kV	Forced Outage Frequency	T	NT	T	NT
	Duration,	T	T	T	NT
	Proportion	T	NT	NT	NT
500 kV	Forced Outage Frequency	NT	NT	NT	NT
	Duration,	NT	NT	NT	NT
	Proportion	NT	NT	NT	NT

In 2022, 18 out of the 48 control chart tests were triggered. From Table 4.2.1 of the Transmission Control Agreement, Appendix C, all 18 tests were triggered in improvement; therefore, are marked in green (T) in the summary table above.

The Control Limit Test (Test 1) was triggered for 7 tests. The mean outage frequency test was triggered at 69 kV, 115kV, and 230 kV the mean outage duration test was triggered at 69kV and 230 kV voltage levels, and the annual proportion of circuits with no forced outages tests was triggered at 69 kV and 230 kV.

The Center Line Test (Test 2) was triggered for 4 tests. The mean outage frequency test was triggered at 69 kV and 115 kV voltage levels, the mean outage duration test was triggered at 115 kV and 230kV voltage levels, and the annual proportion of circuits with no forced outages tests was not triggered.

The Warning Limit Test (Test 3) was triggered for 7 tests. The mean outage frequency test was triggered at 69 kV, 115 kV, and 230 kV voltage levels. The duration test was triggered at 69kV and 230 kV voltage levels, and the annual proportion of circuits with no forced outages tests was triggered at 69 kV and 115 kV voltage levels.

Overall, the control chart results indicate an improved Availability performance of SDG&E's transmission system.

IV. DISCUSSION OF RESULTS

- At the 69 kV Level, the Control Limit, the Center Line, and the Warning Limit tests triggered in improvement for mean outage frequency. The Control Limit and Warning limit tests triggered in improvement for Duration. The Control Limit, and Warning Limit tests triggered on improvements for annual proportion of circuits with no forced outages.
- At the 115 kV Level, the Control Limit, the Center Line, and the Warning Limit tests triggered in improvement for mean outage frequency. The Center Line test triggered in improving for duration. The warning limit triggered in improvement for proportion of circuits with no forced outages.
- At the 230 kV Level, the Control Limit and Warning Limit tests triggered in improvement for mean outage frequency; the Control Limit, Center Line, and Warning Limit tests triggered in improvement for the mean outage duration and the control limit triggered on improvement for proportion of circuits with no forced outages.
- At the 500 kV level, no test was triggered.

The Table 3 below summarizes the limits and results of the control chart tests.

Table 3: Limit Test

Voltage Level		Control Limit		Center Limit	Warning Limit		2022 Metric	Not Triggered/ Triggered	Comments
		Upper	Lower		Upper	Lower			
69 kV	Frequency	2.554	1.117	1.739	2.282	1.280	0.41958042	Triggered	Tests 1, 2 and 3 triggered in improvement
	Duration	2550.45	766.65	1464.15	2177.34	927.86	561.1627	Triggered	Tests 1 and 3 triggered in improvement
	Proportion	0.595	0.348	0.471	0.558	0.385	0.6993	Triggered	Tests 1 and 3 triggered in improvement
115 kV	Frequency	2.773	0.460	1.383	2.320	0.673	0.28125	Triggered	Tests 1, 2 and 3 triggered in improvement
	Duration	5155.81	298.76	1649.81	4088.74	504.97	645.875	Triggered	Test 2 triggered in improvement
	Proportion	0.792	0.295	0.563	0.721	0.369	0.75	Triggered	Test 3 triggered in improvement
230 kV	Frequency	2.648	0.588	1.452	2.248	0.800	0.236842	Triggered	Tests 1 and 3 triggered in improvement
	Duration	2761.39	326.08	1200.99	2220.29	489.36	70.16666	Triggered	Tests 1, 2 and 3 triggered in improvement
	Proportion	0.717	0.193	0.473	0.640	0.269	0.842105	Triggered	Test 1 triggered in improvement
500 kV	Frequency	4.933	0	1.377	3.667	0	0.4	Not Triggered	No test was triggered
	Duration	6852.80	10.60	1623.09	5368.25	31.25	1575	Not Triggered	No test was triggered
	Proportion	0.993	0	0.411	0.926	0	0.8	Not Triggered	No test was triggered

69 kV Voltage Class:

In 2022, out of the 143 transmission lines that are under the control of CAISO, 43 lines experienced 60 outages.

- The 2022 calculated mean forced outage frequency was 0.41958. This value is below the LWL of 1.167 and the LCL of 1.010.
  - The Control Limit Test, Test 1, triggered in improvement since mean forced outage frequency value fell below the LCL.
  - The Center Line test, Test 2, triggered in improvement since more than eight consecutive annual index values fell below the CL.
  - The Warning Limit test, Test 3, triggered in improvement since two out of three consecutive index values fell outside the LWL on the same side of the CL.
- The 2022 mean forced outage duration was 561.162min. Mean forced outage duration was below the Center Line limit of 1374.92.15 min and the Lower Control Limit of 706.44 min.
  - The Control Limit Test, Test 1, triggered in improvement since mean forced outage frequency value fell below the LCL.
  - The Warning Limit test, Test 3, triggered in improvement since two out of three consecutive index values fell outside the LWL on the same side of the CL.
- 100 transmission lines out of a total of 143 lines did not experience outages. The proportion Index of the lines with no forced outages in 2022 was 0.6993. The Proportion Index value is above the CL of 0.487.
  - The Control Limit test, Test 1, triggered in improvement since the proportional index value was above UCL.
  - The Warning Limit test, Test 3, triggered in improvement since two out of three consecutive index values fell outside the UWL on the same side of the CL.

115 kV Voltage Class:

In 2022, of the 32 lines in the 138 kV voltage levels for SDG&E, 8 lines experienced a total of 9 outages.

- The mean forced outage frequency in 2022 was 0.28125. This value is below the LCL of 0.413 and below the CL of 1.281.
  - The Control Limit Test, Test 1, triggered in improvement since mean forced outage frequency value fell below the LCL.

  - The Center Line test, Test 2, triggered in improvement since more than eight consecutive annual index values fell below the CL.
  - The Warning Limit test, Test 3, triggered in improvement since two out of three consecutive index values fell outside the LWL on the same side of the CL.
- The 2022 mean outage duration was 645.875 min. This value is below the CL of 1606.40 min and is above the LCL of 282.57 min.
  - The Center Line, Test 2, triggered in improvement since 10 consecutive values fell below the CL.
- The Proportion index of lines in 2022 with no forced outages was 0.75 which is above the CL value of 0.574 and below the Upper Control Limit (UCL) of 0.8.
  - The Warning Limit, Test 3, triggered in improvement since 2 out of three values were above UWL.

230 kV Voltage Class:

In 2022**,** out of the 38 lines, 6 lines experienced a total of 9 outages.

- The mean forced outage frequency index in 2022 was 0.236842. The value is below the CL of 1.310 and is below the LCL of 0.492.
  - The Control Limit Test, Test 1, triggered an improvement since the value was below the LCL.
  - The Warning Limit test, Test 3, triggered in improvement since two out of three consecutive index values fell below the LWL.
- The mean forced outage duration index was 70.16 min which is significantly below the CL limit of 1171.0 min and the LCL of 287.89 min.
  - The Control Limit Test, Test 1, triggered in improvement since mean forced outage duration value fell below the LCL.
  - The Center Line Test, Test 2, triggered in improvement as eight consecutive annual index values fell below the CL
  - The Warning Limit test, Test 3, triggered in improvement since two out of three consecutive index values fell below the LWL.
- The proportion index of lines with no forced outages was 0.8421. It is above the CL value of 0.505 and is above the UWL of 0.673.
  - The Control Limit Test, Test 1, triggered in improvement since the value is above the UCL

500 kV Voltage Class:

In 2022, of the 5- 500 kV lines, one line experienced 2 total outages.

- The mean forced outage frequency index was 0.4. Which is below the CL value of 1.225 and above the LCL of 0.
- The mean forced outage duration index was 1575 min. The value is lower than the CL of 1600.97 but higher than the LWL of 33.0.
- The proportion index of lines in 2022 with no forced outages was 0.8, which is above than the CL of 0.470 and but is lower than the UWL of 0.872.

SDG&E continues to take proactive measures to improve the performance of its transmission system by having a robust maintenance practices and decreasing outage restoration times. The result of the 2022 availability performance shows that the approach is working.

V. Appendix 1: Summary Outage Data

69kV Annual Outages Summary

Company	Line ID	Frequency	Duration	Mileage
SDG&E	TL 600	0	0	7.8
SDG&E	TL 601	0	0	1.68
SDG&E	TL 602	0	0	2.96
SDG&E	TL 603	0	0	2.81
SDG&E	TL 604	4	1623	2.9
SDG&E	TL 605	0	0	1.35
SDG&E	TL 606	0	0	0.95
SDG&E	TL 607	0	0	2.68
SDG&E	TL 608	0	0	2.16
SDG&E	TL 609	0	0	1.3
SDG&E	TL 610	0	0	6.13
SDG&E	TL 611	0	0	3.8
SDG&E	TL 612	0	0	3.49
SDG&E	TL 613	1	1854	5.24
SDG&E	TL 614	0	0	7.95
SDG&E	TL 615	1	458	3.35
SDG&E	TL 616	0	0	11.13
SDG&E	TL 617	2	285	6.62
SDG&E	TL 618	1	14	6.86
SDG&E	TL 619	1	264	6.87
SDG&E	TL 620	0	0	1.7
SDG&E	TL 621	1	245	6.18
SDG&E	TL 622	0	0	3.14
SDG&E	TL 623	1	6	7.6
SDG&E	TL 624	3	625	4.85
SDG&E	TL 625	0	0	15.56
SDG&E	TL 627	0	0	7.97
SDG&E	TL 628	1	161	10.9
SDG&E	TL 629	2	195	25.1
SDG&E	TL 630	2	87	4.72
SDG&E	TL 631	0	0	8.69

SDG&E	TL 632	1	85	18.5
SDG&E	TL 633	0	0	3.04
SDG&E	TL 634	0	0	14.8
SDG&E	TL 635	0	0	12.07
SDG&E	TL 636	0	0	14.88
SDG&E	TL 637	0	0	13.43
SDG&E	TL 638	0	0	3.43
SDG&E	TL 639	0	0	7.96
SDG&E	TL 640	1	674	3.15
SDG&E	TL 641	0	0	1.82
SDG&E	TL 642	0	0	4.32
SDG&E	TL 643	1	62	8.73
SDG&E	TL 644	0	0	4.62
SDG&E	TL 645	1	7	3.36
SDG&E	TL 646	0	0	2.81
SDG&E	TL 647	1	71	2.13
SDG&E	TL 648	0	0	3.7
SDG&E	TL 649	2	2528	13.3
SDG&E	TL 650	0	0	1.4
SDG&E	TL 651	1	5	4.03
SDG&E	TL 652	1	336	7.05
SDG&E	TL 653	0	0	2.81
SDG&E	TL 654	1	188	2.21
SDG&E	TL 655	0	0	3.57
SDG&E	TL 656	0	0	0.2
SDG&E	TL 657	1	62	0.13
SDG&E	TL 658	0	0	1.9
SDG&E	TL 659	0	0	3.04
SDG&E	TL 660	1	227	6.76
SDG&E	TL 661	0	0	2.9
SDG&E	TL 662	0	0	2.63
SDG&E	TL 663	0	0	5.78
SDG&E	TL 664	0	0	12
SDG&E	TL 665	0	0	2.4
SDG&E	TL 666	0	0	2.7
SDG&E	TL 667	0	0	6.67
SDG&E	TL 668	1	3152	3.7
SDG&E	TL 669	0	0	2.43
SDG&E	TL 670	0	0	7.61
SDG&E	TL 671	0	0	7.04
SDG&E	TL 672	0	0	2.7
SDG&E	TL 673	2	6664	3.14
SDG&E	TL 674	1	178	10.7

SDG&E	TL 675	0	0	5.98
SDG&E	TL 676	0	0	4.27
SDG&E	TL 677	0	0	3.49
SDG&E	TL 678	0	0	8.2
SDG&E	TL 679	1	88	5.07
SDG&E	TL 680	2	817	14.5
SDG&E	TL 681	3	475	16.13
SDG&E	TL 682	0	0	20.22
SDG&E	TL 683	0	0	10.34
SDG&E	TL 684	0	0	6.02
SDG&E	TL 685	0	0	11.2
SDG&E	TL 686	0	0	25.1
SDG&E	TL 687	1	169	11.7
SDG&E	TL 688	0	0	10.72
SDG&E	TL 689	0	0	11
SDG&E	TL 690	2	931	15.6
SDG&E	TL 691	1	467	11.8
SDG&E	TL 692	0	0	6.8
SDG&E	TL 693	1	1	5.3
SDG&E	TL 694	3	221	14.46
SDG&E	TL 695	0	0	5.69
SDG&E	TL 696	0	0	3.5
SDG&E	TL 697	0	0	6.42
SDG&E	TL 698	1	96	12.69
SDG&E	TL 699	0	0	2.68
SDG&E	TL 6902	1	30	0.69
SDG&E	TL 6904	0	0	2.38
SDG&E	TL 6905	0	0	3.83
SDG&E	TL 6906	0	0	6.07
SDG&E	TL 6907	0	0	0.74
SDG&E	TL 6908	0	0	2.03
SDG&E	TL 6910	0	0	6.11
SDG&E	TL 6911	1	66	3.3
SDG&E	TL 6912	0	0	7.7
SDG&E	TL 6913	0	0	2.54
SDG&E	TL 6914	0	0	11.62
SDG&E	TL 6915	0	0	1.93
SDG&E	TL 6916	1	26	6.66
SDG&E	TL 6917	0	0	15.59
SDG&E	TL 6920	0	0	10.9
SDG&E	TL 6923	0	0	13.46
SDG&E	TL 6924	0	0	1.9
SDG&E	TL 6925	0	0	1.6

SDG&E	TL 6926	2	233	8.15
SDG&E	TL 6927	0	0	4.92
SDG&E	TL 6930	0	0	5.41
SDG&E	TL 6931	0	0	6.04
SDG&E	TL 6932	1	134	9.21
SDG&E	TL 6939	0	0	2.44
SDG&E	TL 6943	0	0	1.98
SDG&E	TL 6945	0	0	3.75
SDG&E	TL 6949	1	27	4.6
SDG&E	TL 6950	0	0	0.95
SDG&E	TL 6952	0	0	2.97
SDG&E	TL 6954	0	0	0.7
SDG&E	TL 6956	0	0	3.18
SDG&E	TL 6957	0	0	13.53
SDG&E	TL 6958	0	0	12.44
SDG&E	TL 6959	0	0	2.01
SDG&E	TL 6964	1	165	4.59
SDG&E	TL 6966	0	0	5.42
SDG&E	TL 6970	0	0	4.41
SDG&E	TL 6971	1	128	2.54
SDG&E	TL 6973	0	0	3.01
SDG&E	TL 6974	0	0	2.48
SDG&E	TL 6975	0	0	11.83
SDG&E	TL 6976	0	0	0.54
SDG&E	TL 6978	0	0	3.57
SDG&E	TL 6979	0	0	2.82
Total	143 Lines	60 Outages	24130 Min	897.41 Miles

138kV Annual Outages Summary

Company	Line ID	Frequency	Duration	Milage
SDG&E	TL 13801	0	0	0.2
SDG&E	TL 13804	1	1	23
SDG&E	TL 13805	0	0	2.75
SDG&E	TL 13806	0	0	3.08
SDG&E	TL 13809	1	99	2.61
SDG&E	TL 13810	0	0	14.5
SDG&E	TL 13811	1	116	16.18
SDG&E	TL 13815	2	29	14.93
SDG&E	TL 13816	1	4320	6.73
SDG&E	TL 13819	0	0	6.67
SDG&E	TL 13820	0	0	5.77

SDG&E	TL 13821	0	0	8.19
SDG&E	TL 13822	0	0	9.9
SDG&E	TL 13824	0	0	24.04
SDG&E	TL 13825	1	1	6.34
SDG&E	TL 13826	0	0	1.34
SDG&E	TL 13827	0	0	1.39
SDG&E	TL 13828	0	0	6.89
SDG&E	TL 13830	0	0	5.32
SDG&E	TL 13831	0	0	6.67
SDG&E	TL 13833	0	0	3.77
SDG&E	TL 13834	0	0	3.82
SDG&E	TL 13835	0	0	14.29
SDG&E	TL 13836	0	0	1.11
SDG&E	TL 13837	0	0	3.2
SDG&E	TL 13838	0	0	3.23
SDG&E	TL 13840	0	0	6.2
SDG&E	TL 13843	1	2	7.98
SDG&E	TL 13844	1	599	13.8
SDG&E	TL 13846	0	0	4.63
SDG&E	TL 13848	0	0	6.88
SDG&E	TL 13849	0	0	0.16
Total	32 Lines	9 Outages	5167 Mins	236 Miles

230kV Annual Outages Summary

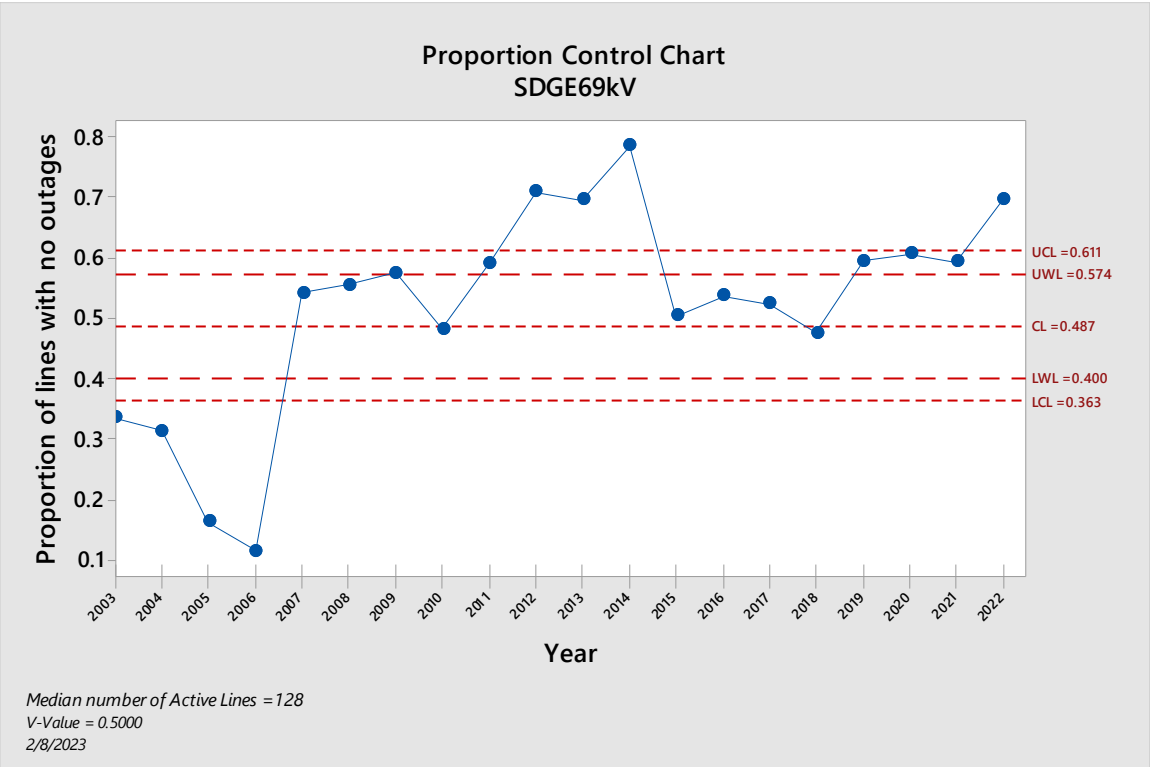
Company	Line ID	Frequency	Duration	Mileage
SDG&E	TL 23001	1	1	35.26
SDG&E	TL 23002	1	6	17.59
SDG&E	TL 23003	0	0	7.22
SDG&E	TL 23004	0	0	35.25
SDG&E	TL 23006	0	0	18.16
SDG&E	TL 23007	0	0	6.91
SDG&E	TL 23010	0	0	17.6
SDG&E	TL 23011	0	0	21.82
SDG&E	TL 23012	0	0	18
SDG&E	TL 23013	0	0	10.77
SDG&E	TL 23014	0	0	0.37
SDG&E	TL 23015	0	0	0.37
SDG&E	TL 23020	0	0	9.65
SDG&E	TL 23021	1	4	28.9
SDG&E	TL 23022	3	214	34.05
SDG&E	TL 23023	2	184	35.79

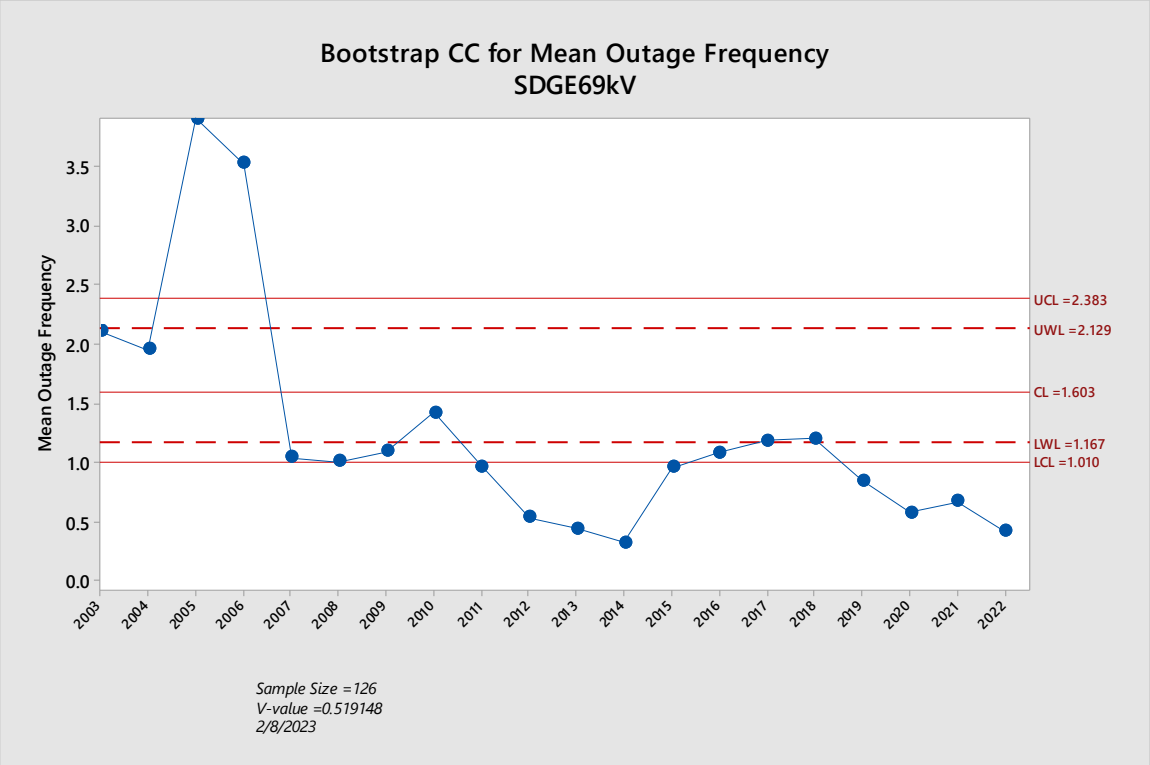
SDG&E	TL 23026	0	0	7.23
SDG&E	TL 23027	0	0	3.85
SDG&E	TL 23028	0	0	11.29
SDG&E	TL 23029	0	0	7.14
SDG&E	TL 23030	0	0	50.6
SDG&E	TL 23040	1	12	4.59
SDG&E	TL 23041	0	0	37.8
SDG&E	TL 23042	0	0	18.94
SDG&E	TL 23050	0	0	9.5
SDG&E	TL 23051	0	0	10.59
SDG&E	TL 23052	0	0	6.91
SDG&E	TL 23053	0	0	18
SDG&E	TL 23054	0	0	28.31
SDG&E	TL 23055	0	0	28.31
SDG&E	TL 23056	0	0	1.02
SDG&E	TL 23061	0	0	5.6
SDG&E	TL 23066	0	0	5.72
SDG&E	TL 23071	0	0	14.58
SDG&E	TL 23072	0	0	13.86
SDG&E	TL 23080	0	0	0.18
SDG&E	TL 23081	0	0	0.18
SDG&E	TL 23082	0	0	0
Total	38 Lines	9 Outages	421 Mins	581.91 Miles

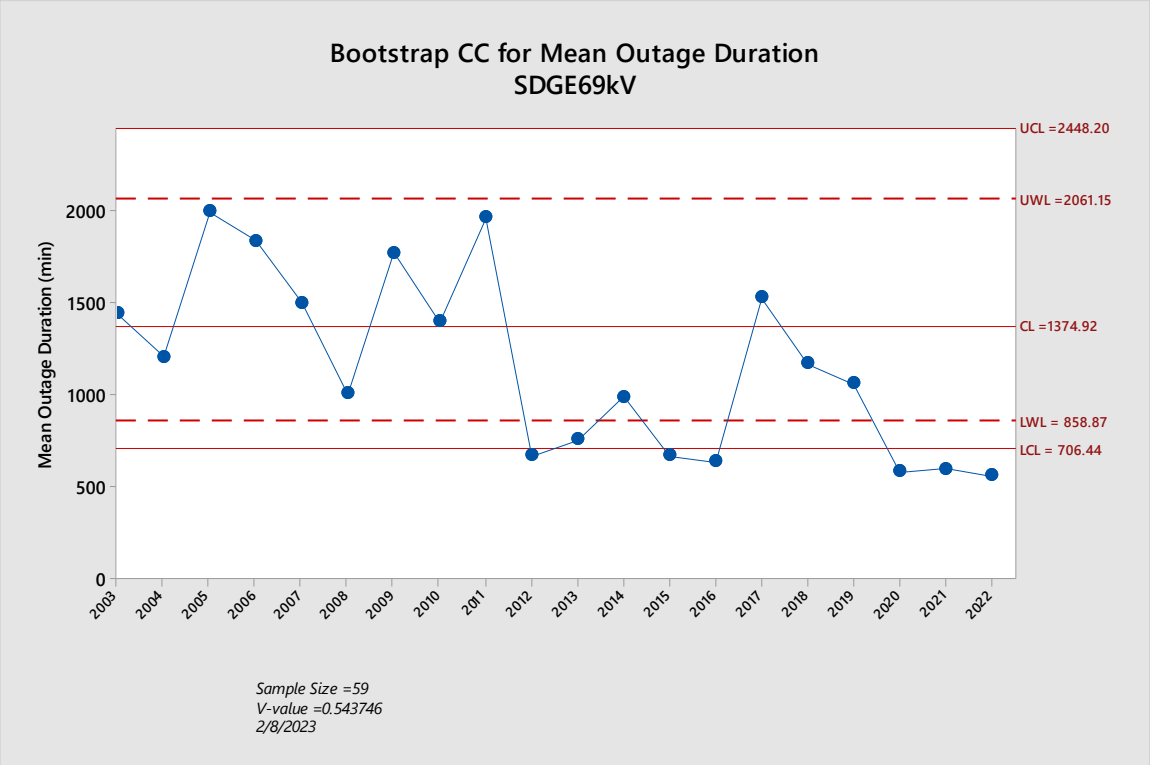
500kV Annual Outages Summary

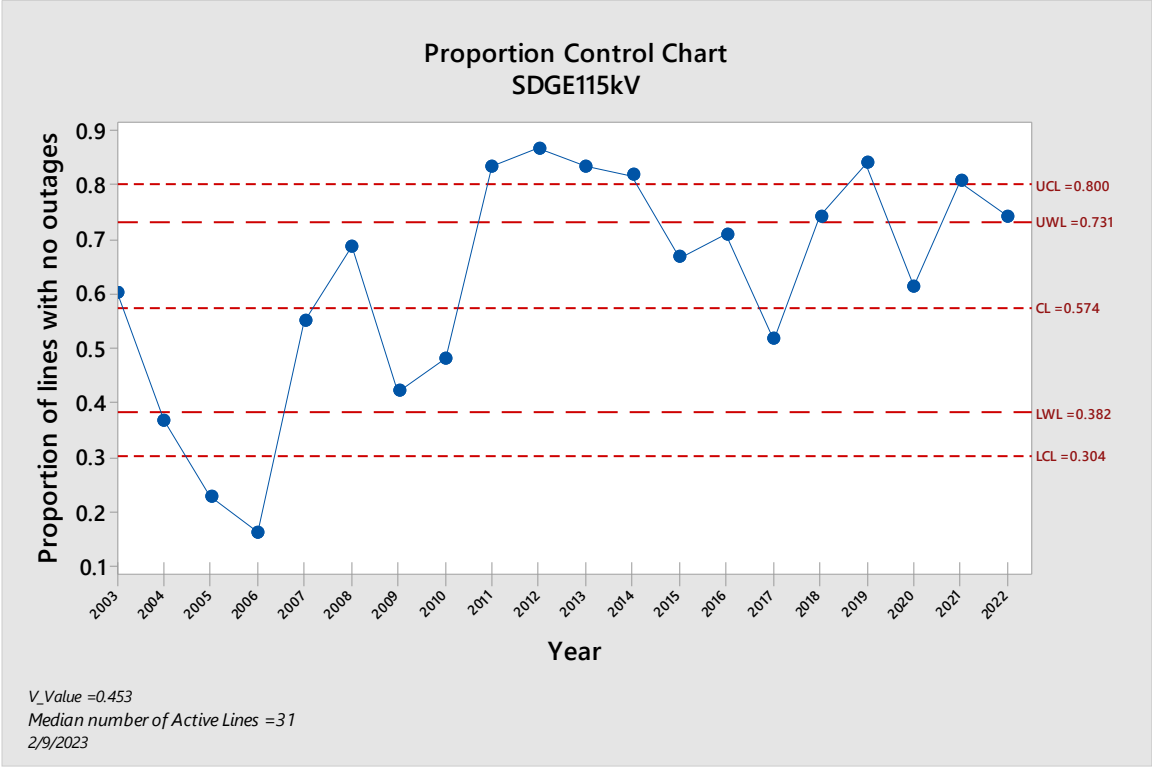
Company	Line ID	Frequency	Duration	Milage
SDG&E	TL 50001	2	1575	52.96
SDG&E	TL 50002	0	0	80.6
SDG&E	TL 50003	0	0	67.46
SDG&E	TL 50004	0	0	30.94
SDG&E	TL 50005	0	0	21.6
Total	5 Lines	2 Outages	1575 Mins	253.56 Miles

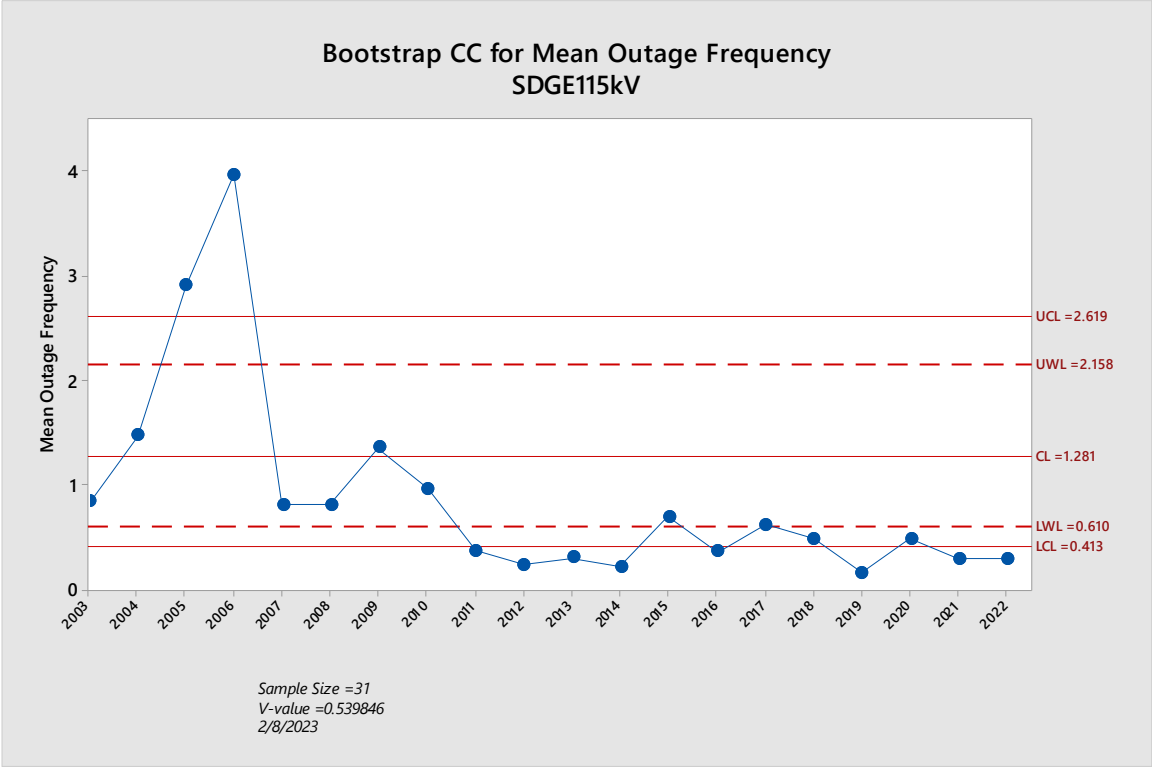
VI. Appendix 2: CONTROL CHARTS

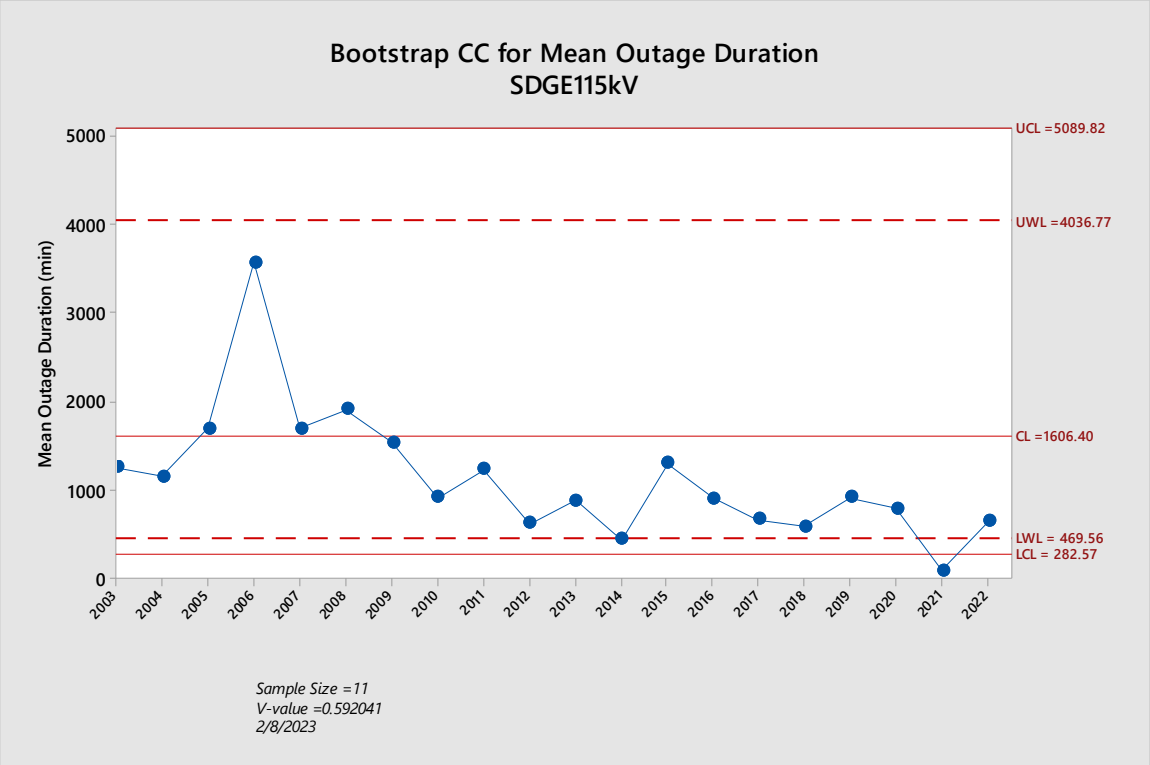


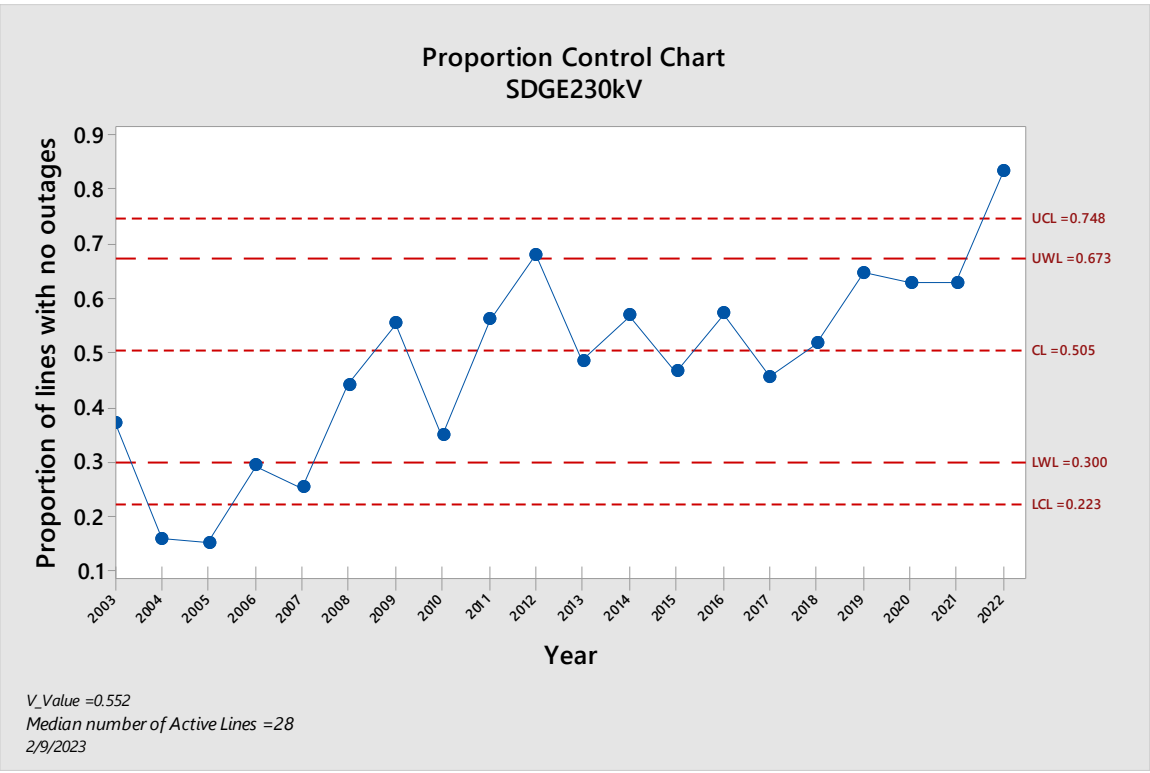

Bootstrap CC for Mean Outage Frequency
SDGE69kV
Mean Outage Frequency
UCL =2.383
UWL =2.129
CL =1.603
LWL =1.167
LCL =1.010
Sample Size =126
V-value =0.519148
2/8/2023

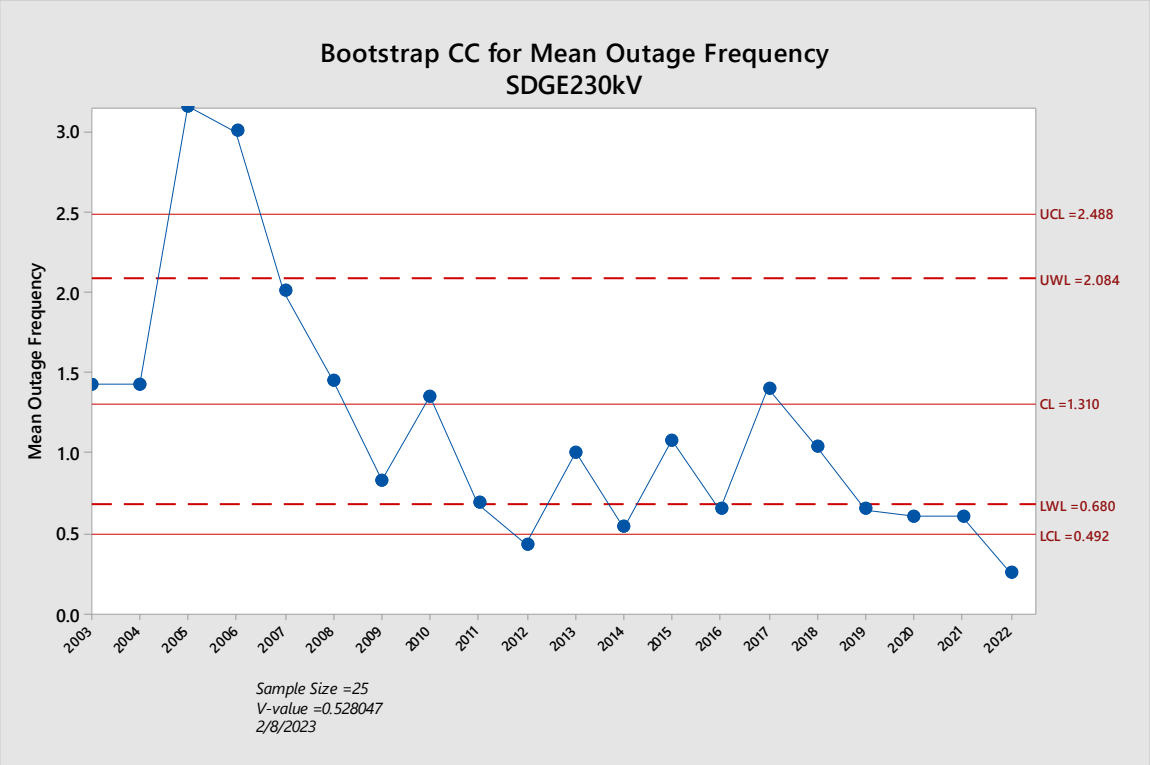

Bootstrap CC for Mean Outage Duration
SDGE69kV
Mean Outage Duration (min)
UCL =2448.20
UWL =2061.15
CL =1374.92
LWL = 858.87
LCL = 706.44
Sample Size =59
V-value =0.543746
2/8/2023

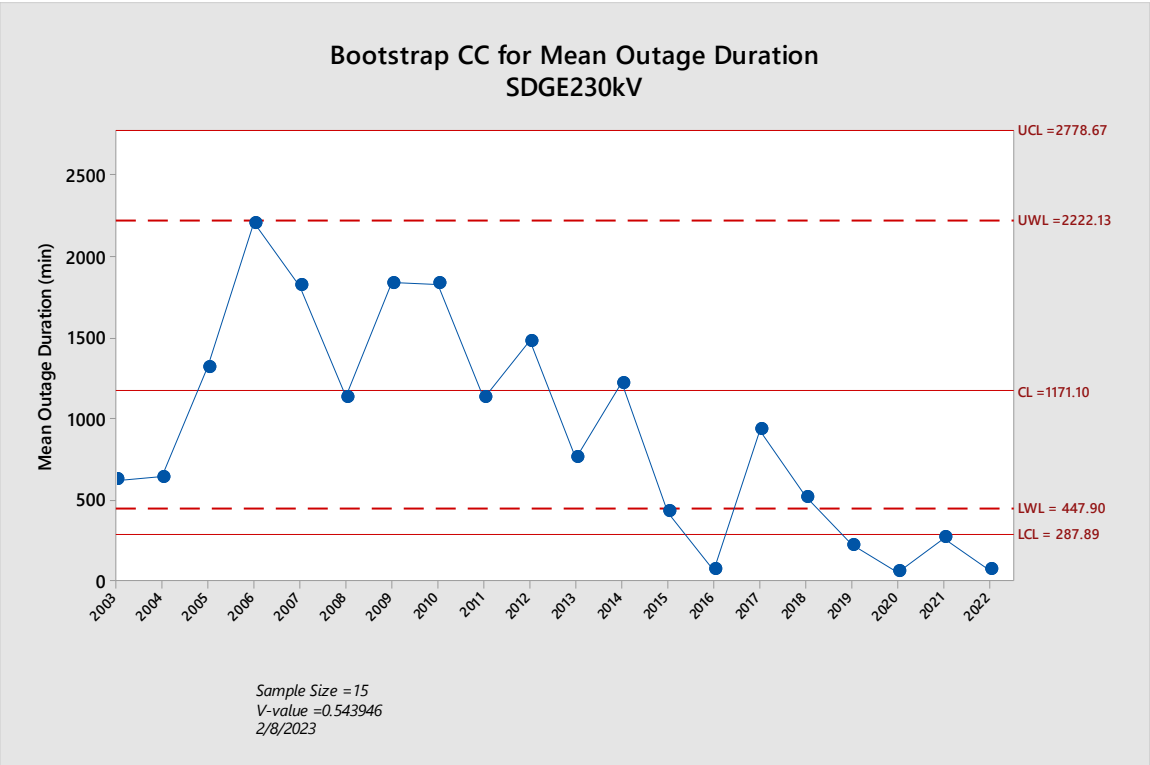

Proportion Control Chart
SDGE115kV
Proportion of lines with no outages
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
UCL =0.800
UWL =0.731
CL =0.574
LWL =0.382
LCL =0.304
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
V_Value =0.453
Median number of Active Lines =31
2/9/2023

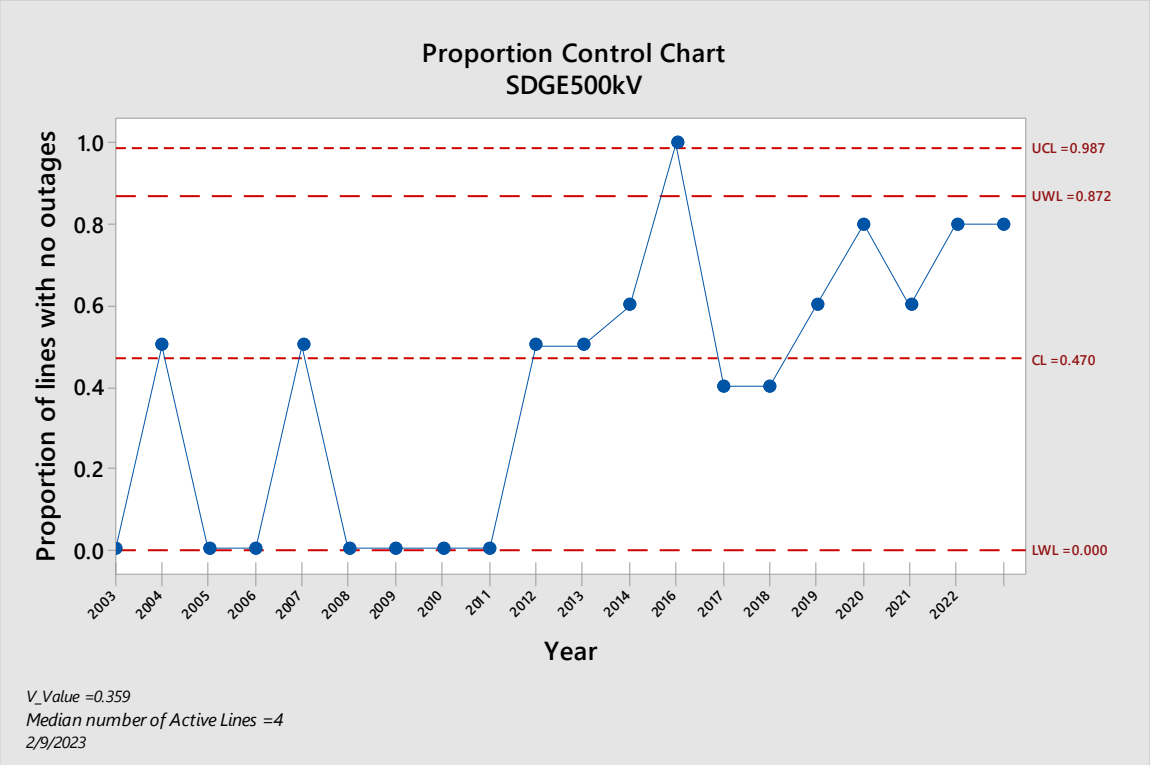

Bootstrap CC for Mean Outage Frequency
SDGE115kV
Mean Outage Frequency
4
3
2
1
0
UCL =2.619
UWL =2.158
CL =1.281
LWL =0.610
LCL =0.413
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Sample Size =31
V-value =0.539846
2/8/2023

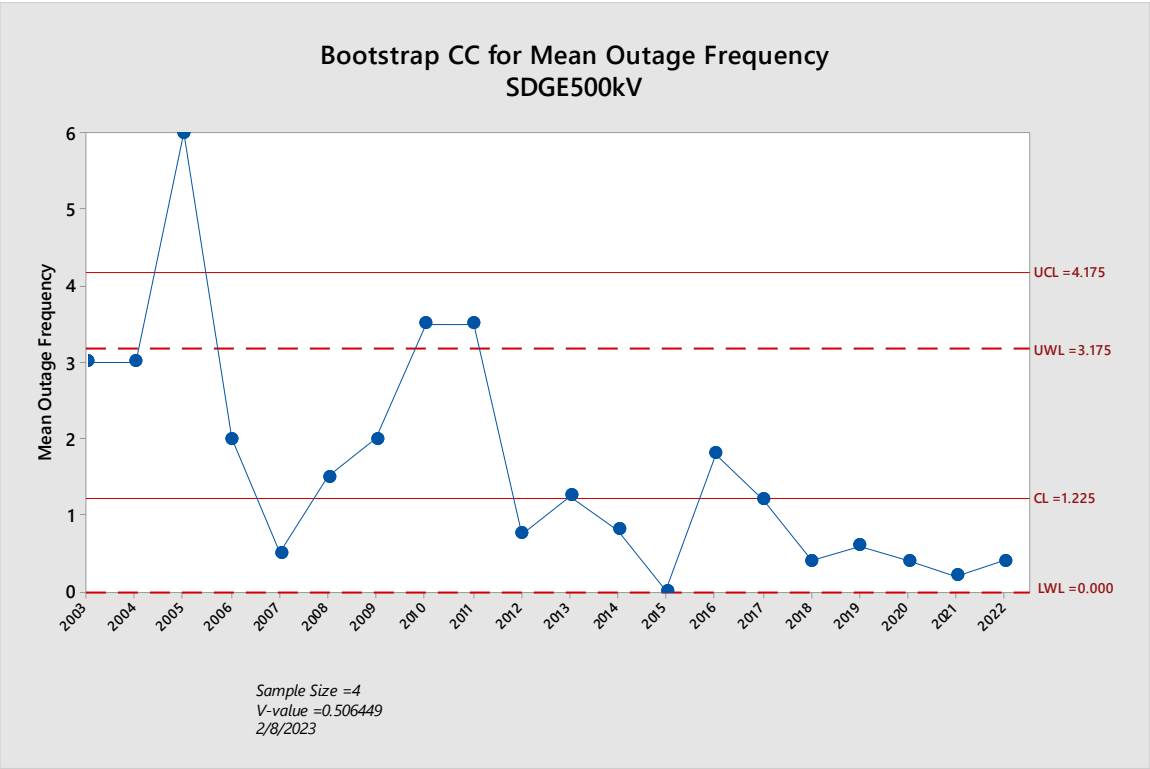

Bootstrap CC for Mean Outage Duration
SDGE115kV
Mean Outage Duration (min)
5000
4000
3000
2000
1000
0
UCL =5089.82
UWL =4036.77
CL =1606.40
LWL = 469.56
LCL = 282.57
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Sample Size =11
V-value =0.592041
2/8/2023

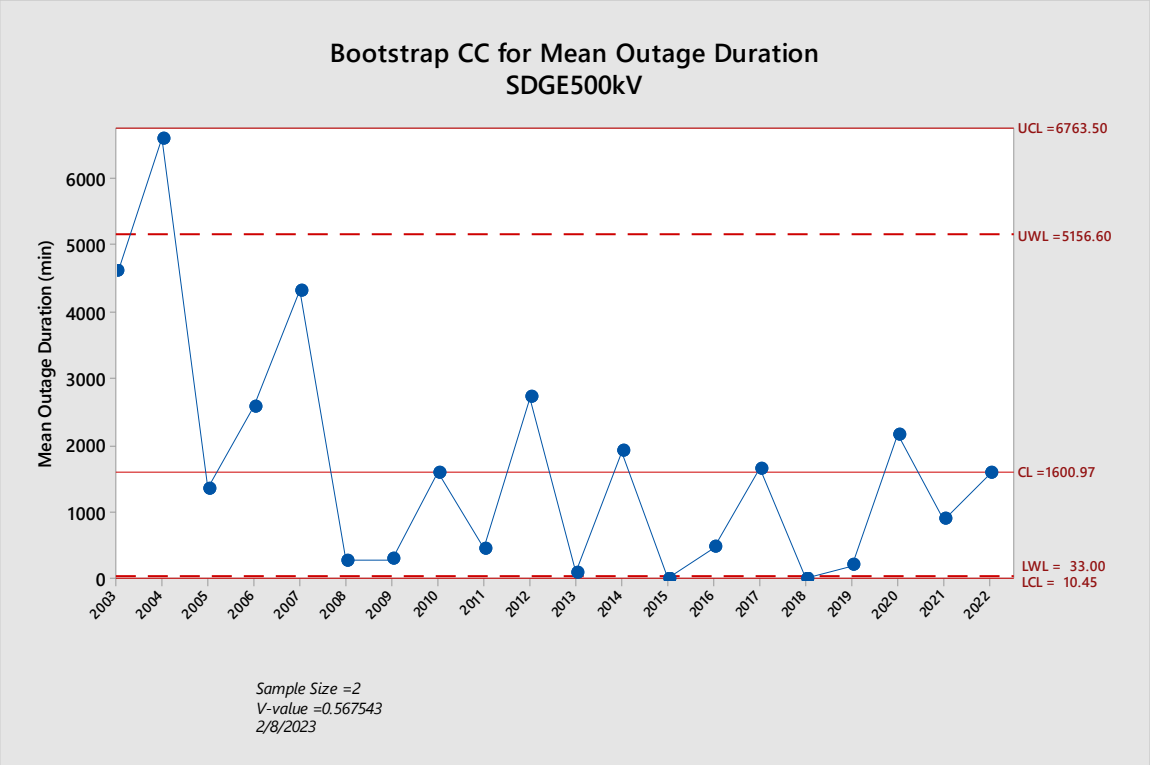

Proportion Control Chart
SDGE230kV
Proportion of lines with no outages
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
UCL =0.748
UWL =0.673
CL =0.505
LWL =0.300
LCL =0.223
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
V_Value =0.552
Median number of Active Lines =28
2/9/2023


Bootstrap CC for Mean Outage Frequency
SDGE230kV
Mean Outage Frequency
3.0
2.5
2.0
1.5
1.0
0.5
0.0
UCL =2.488
UWL =2.084
CL =1.310
LWL =0.680
LCL =0.492
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Sample Size =25
V-value =0.528047
2/8/2023


Bootstrap CC for Mean Outage Duration
SDGE230kV
Mean Outage Duration (min)
2500
2000
1500
1000
500
0
UCL =2778.67
UWL =2222.13
CL =1171.10
LWL = 447.90
LCL = 287.89
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Sample Size =15
V-value =0.543946
2/8/2023


Proportion Control Chart
SDGE500kV
Proportion of lines with no outages
1.0
0.8
0.6
0.4
0.2
0.0
UCL =0.987
UWL =0.872
CL =0.470
LWL =0.000
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2016
2017
2018
2019
2020
2021
2022
Year
V_Value =0.359
Median number of Active Lines =4
2/9/2023


Bootstrap CC for Mean Outage Frequency
SDGE500kV
Mean Outage Frequency
6
5
4
3
2
1
0
UCL =4.175
UWL =3.175
CL =1.225
LWL =0.000
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Sample Size =4
V-value =0.506449
2/8/2023


Bootstrap CC for Mean Outage Duration
SDGE500kV
Mean Outage Duration (min)
6000
5000
4000
3000
2000
1000
0
UCL =6763.50
UWL =5156.60
CL =1600.97
LWL = 33.00
LCL = 10.45
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Sample Size =2
V-value =0.567543
2/8/2023