



March 1, 2020

Steve Rutty
California ISO
250 Outcropping Way
Folsom, CA 95630

SUBJ: Trans Bay Cable Availability Report - 2019 (Public Access)

Dear Mr. Rutty,

In accordance with the Transmission Control Agreement (TCA) section 14.3, TCA Appendix C Section 4.0 and CAISO Tariff 4.8.3 Trans Bay Cable (TBC) submits the following Public Access Availability Report for CAISO review.

Performance:

TBC’s summary performance for 2019 is:

Period	SEU	FEU	Avail	Utilization
Q1	18.17%	0.02%	81.81%	56.13%
Q2	0.00%	0.00%	100.0%	50.25%
Q3	0.00%	0.00%	100.0%	56.69%
Q4	0.40%	0.00%	99.60%	54.66%
YEAR	4.94%	0.00%	95.05%	54.43%

The table above shows the performance data for each quarter during the year 2019, and for the whole year of 2019.

TBC completed all preventative maintenance for 2019, in accordance with CAISO approve Converter Station and Cable Maintenance Practices. Details are provided separately in the CAISO Standard Maintenance Reporting System TBC 2019 Review.

TBC only operates a single DC transmission line and has accrued nine years of operational data. TBCs ability to trend performance is limited to the data acquired since commercial operations. The Total Forced Outage duration in 2019 did not exceed our defined Upper Control Limit (UCL) for outage duration and was found to be within bounds and consistently less than the Center Control values as derived. In 2019, Total Forced Outage Duration was 44 minutes, compared to 0 minutes of the previous year. The following section provides details in TBC’s derivation of UCL, as well as other values used to create the Control Charts.



Control Charts:

TBC used CAISO's TCA, Appendix C, as a reference in creating TBC's control charts. Forced Outage data of the TBC Facility was used to create the charts. The following outage data were not included in the control charts:

- Scheduled Outages
- Outages classified as "Not a Forced Outage" in the Maintenance Procedures
- Forced Outages which:
 - Were caused by events outside TBC's Facility including outages which originate in other TO systems, other electric utility systems or customer equipment
 - Or outages which can be demonstrated to have been caused by earthquakes

The following variable and equations were extracted from the TCA and used to create TBC's control charts:

Annual Average Forced Outage Frequency for the TBC HVDC Facility

$$F_{vc,k} = \frac{1}{N_k} \sum_{i=1}^{N_k} f_{ik}$$

N_k = number of Transmission Line Circuits in Voltage Class in calendar year "k".
See Appendix C, Note 2, Section 4.1.1 of the TCA.

Because the TBC HVDC Facility is considered a single transmission line, N_k will equal one (1) for each calendar year "k".

f_{ik} = frequency of Forced Outages^(IMS) for the "ith" Transmission Line Circuit as calculated in accordance with Appendix C, Section 4.1.1 of the TCA for calendar year "k".

Because the TBC HVDC Facility is considered a single transmission line, "i" will equal one (1), and f_{ik} will simply be f_k . f_k will equal the number of Forced Outages that occurred on the TBC HVDC transmission line each for calendar year "k".

$F_{vc,k}$ = frequency index for the Voltage Class, vc , (units = Forced Outages^(IMS) / Transmission Line Circuit). The frequency index equals the average (mean) number of Forced Outages^(IMS) for all Transmission Line Circuits within a Voltage Class for the calendar year "k".

Because the TBC HVDC facility is considered its own voltage class and a single transmission line "vc" will equal one (1), and $F_{vc,k}$ will simply be F_k . F_k will subsequently equal the number of Forced Outages that occurred on the TBC HVDC transmission line for each calendar year "k".

$$F_k = f_k$$

Annual Average Accumulated Forced Outage Duration for the TBC HVDC Facility

$$D_{vc,k} = \frac{1}{N_{o,k}} \sum_{i=1}^{N_{o,k}} d_{ik}$$

$N_{o,k}$ = number of Transmission Line Circuits in the Voltage Class for which the Forced Outage^(IMS) frequency Availability Measure (f_{ik}) as calculated in accordance with Section 4.1.1 of this Appendix C is greater than zero for the calendar year "k". See Appendix C, Note 2, Section 4.1.1 of the TCA.

Because the TBC HVDC Facility is considered a single transmission line, $N_{o,k}$ will equal one (1) for each calendar year "k".

d_{ik} = accumulated duration of Forced Outages^(IMS) for the “ith” Transmission Line Circuit having a Forced Outage^(IMS) frequency Availability Measure (f_{ik}) greater than zero for calendar year “k” as calculated in accordance with Section 4.1.1 of this Appendix C.

Because the TBC HVDC Facility is considered a single transmission line, “i” will equal one (1), and d_{ik} will simply be d_k . d_k will equal the total accumulated duration of Forced Outages the TBC Facility experienced each calendar year “k”.

$D_{vc,k}$ = duration index for the Voltage Class (units = minutes/Transmission Line Circuit). The duration index equals the average accumulated duration of Forced Outages^(IMS) for all Transmission Line Circuits within a Voltage Class which experienced Forced Outages^(IMS) during the calendar year “k”.

Because the TBC HVDC facility is considered its own voltage class and a single transmission line “vc” will equal one (1), $D_{vc,k}$ will simply be D_k . D_k will subsequently equal the number of Forced Outages that occurred on the TBC HVDC Facility for each calendar year “k”.
 $D_k = d_k$

CL for Annual Average Forced Outage Frequency for the TBC HVDC Facility

$$CL_f = \frac{\sum_{k=1}^Y \sum_{i=1}^{N_k} f_{ik}}{\sum_{k=1}^Y N_k}$$

Y = number of calendar years prior to the date a TO becomes a PTO for which the PTO has reliable, continuously recorded Forced Outage^(IMS) data.

TBC became a PTO from the beginning of commercial operation in November of 2010. Due to this the first calendar year used for the CL calculation will begin from the date of January 1st, 2011.

CL_f = center control line value for the Forced Outage^(IMS) frequencies for each of the Transmission Line Circuits in the Voltage Class for “Y” calendar years prior to the date a TO becomes a PTO.

Because the TBC Facility is considered a single voltage class and a single transmission line, this calculation essentially becomes the average number of Forced Outages since January 1st, 2011.

CL for Annual Average Accumulated Forced Outage Duration for the TBC HVDC Facility

$$CL_d = \frac{\sum_{k=1}^Y \sum_{i=1}^{N_{o,k}} d_{ik}}{\sum_{k=1}^Y N_{o,k}}$$

CL_d = center control line value for accumulated Forced Outage^(IMS) duration for each of the Transmission Line Circuits in the Voltage Class for “Y” calendar years prior to the date a TO becomes a PTO in which the Forced Outage^(IMS) frequency (f_{ik}) was greater than zero.

Because of the assumptions made above, this calculation essentially becomes the average duration (in minutes) of Forced Outages since January 1st, 2011.

Upper Control Limit (UCL) and Lower Control Limit (LCL) for Annual Average Forced Outage Frequency for the TBC HVDC Facility

UCL_f and LCL_f define a range of expected performance extending above and below the CL. The UCL_d and LCL_d were generated by multiplying the total number of Forced Outages of since January 1st, 2011 by 99.75% (0.9975) and .25% (0.0025), respectively.

UCL and LCL for Annual Average Accumulated Forced Outage Duration for the TBC HVDC Facility

UCL_d and LCL_d define a range of expected performance extending above and below the CL. The UCL_d and LCL_d were generated by multiplying the total number of the duration (in minutes) of Forced Outages since January 1st, 2011 by 99.75% (0.9975) and .25% (0.0025), respectively.

Upper Warning Limit (UWL) and Lower Warning Limit (LWL) for Annual Average Forced Outage Frequency for the TBC HVDC Facility

UWL_f and LWL_f define a range showing if the number of annual TBC Forced Outages is approaching the UCL_f and LCL_f . The UWL_f and LWL_f were generated from multiplying the total number of Forced Outages since January 1st, 2011 by 97.5% (0.975) and 2.5% (0.025), respectively.

UWL and LWL for Annual Average Accumulated Forced Outage Duration for the TBC HVDC Facility

UWL_d and LWL_d define a range showing if the annual accumulated duration of Forced Outages is approaching the UCL_d and LCL_d . This number was generated from multiplying the total duration of Forced Outages since January 1st, 2011 by 97.5% (0.975) and 2.5% (0.025), respectively.

Performance Monitoring:

Based on the analysis of the control charts, TBC has identified that performance is accurately represented and in line with the calculated Center Control line values and should continue its preventative and predictive maintenance efforts in this manner. TBC’s preventative and predictive maintenance routines resulted in a year with no forced outages.

Performance Outside Limits:

Performance was inside the upper and lower limits, with the lower control limit specified at 2.5% of the sum of accumulated forced outage duration since 2011. Performance outside of this limit was 0 minutes force outage duration, which was less than 2.5% of the sum of all previous forced outages. This was reviewed and found to be accurate.

Improving Performance:

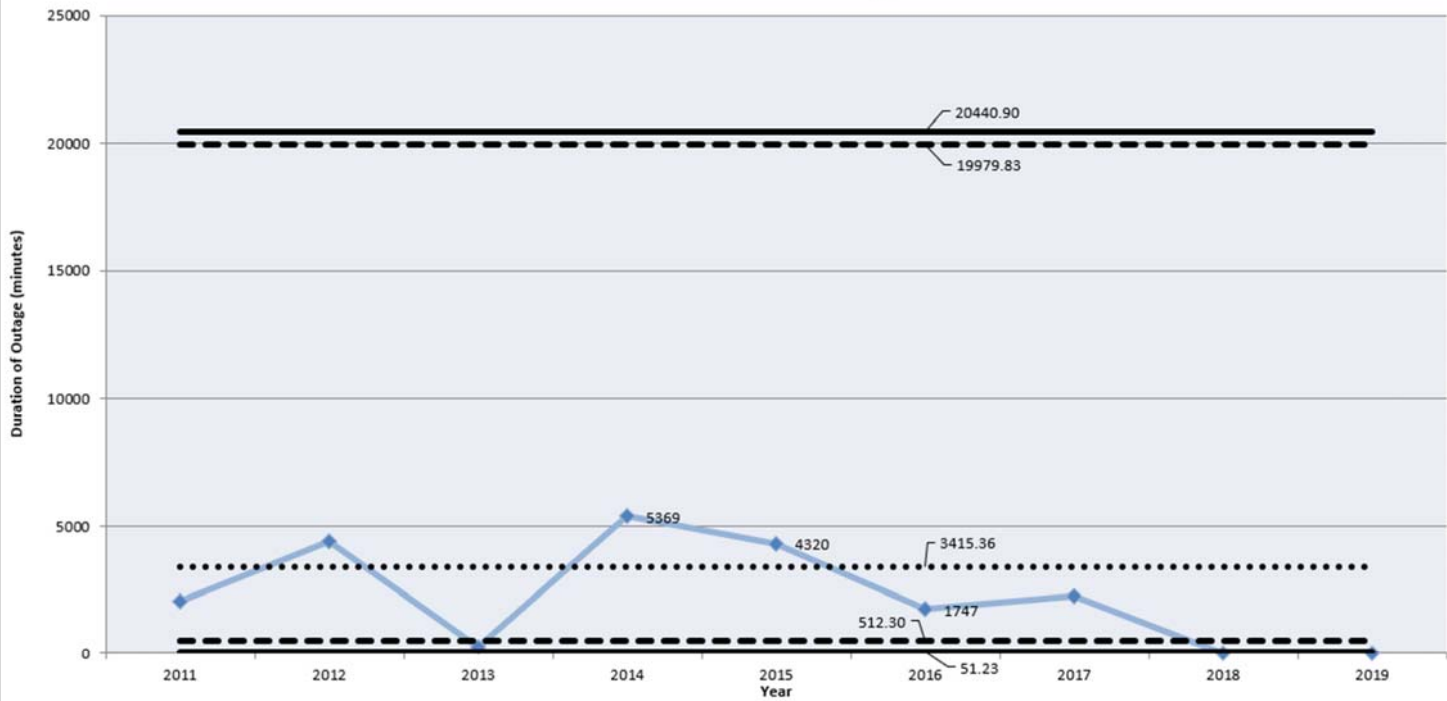
TBC continues to explore new and innovative preventative measures to continue our use of industry best practices. These maintenance techniques are based on current and evolving industry practices and are continuously subject to evaluation for improvement. The 2018 year had 0 forced outages indicating an increase in maintenance and operational. The 2019-year TBC experienced 1 Derate caused by Cooling System pressure. TBC continues to strive to modernize its processes and technologies to ensure safe and reliable operations.

2019 Summary Outage Data:

Outage Type	Description	Duration (min)	Total (min)
Forced	Outage	0	43.8
Forced	Derate	44	
Scheduled	Scheduled	24860	24860
Total Outage Time (min)		24904	
Total Annual Availability (excluding Scheduled)		99.996%	



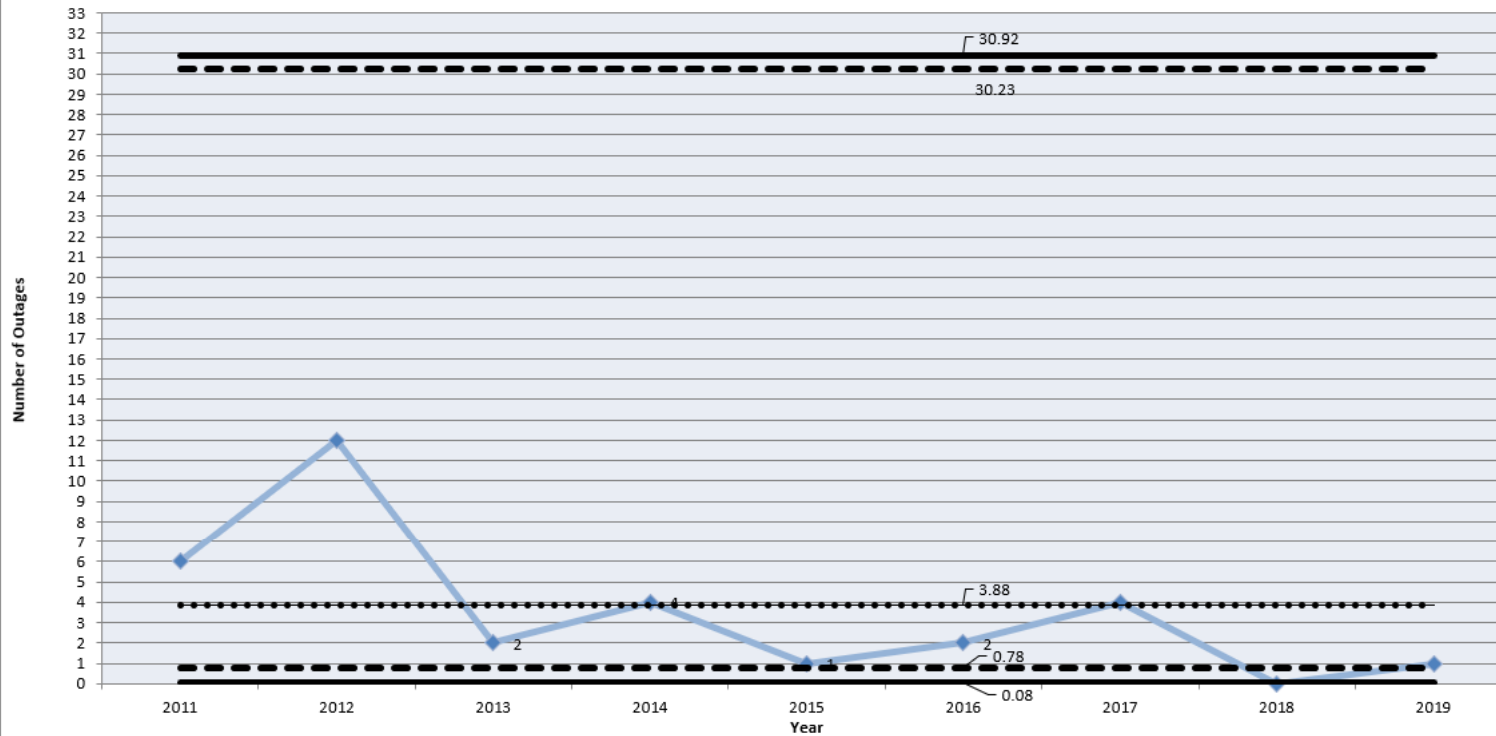
Annual Accumulated Forced Outage Duration



Calendar Year (k)	Annual Accumulated Forced Outage Duration (Dk)	Intermediate Step required for calc.	Center Control Line (CL d)	Upper Warning Limit (UWL d)	Lower Warning Limit (LWL d)	Upper Control Limit (UCL d)	Lower Control Limit (LCL d)
2011	2064	1	3415.36	20440.90	512.30	19979.83	51.23
2012	4404	1					
2013	273	1					
2014	5369	1					
2015	4320	1					
2016	1747	1					
2017	2271	1					
2018	0	0					
2019	44	1					
Total	20492	6					



Annual Forced Outage Frequency



Calendar Year (k)	Annual Forced Outage Frequency (F_k)	Intermediate Step required for calc.	Center Control Line (CL_f)	Upper Warning Limit (UWL_f)	Lower Warning Limit (LWL_f)	Upper Control Limit (UCL_f)	Lower Control Limit (LCL_f)
2011	6	1	3.88	30.92	0.78	30.23	0.08
2012	12	1					
2013	2	1					
2014	4	1					
2015	1	1					
2016	2	1					
2017	4	1					
2018	0	0					
2019	1	1					
Total	31	8					



Respectfully,

Michael Blunt
Director of Operations
Trans Bay Cable LLC

Trans Bay Cable LLC
One Letterman Drive • Bldg C • 5th Floor • San Francisco CA 94129
T +1 415 291 2300 • F +1 415 651 9500 • www.transbaycable.com

