



February 20, 2018

Steve Rutty
California ISO
250 Outcropping Way
Folsom, CA 95630

SUBJ: Trans Bay Cable Availability Report (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 2017 is:

Period	SEU	FEU	Avail	Utilization
Q1	4.73%	1.36%	94.04%	49.89%
Q2	0.00%	0.00%	100.0%	48.67%
Q3	0.00%	0.09%	99.91%	50.24%
Q4	9.93%	0.00%	90.07%	50.24%
Overall	3.62%	0.36%	96.02%	49.76%

The table above shows the performance data for each quarter during the year 2017. During 2017 Q1, TBC conducted its annual maintenance outage and in Q4 conducted a scheduled outage to complete sea bed sampling around TBC's cables. These two scheduled outages accounted for the 3.62% Scheduled Energy Unavailability for the year. In Q1 2017 TBC accumulated just over 30 total hours of forced outage availability due a fault in the fire system and bad connection between a measuring device and the 115-kV line. In Q3 2017 TBC experienced 8 forced outage hours due to derating the system when temperatures in Potrero exceeded 104 °F. The total of all Forced Energy Unavailability's for 2017 resulted in a 0.36% FEU.

TBC completed all preventative maintenance for 2017, in accordance with CAISO approve Converter Station and Cable Maintenance Practices. Details are provided separately in the CAISO Standard Maintenance Reporting System TBC 2017 Review.

TBC only operates a single DC transmission line and has accrued only seven years of operational data. TBC's ability to trend performance is limited to the data acquired since commercial operations. The Total Forced Outage duration in 2017 did not exceed our defined Upper Control Limit (UCL) for outage duration and was found to be within bounds and consistent with the Center Control values as derived. In 2017, Total Forced Outage Duration was 1,773 minutes, within 1.4% 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.

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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:

With seven (7) years of data on the single TBC line available, it can be determined that the trend is stabilizing, indicating reliable performance from TBC’s HVDC System. Since historical events were covered in previous reports, they will not be summarized again. In 2017, due to the inclement weather conditions during the first quarter, TBC experienced water ingress in a fire detection device which caused the station fire protection system to spuriously activate, shutting down the HVDC converter and opening the station breaker. TBC replaced several gaskets in several fire detection devices and will be starting a program in 2018 to systematically replace all gaskets over a three (3) year period to minimize further impacts from weather. TBC also experienced a poor connection to a voltage divider during restoration from its annual shutdown for scheduled maintenance. This forced TBC back out to repair the connection. TBC performed an investigation and determined that quality control processes had not been followed in addition to have separate crews disconnect and reconnect connections. TBC has revised their procedure for site inspections prior to returning to service and has also implemented a tracking program where all disconnected devices are noted and tagged, then again signed when the connection is made up again. Prior to re-energizing TBC will review the list with the contractor to ensure all connections have been restored. In quarter 3, TBC was forced to derate the facility to remain interconnected to the BES, as a result of a historical record setting heat wave in San Francisco which resulted in temperatures outside the design specifications.

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.

Performance Outside Limits:

Performance was inside the upper and lower limits.

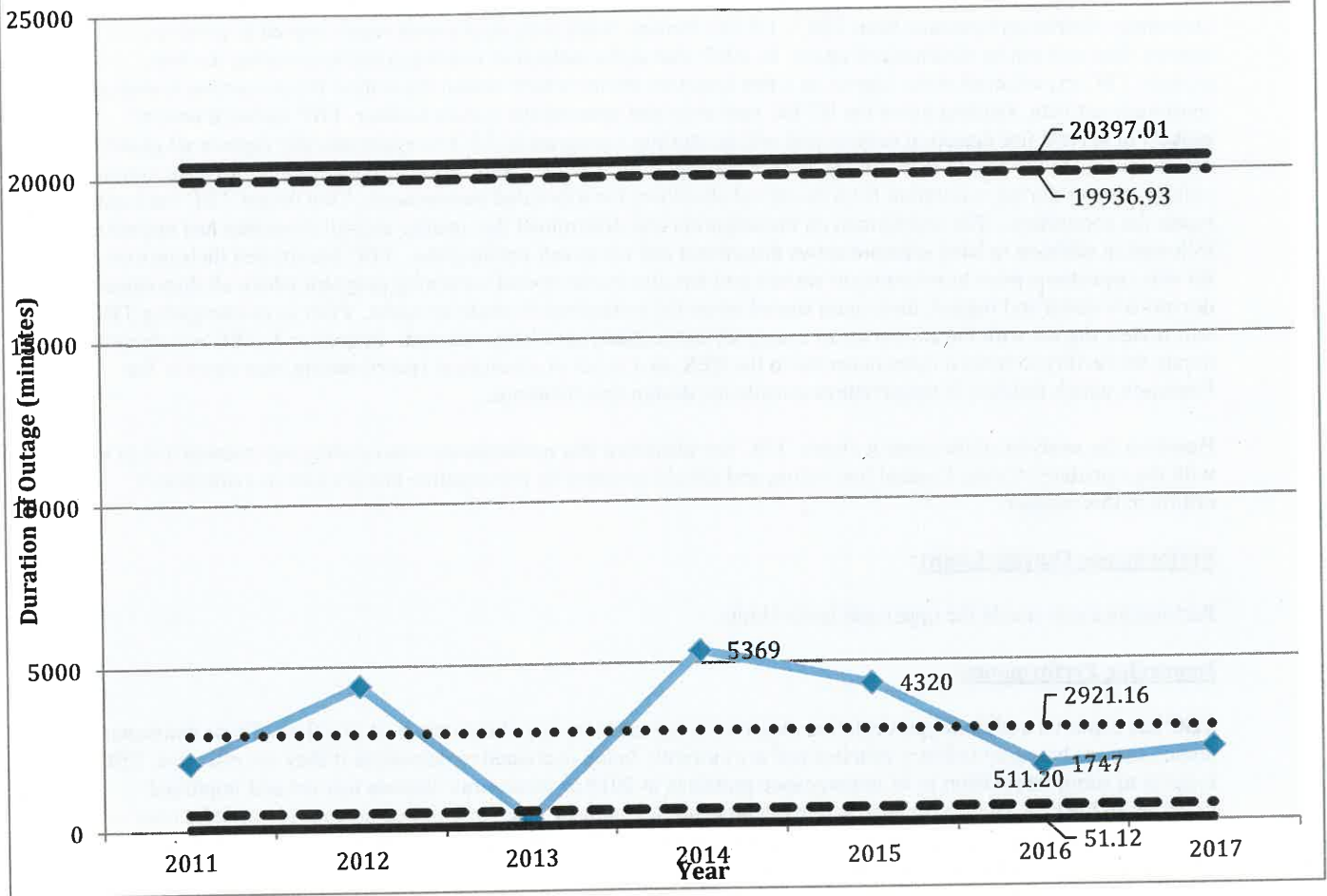
Improving Performance:

TBC has explored additional preventative measures to continue its use of industry best practices. These maintenance techniques are based on industry practice and are currently being evaluated to determine if they are effective. TBC expects to submit a revision to its maintenance practices in 2018 to incorporate lessons learned and improved practices in the preventative and predictive maintenance techniques. The 2017 forced outages identified a need to continue efforts in quality assurance activities and oversight. TBC has undertaken this effort through the use of education, and continual process improvement.

2017 Summary Outage Data:

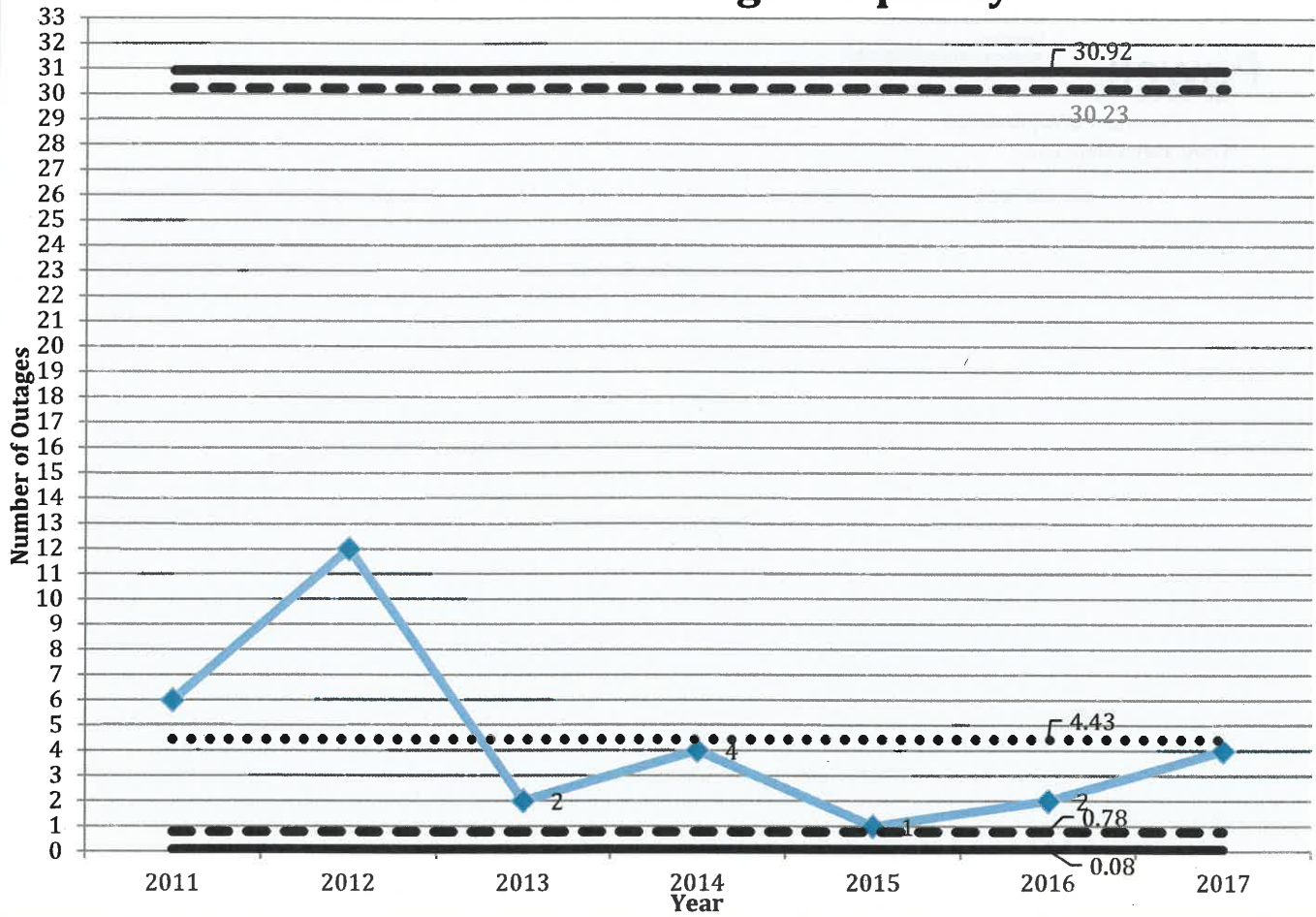
Outage Type	Description	Duration (min)	Total (min)
Forced	Outage	1773	2271
Forced	Derate	498	
Scheduled	Scheduled	19,005	19,005
Total Outage Time (min)		21,276	
Total Annual Availability (excluding Scheduled)		99.57%	

Annual Accumulated Forced Outage Duration



Calendar Year (<i>k</i>)	Annual Accumulated Forced Outage Duration (<i>D_k</i>)	Center Control Line (<i>CL_d</i>)	Upper Warning Limit (<i>UWL_d</i>)	Lower Warning Limit (<i>LWL_d</i>)	Upper Control Limit (<i>UCL_d</i>)	Lower Control Limit (<i>LCL_d</i>)
2011	2064	2921.16	20397.01	511.20	19936.93	51.12
2012	4404					
2013	273					
2014	5369					
2015	4320					
2016	1747					
2017	2271					
Total	20448					

Annual Forced Outage Frequency



Calendar Year (k)	Annual Forced Outage Frequency (F_k)	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	4.43	30.92	0.78	30.23	0.08
2012	12					
2013	2					
2014	4					
2015	1					
2016	2					
2017	4					
Total	31					

Respectfully,
Steven

Powell
Steven Powell

Vice President of Operations
Trans Bay Cable LLC

Digitally signed by Steven Powell
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Bay Cable LLC, ou=Dir of
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Date: 2018.02.20 14:19:05 -08'00'