Low Water Reserve Fund (LWRF) - YUB Technical Session: YEC Notes

Outline

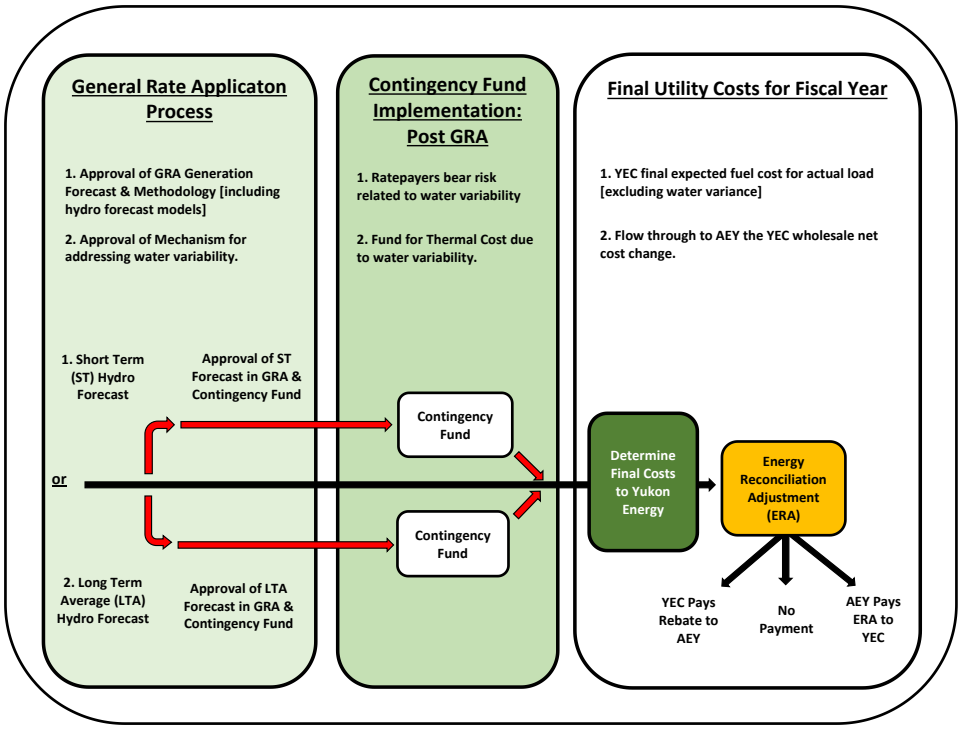
The technical session on the LWRF is to address details on principles and process methods. To facilitate effective discussion on these elements, YEC has prepared notes to assist detailed review for each of the following topics related to the LWRF:

1. Part 1: Basic Principles & Processes – GRA and LWRF Contingency Fund Inter-Relationships
2. Part 2: 2018 GRA-Related Matters Approved in Board Order 2018-10
3. Part 3: 2018 LWRF-Related Matters Addressed in YEC Compliance Filings
4. Part 4: 2018 LWRF - Water-Related Thermal per YEC's Feb 2019 Compliance Filing
5. Part 5: 2018 LWRF – Water Related Thermal per YEC's Sept 2019 Compliance Filing
6. Part 6: 2019 LWRF – Fuel Mix Issues for LWRF Transfer Costs

1.0 PART 1: BASIC PRINCIPLES & PROCESSES – GRA AND LWRF CONTINGENCY FUND INTER-RELATIONSHIPS

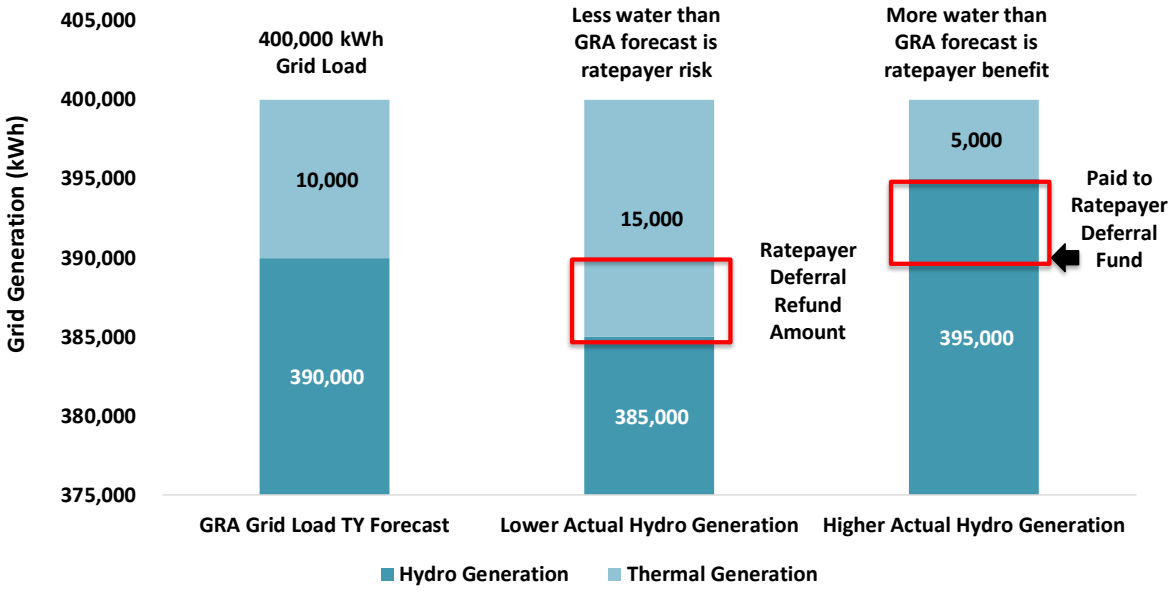
The figure below from YEC's December 6, 2017 Two Part Application re: ERA summarizes basic principles and processes regarding the GRA process and the DCF/LWRF contingency fund process:

1. GRA decisions on rates include thermal generation forecasts related to assumed water conditions - these thermal forecasts are a key determinant in LWRF implementation.
2. Ratepayers bear risk for any actual year-end thermal generation costs due to changes to water conditions from GRA forecasts – The DCF/ LWRF contingency fund addresses these ratepayer costs. (See graphic example on next page.)
3. LWRF determinations occur post GRA and do not affect the GRA rates or forecasts.
    a. LWRF determinations deal with actual results at each year end, after the GRA and related rates have been approved.
    b. This Contingency Fund intended to smooth out rate impacts over time ($8 million cap, not automatically refund to ratepayers as per Rider F deferral account).
    c. Want simplicity for Fund processes, but must meet principles and specified objectives, e.g., the Diesel Deferral Account is a simplified approach rejected by the Board on these grounds (Appendix A to Board Order 2015-01, section 2.3.1.4).



The figure below demonstrates basic principles for LWRF/ DCF year end determinations (assumes no change in overall total generation required):

- Assumes (in left column) test year total generation forecast of 400 MWh with thermal generation forecast at 10 MWh;
- Second column shows year end determination assuming less water that GRA forecast (the cost for the higher thermal generation is refunded to YEC from the Ratepayer Contingency Fund)
- Third column shows year end determination assuming more water than GRA forecast (YEC pays into Ratepayer Contingency Fund the cost for the reduced thermal generation).
- If the GRA used LTA hydro forecast for the forecast thermal generation, the figure shows that YEC as at year end pays for LTA thermal generation regardless as to impacts of actual water conditions during the fiscal year.



In summary, the LWRF/DCF deferral account/ contingency fund mechanism is required to ensure that water-related change to thermal costs is assigned to a ratepayer deferral account at each year end. This water-related fund account is intended to smooth out ratepayer cost impacts over the full range of water year conditions and its cap reflects this requirement.

The DFPVA deferral account provides the same risk assignment to ratepayers for fuel price changes to thermal costs – however, the DFPVA's cap is very low compared to the LWRF.

These deferral accounts have each been applied to YEC's actual generation loads as they occur.

2.0 PART 2: 2018 GRA-RELATED MATTERS APPROVED IN BOARD ORDER 2018-10

Board Order 2018-10 approved the LTA forecast for hydro and thermal generation for the 2018 test year revenue requirement and rates.

Based on YEC's GRA, the LTA was determined based on the DCF Term Sheet in the GRA filing (Table 3.4-1 below):

- The Term Sheet table shows LTA hydro and LTA thermal at 5 GWh load increments from 370 GWh load to 485 GWh load.
- LTA forecasts for each load based on average of YECSIM modelled annual hydro generation under each of 35 water years of record, assuming current hydro licences and capabilities.
- See next page for thermal forecast for each of 35 water years for three different loads.

Line Number	YEC Grid Load Net of Wind (GWh)	YEC Hydro Generation (GWh)	YEC Thermal Generation (GWh)	Increase in Load (GWh)	Increase in Thermal Generation (GWh)	Thermal as % of Increased Load
	Column A	Column B	Column C	Column D	Column E	Column F = E/D
1	370.0	369.337	0.663			
2	375.0	373.626	1.374	5.0	0.710	14%
3	380.0	377.800	2.200	5.0	0.826	17%
4	385.0	381.845	3.155	5.0	0.955	19%
5	390.0	385.750	4.250	5.0	1.096	22%
6	395.0	389.503	5.497	5.0	1.246	25%
7	400.0	393.098	6.902	5.0	1.405	28%
8	405.0	396.528	8.472	5.0	1.570	31%
9	410.0	399.789	10.211	5.0	1.739	35%
10	415.0	402.877	12.123	5.0	1.911	38%
11	420.0	405.793	14.207	5.0	2.084	42%
12	425.0	408.537	16.463	5.0	2.256	45%
13	430.0	411.111	18.889	5.0	2.426	49%
14	435.0	413.521	21.479	5.0	2.590	52%
15	440.0	415.772	24.228	5.0	2.748	55%
16	445.0	417.874	27.126	5.0	2.898	58%
17	450.0	419.836	30.164	5.0	3.038	61%
18	455.0	421.669	33.331	5.0	3.167	63%
19	460.0	423.388	36.612	5.0	3.281	66%
20	465.0	425.007	39.993	5.0	3.380	68%
21	470.0	426.545	43.455	5.0	3.462	69%
22	475.0	428.019	46.981	5.0	3.525	71%
23	480.0	429.452	50.548	5.0	3.567	71%
24	485.0	430.865	54.135	5.0	3.587	72%

LTA calculations at different loads – thermal generation for each of 35 water years

The table below from the GRA Application shows thermal generation forecast for each of 35 water years as used to derive LTA thermal generation for three grid load forecasts (the 420 GWh load forecast approximated 2018 GRA forecast):

- Shows how drought can jump thermal generation to very high levels in a few water years.
- At GRA 2018 forecast load of 420 GWh;
    - LTA over 35 water years was 13.9 GWh in this original assessment
    - Forecast thermal generation exceeded 50 GWh in three water years, and >100 GWh in one water year (1999)
    - In contrast, forecast thermal generation is less than 5 GWh in 20 of the 35 water years.

Average Annual Thermal Generation (Averaged Load Years for 35 Water Years)

	Average Thermal Generation by water year (GW.h)			Distribution of Annual Water Year Levels				
Water Year	Load at 420 GW.h [approx. 2018 GRA load level]	Load at 380 GW.h [approx. 2018 GRA load level no mines]	Load at 450 GW.h [approx. 2018 GRA load level plus 30 GW.h new mine load]		% of Years not less than	Load at 420 GW.h [approx. 2018 GRA load level]	Load at 380 GW.h [approx. 2018 GRA load level no mines]	Load at 450 GW.h [approx. 2018 GRA load level plus 30 GW.h new mine load]
1981	0.2	0.0	0.7	1	3%	107.5	55.2	117.0
1982	0.2	0.0	0.7	2	6%	58.3	18.7	76.8
1983	0.2	0.0	0.7	3	9%	53.8	6.1	71.2
1984	0.4	0.0	31.0	4	11%	50.1	0.6	70.8
1985	0.3	0.0	43.9	5	14%	35.4	0.0	61.2
1986	0.4	0.0	48.0	6	17%	33.2	0.0	58.6
1987	0.2	0.0	27.7	7	20%	31.2	0.0	54.2
1988	0.2	0.0	32.4	8	23%	24.0	0.0	48.0
1989	0.2	0.0	12.9	9	26%	16.7	0.0	43.9
1990	0.2	0.0	14.9	10	29%	14.2	0.0	35.3
1991	0.2	0.0	3.3	11	31%	13.8	0.0	32.4
1992	0.2	0.0	1.6	12	34%	12.6	0.0	31.4
1993	0.2	0.0	2.8	13	37%	11.4	0.0	31.2
1994	0.2	0.0	2.5	14	40%	6.5	0.0	31.0
1995	6.5	0.0	61.2	15	43%	5.1	0.0	30.1
1996	50.1	0.0	71.2	16	46%	3.7	0.0	27.7
1997	53.8	18.7	76.8	17	49%	1.9	0.0	26.5
1998	31.2	0.6	70.8	18	51%	1.6	0.0	25.5
1999	107.5	55.2	117.0	19	54%	0.4	0.0	24.4
2000	58.3	0.0	58.6	20	57%	0.4	0.0	22.7
2001	35.4	0.0	24.4	21	60%	0.3	0.0	21.2
2002	24.0	0.0	31.4	22	63%	0.2	0.0	14.9
2003	14.2	0.0	30.1	23	66%	0.2	0.0	12.9
2004	33.2	6.1	54.2	24	69%	0.2	0.0	10.3
2005	16.7	0.0	21.2	25	71%	0.2	0.0	4.1
2006	12.6	0.0	25.5	26	74%	0.2	0.0	3.3
2007	13.8	0.0	35.3	27	77%	0.2	0.0	2.8
2008	11.4	0.0	22.7	28	80%	0.2	0.0	2.5
2009	1.9	0.0	10.3	29	83%	0.2	0.0	1.9
2010	5.1	0.0	31.2	30	86%	0.2	0.0	1.6
2011	3.7	0.0	26.5	31	89%	0.2	0.0	1.6
2012	1.6	0.0	4.1	32	91%	0.2	0.0	1.0
2013	0.2	0.0	1.6	33	94%	0.2	0.0	0.7
2014	0.2	0.0	1.0	34	97%	0.2	0.0	0.7
2015	0.2	0.0	1.9	35	100%	0.2	0.0	0.7
LTA (Average)	13.9	2.3	28.6			13.9	2.3	28.6
Median	1.6	0.0	25.5			1.6	0.0	25.5

3.0 PART 3: 2018 LWRF-RELATED MATTERS ADDRESSED IN YEC COMPLIANCE FILINGS

The LWRF determination for 2018 must address actual outcomes in 2018 to ensure that water-related thermal generation changes from the approved GRA forecast are assigned to ratepayers through the Fund.

A key requirement in this regard is to separate (a) thermal generation changes due to overall grid load changes from (b) thermal generation changes from LTA water conditions.

- The 2018 GRA thermal generation forecast cost as approved for rates reflects forecast grid loads, assumed LTA hydro generation, and assumed GRA fuel prices and efficiencies.
- The one reasonably certain outcome at the end of 2019 is that actual conditions for grid loads, actual water conditions and actual fuel prices all differed from the approved GRA forecasts.
- The DFPVA ensures that fuel price variances from the GRA forecast are assigned to this deferral account and therefore do not affect YEC's final year end costs for 2018.
- Water related variances from the LTA forecast assumption similarly need to be assigned to the LWRF so as not to affect YEC's final year end costs for 2018.

In accordance with past practice, YEC's first compliance filing in February 2019 used the 2018 LTA forecast procedures to determine LTA thermal generation requirements for the 2018 grid load. The LWRF was then assigned costs for thermal generation changes due to actual thermal varying from the LTA requirement. A simplified example highlights the key steps for the 2018 analysis (numbers are not intended to be accurate):

- Actual load increased above GRA forecast - for this example, assume actual grid generation load at 445 GWh, for a 25 GWh increase over GRA forecast load at 420 GWh
- Actual thermal also increased above GRA forecast – for this example, assume actual thermal generation at 36 GWh, for a 20 GWh increase over GRA forecast thermal at 16 GWh
- Based on the actual grid generation load, LTA thermal generation was lower than the actual generation, indicating actual water conditions below LTA hydro – for this example, assume LTA thermal for the actual grid load at 28 GWh.
- YEC's LWRF determination in the February compliance filing in effect assigned to the LWRF the thermal generation that exceeded the LTA thermal at the actual load, i.e., the difference between 28 GWh LTA and 36 GWh actual, or 8 GWh – this added cost would be refunded to YEC by the LWRF, thereby ensuring that YEC's final costs are consistent with GRA assumed LTA water conditions.

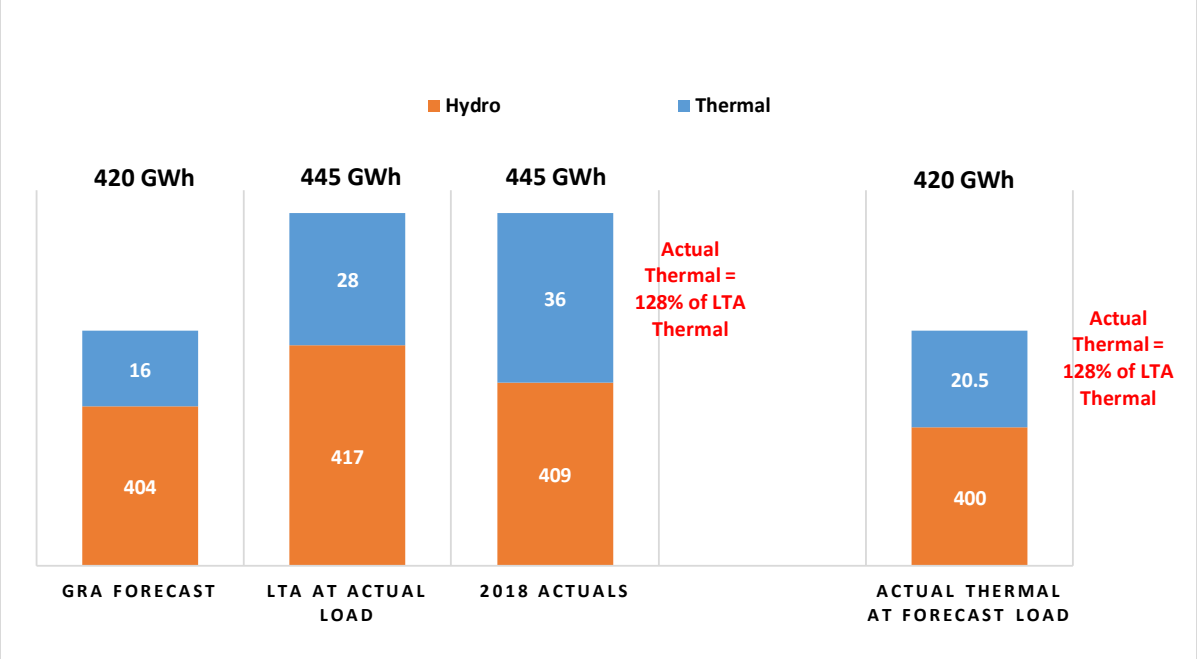
Board Order 2019-04 directs YEC to change the LWRF determination for 2018 so as to limit the LWRF only to the forecast load, i.e., water variance thermal cost risk for load changes would be borne by YEC. The LWRF is to be applicable only for load up to the latest approved forecast level and not for loads that vary from forecast levels. Using the above example for 2018, YEC is required to determine

what portion of the actual thermal (the 36 GWh) would have been required to supply only the forecast load (the 420 GWh) – the LWRF would then be assigned the difference between this number and the LTA GRA forecast thermal (16 GWh in the example).

YEC's second compliance filing in September 2019 sought to comply with the Board's directions through the following process (using the same example as above):

- Determine actual thermal (the 36 GWh) as a percent of LTA thermal for the actual grid load (the 28 GWh LAT thermal) – the example indicates actual at 36/28 = 128% of LTA thermal.
- Actual thermal at forecast load is then assumed to also be 128% of LTA thermal (16 GWh) at that load, or 20.48 GWh = 128% times 16 GWh.
- YEC's LWRF determination in the September compliance filing in effect assigned to the LWRF the thermal generation that exceeded the LTA thermal at the forecast load, i.e., the difference in the example between 16 GWh LTA and 20.48 GWh actual, or 4.48 GWh – this added cost would be refunded to YEC by the LWRF, thereby ensuring that YEC's final costs for the LTA forecast load are consistent with GRA assumed LTA water conditions.

The figure below shows the example referenced to describe the above process adopted to comply with the Board's direction to determine the actual thermal at the forecast load for 2018. The LWRF transfer then equals the forecast load thermal generation 4.5 GWh variance between actual (20.5 GWh) and LTA (16 GWh) thermal generation.



The balance of these notes review the specific processes and numbers for the LWRF determinations in each of the two YEC compliance filings, focusing on the September filing and issues related to compliance with Board Order 2019-04.

4.0 PART 4: 2018 LWRF – WATER RELATED THERMAL PER YEC FEB 2019 COMPLIANCE FILING

GRA 2018 Forecast LTA Thermal at Grid Load of 420.265 GWh

Board Order 2019-04 confirmed (subject to a separate cost of debt matter) that the revenue requirement forecasts in YEC's February compliance filing complied with the Board's directions in Board Order 2018-10. The LTA thermal generation forecast for 2018 in YEC's February compliance filing was provided based on Table 2.4-1 (see below).

- 2018 forecast Load of 420.265 GWh has LTA thermal generation forecast of 16.356 GWh (see below)

YEC Grid Load Net of Expected Fish Lake & Wind (GWh)	LTA YEC Hydro Generation (GWh)	LTA Thermal Generation (GWh)	Load Change (GWh)	Thermal Generation change (GWh)	Thermal as % of Increased Load
Column A	Column B	Column C	Column D	Column E	Column F=E/D
400.0	391.135	8.865			
405.0	394.564	10.436	5.0	1.572	31%
410.0	397.834	12.166	5.0	1.730	35%
415.0	400.909	14.091	5.0	1.924	38%
420.0	403.769	16.231	5.0	2.140	43%
425.0	406.404	18.596	5.0	2.365	47%
430.0	408.818	21.182	5.0	2.587	52%
435.0	411.027	23.973	5.0	2.791	56%
440.0	413.062	26.938	5.0	2.965	59%
445.0	414.965	30.035	5.0	3.096	62%
450.0	416.794	33.206	5.0	3.171	63%

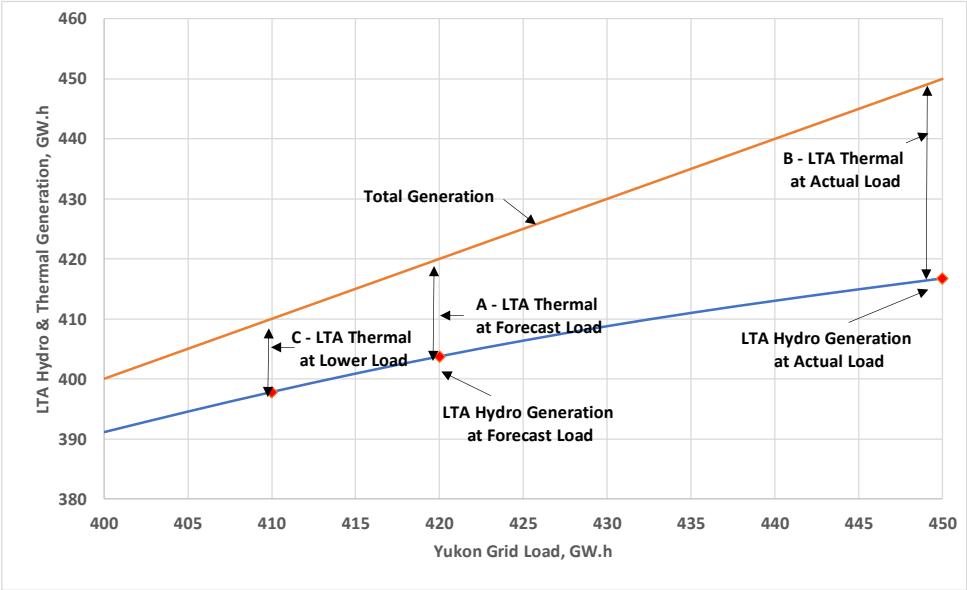
LTA Hydro & Thermal at GRA load forecast of 420 GWh

Load Forecast	LTA Hydro		LTA Thermal	
420.000	403.769	#1	16.231	at 420 GWh load from above table
0.265	0.140	#2	0.125	at 47% of 0.265 GWh (% from above table)
420.265	403.909	#3	16.356	LTA total thermal for GRA forecast

LTA Thermal at 2018 Actual Load of 447.000 GWh – Method Based on original GRA Table

Previous DCF/ LWRF determination of LTA thermal for the year-end actual grid load was based on Term Sheet Table used to determine GRA LTA thermal (e.g., Table 2.4-1 of Feb 2019 compliance filing)

- The figure below shows overall relationships of LTA hydro and LTA thermal over grid load range in GRA LTA thermal table for 2018 final approved GRA forecasts
- LTA thermal share of total generation increases for loads higher than the GRA forecast, and decreases for loads lower than the GRA forecast
- At 447 GWh actual 2018 grid load, LTA thermal equals 31.295 GWh based on this approach
    - #1 30.035 GWh at 445 GWh load from prior table
    - #2 1.260 GWh at 63% of 2 GWh (% from prior table)
    - #3 31.295 GWh LTA total thermal for actual load



To simplify the LTA thermal determination at actual load, YEC's Feb 2019 compliance filing proposed use of a Fixed Change Factor – as shown below, a fixed 45.29% of any load change is the assumed change in the LTA thermal (removes need to go back to the GRA table). The LWRF Term Sheet provided for YUB review when updates needed to the Fixed Change Factor.

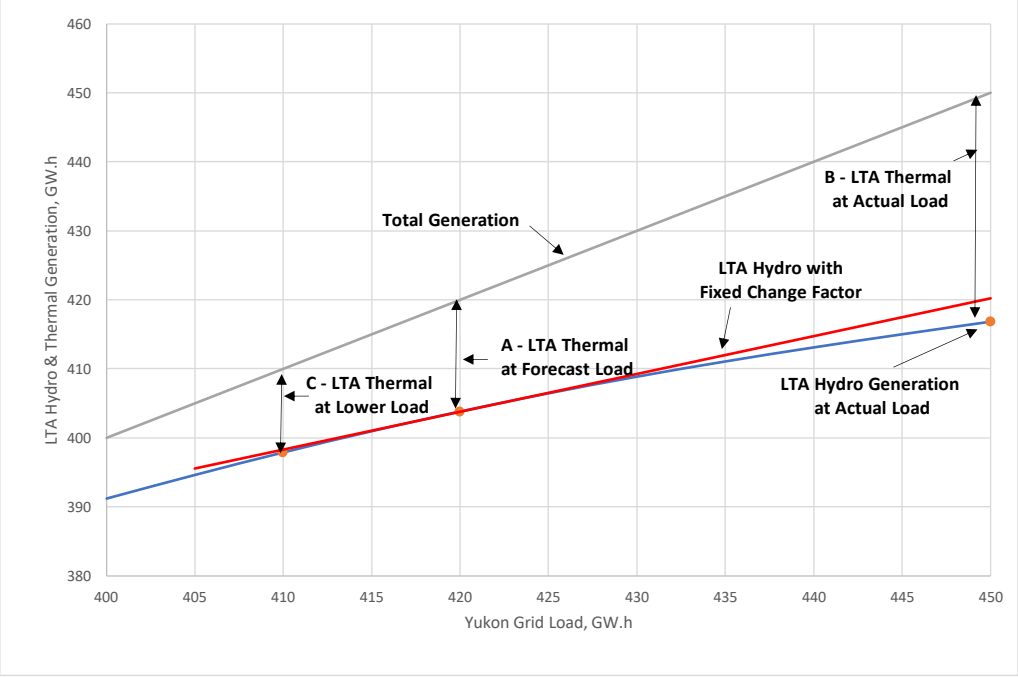
Fixed Change Factor (Based on +/-5 GWh change from GRA Forecast)

Load Forecast	LTA Hydro		LTA Thermal	
415.265	401.061	#4	14.204	LTA thermal at 5 GWh lower load
420.265	403.909	#5	16.356	LTA total thermal at GRA forecast load
425.265	406.532	#6	18.733	LTA thermal at 5 GWh higher load
Change over 10 GWG load change				
10.000	5.471	#7=(#6-#4)	4.529	
Fixed Change Factor		**#8=#7/10 GWh**	**45.29%**	

LTA Thermal at Actual Load of 447.000 GWh using Fixed Change Factor

420.265	GRA forecasts	#9	16.356	GRA LTA thermal forecast
26.735	Change for actual	#10	12.108	Load Change times Fixed Change Factor (#8)
447.000		**#11=#10+#9**	**28.464**	**LTA Thermal at Actual Load**

The figure below shows in red the adjusted LTA hydro with adoption of the Fixed Change Factor in combination with the GRA forecast load. The simplified approach shows slightly higher LTA hydro (and lower LTA thermal) for higher loads than the GRA forecast, and the reverse for lower loads than the GRA forecast.



The Feb 2019 compliance filing provided the following example for the 2018 LWRF determination using the Fixed Change Factor (Table 2.1-1)

1. LTA thermal at forecast load = 16.36 GWh (line 1 below)
2. LTA thermal at actual load = 28.46 GWh (line 8 below)
3. Actual thermal generation = 36.40 GWh (line 2 below)
4. Change in thermal due to water change = #3-#2 = 7.94 GWh (line 9 below)
5. An increase in thermal, thus a payment from LWRF to YEC is required (line 10 below shows $1.256 million assuming average thermal cost at $0.1583/kWh)

		Year end LWRF Deferral Account
		2018
		GW.h
1	**GRA Forecast LTA Thermal Generation**	16.36
2	**Actual Thermal Generation***	36.40
3	**Change in Thermal Generation (2-1)**	20.04
4	**Forecast Load**	420.27
5	**Actual Load**	447.00
6	**Load Variance (5-4)**	26.74
7	**Fixed Change Factor (LTA thermal generation share of load variance at row 6)**	45.3%
8	**LTA Thermal Generation at Actual Load (7x6+1)**	28.46
9	**Thermal Generation Change due to Water Changes (2-8)****	7.94
		Million $
10	**LWRF payment to YEC (charge to YEC) for costs due to water changes (9x0.1583)*****	1.25622

* Actual Thermal for Generation excludes RFID, capital and maintenance thermal.
** Negative is charge to YEC for water>LTA; positive is credit to YEC for water<LTA.
*** Assumed for example average thermal generation cost of $0.1583/kW.h.

5.0 PART 5: 2018 LWRF – WATER RELATED THERMAL PER YEC'S SEPT 2019 COMPLIANCE FILING

Board Order 2019-04 directed YEC to revise its LWRF determinations to limit LWRF only to the forecast load, i.e., water variance thermal cost risk for load changes would be borne now by YEC.

The following summarizes the four step process as directed by the Board to determine the LWRF, with reference to the actual 2018 example in Table 2.1-1 of YEC's Sept. 2019 compliance filing.

	Board Order 2019-04: Steps to Determine LWRF	**2018**
Step A	Determine if Actual Load Varies from Approved Forecast	Yes
Step B	**Determine Total Actual Generation**	447.000 GWh
	1. Actual Generation up to approved forecast level	420.265 GWh
	2. Amount above or below forecast	**26.735 GWh**
	Change in thermal generation as required below for Step D	
	1. Approved Forecast Thermal Generation	16.36 GWh
	2. Actual Thermal Generation	36.40 GWh
	3. Total Change in Thermal Generation	**20.04 GWh**
Step C	**Determine estimated actual thermal generation for the approved Forecast Load** [The following is YEC's proposed process - see text for detailed description]	
	1. LTA thermal at Forecast Load	16.36 GWh
	2. LTA Thermal for Actual Load (Fixed Change Factor)	16.355 + 45.29% of 26.735 = 28.464 GWh
	3. Actual Thermal as % of LTA Thermal (Actual Load)	36.40/ 28.464 = 127.88%
	4. Estimated Actual Thermal Generation at Forecast Load	127.88% x 16.36 GWh =**20.92 GWh**
Step D	**Assign Difference between Step B and Step C to LWRF**	
	1. Forecast Thermal Generation	16.36 GWh
	2. Actual Thermal Generation at Forecast Load	20.92 GWh
	3. Thermal Generation at Forecast Load due to water variation (assigned to LWRF – refund to YEC)	**4.56 GWh**

Process to Address Step C

The critical Step C in the Board's direction is to determine, for the approved forecast level [the 420.27 GWh forecast load], the change in thermal generation due to water condition changes that are different from those in the approved forecast, i.e., different from the long-term average (LTA) water conditions).

- The Board notes YEC's statement in an IR response that "absent new model analysis, there is no basis to estimate what the actual thermal generation would have been with only the forecast load."
- The Board did not direct YEC regarding how to correctly and practically determine what actual thermal generation would have been with only the forecast load.
- Table 2.1-1 of the Sept. 2019 compliance filing estimates actual thermal generation at the forecast load at 20.92 GW.h (see line 9b) – YEC's method for providing this estimate is reviewed below.

The amended LWRF as shown in Table 2.1-1 (see table on next page) uses the Feb 2019 compliance filing procedure as reviewed earlier (with the Fixed Change Factor) to determine LTA thermal at the full actual load (28.46 GWh, see line 8).

- Based on this, the revised LWRF estimates the amount that the actual thermal (36.40 GWh) exceeds LTA thermal for the same actual load (28.464 GWh) or 36.40/28.464=127.88%. This added thermal of 7.94 GWh is the estimate of actual thermal due to changes in water conditions, i.e., actual thermal is 27.88% higher than LTA thermal due to change in water conditions.
- Using this same 27.88% and the forecast thermal approved for the GRA of 16.36 GWh, the following are then determined in compliance with Board Order 2019-04 directions:
    - **Estimated actual thermal generation in this example, at the approved forecast load as required by Step C in the Board's directed four step process, then is assumed to equal 127.88% times the LTA thermal generation at the forecast load, or 20.96 GWh.**
    - The variance in thermal generation from the approved forecast at the approved forecast load as required by **Step D** in the Board's directed four step process then equals 20.96-16.36= 4.56 GWh.
    - The remaining variance in thermal generation due to changes in water condition equals 7.94-4.56=3.38 GW.h, and the cost for this added thermal due to changes in water conditions is borne by YEC and potentially AEY through the ERA.

YEC's Revised Table 2.1-1 for actual 2018 load

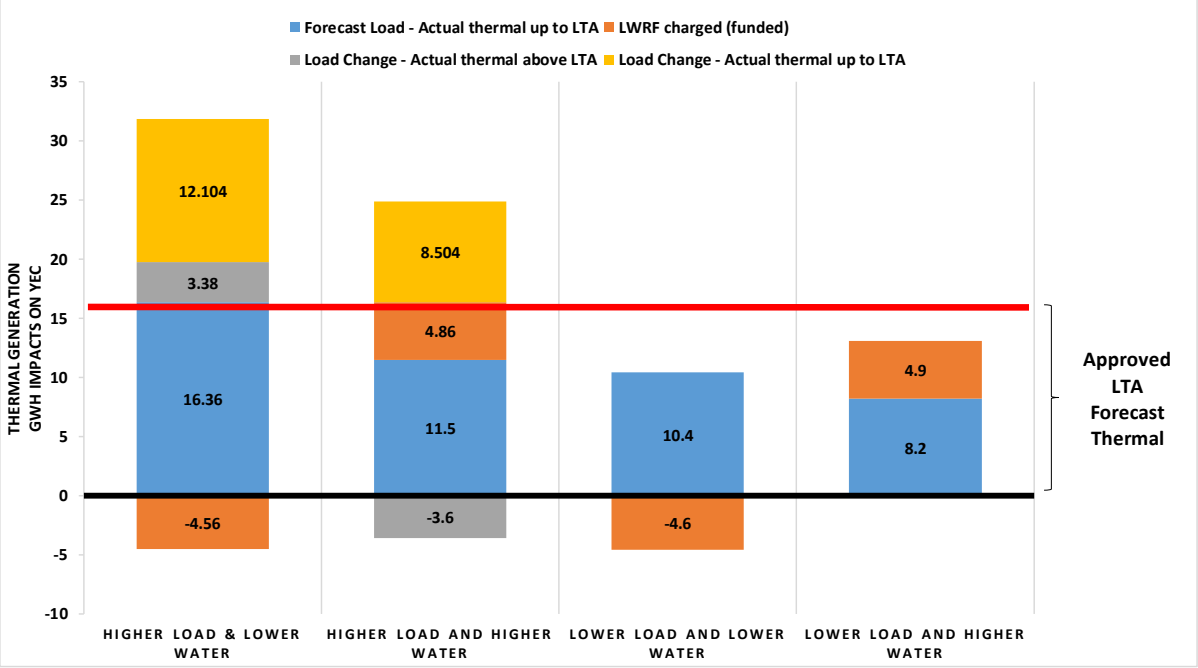
	LWRF Compliance with Board Order 2019-04 - Examples	Year end LWRF Deferral Account
		2018
	Actual Outcomes	GW.h
	Load vs Forecast	**Higher**
	Water conditons vs LTA	**Lower**
1	**GRA Forecast LTA Thermal Generation**	16.36
2	**Actual Thermal Generation***	36.40
3	**Change in Thermal Generation (2-1)**	20.04
4	**Forecast Load**	420.27
5	**Actual Load**	447.00
6	**Load Variance (5-4)**	26.74
7	**Fixed Change Factor (LTA thermal generation share of load variance at row 6)**	45.29%
8	**LTA Thermal Generation at Actual Load (7x6+1)**	28.464
9a	**Actual Thermal Generation as % of LTA Thermal Thermal Generation at Actual Load (2/8)**	127.88%
9b	**Estimated Actual Thermal Generation at Forecast Load (9a x1)**	20.92
10	**Thermal Generation Change due to Water Changes****	
10a	**At Forecast Load (9b-1)**	4.56
10b	**At Actual Load (2-8)**	7.94
10c	**Water Change impact borne by YEC (10b-10a)**	3.38

Implications for LWRF under range of "actual" scenarios for 2018

Table 2.1-1 in YEC's Sept. 2019 Compliance Filing provided LWRF determinations for four 2018 "actual" scenarios based on the 2018 actual load and actual thermal generation:

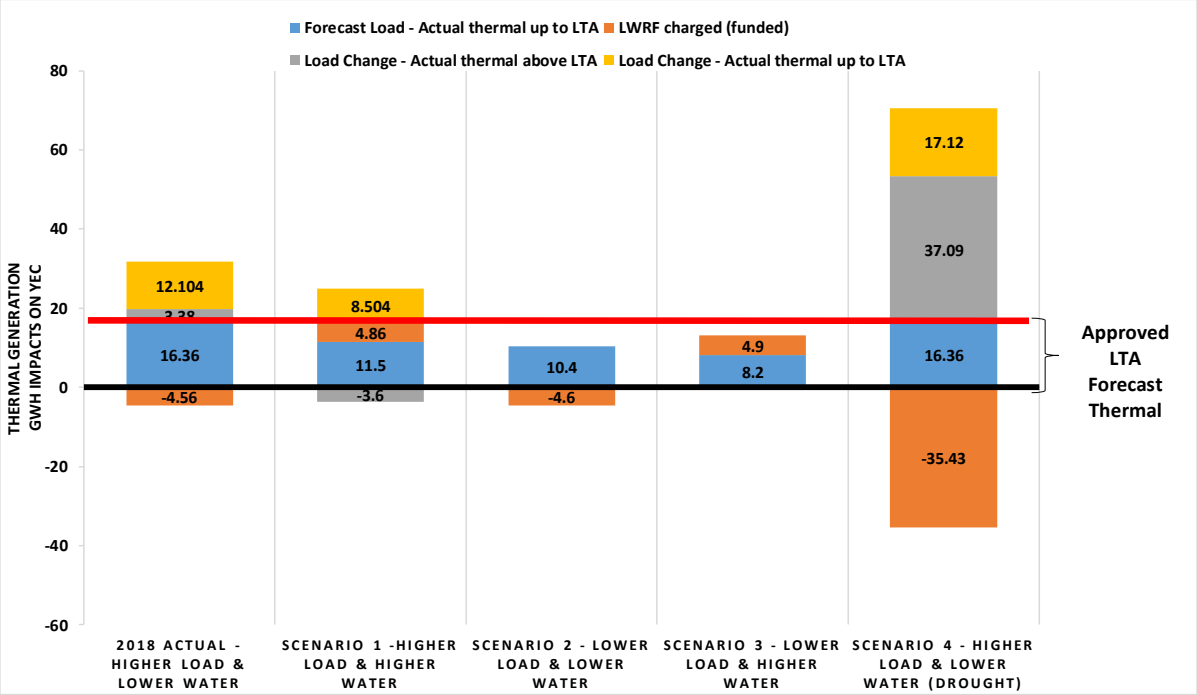
1. Scenarios where "Actual load" exceeds forecast load, and where
    a. Actual water conditions are lower than LTA (i.e., the actual 2018 case); and where
    b. Actual water conditions are higher than LTA.
2. Scenarios where "Actual load" is less than forecast load, and where
    a. Actual water conditions are higher than LTA; and
    b. Actual water conditions are lower than LTA.

The figure below summarizes the four scenarios, breaking out forecast load and load changes as required.



The table on page 19 provides the detail in Table 2.1-1 and expands on the above to include scenarios for a drought with higher load, and for various different water conditions without any load change. This table assesses potential net cost impacts on YEC (and by implication also for the LWRF) due to constraining the LWRF to only the GRA forecast load versus the actual load. Prior DCF and LWRF assessments as approved by the Board in effect resulted in YEC being charged the LTA thermal generation requirement for any actual load; this will not now be the case when there are load changes from forecast and the LWRF is restricted to the GRA forecast.

The earlier figure has been expanded below to show the added scenario 4 with higher load lower water under drought condition. The figure highlights the water-related thermal generation of 37.09 GWh related to load change that YEC would be at risk as a cost.

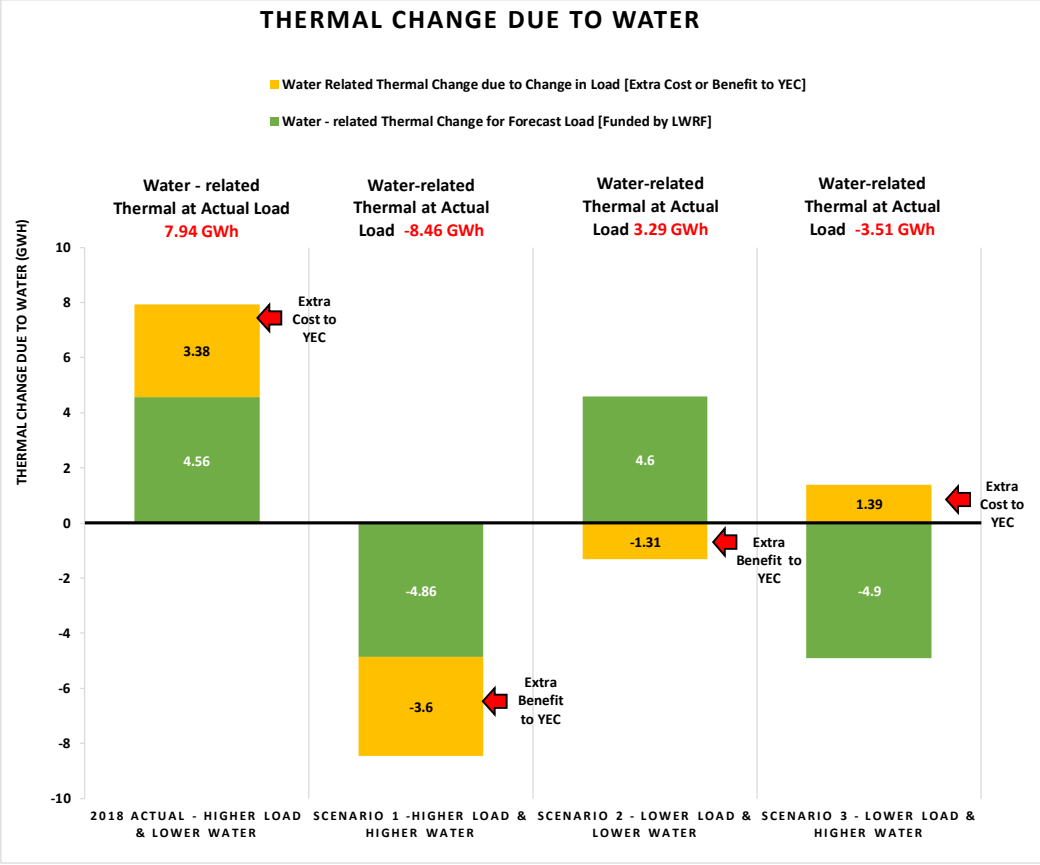


Summary Impacts with LWRF restricted to Forecast Load water variance

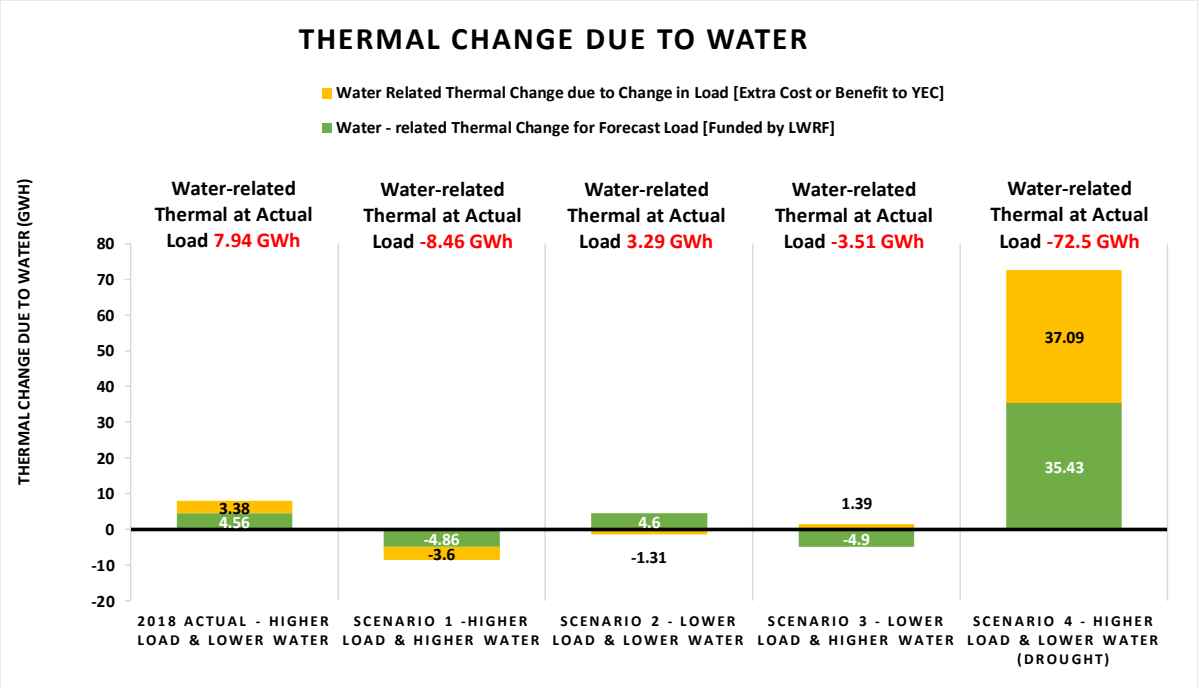
In summary, restricting LWRF water variance adjustment only to the forecast load has impacts on YEC and ratepayers that vary materially depending on the whether actual loads are higher or lower than forecast:

- **When actual loads are higher than forecast**, YEC ends up with impacts that are adverse with bad water conditions and beneficial with good water conditions:
  - YEC thermal cost above LTA cost with bad water conditions (water <LTA) – higher ratepayer benefits (through higher LWRF, i.e., lower YEC withdrawals from LWRF)
  - YEC thermal cost below LTA cost with good water conditions (water >LTA) – lower ratepayer benefits (through lower LWRF, i.e., lower YEC payments to LWRF)
- **When actual loads are lower than forecast**, YEC ends up with the reverse impacts in relation to actual water conditions (beneficial with bad water conditions, bad with good water conditions):
  - YEC thermal cost below LTA cost with bad water conditions (water <LTA) – lower ratepayer benefits (through higher LWRF withdrawals by YEC – reduces LWRF)
  - YEC thermal cost above LTA cost with good water conditions (water >LTA) – higher ratepayer benefits (through higher LWRF payments by YEC – increases LWRF)

The figure below highlights thermal generation changes due to water for the four initial scenarios examined, highlighting when YEC bears a water-related cost versus receives a water-related benefit.



The attached table indicates that the most severe adverse cost impacts for YEC would occur with a load increase (above last GRA forecast) during drought water conditions. This same outcome is highlighted in the figure below.



Expanded table 2.1-1 – Example LWRF Determinations – 2018 Year End with other 2018 "Actual" Scenarios

			Other 2018 "Actual" Scenarios						
	Actual Outcomes	**2018 Actual**	**Scen. 1**	**Scen. 2**	**Scen. 3**	**Scen. 4**	**Scen. 5**	**Scen. 6**	**Scen. 7**
	Load vs Forecast	**Higher**	**Higher**	**Lower**	**Lower**	**Higher**	**No change**	**No change**	**No change**
	Water conditons vs LTA	**Lower**	**Higher**	**Lower**	**Higher**	**Lower (drought)**	**Lower**	**Higher**	**Lower (drought)**
		GW.h	GW.h	GW.h	GW.h	GW.h	GW.h	GW.h	GW.h
1	**GRA Forecast LTA Thermal Generation**	16.36	16.36	16.36	16.36	16.36	16.36	16.36	16.36
2	**Actual Thermal Generation***	36.40	20.00	15.00	8.20	106.00	17.60	9.50	50.00
3	**Change in Thermal Generation (2-1)**	20.04	3.64	(1.36)	(8.16)	89.64	1.24	(6.86)	33.64
4	**Forecast Load**	420.27	420.27	420.27	420.27	420.27	420.27	420.27	420.27
5	**Actual Load**	447.00	447.00	410.00	410.00	458.07	420.26	420.26	420.26
6	**Load Variance (5-4)**	26.74	26.74	(10.27)	(10.27)	37.80	(0.00)	(0.00)	(0.00)
7	**Fixed Change Factor (LTA thermal generation share of load variance at row 6)**	45.29%	45.29%	45.29%	45.29%	45.30%	45.30%	45.30%	45.30%
8	**LTA Thermal Generation at Actual Load (7x6+1)**	28.464	28.464	11.706	11.706	33.480	16.355	16.355	16.355
9a	**Actual Thermal Generation as % of LTA Thermal Thermal Generation at Actual Load (2/8)**	127.88%	70.26%	128.14%	70.05%	316.61%	107.61%	58.08%	305.71%
9b	**Estimated Actual Thermal Generation at Forecast Load (9a x1)**	20.92	11.49	20.96	11.46	51.782	17.60	9.50	50.00
10	**Thermal Generation Change due to Water Changes****								
10a	**At Forecast Load (9b-1)**	4.56	(4.86)	4.60	(4.90)	35.43	1.24	(6.86)	33.64
10b	**At Actual Load (2-8)**	7.94	(8.46)	3.29	(3.51)	72.52	1.24	(6.86)	33.64
10c	**Water Change impact borne by YEC (10b-10a)**	**3.38**	**(3.60)**	**(1.31)**	**1.39**	**37.09**	**(0.00)**	**0.00**	**(0.00)**
		Million $							
11	**LWRF payment to YEC (charge to YEC) for costs due to water changes (10a x0.1583)*****	0.722	(0.770)	0.729	(0.775)	5.608	0.197	(1.085)	5.326
12	**Residual Impact of water change born by YEC (10c x 0.1583)**	**0.534**	**(0.570)**	**(0.207)**	**0.220**	**5.872**	**(0.000)**	**0.000**	**(0.000)**

Assuming thermal generation costs at $0.1583/kWh as approved for the 2018 GRA forecast, the above at line 12 examines net cost change for YEC with water change assignments to the LWRF limited to the forecast load vs the total actual load. Net cost increases or reductions vary depending on load change direction and water conditions. Potential adverse cost impacts approaching $6 million are noted for Scenario 4 (load increase with drought water conditions).

6.0 PART 6: 2019 LWRF – FUEL MIX ISSUES FOR LWRF TRANSFER COSTS

In addition to LWRF overall thermal generation assigned to the LWRF at the end of 2018, it is also necessary to address actual diesel/LNG fuel mix relative to the GRA forecast assumption of 90:10 diesel/LNG fuel mix. Fuel mix assessments affect the final costs for thermal generation transfers in or out of the LWRF.

In addressing situations where actual diesel share of thermal is higher or lower than 10%, YEC's GRA and compliance filings proposed that LWRF transfers be calculated so that YEC's final fiscal year expense after all LWRF transfers is as close as possible to 10% diesel and 90% LNG as assumed in the GRA forecast. In practice, situations to date have involved diesel at more than 10% of the actual thermal fuel mix – however, examples have also been examined where diesel generation could be less than 10% of the actual thermal fuel mix.

- In the GRA and the February compliance filing, YEC proposed that LWRF transfers be calculated so that YEC's final fiscal year expense for total thermal generation (after all transfers) is 90% LNG and 10% diesel, subject to a constraint that maintained actual diesel generation and prevented LNG transfers into or out of the LWRF exceeding 100%.
    - This approach reflects situations where LNG was assumed to make up all of the LNG transfers in order to move the final year end mix as close as possible to the 90% LNG and 10% diesel; LNG transfers in excess of 100% of the thermal generation were assumed to be unacceptable. Under these circumstances, actual diesel exceeded 10% of actual thermal generation.
    - This approach was also provided in the context of LWRF determinations based on the actual grid load and not only the GRA forecast load.
- In the September compliance filing YEC was required to address LWRF transfers limited to the GRA forecast load. In this situation, it was apparent that all actual diesel generation could not be assumed to be required for forecast load when, as in 2018, forecast load was well below actual load. The compliance filing proposed that the diesel share of the actual load be assumed also to apply for forecast load actual diesel.

The attached table provides expanded LWRF operations examples for 2018 that include fuel mix determinations. The analysis addresses determinations based on Board Order 2019-04 (i.e., LWRF limited to forecast load) and also based on filings prior to Board Order 2019-04 (i.e., LWRF determinations based on actual grid load). The following refinements have been included for the fuel mix determinations related to LWRF transfers:

- For LWRF based only on forecast load – diesel share of actual thermal at the forecast load is assumed at the diesel share of actual load generation, subject to LNG share never being more than 90%. This refinement was adopted to ensure that final fuel mix after all transfers does not have LNG exceeding the 90% assumed in the GRA forecast.
- For LWRF based on actual load – when actual thermal exceeds LTA (i.e., lower water conditions), LTA generation fuel mix assumes diesel at the share applicable to actual

generation (this refinement addresses situations where all actual diesel generation can not be assumed to be required for forecast load); otherwise, LTA generation fuel mix continues to assume actual diesel with LNG not to exceed 90%.

- The refined fuel mix determinations no longer require that LWRF transfers constrain the LNG share to not exceed 100% of the transfer, i.e., the refined rules focus on the final fuel mix (for the forecast load or the actual load, depending on the assessment) that results at year for YEC after all LWRF transfers.

The Table below summarizes outcomes for actual 2018 and four load change scenarios from the detailed analysis in the attached table:

- For Order 2019-04 LWRF determinations, the final YEC cost after LWRF transfers for the forecast load in each case is the same ($2.59 million) with the 90/10 LNG/diesel fuel mix yielding the same average fuel cost at $0.1583 per kWh. Actual YEC costs for the change in load vary depending on the scenario.
- For the LWRF prior to Board Order 2019-04 directions, the final YEC cost varies by scenario – but is approximately the same for the same loads regardless of the variances assumed for water conditions.

	Actual	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Actual Load vs Forecast	**Higher**	**Higher**	**Lower**	**Lower**	**Higher**
Actual Water conditions vs LTA	**Lower**	**Higher**	**Lower**	**Higher**	**Lower (drought)**
Order 2019-04					
LTA MWH for forecast (excludes balance of thermal) MWh	16,355	16,355	16,355	16,355	16,355
Actual at forecast as estimates ($000)	3,512	2,021	3,237	2,006	9,875
Net of LWRF	2,590	2,590	2,590	2,590	2,590
average cost per kwh	0.1583	0.1583	0.1583	0.1583	0.1583
Balance of Thermal MWh	*15,485*	*8,508*	*(5,958)*	*(3,257)*	*54,218*
Actual cost ($000)	2,600	1,496	(920)	(570)	10,339
average cost per kwh	0.1679	0.1758	0.1545	0.1751	0.1907
Total Cost to YEC	5,190	4,086	1,670	2,019	12,929
average cost per kwh	0.1630	0.1643	0.1606	0.1542	0.1832
Prior to Order 2019-04					
LTA MWH for actual (includes all load) MWh	28,464	28,464	11,706	11,706	33,480
Actual at forecast as estimates ($000)	$6,112	$3,517	$2,317	$1,436	$20,214
Net of LWRF	$4,780	$4,758	$1,854	$1,950	$6,385
average cost per kwh	$0.1679	$0.1672	$0.1583	$0.1666	$0.1907

In summary, the detailed fuel mix assessment for 2018 increases the dollar value of the year end 2018 actual example for the LWRF transfer from $0.722 million in Table 2.1-1 (which assumed the average fuel price of $0.1583/kWh) to $0.922 million (average cost of $0.2022 per kWh). The increase in average cost reflects the high proportion of diesel in the LWRF transfer required to yield a year end 90/10 LNG/diesel mix for the forecast load thermal generation cost.

Expanded LWRF Operation Examples for 2018 - Inclusion of Thermal Fuel Mix

		Actual	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	Actual Load vs Forecast	**Higher**	**Higher**	**Lower**	**Lower**	**Higher**
	Actual Water conditions vs LTA	**Lower**	**Higher**	**Lower**	**Higher**	**Lower (drought)**
Line No	**2018 GRA**					
L1a	Diesel Fuel Cost cents per kW.h	26.333	26.333	26.333	26.333	26.333
L1b	LNG Fuel Cost cents per kW.h	14.668	14.668	14.668	14.668	14.668
L1c	GRA YIS firm Load forecast	420,265	420,265	420,265	420,265	420,265
L1d	GRA LTA Thermal Generation forecast	16,355	16,355	16,355	16,355	16,355
L1e	GRA Fixed Change Factor	45.3%	45.3%	45.3%	45.3%	45.3%
	Summary of Annual "Actual" Cases					
	Actual Load vs forecast (Incremental change)	26736	26736	(10265)	(10265)	37802
	Actual Thermal vs LTA Thermal at actual load	128%	70%	128%	70%	317%
	Calculation of Thermal Cost to Charge (Refund) LWRF with Board Order 2019-05					
	Assumptions					
L7b=L7-L7a	*YEC Net Diesel/LNG*	36,400	20,000	15,000	8,200	106,000
L7b1	*Diesel*	6,628	5,000	1,000	2,000	40,000
L7b2	*LNG*	29,772	15,000	14,000	6,200	66,000
L7b3=L7b1/L7b	*Diesel % of total net thermal*	*18%*	*25%*	*7%*	*24%*	*38%*
L8	YEC Wind	-	-	-	-	-
L9	Total Grid load	455,391	455,391	418,390	418,390	466,458
	LTA Expected Generation Sources					
L10	YECL Fish Lake (expected)	8,391	8,391	8,391	8,391	8,391
L11	YEC Wind (expected)	-	-	-	-	-
L12=L9-L10-L11	YEC Grid load net of expected Fish Lake and Wind	447,000	447,000	409,999	409,999	458,067
L13=L12-L1c+L11	Load Variance	26,736	26,736	(10,265)	(10,265)	37,802
*L14=L1d+L13*L1e*	LTA Thermal Generation at Actual Load	28,464	28,464	11,706	11,706	33,480
L15=L17/L14	Actual Thermal as % of LTA Thermal Thermal Generation at Actual Load	127.88%	70.26%	128.14%	70.05%	317%
*L16=L1d*L15*	Estimated Actual Thermal Generation at Forecast Load	20,915	11,492	20,958	11,457	51,782
L17=L16	Estimated Actual Thermal Generation at Forecast Load	20,915	11,492	20,958	11,457	51,782
*L17a=L17*L7b3*	Diesel	*3,808*	*2,873*	*1,397*	*2,794*	*19,541*
L17b=L17-L17a	LNG (Modified from filing where LNG never >90%)	*17,106*	*8,619*	*19,561*	*8,662*	*32,242*
L18=L1d	Forecast YEC Net Thermal Generation	16,355	16,355	16,355	16,355	16,355
L18a	Diesel (at 10%)	*1,636*	*1,636*	*1,636*	*1,636*	*1,636*
L18b	LNG (at 90%)	*14,720*	*14,720*	*14,720*	*14,720*	*14,720*
L19=L17-L18	YEC Thermal Generation to be included in LWRF	4,559	(4,864)	4,603	(4,898)	35,427
L19a	YEC Diesel Generation to be included in LWRF	2,173	1,237	(238)	1,159	17,905
L19b	YEC LNG Generation to be included in LWRF	2,387	(6,101)	4,841	(6,057)	17,522
L20=L1axL19a+L1bx						
L19b	Incremental YEC Thermal Generation Cost to Charge (Refund) LWRF ($000s)	$922	($569)	$647	($583)	$7,285
	Calculation of Thermal Cost to Charge (Refund) LWRF prior to Board Order 2019-04					
L16=L14	Expected YEC Thermal Generation in Rates	28,464	28,464	11,706	11,706	33,480
L16a=L16-L16b	Diesel	*5,183*	*5,000*	*1,171*	*2,000*	*12,634*
L16b	LNG = (90% of L16 subject to not exceeding L16 less L7b3*L16) when L15>100% and otherwise not exceeding L16 less L17a [Modified]*	*23,282*	*23,464*	*10,535*	*9,706*	*20,846*
	*Modified from Feb compliance filing -					
L17=L7	Actual YEC Net Thermal Generation	36,400	20,000	15,000	8,200	106,000
L17a	Diesel=L7b1	6,628	5,000	1,000	2,000	40,000
L17b	LNG=L7b2	29,772	15,000	14,000	6,200	66,000
L18=L17-L16	YEC Thermal Generation to be included in LWRF	7,935	(8,465)	3,294	(3,506)	72,520
L18a	YEC Diesel Generation to be included in LWRF	1,445	0	(171)	0	27,366
L18b	YEC LNG Generation to be included in LWRF	6,490	(8,465)	3,465	(3,506)	45,154
L19=L1axL18a+L1bx						
L18b	Incremental YEC Thermal Generation Cost to Charge (Refund) LWRF ($000s)	$1,332	($1,242)	$463	($514)	$13,830
	Description Summaries					
	LNG share of expected at L16 (prior toOrder 2019-04)	81.8%	82.4%	90.0%	82.9%	62.3%
	Diesel share actual	18%	25%	7%	24%	38%
	Diesel share forecast expected with Order 2019-04	18%	25%	7%	24%	38%
	Diesel share LWRF transfer with Order 2019-05	48%	-25%	-5%	-24%	51%
	Diesel share actual LTA prior to Order 2019-04	18%	18%	10%	17%	38%
	Diesel share LWRF transfer prior to Order 2019-04	18%	0%	-5%	0%	38%
	YEC Thermal Cost for actual Thermal before LWRF ($000)	$6,112	$3,517	$2,317	$1,436	$20,214
	Impact of LWRF on YEC ($000)					
	With Order 2019-04	($922)	$569	($647)	$583	($7,285)
	Prior to Order 2019-04	($1,332)	$1,242	($463)	$514	($13,830)
	YEC Net Cost After LWRF ($000)					
	With Order 2019-04	$5,190	$4,086	$1,670	$2,019	$12,929
	Prior to Order 2019-04	$4,780	$4,758	$1,854	$1,950	$6,385
	Net Impact on YEC of Order 2019-04 ($000)	$410	($673)	($184)	$69	$6,544