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January 11, 2022

Mr. Patrick Wruck
Commission Secretary and Manager
Regulatory Support
British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Wruck:

RE: British Columbia Utilities Commission (BCUC or Commission)
British Columbia Hydro and Power Authority (BC Hydro)
Annual Reporting of Reliability Indices Annual Response to Directive 26 of BCUC Decision on F2005/F2006 Revenue Requirements Application (F05/F06 RRA)
Responses to BCUC Staff Information Request No. 1

BC Hydro writes to provide its responses to BCUC Staff Information Request No. 1 on BC Hydro's Fiscal 2021 Annual Reporting of Reliability Indices dated June 4, 2021.

In the course of responding to these BCUC Staff Questions, BC Hydro became aware of a potential issue regarding our reporting of certain transmission-related reliability indices. As such, BC Hydro will be reviewing this potential issue further and will advise the BCUC of the outcome and prepare a subsequent filing with revised information, if/as needed.

For further information, please contact Alicia Henderson at 604-623-4381 or by email at bchydroregulatorygroup@bchydro.com.

Yours sincerely,

Chris Sandve
Chief Regulatory Officer

bf/ma

Enclosure

1.0 Reference: Distribution and Transmission Reliability Indices
F2021 Annual Reporting of Reliability Indices dated June 4, 2021 (Annual Reliability Report), Attachment 1, p. 3
Reliability Indices

On page 3 of Attachment 1 of the F2021 Annual Reporting of Reliability Indices (Report), British Columbia Hydro and Power Authority (BC Hydro) provides the following tables:

Table 3 Reliability Indices – BC Hydro Overall – Normalized using IEEE 2.5 Beta Method

Year	BC Hydro Overall – Normalized using IEEE 2.5 Beta method				
	SAIFI	SAIDI	CAIDI	CEMI-4 (%)	%ASAI
F2012	1.67	3.89	2.34	15.37	99.956
F2013	1.46	3.33	2.28	10.45	99.962
F2014	1.68	4.14	2.46	12.52	99.953
F2015	1.35	3.37	2.49	10.13	99.962
F2016	1.60	3.42	2.14	14.00	99.961
F2017	1.88	4.37	2.33	16.43	99.950
F2018	1.67	3.94	2.36	14.55	99.955
F2019	1.39	3.21	2.32	10.65	99.963
F2020	1.68	3.56	2.12	14.59	99.959
F2021	1.56	3.52	2.25	19.19	99.960

Table 4 Reliability Indices – BC Hydro CEMI 4 Overall (All-Event Indices, Not Normalized)

Year	BC Hydro Overall
	CEMI-4 %
F2012	17.43
F2013	12.88
F2014	15.10
F2015	15.15
F2016	23.77
F2017	19.45
F2018	20.87
F2019	17.14
F2020	18.39
F2021	20.17

Note: CEA does not survey for CEMI-4 or IEEE 2.5 Beta.

1.1.1 Please explain the reason for the increase in CEMI-4 from F2020 to F2021, as provided in Table 3.

RESPONSE:

BC Hydro has discovered an error in the formula used to calculate CEMI-4% for fiscal 2021 in Table 3. All other values in Table 3 have subsequently been reviewed and found to be correct. The updated Table 3 is shown below.

The corrected CEMI-4% for fiscal 2021 (normalized using the IEEE 2.5 beta method) is 14.35% which makes it lower than fiscal 2020.

Table 3 Reliability Indices – BC Hydro Overall – Normalized using IEEE 2.5 Beta Method

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F2020	1.68	3.56	2.12	14.59	99.959
F2021	1.56	3.52	2.25	14.35	99.960

Note: With F2021 CEMI-4 (%) restated.

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Table 4 Reliability Indices – BC Hydro CEMI 4 Overall (All-Event Indices, Not Normalized)

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F2020	18.39
F2021	20.17

Note: CEA does not survey for CEMI-4 or IEEE 2.5 Beta.

1.1.2 Please explain the relationship between CEMI-4, SAIDI and SAFI, given the increase in CEMI-4 and decrease in SAIDI and SAIFI from F2020 to F2021, as provided in Table 3.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.1.1 which presents the corrected CEMI-4% value for fiscal 2021 from what appears in Table 3 in the preamble to the question. The corrected value for CEMI-4% is 14.35%. This is a decrease from fiscal 2020 to fiscal 2021, which is similar to the decreasing SAIDI and SAIFI values for the same period.

The relationship between SAIFI and CEMI-4 is not a direct relationship but can have directional similarities because they both report on customer outage counts.

SAIDI reports the average durations of outages. CEMI-4 does not use duration of outages in its calculation. Therefore, generally there is no relationship between

SAIDI and CEMI-4. Please refer to the IEEE Standard 1366 - Guide for Electric Power Distribution Reliability Indices[1] for definition of these indices.

The IEEE Standard definitions for CEMI-4%, SAIFI, SAIDI are reproduced below for reference:

1.1.1 SAIFI: System Average Interruption Frequency Index

The System Average Interruption Frequency Index (SAIFI) indicates how often the average customer experiences a sustained interruption over a predefined period of time. Mathematically, this is given in Eq. (1).

$$SAIFI = \frac{\sum \text{Total Number of Customers Interrupted}}{\text{Total Number of Customers Served}} \quad (1)$$

To calculate the index, use Eq. (2).

$$SAIFI = \frac{\sum N_i}{N_T} = \frac{CI}{N_T} \quad (2)$$

1.1.2 SAIDI: System Average Interruption Duration Index

The System Average Interruption Duration Index (SAIDI) indicates the total duration of interruption for the average customer during a predefined period of time. It is commonly measured in minutes or hours of interruption. Mathematically, this is given in Eq. (3).

$$SAIDI = \frac{\sum \text{Customer Minutes of Interruption}}{\text{Total Number of Customers Served}} \quad (3)$$

To calculate the index, use Eq. (4).

$$SAIDI = \frac{\sum r_i N_i}{N_T} = \frac{CMI}{N_T} \quad (4)$$

1.1.3 $CEMI_n$: Customers Experiencing Multiple Interruptions

The Customers Experiencing Multiple Interruptions Index ($CEMI_n$) indicates the ratio of individual customers experiencing *n* or more sustained interruptions to the total number of customers served. Mathematically, this is given in Eq. (13).

$$CEMI_n = \frac{\text{Total Number of Customers that experienced n or more sustained interruptions}}{\text{Total Number of Customers Served}} \quad (13)$$

To calculate the index, use Eq. (14).

$$CEMI_n = \frac{CN_{(k \geq n)}}{N_T} \quad (14)$$

[1] https://standards.ieee.org/standard/1366-2012.html.

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F2017	19.45
F2018	20.87
F2019	17.14
F2020	18.39
F2021	20.17

Note: CEA does not survey for CEMI-4 or IEEE 2.5 Beta.

1.1.3 Please describe the factors that have resulted in BC Hydro's 9-year CEMI-4 performance as provided in Table 3.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.1.1 which provides corrected results for CEMI-4.

The contributing factors affecting CEMI-4 performance are generally the same factors that impact all customer outages on the BC Hydro system.

The primary contributing factor impacting CEMI-4 over the past nine years was tree caused outages. All other contributing factors impacting CEMI-4 (e.g.,

equipment failures, motor vehicle incidents, etc.) are consistently lower and vary in impact from year to year. The regions of the province impacting CEMI-4 also vary from year to year due to the areas affected by weather events.

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F2018	20.87
F2019	17.14
F2020	18.39
F2021	20.17

Note: CEA does not survey for CEMI-4 or IEEE 2.5 Beta.

1.1.4 Please explain the reason for the difference in the "Not-Normalized" CEMI-4 value in Table 4 and the "Normalized" CEMI-4 value in Table 3, for F2021.

RESPONSE:

"Not-Normalized" CEMI-4 values in Table 4 are based on all outage events that occurred in fiscal 2021. The IEEE Beta 2.5 "Normalized" CEMI-4 values in Table 3, which were restated in BC Hydro's response to BCUC Staff IR 1.1.1, are based on outage data that excludes outages that occurred in fiscal 2021 Major Event Days as defined by IEEE Standard 1366 - Guide for Electric Power Distribution Reliability Indices.[1]

[1] https://standards.ieee.org/standard/1366-2012.html.

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Note: CEA does not survey for CEMI-4 or IEEE 2.5 Beta.

1.1.4 Please explain the reason for the difference in the "Not-Normalized" CEMI-4 value in Table 4 and the "Normalized" CEMI-4 value in Table 3, for F2021.

1.1.4.1 Please list and provide the reasons for any outage events that have been excluded from the "Normalized" CEMI-4 value for F2021.

RESPONSE:

The IEEE Beta 2.5 method of normalizing Major Events excludes all events across the entire BC Hydro system for the entire day identified as a Major Event Day.

Please refer to the IEEE Standard 1366 - Guide for Electric Power Distribution Reliability Indices[1] for the definition of the Beta 2.5 normalization process.

The following table lists the fiscal 2021 IEEE Beta 2.5 normalized Major Event Days. The reasons for all the Major Event Days were due to storms.

Date	Cause of Major Event	Areas of BC Affected by Major Event
October 13, 2020	**Windstorm**	**Lower Mainland and Vancouver Island**
November 17, 2020	**Winter Snowstorm**	**Lower Mainland and Vancouver Island**
December 21, 2020	**Winter Snowstorm**	**Lower Mainland, all of the South coast, Southern Interior and Vancouver Island**
January 5, 2021	**Windstorm**	**Lower Mainland and Vancouver Island**
January 13, 2021	**Winter Snowstorm with High Winds**	**Lower Mainland, all of the South coast, Southern Interior and Vancouver Island**
March 28, 2021	**Windstorm**	**Lower Mainland, all of the South coast, and Vancouver Island**

[1] **https://standards.ieee.org/standard/1366-2012.html**.

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F2013	12.88
F2014	15.10
F2015	15.15
F2016	23.77
F2017	19.45
F2018	20.87
F2019	17.14
F2020	18.39
F2021	20.17

Note: CEA does not survey for CEMI-4 or IEEE 2.5 Beta.

1.1.5 Please describe any actions BC Hydro has undertaken or is planning to undertake with respect to CEMI-4 performance.

RESPONSE:

BC Hydro does not use CEMI-4 as a system-wide performance metric. At the localized feeder level, tracking CEMI-4 helps BC Hydro to prioritize the worst preforming circuits and make investments to reduce customer interruptions. Examples of those investments include:

- **Vegetation Management Programs;**
- **Distribution Automation Recloser Program;**

- **Circuit relocations to move sections of circuits causing high interruption counts;**
- **All maintenance programs that pre-emptively eliminate asset failures;**
- **Undergrounding of circuits – either entire circuit or part of circuits; and**
- **Animal outage mitigation.**

2.0 Reference: Distribution and Transmission Reliability Indices
F2021 Annual Reliability Report, Attachment 1, p. 4
Reliability Indices

On page 4 of Attachment 1, BC Hydro provides the following reliability indices table:

Table 5 Reliability Indices – BC Hydro (Transmission) and CEA (Transmission) (Forced Data) (All-Event Indices, Not Normalized)

Year	BC Hydro (Transmission) (Forced)					CEA (Transmission) (Forced)				
	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI
F2012	0.43	0.86	1.55	19.39	1.81	0.84	0.81	1.73	23.35	2.13
F2013	0.56	0.74	1.64	17.16	2.19	0.84	0.90	4.48	51.18	4.98
F2014	0.74	0.87	2.57	25.18	3.01	0.86	0.83	2.59	27.07	3.11
F2015	0.83	0.74	2.11	26.41	2.86	0.72	0.83	2.56	19.24	3.10
F2016	0.79	0.53	2.46	27.77	3.90	0.85	0.74	2.15	15.60	2.90
F2017	0.63	0.61	2.52	33.61	4.13	0.70	0.75	1.93	22.33	2.58
F2018	0.30	0.69	2.50	30.13	3.62	0.55	0.77	2.24	20.02	2.90
F2019	0.57	0.34	0.92	7.61	2.71	0.65	1.06	3.48	33.87	3.27
F2020*	0.90	0.89	2.74	46.30	3.08	0.82	0.89	2.63	30.07	2.94
F2021	0.70	0.75	7.10	64.75	9.47	n/a	n/a	n/a	n/a	n/a

Note: The CEA Bulk Electricity Study program reports only on forced outage results as not all the participating utilities report planned outages.

* F2020 BC Hydro (Transmission) Forced numbers filed last year were incorrect; the table has been updated to reflect the corrected numbers.

1.2.1 Please explain the reason for the increase in BC Hydro's SAIDI from F2020 to F2021.

RESPONSE:

BC Hydro assumes that BCUC Staff IRs 1.2.1 and 1.2.1.1 specifically refer to T-SAIDI.

For fiscal 2021, T-SAIDI, DPUI, and SARI are all higher than the previous nine years mainly due to longer total transmission line outage duration. Transmission line outage duration is used in the numerator when calculating T-SAIDI, DPUI, and SARI; as a result, an increase in transmission line outage duration will impact all three of these indices and result in higher T-SAIDI, DPUI, and SARI.

The longer transmission line outage duration in fiscal 2021 was primarily due to the following:

- **Multiple outages due to customer equipment issues of one particular Transmission Service customer, which account for 37% of the fiscal 2021 total T-SAIDI and SARI, and 31% of total DPUI; and**
- **Increased impacts from major storm events, which account for 20%of the fiscal 2021 total T-SAIDI and SARI, and 28% of total DPUI.**

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F2014	0.74	0.87	2.57	25.18	3.01	0.86	0.83	2.59	27.07	3.11
F2015	0.83	0.74	2.11	26.41	2.86	0.72	0.83	2.56	19.24	3.10
F2016	0.79	0.63	2.46	27.77	3.90	0.85	0.74	2.15	15.60	2.90
F2017	0.63	0.61	2.52	33.61	4.13	0.70	0.75	1.93	22.33	2.58
F2018	0.30	0.69	2.50	30.13	3.62	0.55	0.77	2.24	20.02	2.90
F2019	0.57	0.34	0.92	7.61	2.71	0.65	1.06	3.48	33.87	3.27
F2020*	0.90	0.89	2.74	46.30	3.08	0.82	0.89	2.63	30.07	2.94
F2021	0.70	0.75	7.10	64.75	9.47	n/a	n/a	n/a	n/a	n/a

Note: The CEA Bulk Electricity Study program reports only on forced outage results as not all the participating utilities report planned outages.

* F2020 BC Hydro (Transmission) Forced numbers filed last year were incorrect; the table has been updated to reflect the corrected numbers.

1.2.1 Please explain the reason for the increase in BC Hydro's SAIDI from F2020 to F2021.

1.2.1.1 Please comment on BC Hydro's F2021 SAIDI performance against the previous 9-year BC Hydro and CEA historical data.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.2.1, where we explain why BC Hydro's fiscal 2021 T-SAIDI performance is higher than the previous nine years of BC Hydro's historical data.

BC Hydro's T-SAIDI is lower than the CEA composite average for five of the nine previous years. Overall, BC Hydro's T-SAIDI average of 2.11 for the previous nine years is lower than CEA's composite average of 2.64 for the same period.

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F2014	0.74	0.87	2.57	25.18	3.01	0.86	0.83	2.59	27.07	3.11
F2015	0.83	0.74	2.11	26.41	2.86	0.72	0.83	2.56	19.24	3.10
F2016	0.79	0.53	2.46	27.77	3.90	0.85	0.74	2.15	15.60	2.90
F2017	0.63	0.61	2.52	33.61	4.13	0.70	0.75	1.93	22.33	2.58
F2018	0.30	0.69	2.50	30.13	3.62	0.55	0.77	2.24	20.02	2.90
F2019	0.57	0.34	0.92	7.61	2.71	0.65	1.06	3.48	33.87	3.27
F2020*	0.90	0.89	2.74	46.30	3.08	0.82	0.89	2.63	30.07	2.94
F2021	0.70	0.75	7.10	64.75	9.47	n/a	n/a	n/a	n/a	n/a

Note: The CEA Bulk Electricity Study program reports only on forced outage results as not all the participating utilities report planned outages.

* F2020 BC Hydro (Transmission) Forced numbers filed last year were incorrect; the table has been updated to reflect the corrected numbers.

1.2.2 Please explain the reason for the increase in BC Hydro's DPUI from F2020 to F2021.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.2.1, where we explain why BC Hydro's fiscal 2021 DPUI performance is higher than the previous nine years of BC Hydro's historical data including fiscal 2020.

2.0 Reference: Distribution and Transmission Reliability Indices
F2021 Annual Reliability Report, Attachment 1, p. 4
Reliability Indices

On page 4 of Attachment 1, BC Hydro provides the following reliability indices table:

Table 5 Reliability Indices – BC Hydro (Transmission) and CEA (Transmission) (Forced Data) (All-Event Indices, Not Normalized)

Year	BC Hydro (Transmission) (Forced)					CEA (Transmission) (Forced)				
	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI
F2012	0.43	0.86	1.55	19.39	1.81	0.84	0.81	1.73	23.35	2.13
F2013	0.56	0.74	1.64	17.16	2.19	0.84	0.90	4.48	51.18	4.98
F2014	0.74	0.87	2.57	25.18	3.01	0.86	0.83	2.59	27.07	3.11
F2015	0.83	0.74	2.11	26.41	2.86	0.72	0.83	2.56	19.24	3.10
F2016	0.79	0.63	2.46	27.77	3.90	0.85	0.74	2.15	15.60	2.90
F2017	0.63	0.61	2.52	33.61	4.13	0.70	0.75	1.93	22.33	2.58
F2018	0.30	0.69	2.50	30.13	3.62	0.55	0.77	2.24	20.02	2.90
F2019	0.57	0.34	0.92	7.61	2.71	0.65	1.06	3.48	33.87	3.27
F2020*	0.90	0.89	2.74	46.30	3.08	0.82	0.89	2.63	30.07	2.94
F2021	0.70	0.75	7.10	64.75	9.47	n/a	n/a	n/a	n/a	n/a

Note: The CEA Bulk Electricity Study program reports only on forced outage results as not all the participating utilities report planned outages.

* F2020 BC Hydro (Transmission) Forced numbers filed last year were incorrect; the table has been updated to reflect the corrected numbers.

1.2.2 Please explain the reason for the increase in BC Hydro's DPUI from F2020 to F2021.

1.2.2.1 Please comment on BC Hydro's F2021 DPUI performance against the previous 9-year BC Hydro and CEA historical data.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.2.1, where we explain why BC Hydro's fiscal 2021 DPUI performance is higher than the previous nine years of BC Hydro's historical data.

BC Hydro's DPUI is lower than the CEA composite average for four of the nine previous years. Overall, BC Hydro's DPUI average of 25.95 for the previous nine years is lower than CEA's composite average of 26.97 for the same period.

2.0 Reference: Distribution and Transmission Reliability Indices
F2021 Annual Reliability Report, Attachment 1, p. 4
Reliability Indices

On page 4 of Attachment 1, BC Hydro provides the following reliability indices table:

Table 5 Reliability Indices – BC Hydro (Transmission) and CEA (Transmission) (Forced Data) (All-Event Indices, Not Normalized)

Year	BC Hydro (Transmission) (Forced)					CEA (Transmission) (Forced)				
	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI
F2012	0.43	0.86	1.55	19.39	1.81	0.84	0.81	1.73	23.35	2.13
F2013	0.56	0.74	1.64	17.16	2.19	0.84	0.90	4.48	51.18	4.98
F2014	0.74	0.87	2.57	25.18	3.01	0.86	0.83	2.59	27.07	3.11
F2015	0.83	0.74	2.11	26.41	2.86	0.72	0.83	2.56	19.24	3.10
F2016	0.79	0.53	2.46	27.77	3.90	0.85	0.74	2.15	15.60	2.90
F2017	0.63	0.61	2.52	33.61	4.13	0.70	0.75	1.93	22.33	2.58
F2018	0.30	0.69	2.50	30.13	3.62	0.55	0.77	2.24	20.02	2.90
F2019	0.57	0.34	0.92	7.61	2.71	0.65	1.06	3.48	33.87	3.27
F2020*	0.90	0.89	2.74	46.30	3.08	0.82	0.89	2.63	30.07	2.94
F2021	0.70	0.75	7.10	64.75	9.47	n/a	n/a	n/a	n/a	n/a

Note: The CEA Bulk Electricity Study program reports only on forced outage results as not all the participating utilities report planned outages.

* F2020 BC Hydro (Transmission) Forced numbers filed last year were incorrect; the table has been updated to reflect the corrected numbers.

1.2.3 Please explain the reason for the increase in BC Hydro's SARI from F2020 to F2021.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.2.1, where we explain why BC Hydro's fiscal 2021 SARI performance is higher than the previous nine years of BC Hydro's historical data including fiscal 2020.

2.0 Reference: Distribution and Transmission Reliability Indices
F2021 Annual Reliability Report, Attachment 1, p. 4
Reliability Indices

On page 4 of Attachment 1, BC Hydro provides the following reliability indices table:

Table 5 Reliability Indices – BC Hydro (Transmission) and CEA (Transmission) (Forced Data) (All-Event Indices, Not Normalized)

Year	BC Hydro (Transmission) (Forced)					CEA (Transmission) (Forced)				
	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI
F2012	0.43	0.86	1.55	19.39	1.81	0.84	0.81	1.73	23.35	2.13
F2013	0.56	0.74	1.64	17.16	2.19	0.84	0.90	4.48	51.18	4.98
F2014	0.74	0.87	2.57	25.18	3.01	0.86	0.83	2.59	27.07	3.11
F2015	0.83	0.74	2.11	26.41	2.86	0.72	0.83	2.56	19.24	3.10
F2016	0.79	0.53	2.46	27.77	3.90	0.85	0.74	2.15	15.60	2.90
F2017	0.63	0.61	2.52	33.61	4.13	0.70	0.75	1.93	22.33	2.58
F2018	0.30	0.69	2.50	30.13	3.62	0.55	0.77	2.24	20.02	2.90
F2019	0.57	0.34	0.92	7.61	2.71	0.65	1.06	3.48	33.87	3.27
F2020*	0.90	0.89	2.74	46.30	3.08	0.82	0.89	2.63	30.07	2.94
F2021	0.70	0.75	7.10	64.75	9.47	n/a	n/a	n/a	n/a	n/a

Note: The CEA Bulk Electricity Study program reports only on forced outage results as not all the participating utilities report planned outages.

* F2020 BC Hydro (Transmission) Forced numbers filed last year were incorrect; the table has been updated to reflect the corrected numbers.

1.2.3 Please explain the reason for the increase in BC Hydro's SARI from F2020 to F2021.

1.2.3.1 Please comment on BC Hydro's F2021 SARI performance against the previous 9-year BC Hydro and CEA historical data.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.2.1, where we explain why BC Hydro's fiscal 2021 SARI performance is higher than the previous nine years of BC Hydro's historical data.

BC Hydro's SARI is lower than the CEA composite average for five of the nine previous years. Overall, BC Hydro's SARI average of 3.03 for the previous nine years is lower than CEA's composite average of 3.10 for the same period.

2.0 Reference: Distribution and Transmission Reliability Indices
F2021 Annual Reliability Report, Attachment 1, p. 4
Reliability Indices

On page 4 of Attachment 1, BC Hydro provides the following reliability indices table:

Table 5 Reliability Indices – BC Hydro (Transmission) and CEA (Transmission) (Forced Data) (All-Event Indices, Not Normalized)

Year	BC Hydro (Transmission) (Forced)					CEA (Transmission) (Forced)				
	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI	T-SAIFI-MI	T-SAIFI-SI	T-SAIDI	DPUI	SARI
F2012	0.43	0.86	1.55	19.39	1.81	0.84	0.81	1.73	23.35	2.13
F2013	0.56	0.74	1.64	17.16	2.19	0.84	0.90	4.48	51.18	4.98
F2014	0.74	0.87	2.57	25.18	3.01	0.86	0.83	2.59	27.07	3.11
F2015	0.83	0.74	2.11	26.41	2.86	0.72	0.83	2.56	19.24	3.10
F2016	0.79	0.63	2.46	27.77	3.90	0.85	0.74	2.15	15.60	2.90
F2017	0.63	0.61	2.52	33.61	4.13	0.70	0.75	1.93	22.33	2.58
F2018	0.30	0.69	2.50	30.13	3.62	0.55	0.77	2.24	20.02	2.90
F2019	0.57	0.34	0.92	7.61	2.71	0.65	1.06	3.48	33.87	3.27
F2020*	0.90	0.89	2.74	46.30	3.08	0.82	0.89	2.63	30.07	2.94
F2021	0.70	0.75	7.10	64.75	9.47	n/a	n/a	n/a	n/a	n/a

Note: The CEA Bulk Electricity Study program reports only on forced outage results as not all the participating utilities report planned outages.

* F2020 BC Hydro (Transmission) Forced numbers filed last year were incorrect; the table has been updated to reflect the corrected numbers.

1.2.4 Please describe any actions BC Hydro has undertaken or is planning to undertake with respect to improving SADI, DPUI and SARI performance.

RESPONSE:

BC Hydro assumes that BCUC Staff IR 1.2.4 specifically refers to T-SAIDI.

BC Hydro continues to prioritize maintenance activities to minimize the risk of forced outages, including more frequent inspections and equipment replacement when the equipment is nearing end of life. The increased vegetation management activities to comply with FAC-003 on high voltage transmission circuits, additional maintenance on lower-voltage transmission and increased hazard tree removals also help to reduce the number of forced outages on the system due to vegetation incursion.

Specific activities that BC Hydro is undertaking to reduce the duration of forced outages include communication upgrades to improve the reliability of the Schweitzer relay system which provides fault location information. In addition, visual fault indicators have also been installed on some radial transmission lines to assist the field crews in identifying the location of a line trip to enable faster response and repairs.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average [Note 2]						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Interval] [Note 1]	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Interval] [Note 1]	Weighted FOF (%) (including starting failures) [Interval] [Note 1]	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Interval] [Note 1]	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	86.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 [Note 3]	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 [Note 3]	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 [Note 3]	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 [Note 3]	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 [Note 3]	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 [Note 3]	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 [Note 4]	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 [Note 4]	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.1 Please explain the significance of using a weighted average when calculating the above reliability indices.

RESPONSE:

This response also answers to BCUC Staff IRs 1.3.1.1 to 1.3.1.4 and 1.3.2 to 1.3.4.

There are three terms referenced amongst others in the above table: (1) average availability factor, (2) average operating factor, and (3) average forced outage factor.

1. **Average availability factor includes generation time, synchronous condense time, stand-by time and time from forced outages due to external causes (e.g., act of nature, grid failure). It is shown as a percentage against the number of hours in a year (365 days x 24 hours). The average availability factor goes up and down depending on outage time for planned maintenance, planned capital, emergent maintenance, and forced outages.**

2. **Average operating factor includes generation time and synchronous condense time and is shown as a percentage against the number of hours in a year. The average operating factor goes up and down depending on the same outages that impact the average availability factor. Stand-by time and time from forced outages due to external causes also impact the average operating factor as they will determine the amount of time units spend operating when they are available.**

3. **Average forced outage factor includes forced outage time and is shown as a percentage against the number of hours in a year.**

BC Hydro focuses on measuring and sustaining performance using average forced outage factor for Key Generation Facilities so that the units at those facilities can be reliably dispatched at the most beneficial times. BC Hydro's seven Key Generation Facilities provide 90% of the average annual electricity generated by BC Hydro. BC Hydro has consistently met its Service Plan objectives for the Key Generating Facility Forced Outage Factor metric. This metric provides a long-term indicator of the effectiveness of our maintenance and capital investment programs.

BC Hydro has 83 hydro generating units with a wide range of capacities. The weighted averages provided in the table consider the capacity of each generating unit to account for the large differences in the sizes of BC Hydro's generating units. For example, for the non-weighted values in the table, one hour of time on a 524 MW Revelstoke unit is weighted the same as one hour of time on a 3 MW Shuswap unit. In contrast the weighted values in the table are proportional to the capacity of each unit.

Given the significant variability of how utilities measure and report on reliability indices, BC Hydro uses CEA comparisons at a high level to monitor relative relationships between the indices. The relative relationships between BC Hydro's weighted and non-weighted averages and CEA averages are similar. However, the difference between BC Hydro's weighted averages and CEA averages is generally smaller than the difference between BC Hydro's non-weighted averages and CEA averages.

Regarding the average availability factor, the majority of BC Hydro's outages are considered as planned outages. BC Hydro's large integrated system provides flexibility that allows us to schedule outages at a time when the unit unavailability is an acceptable risk to the system. BC Hydro's continued effective delivery of our maintenance and capital plans helps keep our assets current and functioning, which reduces the likelihood of forced outages on our system ensuring delivery of reliable power at a lower cost.

BC Hydro seeks to balance planned investments and forced outage tolerance recognizing that forced outages are generally higher cost and can limit system flexibility if they occur at inopportune times. As a result, BC Hydro's average availability factor has been below the CEA average for the past nine years mainly because BC Hydro spent 12.0% of time over those nine years for planned outages compared to the CEA average of 6.61% over the same period. Most recently, the higher availability factor in fiscal 2021 compared to fiscal 2020 was a result of BC Hydro spending 17.3% less time on planned outages in fiscal 2021 compared to fiscal 2020. This reduction was mainly due to work plan execution limitations caused by the COVID-19 pandemic, as well as the need to operate units to manage water levels across the overall system.

Regarding the average operating factor, the results are mostly impacted by system outages (as described for average availability factor) and stand-by time. Units in stand-by provide valuable dispatch flexibility for changing load conditions. Several variables influence the stand-by time such as availability of energy (inflow and storage), domestic load and requirements for reservoir storage/dispatch, deliveries from IPPs and export market conditions where parameters vary seasonally and within the day. BC Hydro unit dispatch aims to maximize consolidated net revenue from operations, while also meeting various obligations (e.g., environmental and regulatory).

Since fiscal 2014, BC Hydro's average operating factor has declined at a similar rate to the CEA average but at a greater rate relative to the BC Hydro average availability factor. This decline is due to BC Hydro stand-by time trending up over this period. In recent years, the stand-by time has increased due to below-average inflows in parts of the system, and changes in operation of some generating units. In addition, BC Hydro operated our units more in fiscal 2021 than in fiscal 2020 due to less planned outage time in fiscal 2021. This increase in operation was mainly due to work plan execution limitations resulting from the COVID-19 pandemic, as well as the need to operate units to manage water levels across the overall system.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average [Note 2]						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Internal] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Internal] [Note 1]	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Internal] [Note 1]	Weighted FOF (%) (including starting failures) [Internal] [Note 1]	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Note 1]	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	88.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 [Note 3]	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 [Note 3]	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 [Note 3]	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 [Note 3]	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 [Note 3]	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 [Note 3]	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 [Note 3]	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 [Note 3]	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.1 Please explain the significance of using a weighted average when calculating the above reliability indices.

1.3.1.1 Please explain how BC Hydro's weighted average reliability indices are comparable to the CEA averages.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.3.1 where we explain that the weighted averages provided in the table consider the capacity of each generating unit to account for the large differences in the sizes of BC Hydro's generating units.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average [Note 2]						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Internal] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Internal] [Note 1]	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Internal] [Note 1]	Weighted FOF (%) (including starting failures) [Internal] [Note 1]	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Internal] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Internal] [Note 1]	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	88.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 [Note 3]	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 [Note 3]	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 [Note 3]	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 [Note 3]	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 [Note 3]	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 [Note 3]	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 [Note 3]	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 [Note 3]	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.1 Please explain the significance of using a weighted average when calculating the above reliability indices.

1.3.1.2 Please explain the reason why BC Hydro's Availability Factor has been below the CEA average for the past 9 years.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.3.1 where we explain that the majority of BC Hydro's outage time is for planned outages, and that BC Hydro's average availability factor has been below the CEA average for the past nine years mainly because BC Hydro spent 12.0% of time over those nine years for planned outages compared to the CEA average of 6.61% for the same period. BC Hydro's large integrated system provides flexibility that allows us to schedule outages to deliver our capital and maintenance plans at a time when the unit unavailability is an acceptable risk to the system.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average Note 2						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] Note 1	Average Forced Outage Factor (%) (including starting failures) [Interval] Note 1	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Interval] Note 1	Weighted FOF (%) (including starting failures) [Interval] Note 1	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] Note 1	Average Forced Outage Factor (%) (including starting failures) [Interval] Note 1	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	88.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 Note 3	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 Note 3	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 Note 3	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 Note 3	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 Note 3	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 Note 3	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 Note 4	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 Note 4	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.1 Please explain the significance of using a weighted average when calculating the above reliability indices.

1.3.1.3 Please explain the reason for the increase in Availability Factor from F2020 to F2021.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.3.1 where we explain that an increase in average availability factor from fiscal 2020 to fiscal 2021 was a result of BC Hydro spending 17.3% less time on planned outages in fiscal 2021 compared to fiscal 2020. This was mainly due to work plan execution limitations caused by the COVID-19 pandemic, as well as the need to operate units to manage water levels across the overall system.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average [Note 4]						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Internal] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Internal] [Note 1]	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Internal] [Note 1]	Weighted FOF (%) (including starting failures) [Internal] [Note 1]	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Internal] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Internal] [Note 1]	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	88.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 [Note 2]	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 [Note 2]	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 [Note 2]	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 [Note 2]	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 [Note 2]	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 [Note 2]	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 [Note 2]	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 [Note 2]	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.1 Please explain the significance of using a weighted average when calculating the above reliability indices.

1.3.1.4 Please describe any actions BC Hydro has undertaken or is planning to undertake with respect to improving its Availability Factor.

RESPONSE:

BC Hydro is not currently planning to undertake any actions specifically to improve our Availability Factor. Please refer to BC Hydro's response to BCUC Staff IR 1.3.1 where we explain that BC Hydro is focused on measuring and sustaining performance using average forced outage factor for Key Generation Facilities. This ensures the units at those facilities can be reliably dispatched at the most beneficial times.

BC Hydro has consistently met its Service Plan objectives for the Key Generating Facility Forced Outage Factor metric and this metric provides a long-term indicator of the effectiveness of our maintenance and capital investment programs.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average [Note 2]						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Interval] [Note 1]	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Interval] [Note 1]	Weighted FOF (%) (including starting failures) [Interval] [Note 1]	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Interval] [Note 1]	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	88.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 [Note 3]	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 [Note 3]	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 [Note 3]	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 [Note 3]	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 [Note 3]	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 [Note 3]	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 [Note 3]	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 [Note 3]	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.2 Please provide the definition of Average Operating Factor.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.3.1 where we explain that average operating factor includes generation time and synchronous condense time and is shown as a percentage against the number of hours in a year.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average [Note 2]						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Internal] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Internal] [Note 1]	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Internal] [Note 1]	Weighted FOF (%) (including starting failures) [Internal] [Note 1]	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Note 1]	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	88.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 [Note 3]	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 [Note 3]	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 [Note 3]	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 [Note 3]	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 [Note 3]	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 [Note 3]	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 [Note 3]	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 [Note 3]	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.3 Please explain the reason why BC Hydro's Operating Factor has remained below the CEA average between F2014 and F2020.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.3.1 where we explain that the average operating factor is impacted by outage time and stand-by time. Outage time is primarily driven by planned outages to deliver our capital and maintenance plans. Stand-by time is primarily driven by unit dispatch decisions. BC Hydro's average operating factor has remained below the CEA average between fiscal 2014 and fiscal 2020 mainly due planned outages.

3.0 Reference: Generation Reliability Indices
F2021 Annual Reliability Report, Attachment 2, p. 1
Reliability Indices

On page 1 of Attachment 2, the following table is provided by BC Hydro:

	BC Hydro Hydroelectric Units -Total Average					BC Hydro Hydroelectric Units - Weighted Average [Note 2]						CEA Hydroelectric Units -Total Average				
Fiscal Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Interval] [Note 1]	Failure Rate	Weighted Availability Factor (%)	Weighted Operating Factor (%)	Weighted Forced Outage Count (including starting failures) [Interval] [Note 1]	Weighted FOF (%) (including starting failures) [Interval] [Note 1]	Weighted Failure Rate	Calendar Year	Average Availability Factor (%)	Average Operating Factor (%)	Average Forced Outage Count (including starting failures) [Interval] [Note 1]	Average Forced Outage Factor (%) (including starting failures) [Interval] [Note 1]	Failure Rate
F2012	82.2	69.8	2.4	5.0	2.7	85.4	69.9	2.3	1.8	2.6	C2011	88.4	72.5	2.5	3.9	2.2
F2013	82.7	72.6	2.0	3.4	2.3	82.6	72.1	1.7	0.5	2.2	C2012	89.2	72.0	2.5	3.8	2.3
F2014 [Note 3]	80.5	64.7	2.5	4.7	2.7	81.3	65.8	2.3	1.7	2.6	C2013	87.9	74.0	2.4	3.9	2.1
F2015 [Note 3]	81.1	65.1	2.4	3.7	2.9	83.5	62.4	2.6	1.3	3.7	C2014	87.5	73.5	2.4	5.0	2.1
F2016 [Note 3]	82.2	65.9	2.0	4.1	2.4	85.1	66.7	1.8	2.6	2.3	C2015	87.9	70.4	3.2	4.7	2.1
F2017 [Note 3]	81.7	67.6	1.8	4.4	1.9	83.4	65.2	2.3	3.5	3.2	C2016	86.7	71.7	3.1	4.8	1.9
F2018 [Note 3]	80.5	65.5	1.7	2.8	2.0	84.1	66.0	1.8	0.7	2.4	C2017	86.7	73.0	3.3	4.9	2.2
F2019 [Note 3]	79.6	61.9	2.0	2.8	2.3	86.0	63.4	1.9	0.6	2.0	C2018	85.6	67.8	3.7	5.0	2.1
F2020 [Note 4]	76.8	59.1	2.0	4.3	2.3	81.4	61.3	1.8	1.6	2.1	C2019	87.1	70.8	3.3	3.7	1.9
F2021 [Note 4]	81.4	63.8	1.9	2.8	2.2	86.4	66.7	1.8	1.3	1.9	C2020	n/a	n/a	n/a	n/a	n/a

1.3.4 Please explain the reason for the decline in Operating Factor from F2017 to F2020 and the subsequent increase from F2020 to F2021.

RESPONSE:

Please refer to BC Hydro's response to BCUC Staff IR 1.3.1 where we explain that the average operating factor declined from fiscal 2017 to fiscal 2020 as a result of the stand-by time trending upwards primarily due to periods of below average inflows in parts of the system and changes in operation of some units. The subsequent increase in operating factor from fiscal 2020 to fiscal 2021 was due to less planned outage time in fiscal 2021 mainly due to work plan execution limitations resulting from the COVID-19 pandemic, as well as the need to operate units to manage water levels across the overall system.