



**OPTIONAL**  
**Specimen EPA Calculations**  
**Model Demo**

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- Escalated and Adjusted Energy Prices
  - Firm Energy
  - Non-Firm Energy
- Allocation of Energy for Seasonally Firm Projects
- Liquidated Damages
  - Seasonally Firm Energy
  - Hourly Firm Energy
- Firm Energy Adjustments
- Performance Security



## Calculate the Escalated Firm Energy Price (EFEP) effective as of Jan 1, 2015

### Assumptions:

- Firm Energy Price: \$70.00/MWh (Jan 1, 2009 \$)
- Cost of Interconnection Security per \$M of ISA: \$0.30/MWh (Jan 1, 2009 \$)
- Pre-COD escalation: 250%
- Post-COD escalation: 50%
- Guaranteed COD: May 1, 2011
- Interconnection Security Amount from Final Interconnection Report: \$3.7 million

BC CPI Index		Time of Delivery Factor for January	
Jan 1, 2009	100.0	Peak	122%
May 1, 2011	104.73	Super-Peak	141%
Jan 1, 2015	112.98	Off-Peak	105%

- Escalated Firm Energy Price<sub>y</sub> = [FEP + CIS \* interconnection security] \* {escalation<sub>pre-COD</sub> \* [(CPI<sub>COD</sub> / CPI<sub>Jan09</sub>) - 1] + 1} \* {escalation<sub>post-COD</sub> \* [(CPI<sub>y</sub> / CPI<sub>COD</sub>) - 1] + 1}

where y is the year in which the escalated firm energy price is to be calculated

- Sample Calculations

- EFEP before time of delivery adjustment

$$\text{EFEP} = [70.00 + (0.30 * 3.70)] * \left\{ \left[ 2.5 * \left( \frac{104.73}{100.00} - 1 \right) \right] + 1 \right\} * \left\{ \left[ 0.5 * \left( \frac{112.98}{104.73} - 1 \right) \right] + 1 \right\} = \$81.90/\text{MWh}$$

- EFEP after time of delivery adjustment

Peak hours : \$81.90/MWh \* 122% = \$99.92/MWh

Super - Peak hours : \$81.90/MWh \* 141% = \$115.48/MWh

Off - Peak hours : \$81.90/MWh \* 105% = \$86.00/MWh

## Calculate the Non-Firm Energy Price (NFEP) for the month of March 2015

### Assumptions:

- Non-Firm Energy Price Percentage: Option A = 70% and Option B = 30%
- Transmission Losses: 6.28%
- BC CPI Index
  - January 1, 2009: 100.00
  - January 1, 2015: 112.98
- Monthly average Bank of Canada Daily “noon rate” for March 2015: 1.0150 CDN\$/US\$
- Average Dow Jones Mid-C Daily Non-Firm Index for March 2015
  - On-Peak: US\$56.30/MWh
  - Off-Peak: US\$49.70/MWh
- Option A Non-Firm Energy Price for 2015 (Appendix 3 of EPA): \$49.42/MWh
- Time of Delivery Factors for March 2015
  - Peak: 112%
  - Super-Peak: 124%
  - Off-Peak: 99%
  - On-Peak: 115%

- Non-Firm Energy Price<sub>n</sub> = (1 – losses) \* [(Option A% \* NFEP<sub>A</sub> \* CPI<sub>Jan 2015</sub> / CPI<sub>Jan 2009</sub> \* TDF<sub>n</sub>) + (Option B% \* Mid-C Non-Firm Price<sub>n</sub> \* exchange rate)]

where “n” means peak, super-peak or off-peak. The Mid-C peak non-firm price is defined as the Mid-C on-peak non-firm price \* (TDF<sub>peak</sub> / TDF<sub>on-peak</sub>), and the Mid-C super-peak non-firm price is defined as Mid-C on-peak non-firm price \* (TDF<sub>super-peak</sub> / TDF<sub>on-peak</sub>)

- Sample Calculations for March 2015

$$\text{NFEP}_{\text{Peak}} = (1 - 0.0628) * \left[ \left( 0.70 * 49.42 * \frac{112.98}{100.00} * 1.12 \right) + \left( 0.30 * 56.30 * \frac{1.12}{1.15} * 1.0150 \right) \right] = \$56.67/\text{MWh}$$

$$\text{NFEP}_{\text{Super-Peak}} = (1 - 0.0628) * \left[ \left( 0.70 * 49.42 * \frac{112.98}{100.00} * 1.24 \right) + \left( 0.30 * 56.30 * \frac{1.24}{1.15} * 1.0150 \right) \right] = \$62.75/\text{MWh}$$

$$\text{NFEP}_{\text{Off-Peak}} = (1 - 0.0628) * \left[ \left( 0.70 * 49.42 * \frac{112.98}{100.00} * 0.99 \right) + \left( 0.30 * 49.70 * 1.0150 \right) \right] = \$50.45/\text{MWh}$$

# Allocation of Energy for Seasonally Firm Projects

	Allocation for Interim Monthly Payments				Allocation for Seasonal True-up			
	Month 1	Month 2	Month 3	Total	Month 1	Month 2	Month 3	Total
<b>Eligible Energy</b>								
Super-Peak	8	10	8	26	8	10	8	26
Peak	10	17	20	47	10	17	20	47
Off-Peak	7	13	16	36	7	13	16	36
<b>TOTAL</b>	<b>25</b>	<b>40</b>	<b>44</b>	<b>109</b>	<b>25</b>	<b>40</b>	<b>44</b>	<b>109</b>
<b>Energy Allocation</b>								
Firm	25.0	26.7	26.7	78.3	Firm Energy Delivery			80
Non-Firm	0.0	13.3	17.3	30.7	Non-Firm Energy Delivery			29
<b>TOTAL</b>	<b>25.0</b>	<b>40.0</b>	<b>44.0</b>	<b>109.0</b>				<b>109</b>
<b>Cost Allocation</b>								
Super-Peak Firm	8.0	6.7	4.8	19.5	5.9	7.3	5.9	19.1
Peak Firm	10.0	11.3	12.1	33.5	7.3	12.5	14.7	34.5
Off-Peak Firm	7.0	8.7	9.7	25.4	5.1	9.5	11.7	26.4
Super-Peak Non-Firm	0.0	3.3	3.2	6.5	2.1	2.7	2.1	6.9
Peak Non-Firm	0.0	5.7	7.9	13.5	2.7	4.5	5.3	12.5
Off-Peak Non-Firm	0.0	4.3	6.3	10.6	1.9	3.5	4.3	9.6
<b>TOTAL</b>	<b>25.0</b>	<b>40.0</b>	<b>44.0</b>	<b>109.0</b>	<b>25.0</b>	<b>40.0</b>	<b>44.0</b>	<b>109.0</b>

# Liquidated Damages for Seasonally Firm Energy

## Calculate LD Payment for Season 3 in 2015

### Assumptions:

- EFEP<sub>2015</sub> = \$81.90/MWh
- BC CPI Index
  - January 1, 2009: 100.00
  - January 1, 2015: 112.98
- Transmission Losses: 6.28%
- Firm Energy obligation for season 3: 85 GWh
- Delivered Eligible Energy for season 3: 84 GWh
- Average of the Dow Jones Mid-C Daily Firm Price Indices for season 3:
  - On-Peak = US\$66.32/MWh
  - Off-Peak = US\$46.32./MWh
- Average of the Bank of Canada Daily “Noon Rate” for season 3 = 1.0138 C\$/US\$
- Number of Hours in Delivery Periods



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Peak</b>	319.0	288.1	319.0	308.7	319.0	308.7	319.0	319.0	308.7	319.0	308.7	319.0
<b>Super-Peak</b>	106.3	96.0	106.3	102.9	106.3	102.9	106.3	106.3	102.9	106.3	102.9	106.3
<b>Off-Peak</b>	318.7	287.8	318.7	308.4	318.7	308.4	318.7	318.7	308.4	318.7	308.4	318.7



# Liquidated Damages for Seasonally Firm Projects (cont.)

- Seasonal Mid-C Price = average of the Bank of Canada “Noon Rates” \*  
 [(# of on-peak hours/total hours in season \* average of the daily firm on-peak price indices) +  
 (# of off-peak hours/total hours in season \* average of the daily firm off-peak price indices)]

$$\text{Seasonal Mid - C} = 1.0138 \text{ C\$/US\$} * \left( \frac{1,262.2 \text{ hrs}}{2,208 \text{ hrs}} * \text{US\$}66.32/\text{MWh} + \frac{945.8 \text{ hrs}}{2,208 \text{ hrs}} * \text{US\$}46.32/\text{MWh} \right) = \$58.55/\text{MWh}$$

- Seasonal TDF

	Time of Delivery Factors			Number of Hours		
	Aug	Sep	Oct	Aug	Sep	Oct
Peak	101%	107%	112%	319.0	308.7	319.0
Super-Peak	110%	116%	127%	106.3	102.9	106.3
Off-Peak	86%	91%	93%	318.7	308.4	318.7

$$\text{Seasonal TDF} = \left[ \frac{(101\% * 319.0) + (107\% * 308.7) + \dots + (91\% * 308.4) + (93\% * 318.7)}{(319.0 + 308.7 + \dots + 308.4 + 318.7)} \right] = 101\%$$

- LD Factor is the greater of:

$$\text{(i) } \$5.00/\text{MWh} * \frac{112.98}{100.00} = \$5.65/\text{MWh} \quad \text{and} \quad \text{(ii) } 58.55/\text{MWh} - \left( \frac{81.90 * 101\%}{1 - 0.0628} \right) = -\$29.76/\text{MWh}$$

- LD Amount = \$5.65 \* (85 GWh – 84 GWh) \* 1,000 MWh/GWh \* (1-0.0628) = \$5,295.18

## Calculate the LD payment for January 10, 2015

### Assumptions:

- EFEP<sub>2015</sub> = \$81.90/MWh
- BC CPI Index
  - January 1, 2009: 100.0
  - January 1, 2015: 112.98
- Transmission Losses: 6.28%
- Bank of Canada Daily “noon rate” for January 10, 2015: 1.0314 CDN\$/US\$
- Dow Jones Mid-C Daily Firm Index for January 10, 2015
  - On-Peak: US\$180.50/MWh
  - Off-Peak: US\$70.60/MWh

	Hourly Firm Energy (January)	Hourly Firm Credit (January)	Time of Delivery Factor (January)
Peak	9.0 MWh/h	\$20.0/MWh	122%
Super-Peak	10.0 MWh/h	\$20.0/MWh	141%
Off-Peak	8.0 MWh/h	\$0.0/MWh	105%
On-Peak			127%

# Liquidated Damages for Hourly Firm Projects (cont.)

Delivered Eligible Energy for January 10, 2015 (in MWh)

	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
HFE	8.0	8.0	8.0	8.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0
ME	8.7	8.5	8.6	8.0	7.5	7.4	8.0	7.8	8.0	8.5	9.0	9.5
DS	0.0	0.0	0.0	0.0	0.5	0.6	1.0	1.2	1.0	0.5	0.0	0.0
	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
HFE	9.0	9.0	9.0	9.0	10.0	10.0	10.0	10.0	9.0	9.0	8.0	8.0
ME	9.0	9.0	9.0	9.0	9.5	9.7	10.2	10.2	10.1	10.2	9.0	9.0
DS	0.0	0.0	0.0	0.0	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0

## ● Delivery Shortfalls (January 10, 2015)

- Peak Hours (6:00 to 22:00) = 3.7 MWh
- Super-Peak Hours (16:00 to 20:00) = 0.8 MWh
- Off-Peak Hours (1:00 to 6:00 and 22:00 to 24:00) = 1.1 MWh

## ● Mid-C Prices (January 10, 2015)

- Peak Hours =  $180.50 * 1.0314 * (122\%/127\%) = \$178.84/\text{MWh}$
- Super-Peak Hours =  $180.50 * 1.0314 * (141\%/127\%) = \$206.69/\text{MWh}$
- Off-Peak Hours =  $70.60 * 1.0314 = \$72.82/\text{MWh}$

# Liquidated Damages for Hourly Firm Projects (cont.)

- LD Factors: [greater of (i) and (ii) in each case]

where (i)  $\$5.00/\text{MWh} * \frac{\text{CPI}_{2015}}{\text{CPI}_{2009}}$  and (ii) Mid - C Firm Price -  $\left[ \frac{(\text{EFEP} * \text{TDF})}{1 - \text{losses}} - \left( \text{HFC} * \frac{\text{CPI}_{2015}}{\text{CPI}_{2009}} \right) \right]$

➤ Peak Hours

(i)  $\$5.00/\text{MWh} * \frac{112.98}{100.00} = \$5.65 / \text{MWh}$

(ii)  $178.84 - \left[ \frac{(81.90 * 122\%)}{(1 - 6.28\%)} - \left( 20.0 * \frac{112.98}{100.00} \right) \right] = \$94.82 / \text{MWh}$

➤ Super-Peak Hours

(i)  $\$5.00/\text{MWh} * \frac{112.98}{100.00} = \$5.65 / \text{MWh}$

(ii)  $206.69 - \left[ \frac{(81.90 * 141\%)}{(1 - 6.28\%)} - \left( 20.0 * \frac{112.98}{100.00} \right) \right] = \$106.07 / \text{MWh}$

➤ Off-Peak Hours

(i)  $\$5.00/\text{MWh} * \frac{112.98}{100.00} = \$5.65 / \text{MWh}$

(ii)  $72.82 - \left[ \frac{(81.90 * 105\%)}{(1 - 6.28\%)} - \left( 0.0 * \frac{112.98}{100.00} \right) \right] = -\$18.94 / \text{MWh}$

- LD Amounts for January 10, 2015

Peak	$\$94.82/\text{MWh} * 3.7 \text{ MWh} * (1-0.0628)$	\$328.80
Super-Peak	$\$106.07/\text{MWh} * 0.8 \text{ MWh} * (1-0.0628)$	\$79.53
Off-Peak	$\$5.65/\text{MWh} * 1.1 \text{ MWh} * (1-0.0628)$	\$5.82
<b>Total</b>		<b>\$414.15</b>

# Firm Energy Adjustments

Actual Total Energy Delivered (GWh)	EPA Year					
	1	2	3	4	5	6
Season 1	94	97	100	105	102	100
Season 2 (Freshet)	105	120	110	115	105	105
Season 3	110	112	106	109	106	106
Season 4	95	93	92	93	94	96
<b>Total</b>	404	422	408	422	407	407

Yellow cell in each row represents the minimum amount of energy that can be delivered with an 80% confidence.

	Contracted Firm (GWh)		Adjusted Firm (GWh)	
	EPA years 1 to 6		Before freshet cap	After freshet cap
<b>Effective Period</b>	<b>EPA years 1 to 6</b>		<b>EPA years 7 to 11</b>	
Season 1	90	90	99	99
Season 2 (Freshet)	100	100	105	99
Season 3	115	115	106	106
Season 4	95	95	93	93
<b>Total</b>	400	400	403	397
<b>Freshet Energy as % of Total Energy</b>	25%	25%	26%	25%
<b>Allowable Freshet Firm Energy</b>	100		99	

Columns shown in yellow are the firm energy amounts used for payment and LD calculations.

## Power Acquisitions

	Offered FE Amount	EPA Year (Actual Firm Energy Delivery in GWh)					Adjusted FE Amount
	Applicable for EPA yr 1 to 6	2	3	4	5	6	Applicable for EPA yr 7 to 11
Season 1	90	90	90	90	90	90	99
Season 2	100	100	100	100	100	100	99
Season 3	115	112	106	109	106	106	106
Season 4	95	93	92	93	94	95	93
<b>Total</b>	<b>400</b>	<b>395</b>	<b>388</b>	<b>392</b>	<b>390</b>	<b>391</b>	<b>397</b>

Average annual firm energy for EPA years 2 to 6	391.2	GWh
95% of offered firm energy amount	380.0	GWh
Performance security rate for EPA years 7 to 11 (January 1, 2009 \$)	4.00	\$/MWh
Escalated performance security rate (based on EPA year 7) – assume 2% escalation	4.88	\$/MWh
Adjusted firm energy amount for EPA years 7 to 11	397	GWh
<b>Annual Performance Security for EPA years 7 to 11</b>	<b>1,936</b>	<b>\$ X 1000</b>

- Purpose of model is to assist Proponents with the calculation of energy prices, allocation of energy for billing purposes, and calculation of liquidated damages
- Two versions of the computation model
  - Seasonally Firm Projects
  - Hourly Firm Projects
- Each version comprises 3 Commercial Proposal worksheets, 2 data input worksheets and 3 calculation worksheets
  - Commercial Proposal worksheets (CP Items 1-11, CP Item 12 and CP Item 13)
  - EPA Data
  - Data Input
  - Energy Price Calculation
  - Energy Allocation and Payments
  - LD Amounts

- Commercial Proposal worksheets represent a partial duplication of the worksheets provided in the Commercial Proposal originally issued by BC Hydro on September 22, 2008
- EPA Data worksheet contains information extracted from the Specimen EPA or have been posted to the Clean Power Call RFP Website (do not require change or input from user)
  - Time of delivery factors
  - Hourly firm energy credits
  - Number of hours in each of the 36 delivery periods
  - Fixed annual prices for non-firm energy pricing option A
- Data Input worksheet (data to be entered by user)
  - BC CPI
  - Bank of Canada currency exchange rate
  - Monthly on-peak and off-peak Mid-C prices



## ● Energy Prices

- Blue values are to be entered by user via “CP Item 1-11” worksheet
- Red values are to be entered directly on the “Energy Prices” worksheet
- Energy prices are calculated by selected the **year** and **month** in the yellow shaded cells

## ● Energy Allocation (Seasonal)

- Red values are to be entered by user via “CP Item 13” worksheet
- For the year selected in the “Energy Prices” worksheet, the energy allocation for a season is calculated by selecting the **season** in the yellow shaded cell

## ● Liquidated Damages (Seasonal)

- LDs are calculated for the year selected in the “Energy Prices” worksheet and the season selected in the “Energy Allocation (Seasonal)” worksheet

## ● Energy Prices

- Same as Seasonally Firm Projects

## ● Energy Allocation (Hourly)

- Red values are to be entered by user via “CP Item 12” worksheet
- User to enter the **hourly metered energy amounts** in the yellow shaded cells on the right of the worksheet

## ● Liquidated Damages (Hourly)

- User to input **daily Mid-C firm energy indices for on-peak and off-peak hours** in the yellow shaded cells
- User to **input daily Bank of Canada “Noon” rate for currency exchange rate** in the yellow shaded cells