Union Gas Limited
Supplemental Weather Normalization Evidence

The purpose of this evidence is to supplement and update Union's proposal at Exhibit B, Tab 1, pages 12-16 to reflect the full effect of the 20 year declining trend weather normalization method in Union's rates effective January 1, 2008.

1.0 WEATHER NORMALIZATION

Weather normalization is an estimation method used to calculate the average or typical annual weather effect on natural gas consumption for a future year. The weather forecast is "normalized" to calculate the expected gas use by consumers in a coming year, based on expected average weather conditions. This estimate of gas consumption is then used to determine the revenue forecast. It is important that over time the estimates produced by the weather normalization method are as accurate as possible and that weather risk is symmetrical. The estimate may not be correct every year, but over time, the method of normalization should achieve a balance in the magnitude of over- and under-estimates.

The weather normalization method is also used for planning and managing Union's gas supply (including commodity purchases and upstream transportation capacity planning), planning of facilities expansions, allocating upstream transportation capacity to direct purchase customers, and allocating storage capacity to customers electing semi-unbundled and unbundled service.

2.0 ENBRIDGE'S 2007 RATES PROCEEDING (EB-2006-0034)

Enbridge analyzed nine weather normalization methods in its recent 2007 rates proceeding (EB-2006-0034). Enbridge's evidence was essentially an update of the evidence Union presented in its 2004 rates proceeding (RP-2003-0063). Like Union, Enbridge used Toronto Pearson weather data as the base for its calculations.

Enbridge added the "Energy Probe" method as a replacement to the Leo de Bever method. The Energy Probe method is a variant of the Leo de Bever method with two additional explanatory variables: a time trend and a simple 5 year moving average. Enbridge also included a 50/50 blend method of the 30 year average and the 20 year declining trend methods to replicate one of the possible results from the method that was approved for Union in the RP-2003-0063 proceeding. The only other difference was that Enbridge's historical data is on a fiscal year ending September 30 basis, while Union's historical data is on a calendar year ending December 31 basis. However, the differences in fiscal years is not material.

Enbridge's analysis showed that the 20 year declining trend was the most appropriate method for its Central region (the Greater Toronto Area) which accounts for 80% of Enbridge's volumes.

During the EB-2006-0034 proceeding, the Chair of the Board panel produced a schedule that calculated percentage differences between the 20 year declining trend method, 50/50 blend method, and the Energy Probe method relative to actual heating degree days

("HDD"s) in Enbridge's Central region. The schedule was designated Exhibit K4.4, and has been reproduced as Appendix E to the evidence filed in Tab 1. That schedule showed that the 20 year declining trend method was the most accurate for Enbridge's Central region.

The other analysis performed by Enbridge identified that the 50/50 blend method was best suited for Enbridge's Niagara region (based on the criteria of accuracy, symmetry and stability) and the Energy Probe method was best suited for Enbridge's Eastern region. Enbridge proposed in its final argument the method that was best suited for each region be implemented for that region.

In its EB-2006-0034 Decision, the Board followed Enbridge's recommended approach and approved three weather normalization methods for Enbridge:

- the 20 year declining trend normal for the Central region (Greater Toronto Area)
- the 50/50 blend normal for the Niagara region
- and the Energy Probe normal for the Eastern region (Ottawa)

3.0 UNION'S 2004 RATES PROCEEDING (RP-2003-0063)

In the RP-2003-0063 proceeding, Union proposed to change the way in which it calculated weather normalized consumption, moving from the 30 year rolling simple average method to the 20 year declining trend method.

To set the context for assessing potential new weather normalization methods, Union established five objectives in the RP-2003-0063 proceeding: symmetry, accuracy, stability, sustainability and simplicity. These objectives are described in further detail in Appendix A. Symmetry, accuracy and stability were quantitatively measured, whereas sustainability and simplicity were qualitatively measured. Stability, sustainability and simplicity were assigned the least weight in Union's analysis of the best method to use.

Enbridge used the three quantitatively measured objectives (symmetry, accuracy and stability) as its criteria in analyzing the various weather normalization methods in the EB-2006-0034 proceeding. This difference in evaluation technique removed the two subjective criteria and also the criteria with the lowest weights. If Union had performed its analysis in 2004 using only the three quantitative criteria, the conclusions would not have changed. Union would still have proposed the 20 year declining trend method.

In the RP-2003-0063 proceeding, Union analyzed the following methods using the criteria it developed: 30-year rolling simple average, trend methods (30-years and 20-years), Enbridge's historical weighted trend (also known as the Leo de Bever method), 20 year trend with forecast information, 20-year rolling simple average and 10-year rolling simple average method.

In its RP-2003-0063 Decision, the Board expressed concerns with the statistical evidence presented by Union. In order to reduce rate shock and test the suitability of changing the weather normalization method the Board weighted the 30 year rolling simple average and

the 20 year declining trend 70/30. Further, the Board indicated that it would allow 5% changes in the weightings per year until a 50/50 weighting was established. Although Enbridge presented essentially the same analysis and evidence in the EB-2006-0034 proceeding, and the results of the traditional statistical regression diagnostic tests were questioned, the Board did not raise any of the statistical concerns in Enbridge's EB-2006-0034 Decision as the Board referenced in Union's RP-2003-0063 Decision. Nevertheless, Union will address each of the concerns raised about the statistical data below.

One concern raised by the Board was whether an estimator derived from ordinary least squares was more or less appropriate than using a more sophisticated regression technique. A trend line by construction is the estimate with the minimum error.[1] The linear trend method employed by Union and Enbridge is a simple mathematical representation of declining HDD over time. The method does not seek to explain, nor need it explain, the causes of the declining HDD. Rather, the method seeks to allow Union and Enbridge to state a "normal" HDD in the future, i.e. one that will not be biased in forecast error and is relatively accurate and relatively stable. In its EB-2006-0034 Decision, the Board concluded that a linear trend method is the appropriate method to be used (page 10).

[1] Minimum Least Square Error (MSE) is a basic and commonly used statistical procedure. This error analysis procedure finds the minimum error that is present in either a causal or time series statistical pattern. The MSE is the average of the total least squares of all the errors observed from the equation estimates. The square of the error is computed as this addresses both the presence of positive and negative errors and the effect of small and large errors.

Another concern raised in the RP-2003-0063 proceeding was the application of traditional statistical regression diagnostic tests (i.e. the adjusted R^2, the t-test and the F-test) and why Union had not applied these analytical tools. Union did not employ these tools because they are not relevant to the setting of the trend line. That is because these diagnostic tests are relevant primarily when evaluating a cause and effect relationship. Union was not, and Enbridge was not, seeking to establish a cause and effect relationship between the number of HDDs and the year in which they occurred. All Union and Enbridge were trying to do with the simple trend line is to have an estimator that would produce the most symmetrical, accurate and stable result in setting the normalized HDDs over time.

The issue of heteroskedasticity/non-stationarity, which is the increasing variability over time of a variable, was also raised in the RP-2003-0063 proceeding. The presence of heteroskedasticity can mean that the statistical regression diagnostic test results (i.e. the adjusted R^2, the t- test and the F-test) are no longer valid. As discussed above, the results of the statistical regression diagnostic tests were not the criteria Union used to select the best method. Accordingly, Union did not provide a Chow test for heteroskedasticity in its RP-2003-0063 pre-filed evidence. However, Union was asked to provide the results of the Chow test and did so in response to Undertaking N3.4 (see Appendix B). The Chow test results showed that heteroskedasticity was not an issue.

4.0 RELATIONSHIP BETWEEN TORONTO DATA AND UNION

The weather normalization evidence in both Union's 2004 rates proceeding (RP-2003-0063) and Enbridge's 2007 rates proceeding (EB-2006-0034) were based on Toronto Pearson airport weather data. The statistical correlation between weather in Union's franchise area and Toronto Pearson airport is very high: 99 percent for Union's Southern Operations area and 94 percent for Union's Northern & Eastern Operations area. This means that Union can and should use the Toronto Pearson data as the basis for evaluating weather normalization methods.

5.0 NO DIFFERENCE BETWEEN WHAT ENBRIDGE PROPOSED FOR ITS CENTRAL REGION AND UNION'S SOUTHERN AND NORTHERN & EASTERN OPERATIONS AREAS

The Board has now approved the use of the 20 year declining trend method in Enbridge's Central region. The weather data for this area is based on Toronto Pearson weather data. Union can find no differences in the analysis Enbridge provided for its Central region and the analysis that Union undertook for its Southern and Northern & Eastern Operations areas.

6.0 THE 20 YEAR DECLINING TREND IS APPROPRIATE

Union's evidence in Tab 1 proposes to reflect the full effect of the 20 year declining trend weather normalization method, effective January 1, 2008. This proposal is based on

Union's belief, supported by its evidence filed in the RP-2003-0063 proceeding and by the Board's recent EB-2006-0034 Decision, that the 20 year declining trend weather normal method is the best weather normalization method.

The two tables presented below provide an analysis of the three weather normalization methods the Board approved for Enbridge, on the same basis as the tables provided by the Chair of the Board panel (Exhibit K4.4) in the EB-2006-0034 proceeding.

The tables indicate that the 20 year declining trend method is more accurate than the two other methods examined for both Union's Southern Operations area and Union's Northern & Eastern Operations area. This is the conclusion that can be reached by analyzing the average error of each method. The lower the average error, the more accurate the results.

In terms of symmetry, the 20 year declining trend method is as symmetrical (Southern Operations area) or better (Northern & Eastern Operations area) than the two other methods. These results can be found by comparing the number of times the method over-estimated the number of HDDs relative to the number of estimates. For example, the 20 year declining trend method over-estimates just over 50% of the time in the Northern & Eastern Operations area, indicating the desired symmetry is present in the 20 year declining trend method.

The 50/50 blend method performs best in terms of stability for both the Southern Operations Area and the Northern & Eastern Operations area. This method is more stable because it includes a component of the 30 year rolling simple average which smoothes variations over time.

Like Enbridge, Union believes that accuracy and symmetry are equally important. Although it is important to Union to have stable HDD forecasts over time, Union views stability as less significant than accuracy and symmetry.

Table 1
Union Southern Operations Area Weather Normal Comparison

Test Year	Actual HDD	Blended 50 50 Method			20 Year Declining Trend Method			Energy Probe Method		
		Estimate	Diff.	% Diff.	Estimate	Diff.	% Diff.	Estimate	Diff.	% Diff.
1990	3,572	3,970	398	11.1%	3,955	384	10.7%	4,014	443	12.4%
1991	3,631	3,985	354	9.7%	3,980	349	9.6%	4,151	520	14.3%
1992	4,031	3,931	(100)	(2.5)%	3,883	(148)	(3.7)%	3,886	(145)	(3.6)%
1993	4,105	3,885	(220)	(5.4)%	3,797	(308)	(7.5)%	3,732	(373)	(9.1)%
1994	4,055	3,909	(146)	(3.6)%	3,841	(214)	(5.3)%	3,843	(211)	(5.2)%
1995	3,987	3,911	(76)	(1.9)%	3,841	(146)	(3.7)%	3,955	(32)	(0.8)%
1996	4,153	3,924	(228)	(5.5)%	3,859	(293)	(7.1)%	4,004	(149)	(3.6)%
1997	4,005	3,914	(91)	(2.3)%	3,839	(166)	(4.2)%	4,008	3	0.1%
1998	3,225	3,947	722	22.4%	3,899	675	20.9%	4,024	799	24.8%
1999	3,641	3,948	307	8.4%	3,904	263	7.2%	3,999	358	9.8%
2000	3,876	3,881	4	0.1%	3,794	(82)	(2.1)%	3,795	(82)	(2.1)%
2001	3,467	3,858	391	11.3%	3,759	292	8.4%	3,775	308	8.9%
2002	3,636	3,874	238	6.6%	3,793	158	4.3%	3,847	211	5.8%
2003	3,958	3,831	(127)	(3.2)%	3,721	(237)	(6.0)%	3,821	(137)	(3.5)%
2004	3,786	3,805	20	0.5%	3,692	(94)	(2.5)%	3,887	101	2.7%
2005	3,778	3,824	46	1.2%	3,721	(57)	(1.5)%	3,874	96	2.5%
2006	3,332	3,822	490	14.7%	3,726	394	11.8%	3,814	482	14.5%
ACCURACY: Average Error			117	3.6%		45	1.7%		129	4.0%
Frequency Over Estimated			10			7			10	
Total Number of Estimates			17			17			17	
SYMMETRY: frequency over/ total			58.8%			41.2%			58.8%	
STABILITY: std. dev.			54			85			112	

Table 2
Union Northern & Eastern Operations Area Weather Normal Comparison

Test Year	Actual HDD	Blended 50 50 Method			20 Year Declining Trend Method			Energy Probe Method		
		Estimate	Diff.	% Diff.	Estimate	Diff.	% Diff.	Estimate	Diff.	% Diff.
1990	4,994	5,259	266	5.3%	5,203	209	4.2%	5,146	152	3.1%
1991	5,019	5,289	271	5.4%	5,252	233	4.6%	5,350	331	6.6%
1992	5,489	5,257	(232)	(4.2)%	5,194	(295)	(5.4)%	5,182	(307)	(5.6)%
1993	5,460	5,224	(236)	(4.3)%	5,131	(329)	(6.0)%	5,095	(366)	(6.7)%
1994	5,294	5,273	(21)	(0.4)%	5,220	(73)	(1.4)%	5,260	(34)	(0.6)%
1995	5,358	5,273	(85)	(1.6)%	5,216	(142)	(2.7)%	5,306	(51)	(1.0)%
1996	5,550	5,278	(272)	(4.9)%	5,228	(322)	(5.8)%	5,270	(280)	(5.1)%
1997	5,384	5,272	(112)	(2.1)%	5,219	(165)	(3.1)%	5,299	(85)	(1.6)%
1998	4,457	5,316	859	19.3%	5,304	846	19.0%	5,339	882	19.8%
1999	4,754	5,315	561	11.8%	5,304	550	11.6%	5,332	578	12.2%
2000	5,158	5,230	72	1.4%	5,169	11	0.2%	5,163	4	0.1%
2001	4,592	5,185	593	12.9%	5,090	498	10.9%	5,168	576	12.6%
2002	4,997	5,193	197	3.9%	5,115	119	2.4%	5,234	237	4.7%
2003	5,111	5,114	3	0.1%	4,979	(132)	(2.6)%	5,206	95	1.9%
2004	5,148	5,098	(51)	(1.0)%	4,971	(177)	(3.4)%	5,404	255	5.0%
2005	4,829	5,098	268	5.6%	4,966	137	2.8%	5,269	440	9.1%
2006	4,423	5,093	671	15.2%	4,967	544	12.3%	5,145	722	16.3%
ACCURACY: Average Error			162	3.7%		89	2.2%		185	4.2%
Frequency Over Estimated			10			9			11	
Total Number of Estimates			17			17			17	
SYMMETRY: frequency over/ total			58.8%			52.9%			64.7%	
STABILITY: std. dev.			78			116			87	

EVALUATION CRITERIA FOR WEATHER NORMALIZATION METHODS

The five objectives that Union established in the RP-2003-0063 proceeding to evaluate weather normalization methods are: symmetry, accuracy, stability, sustainability and simplicity.

- Symmetry – the method should result in an unbiased normal temperature condition where there are equal expectations of positive variations and negative variations from actual HDDs. The smaller the mean percent error (MPE), the more symmetrical the method. In the case of the Bias Frequency, the closer the ratio is to 1:1, the less biased (more symmetrical) the method.

- Accuracy – the method should result in a point estimate that has a minimum variance over time between the normal HDD and the actual HDD value. Accuracy is an error measure that indicates over time the difference between the estimator and actual weather. The most precise accuracy measurement tool is the root mean square error (RMSE). For the RMSE, smaller test results mean greater accuracy.

- Stability – the new method should result in year over year normalized HDD estimate that does not vary significantly. Stability is a measure of variation; the standard deviation is used to measure variance. Increasing instability means that the fluctuation from one year's forecast to the next is increasing over time. The increase in variation of the historical weather statistics is a direct contributing factor to increasing instability. For

stability, a smaller standard deviation means that the method provides a more stable estimate because the difference between the forecast HDDs in two consecutive years is less significant.

- Sustainability – the new method should stand the test of time and not require significant amendments in the near future. Sustainability is a qualitative assessment of the company being able to understand and maintain the tools underlying the method, over an extended period. The greater the reliance on external participants in the calculation of the methods the lower the assessment of its sustainability.

- Simplicity – the method and its results should be easily understood and administered. Simplicity addresses the need for internal and external stakeholders to understand and accept the approach that is being taken to calculate the weather normal. The greater the reliance on simple arithmetic methods and limited steps between the input data and the results, the easier it will be to understand the outcome.

Exhibit N3.4
Vol. 3, para. 354

UNION GAS LIMITED

Undertaking of Mr. Fogwill
To Mr. Aiken

Please perform the Chow test, on a best-efforts basis.

A Chow test was performed on the 20 Year trend equation for the Toronto Pearson data period 1983 to 2002. The test result for this equation is 2.85. The Chow test result of 2.85 indicates that the estimated trend is the same during the first 10 years of the 20 year period as it is during the last 10 years of the period.

Witness:	Allan Fogwill
Question:	October 8, 2003
Answer:	October 14, 2003
Docket:	RP-2003-0063