

February 21, 2008

#### BY COURIER & RESS

Ms. Kirsten Walli Board Secretary Ontario Energy Board Suite 2700, 2300 Yonge Street Toronto, Ontario M4P 1E4

Dear Ms. Walli:

Re: Union Gas Limited

Application for Order Varying Conditions of Approval

**Board File # EB-2008-0038** 

Enclosed please find two (2) copies of Union's Application for the above-noted project.

In the event you have any questions on the above or would like to discuss in more detail, please do not hesitate to contact me at (519) 436-4601.

Sincerely,

Mark A. Murray,

Manager, Regulatory Projects

:mjp Encl.

cc: Neil McKay, Manager Facilities Applications (neil.mckay@oeb.gov.on.ca)

Giovanna Dragic, Senior Case Administrator (giovanna.dragic@oeb.gov.on.ca)

# **ONTARIO ENERGY BOARD**

IN THE MATTER OF the Ontario Energy Board Act, 1998, S.O. 1998, c.15, Schedule B; and in particular Sections 38(1) and 40(1) thereof;

AND IN THE MATTER OF an Application by Union Gas Limited for an Order varying the conditions of approval in the following proceedings EBO 172 (Dow A Pool), EBRM 167 (Oil Springs East Pool), EBRM 98 (Payne Pool), and EBRM 95 (Enniskillen 28 Pool) relating to the allowable pressure gradient in these four natural gas storage pools in the City of Sarnia and Townships of St. Clair and Enniskillen, in the County of Lambton;

### UNION GAS LIMTED

- 1. Union Gas Limited ("Union") wishes to operate the following natural gas storage pools: Dow A Pool, Oil Springs East Pool, Payne Pool, and Enniskillen 28 Pool, above 0.7 psi per foot as permitted under the CSA Standard Z341.1-06.
- 2. Union therefore applies for leave to operate the natural gas storage pools above the 0.7 psi per foot operating condition as set out in the Conditions of Approval issued in the following proceedings: EBO 172 (Dow A Pool), EBRM 167 (Oil Springs East Pool), EBRM 98 (Payne Pool), and EBRM 95 (Enniskillen 28 Pool).
- 3. Attached as Schedule A is a map showing the general location of the four storage pools.
- 4. In order to meet the proposed in-service date, Union respectfully requests a Board Decision, no later than July 1, 2008.

Dated at the Municipality of Chatham-Kent, Ontario this 21st day of February, 2008.

UNION GAS LIMITED

Per: Dan Jones

Assistant General Counsel Union Gas Limited

Comments respecting this Application should be directed to:

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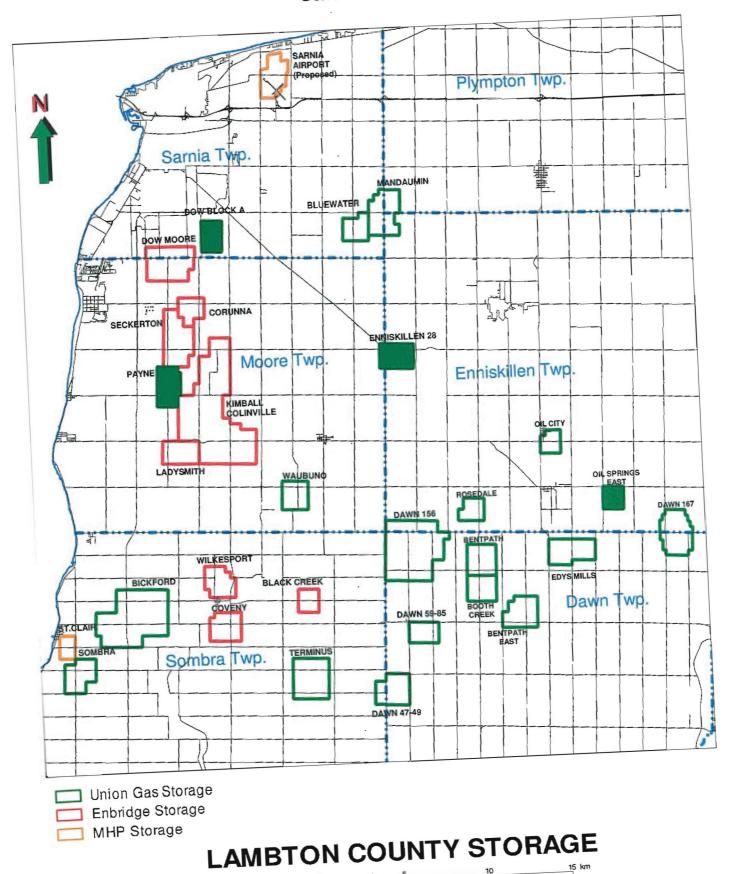
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# Schedule A



# Vary Application

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#### BACKGROUND

- 1. In Ontario Energy Board ("Board") proceedings EBO 172, EBRM 95, EBRM 98, and EBRM 167, [Oil Springs East, Enniskillen 28, Payne, and Dow A ("Pools")] a condition of approval that limited the operating pressure of the Pools to 15.8 kPa/m (0.7 psi per foot) of depth was attached to either: the Inject, Store, Remove Order; or, the Report to the Ministry of Natural Resources ("MNR") regarding a well drilling licence. Attached as Schedule 1 is a Table identifying the Pools, the document where this condition was imposed, and the exact wording of the condition in each case ("Conditions of Approval").
- 2. At the time, the imposition of these limits or operating pressures reflected concerns of Board Staff about operating storage pools at higher pressure gradients in absence of codes or regulations to govern such operations. Since these conditions were imposed, the MNR adopted Operating Standards under O.Reg 245/97 ("Operating Standards") requiring hydrocarbon storage to be designed, constructed, operated, maintained and abandoned in accordance with CSA Standard Z341 "Storage of Hydrocarbons in Underground Formations".
- 3. Union is applying to the Board for leave to vary the Conditions of Approval, limiting the operating pressure it previously placed on these Pools. Approval of this application would result in the Pools being governed by CSA Standard Z341.1-06 which is consistent with other Union storage pools.
- 4. It is Union's understanding that Board approvals require applicant's to conform to CSA Z341.1-06 to the satisfaction of the MNR.
- 5. Union has discussed the proposed changes with the Petroleum Resources Section of the MNR and has provided them with the technical information to satisfy the CSA requirements.
- 6. Union proposes to increase the operating pressure of the Pools to increase their working capacity by 56,700 10<sup>3</sup>m<sup>3</sup>. The capacity created will be used to meet the requirements of Union's customers such as power generators and marketers and specifically the needs of customers seeking storage services dealt with in the ("Board") decision in the EB-2005-0551

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- Natural Gas Electricity Interface Review ("NGEIR") and an economic study on the value of the proposed changes is not necessary.
- 7. Union's request will result in an average increase in pool pressure of approximately 315 kPa (45 psi). This increase is within the limits as prescribed by CSA Z341.1-06 code. The Pools will continue to be operated in compliance with all required codes and regulations.
- 8. If this application is approved, Union will begin operating the Pools at higher pressure gradients during the 2008 injection season.
- 9. A leave to construct order from the Board and a report from the Board to the MNR are not required for approval of this application.
- 10. Union has discussed these changes with the Lambton County Storage Association ("LCSA") and representative landowners in the Pools. No concerns regarding these changes have been identified at the current time.
- 11. There are no environmental impacts as a result of the proposed changes in operating pressure.
- 12. Union is proposing to increase the pressures in these Pools by November 1, 2008. In order to meet this timetable, a Board Decision on Union's Application is respectfully requested by July 1, 2008.

#### GEOLOGY AND RESERVOIR ENGINEERING

13. Schedule 2 is a table summarizing the: minimum depth-to-crest, in situ pressure limits and maximum formation operating pressure for each Pool.

## Oil Springs East Pool

14. The Oil Springs East Pool was discovered in 1974 with the drilling of the Husky Union Enniskillen 4-22-II well and was converted to natural gas storage in 1990. A location map showing the Oil Springs East Pool in relation to the surrounding area is shown in Schedule 3. Currently, the pool is operated and monitored using six injection/withdrawal wells and two observation wells. The Oil Springs East Pool has a total capacity of 130,600 10<sup>3</sup>m<sup>3</sup> and a



- working capacity of 99,200 10<sup>3</sup>m<sup>3</sup>. The pool operates between a cushion pressure of 2,100 kPaa and a maximum pressure of 7,760 kPaa.
- A map showing the Oil Springs East Pool DSA and Guelph structure is included at Schedule
   The geological interpretation was completed using 3D seismic data and well information.
   The map is contoured in 10 m intervals and shows the reef reaching approximately 80 m
   above the regional Guelph surface. The minimum depth-to-crest is established at 509.3 m.
- 16. A cross section illustrating the reef structure of the Oil Springs East Pool is provided as Schedule 5. The cross section illustrates the relationship of the pinnacle reef to the surrounding formations. The A2 Salt, A1 Carbonate and A1 Anhydrite units pinch out against the flank of the reef providing lateral seals. The A2 Anhydrite, A2 Shale, and A2 Carbonate drape over the reservoir forming an effective caprock seal ranging in thickness from 22.8 to 25.8 m. The A2 Anhydrite overlying the crest of the reef ranges in thickness from 0.8 to 2.7 m.
- 17. In order to determine the maximum safe delta pressure limit for the Oil Springs East Pool, tests were completed on the reservoir and caprock formations to determine threshold pressure, geomechanical strengths, and in situ stresses. In addition, micro fracture testing was completed on reservoir and caprock formations in well UD.282 in the Dawn 156 Pool to determine the local in situ fracture pressure gradient for Silurian reefs in Lambton County. Results from these tests are summarized in Schedule 2. In all cases the fracture closure pressure represents the most conservative maximum reservoir pressure.
- 18. Clause 7.6.2 (b) of CSA Z341.1-06 requires that "The maximum operating pressure shall not exceed 80% of the fracture pressure of the caprock formation". Therefore the theoretical MOP of the storage zone according to code is a wellhead ("WH") pressure of 9,491 kPaa (Schedule 2, Column J).
- 19. In addition, a review of well casings, wellheads, and surface facilities was completed. As a result of this review, all wells in the Oil Springs East Pool will receive new wellheads and master valves and one well will be relined with a smaller diameter casing. This work is

- scheduled to be completed prior to delta pressuring. The MOP of the physical facilities in the Pool is 8,782 kPaa WH.
- 20. Union is proposing to operate the Oil Springs East Pool at 8,060 kPaa WH. This equates to a pressure gradient of 16.51 kPa/m. This will increase the working capacity from 99,200 10<sup>3</sup>m<sup>3</sup> to 105,000 10<sup>3</sup>m<sup>3</sup> which is an incremental capacity gain of 5,800 10<sup>3</sup>m<sup>3</sup>.

### Enniskillen 28 Pool

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- 21. The Enniskillen 28 Pool was discovered in 1954 with the drilling of the Union Enniskillen 28 well and was converted to natural gas storage in 1989. A location map showing the Enniskillen 28 Pool in relation to the surrounding area is shown in Schedule 6. Currently, the pool is operated and monitored using eight injection/withdrawal wells and three observation wells. The Enniskillen 28 Pool has a total capacity of 126,900 10<sup>3</sup>m<sup>3</sup> and a working capacity of 95,100 10<sup>3</sup>m<sup>3</sup>. The pool operates between a cushion pressure of 2,413 kPaa and a maximum pressure of 8,500 kPaa.
- 22. A map showing the Enniskillen 28 Pool DSA and Guelph structure is included at Schedule 7. The geological interpretation was completed using 3D seismic data and well information.

  The map is contoured in 10 m intervals and shows the reef reaching greater than 110 m above the regional Guelph surface. The minimum depth-to-crest is established at 554.1 m.
- 23. A cross section illustrating the reef structure of the Enniskillen 28 Pool is provided as Schedule 8. The cross section illustrates the relationship of the pinnacle reef to the surrounding formations. The A2 Salt, A1 Carbonate and A1 Anhydrite units pinch out against the flank of the reef providing lateral seals. The A2 Anhydrite, A2 Shale, and A2 Carbonate drape over the reservoir forming an effective caprock seal ranging in thickness from 29.7 to 35.3 m. The A2 Anhydrite overlying the crest of the reef ranges in thickness from 1.5 to 6.3 m.
- 24. In order to determine the maximum safe delta pressure limit for the Enniskillen 28 Pool, tests were completed on the reservoir and caprock formations to determine threshold pressure, geomechanical strengths, and in situ stresses. In addition, micro fracture testing was completed on reservoir and caprock formations in well UD.282 to determine the local in situ

- fracture pressure gradient for Silurian reefs in Lambton County. Results from these tests are summarized in Schedule 2. In all cases, the fracture closure pressure represents the most conservative maximum reservoir pressure.
- 25. Clause 7.6.2 (b) of CSA Z341.1-06 requires that "The maximum operating pressure shall not exceed 80% of the fracture pressure of the caprock formation". Therefore the theoretical MOP of the storage zone according to code is a WH pressure of 10,280 kPaa (Schedule 2, Column J).
- 26. In addition, a review of well casings, wellheads, and surface facilities was completed. As a result of this review, all wells in the Enniskillen 28 Pool will receive new wellheads and master valves. This work is scheduled to be completed prior to delta pressuring. The MOP of the facility is 10,030 kPaa.
- 27. Union is proposing to operate the Enniskillen 28 Pool at 8,730 kPaa WH. This equates to a pressure gradient of 16.51 kPa/m. This will increase the working capacity from 95,100 10<sup>3</sup>m<sup>3</sup> to 99,100 10<sup>3</sup>m<sup>3</sup> which is an incremental capacity gain of 4,000 10<sup>3</sup>m<sup>3</sup>.

## Payne Pool

- 28. The Payne Pool was discovered in 1949 with the drilling of the Imperial 222 Payne No. 1 well and was converted to gas storage in 1957. A location map showing the Payne pool in relation to the surrounding area is contained in Schedule 9. Currently the pool is operated and monitored using 10 injection/withdrawal wells and two observation wells. The Payne Pool has a total capacity of 833,700 10<sup>3</sup>m<sup>3</sup> and a working capacity of 662,400 10<sup>3</sup>m<sup>3</sup>. The pool operates between a cushion pressure of 2,100 kPaa and a maximum pressure of 8,900 kPaa.
- 29. A map showing the Payne Pool DSA and Guelph structure is included at Schedule 10. The geological interpretation was completed using 3D seismic data and well information. The map is contoured in 10 m intervals and shows the reef reaching greater than 120 m above the regional Guelph surface. The minimum depth-to-crest is established at 589.4 m.
- 30. A cross section illustrating the reef structure of the Payne Pool is provided as Schedule 11.

  The cross section illustrates the relationship of the pinnacle reef to the surrounding

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formations. The A2 Salt, A1 Carbonate and A1 Anhydrite units pinch out against the flank of the reef providing lateral seals. The A2 Anhydrite, A2 Shale, and A2 Carbonate drape over the reservoir forming an effective caprock seal ranging in thickness from 30.3 to 38.4 m. The A2 Anhydrite overlying the crest of the reef ranges in thickness from 3.3 to 10.8 m.

- 31. In order to determine the maximum safe delta pressure limit for the Payne Pool, tests were completed on the reservoir and caprock formations to determine threshold pressure, geomechanical strengths, and in situ stresses. In addition, micro fracture testing was completed on reservoir and caprock formations in well UD.282 to determine the local in situ fracture pressure gradient for Silurian reefs in Lambton County. Results from these tests are summarized in Schedule 2. In all cases, the fracture closure pressure represents the most conservative maximum reservoir pressure.
- 32. Clause 7.6.2 (b) of CSA Z341.1-06 requires that "The maximum operating pressure shall not exceed 80% of the fracture pressure of the caprock formation". Therefore the theoretical MOP of the storage zone according to code is a WH pressure of 10,896 kPaa (Schedule 2, Column J).
- 33. In addition, a review of well casings, wellheads, and surface facilities was completed. As a result of this review, all wells in the Payne Pool have received new wellheads and master valves, six wells have been relined with a smaller diameter casing and three wells were abandoned. This work was completed in 2007. The MOP of the physical facilities constructed in the pool is 10,030 kPaa.
- 34. Union is proposing to operate the Payne Pool is 9,250 kPaa WH. This equates to a pressure gradient of 16.51 kPa/m. This will increase the working capacity from 662,400 10<sup>3</sup>m<sup>3</sup> to 700,400 10<sup>3</sup>m<sup>3</sup> which is an incremental capacity gain of 38,000 10<sup>3</sup>m<sup>3</sup>.

#### Dow A Pool

35. The Dow A Pool was discovered in 1980 with the drilling of the Dow Sarnia 1-8-Block A well by Dow Chemical and was converted to natural gas storage in 1991. A location map showing the Dow A pool in relation to the surrounding area is contained in Schedule 12. Currently the pool is operated and monitored using six injection/withdrawal wells and two

- observation wells. The Dow A Pool has a total capacity of 207,600 10<sup>3</sup>m<sup>3</sup> and a working capacity of 171,600 10<sup>3</sup>m<sup>3</sup>. The pool operates between a cushion pressure of 2,100 kPaa and a maximum pressure of 10,310 kPaa.
- 36. A map showing the Dow A Pool DSA and Guelph structure is included at Schedule 13. The geological interpretation was completed using 3D seismic data and well information. The map is contoured in 10 m intervals and shows the reef reaching greater than 115 m above the regional Guelph surface. The minimum depth-to-crest is established at 687.5 m.
- 37. A cross section illustrating the reef structure of the Dow A Pool is provided at Schedule 14. The cross section illustrates the relationship of the pinnacle reef to the surrounding formations. The A2 Salt, A1 Carbonate and A1 Anhydrite units pinch out against the flank of the reef providing lateral seals. The A2 Anhydrite, A2 Shale, and A2 Carbonate drape over the reservoir forming an effective caprock seal ranging in thickness from 44.4 to 46.5 m. The A2 Anhydrite overlying the crest of the reef ranges in thickness from 11.0 to 12.5 m.
- 38. In order to determine the maximum safe delta pressure limit for the Dow A Pool, geomechanical characteristics and relative permeability tests were completed on sidewall core samples and correlated with the other pool results to determine threshold pressure, geomechanical strengths, and in situ stresses. In addition, micro fracture testing was completed on reservoir and caprock formations in well UD.282 to determine the local in situ fracture pressure gradient for Silurian reefs in Lambton County. The results from these tests and correlations are summarized in Schedule 2. In all cases, the fracture closure pressure represents the most conservative maximum reservoir pressure.
- 39. Clause 7.6.2 (b) of CSA Z341.1-06 requires that "The maximum operating pressure shall not exceed 80% of the fracture pressure of the caprock formation". Therefore the theoretical MOP of the storage zone according to code is a WH pressure of 12,590 kPaa (Schedule 2, Column J).
- 40. In addition, a review of well casings, wellheads, and surface facilities was completed. As a result of this review, all wells in the Dow A Pool will receive new wellheads and master

- valves. This work is scheduled to be completed prior to delta pressuring. The MOP of the physical facilities is 11,131 kPaa.
- 41. Union is proposing to operate the Dow A Pool is 10,690 kPaa WH. This equates to a pressure gradient of 16.51 kPa/m. This will increase the working capacity from 171,600 10<sup>3</sup>m<sup>3</sup> to 180,500 10<sup>3</sup>m<sup>3</sup> which is an incremental capacity gain of 8,900 10<sup>3</sup>m<sup>3</sup>.

## LANDS ISSUES

- 42. Union implemented a landowner consultation and notification program to inform the landowners and the LCSA about the proposed changes in operating pressure in the Pools.
- 43. For Pools where the landowners are represented by "captains" (Enniskillen and Payne) Union discussed the proposed operating pressure changes with these individuals.
- 44. In Pools without pool captains (Dow A and Oil Springs East), Union has attempted to contact all individuals in these Pools to explain the proposed changes to them. Contact with these landowners is ongoing and will be completed by April 2008.
- 45. Union also contacted members of the executive of the LCSA to explain the proposed changes to them.
- 46. During this consultation process, no significant issues in regard to the change in operating pressures were identified.
- 47. Union will continue to meet with landowners in these Pools and the LCSA to address the concerns that have been identified and any new issues that may be brought forward.

Vary Application

# 2008 Storage Enhancement Project Pressure Gradient Conditions

Pool	Order	Condition						
Dow A	EBO 172 Condition 2 of the Inject Store Remove Order	Neither Union nor the joint venture shall operate the pool above a pressure representing a pressure gradient of .7 psi per foot of depth without leave of the board. Union or the joint venture shall support any leave application with an engineering, geological and economic study showing that the greater pressures are safe and in the public interest prior to applying to exceed said pressure.						
Oil Springs East	EBRM 167 Condition 4 Inject Store Remove Order	ICG shall not operate the oil springs east pool above a pressure representing a pressure gradient of .7 psi per foot of depth without leave of the board. Union shall support any leave application with an engineering and economic study showing that the greater pressures are safe and in the public interest						
Payne	EBRM 98 Condition 3 Well Drilling Application for Payne 23 Observation Well	Union shall not operate the Payne pool above a pressure representing a pressure gradient of .7 psi per foot of depth without leave of the board. Union shall support any leave application with an engineering study and economic study showing that the greater pressures are safe and in the public interest.						
Enniskillen 28	EBRM 95 Condition 3 Well Drilling Application	Union shall not operate the enniskillen pool above a pressure representing a pressure gradient of .7 psi per foot of depth without leave of the board. Union shall support any leave application with an engineering study and economic study showing that the greater pressures are safe and in the public interest.						

## **Pressure and Strength Summary**

		IN SITU ROCK PRESSURE LIMITS							
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(1)	(J)
Pool	Minimum Depth-to- Crest	Compressive Strength	Shear Strength	Formation Breakdown Pressure	Threshold Pressure	Tensile Strength	Fracture Closure Pressure	Maximum Formation Operating Pressure	
	(m)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(kPaa)	(kPaa WH)
Oil Springs East	509.3	151,860	33,800	20,586	18,500	17,500	12,391	9,913	9,491
Enniskillen 28	554.1	117,000	33,900	22,397	20,500	19,688	13,481	10,785	10,280
Payne	589.4	141,800	30,960	23,824	20,500	20,946	14,340	11,472	10,896
Dow A	687.5	>110,950	>30,600	27,789	23,300	>21,513	16,727	13,382	12,590

Notes:

- 1) Maximum Formation Operating Pressure = 80% (per CSA Z341.1 Series 06) of Fracture Closure Pressure.
- 2) Fracture Closure Pressure is also referred to as Minimum In situ Stress.
- 3) Minimum Depth-to-Crest represents "Bottom-Hole".
- 4) All pressures are bottom-hole reservoir pressures unless otherwise specified.
- 5) Fracture Closure Pressure values are derived from applying the minimum gradient of 24.33 kPa/m as determined from the micro fracture testing completed in well UD.282.
- 6) Dow A strengths and threshold pressure derived from permeability, Young's Modulus, Poisson's Ratio, and grain density correlations with other four pools.

