Drilling Program Union Waubuno 4, Moore 4-10-2 Waubuno Pool

Enbridge Gas Inc. Geology and Reservoir Engineering

October 9, 2024



Oil, Gas and Salt Resources Act Application for a Well Licence

| Form 1 To the Minister of Natural Resources v.2015-12-1 The undersigned operator applies for a well licence under the Oil, Gas and Salt Resources Act and the Regulations thereunder and submits v.2015-12-1 | | | | | | | v.2015-12-15 | | | |
|--|---------------------------------------|---------------------------------|----------------------------|-------------------|----------------|---------------------|------------------|----------------------|-----------------------|--------------|
| 1. WELL NAM | # ME Unio | Union Waubuno 4, Moore 4-10-2 | | | | | Target For | Guelp | bh | |
| Purpose of Pr | oposed Well (| [Well Type] |) | | | Natu | ıral Gas Storage | | | |
| 2. OPERATO | R Enbr | idge Gas In | с. | | | | Tel #519 436 | 5-4600 | Fax # 51 | 9 436-4560 |
| Street Addres | ss 50 K | eil Drive No | orth | | | City | Chatham | Prov. C | n Postal Code | N7M 5M1 |
| Mailing Addre | ess | | | | | City | | Prov. | Postal Code | |
| Contact Name | e | | | Oladapo L | aniya | | Contact Te | el # | 519-436-4 | 600 |
| Emai | 1 | | olad | apo.laniya(| @enbridge | .com | | | | |
| 3. LOCATION | N Co | ounty La | mbton | | | Township | Moore | | | |
| Tract 4 | Lot | 10 | Conces | sion | 2 | Offshore: | Block Tra | act Lic | ence/Lease No. | |
| Surface locati | on,4 | <u>83.4</u> m | North | South X | Latitude | 42°46'59.40" N | Botto | om-hole Lat. | 42°46' | 59.40" N |
| metres from Lot Boundarie | es <u>1</u> | <u>09.6</u> m | East | West X | Longitu | de 82º18'28.89" | W Botto | om-hole Long. | 82°18' | 28.89" W |
| Within 1.6 km | n of Designate | d Storage A | Area? | Yes X | No | | Off-target | Yes X | No | |
| 4. WELL PAF | RTICULARS | | Vertical X | Horiz | ontal | Directional | Deepening | Re-ent | try La | teral |
| Rig Type: | Rotary X | Cable | | Well to be co | red? Yes | No X | Formation at TI |) Guelph | | |
| Ground Eleva | tion 18 | 9.2 Pr | oposed De | pth 64 | 0.0 Prop | osed Depth TVD | 640.0 Pr | oposed Start 1 | Date | Apr-25 |
| 5. POOLING | | | | | | | | | | |
| Pooling of the Spacing Unit or unitization of the Unit Area shown on the attached well location plan has been completed (see Ont. Reg. 245/97 definitions for "pooled spacing unit" and "unitize") Yes X No | | | | | | | | | | |
| 6. DRILLING | CONTRACTO | DR | | | Predat | tor Drilling Inc. | | Tel #40 |)3-264-6712 | |
| Address | | : | 2120, 500 4 | th Ave S.W. | | City | Calgary | Prov. | AB Postal Code | e T2P 2V6 |
| 7. PROPOSE | D CASING AN | D CEMENT | ING PROG | RAM | | | | CASING | | |
| Hole Size | Casing O.D. | Weight | Grade | New, Used | Setting | Setting For | rmation | How | Cement | Cement Top |
| (mm) 508.0 | (mm) 406.40 | (kg/m) 96.73 | H-40 | or in-hole New | 52.5 | Hamil | ton | Set Cemented | 0:1:0 | KB / RF 4 |
| 374.4 269.9 | 298.50 219.10 | 62.50 47.62 | H-40 K-55 | New New | 395.5 552.7 | F Unit S A-2 Anh | Shale ydrite | Cemented Cemented | 0:1:8; 0:1:0 0:1:0 | 4 4 |
| - | | | | | | | | | | |
| 8. BLOW-OU Diverter,Annu | I T PREVENTI ular Preventer | ON EQUIP r; Blind Rar | MENT ns, Pipe Ra | ms | | | | | | |
| 9. WELL SEC | URITY Na | ame of Trus | stee | 1236596 | Ontario Limite | ed Total # U | nplugged Wells | 368 Cı | ırrent Balance | \$70,000 |
| 10. REMARK | (S | | | Harrison Per | ısa & Associat | es | | | | |
| | | | | | | | | | | |
| 11. ENCLOSURES Fee X Location Plan X (Land wells only) Drilling Program X | | | | | | | | | | |
| 12. NOTICE | OF COLLECTI | ON | | | 1. 6 | | | | 1. 6 | |
| The Ministry of Natural Resources and Forestry is collecting your personal information under the authority of the <i>Oil, Gas and Salt Resources Act</i> . Any personal information provided on this application will be used for licensing and law enforcement purposes only and will be protected in accordance with the Freedom of Information and Protection of Privacy Act. | | | | | | | | | | |
| If you have questions about use of your personal information, please contact the Policy and Program Officer, Petroleum Operations Section, Ministry of Natural Resources and Forestry, 659 Exeter Road, London N6E1L3, 519-873-4638. 13. AUTHORITY The undersigned certifies that the information provided herein is complete and accurate, the operator has the right to drill or operate a well in the above location, and he/she has authority to bind the operator. | | | | | | | | | | |
| Date (d/m/y) | 9-Oct | -24 | Name | Oladapo L | aniya | Signature | | | | |

Enbridge Gas Inc.

Title Engineer, Underground Storage and Reservoir

Company

Map To Hospital



Bluewater Health - Sarnia

89 Norman St, Samia, ON N7T 6S3, Canada

Survey



Schematic



| Contacts | | | | | |
|-------------------------------|--------------------------------------|--|--|--|--|
| Union Waubuno 4, Moore 4-10-2 | | | | | |
| Police Fire & Ambulance | 911 | | | | |
| 911 Address | 2550 Tefler Road, St. Clair Township | | | | |
| | | | | | |
| Tecumseh Control Room | 519-862-6012 | | | | |
| M.O.E. Spills Hotline | 1-800-268-6060 | | | | |
| MNR Contact | 519-873-4645 | | | | |
| MOL | 1-877-202-0008 | | | | |

ENBRIDGE GAS CONTACTS

| Rob Newport - | Storage Superintenent | 519-683-4468 x5102178 519-365-0897 | Rob.Newport@enbridge.com |
|---|---|---|-----------------------------------|
| Shelie Cascadden | Geologist Specialist | 519-818-7008 | Shelie.Cascadden@enbridge.com |
| Oladapo Laniya | Engineer, Underground Storage and Reservoir | 5875783305 | oladapo.laniya@enbridge.com |
| Chris Walters | Land Agent | 519-862-6092 226-964-2042 | chris.walters@enbridge.com |
| Contractors | | | |
| Contractor | Contact | Phone | Email |
| Drilling and Cementing Predator Drilling | Emery Sutton, Tool Push | 403-504-6629 | Esutton@predatordrilling.com |
| | Paulo Facca | 403-264-6712 403-669-1372 | PFacca@predatordrilling.com |
| Terry Marsh Well Drilling | Terry Marsh | 519-695-6060 519-695-9804 | |
| Black Creek | lan Veen | 519-834-2941 519-383-4645 | |
| Wellheads | Welds Determ | 540.000.0500 | |
| vveiimaster | Waldo Peters | 519-688-0500 | wpeters@weilmaster.ca |
| Stream-Flo | Dave Olmsted | 587-416-4512 780-905-8251 | dolmsted@streamflo.com |
| ECAN | Robert Wainwright | 519-627-3824 | |
| Drill Bits: | | 519-400-3922 | |
| Tom Linehan | Varel Rock Bits Canada Sales Manager | Office: 403-968-9369 Cell: 403-303-2533 | tlineham@varel.com |
| Keith Hannah | Trendon Bit Service Ltd. Director, Sales | Office: 403-536-2770 | khannah@trendon.ca |
| Wireline Services: | | | |
| Baker Hughes | Peter Johnston | Office: 519-332-8030 Cell: 226-402-1729 | peter.johnston@bakerhughes.com |
| Weatherford | Jenna Richardson | Office: 519-683-2010 Cell: 519-436-3541 | jenna.richardson1@weatherford.com |
| Water Hauling: | | | |
| McKeegan | Melvin McKeegan | 519-864-1782 519-332-7676 | |
| Harold Marcus Limited | Denis Marcus | Office: 519-695-3735 Cell: 519-380-5238 | dmarcus@haroldmarcus.com |
| Rental Equipment: | | | |
| Dale Holland | Wheatley Wireline Services Ltd. | Office: 519-825-3680 Fax: 519-825-9348 Cell: 519-322-8015 | |
| Keith Davis | Ecan Energy Services Inc. | Office: 519-627-3824 Fax: 519-627-5306 | kmecanen@kent.net |

| | | Contact | S | | |
|-----------------------------------|----------------------------|--------------------|---------|--------------|------------------------------|
| | | Union Waubuno 4, M | oore | e 4-10-2 | |
| | | Cel | l: | 519-437-7038 | |
| | | | | | |
| | | 0// | | 700 055 0000 | |
| Vern Anger | Canfish Services Inc. | Offi | ce: | 780-955-2600 | |
| | Fishing Supervisor | Cel | I: | 403-845-0012 | |
| Aaron Varstraata | Dark Enony Solutions | Off | ~~· | 226 006 1909 | aaron@darkanargycalutions aa |
| Aalon verstraete | Dark Enery Solutions | Col | ь. Г | 510 390 5473 | aaron@darkenergysoldtions.ca |
| | | Cei | I. | 519-360-3473 | |
| Welders: | | | | | |
| | | | | | |
| St. Clair Mechanical President | John Dawson | Offi | ce: | 519-864-0927 | |
| | | Cel | I: | 519-330-9672 | |
| Covernment & Other Age | ncies | | | | |
| dovernment & Outer Ager | <u>icits</u> | | | | |
| | | 08 | | 510 872 4624 | a san munf aan an aa |
| NOID | | UII - | ice: | 519-8/5-4054 | ogsr.mnr1.gov.on.ca |
| MNK | Petroleum Resources Centre | Fax | : | 519-873-4645 | |
| MOECC | Spill Penarting | 1.9 | 00 2 | 268 6060 | |
| MOLECE | Spin Reporting | 1-0 | 00-2 | 208-0000 | |
| MOL | Health & Safety | 1-8 | 00-2 | 265-1676 | |
| | | Of | ice | 519-686-2772 | |
| Oil Cas & Salt Descurress L | ihan ay | - E | | 510 (9(7005 | |
| Oil, Gas & Salt Resources Library | | | | 319-080-7225 | |

Geological Prognosis of:

Union Waubuno 4, Moore 4-10-2

| Lot: | 10 |
|--------|---------|
| Conc: | 2 |
| Tract: | 4 |
| Pool: | Waubuno |

Township:
County:Moore
LambtonObjective:
Coordinates:Natural gas Storage
483.4 m.UTM Coords:4737566, 393010

Geology Contacts: Shelie Cascadden

436-4600 x5002153 (work) 519-818-7008 (cell)

Remarks: Base of Gas Tops derived from

-465.4m UW.2, UI.25 and UM.20 and 2023 seismic reinterpretation

| Contacts | Top (m.) | Elev.(m.) | Thickness | Gas | Oil | H2O | Remarks/Expected Pressure |
|------------------------|----------|-----------|-----------|-----|-----|-----|---------------------------|
| Rig Floor | 0.0 | 193.2 | 4.0 | | | | |
| Ground Elevation | 4.0 | 189.2 | 33.0 | | | | Surveyed |
| Kettle Point / Bedrock | | | 0.0 | | | | |
| Hamilton | 37.0 | 156.2 | 126.0 | | | | |
| Dundee | 163.0 | 30.2 | 36.0 | | | х | Sulphur Water |
| Detroit River | 199.0 | -5.8 | 85.0 | | | | |
| Bois Blanc | 284.0 | -90.8 | 55.0 | | | | |
| Bass Island | 339.0 | -145.8 | 44.0 | | | | |
| G Unit | 383.0 | -189.8 | 7.0 | | | | |
| F Unit Shale | 390.0 | -196.8 | 31.0 | | | | |
| F Salt | | | 0.0 | | | | |
| E Unit Carbonate | 421.0 | -227.8 | 37.0 | | | | |
| D Unit Salt | | | 0.0 | | | | |
| C Unit Shale | 458.0 | -264.8 | 10.0 | | | | |
| B Unit Marker | 468.0 | -274.8 | 6.0 | | | | |
| B Unit | | | 0.0 | | | | |
| B Salt | 474.0 | -280.8 | 52.5 | | | | |
| B Anhydrite | | | 0.0 | | | | |
| A-2 Unit Carbonate | 526.5 | -333.3 | 21.5 | | | | |
| A-2 Shale | 548.0 | -354.8 | 4.0 | | | | |
| A-2 Salt | | | 0.0 | | | | |
| A-2 Anhydrite | 552.0 | -358.8 | 3.0 | | | | |
| A-1 Unit Carbonate | | | 0.0 + | | | | |
| A-1 Anhydrite | | | 0.0 | | | | |
| Guelph | 555.0 | -361.8 | 85.0 | x | | | Gas possible |
| | | | | | | | |
| Total Depth | 640.0 | -446.8 | | | | | |

Geology & Reservoir Engineering, Enbridge Gas Inc.

Sample Requirements:

One sample shall be collected every 3 meters of formation drilled once the Kettle Point/bedrock is reached

October 9, 2024

WELLBORE, CASING AND CEMENTING SUMMARY Union Waubuno 4, Moore 4-10-2

| Description | Hole Size (mm) | MD / TVD (mKB) | Drilling Fluids | Casing Size, Grade, Weight kg/m | Formation @ Depth | Depth Into Formation (m) | How Set |
|----------------------|----------------------|----------------------|--------------------|---------------------------------------|----------------------|--------------------------------|---|
| Conductor Hole | 508 | 38.0 38.0 | n/a | 508 LP n/a | Hamilton | 1 | Driven - Cement squeeze if necessary. If a rotary rig is used for the drilling of the well conductor casing will not be run |
| Surface Hole | 508 | 52.5 52.5 | n/a or water | 406.40 H-40 96.73 | Hamilton | 15.5 | Cement to surface with 10.12 Class G 0-1-0 cement with 2-3% CaCl2. See Cement Program for volumes |
| Intermediate Hole | 374.4 | 395.5 395.5 | Fresh Water | 298.50 H-40 62.50 | F Unit Shale | 5.5 | Cement to Surface with 18.98 Tonne Class G 0-1-8 plus 1-3% CaCl2 followed by 12.89 Class G with 1-3% CaCl2. Depending on hole conditions, consideration may be given to running tixotropic cement or additional loss circulation materials |
| Production Hole | 269.9 | 553.2 553.2 | Brine | 219.10 K-55 47.62 | A-2 Anhydrite | 1.2 | Cement to surface with 30.87 Tonnes Class G, 0-1-0 with 2% CaCl2+10% NaCl. See Cement Program for details |
| Main Hole | 200 | 640.0 640.0 | Fresh Water | | Guelph | 85 | |

Union Waubuno 4, Moore 4-10-2

Pre Spud

Fresh Water Well samples

Obtain samples from all fresh water wells located within a minimum radius of 750m of the proposed well. Perform water analysis and keep copies of the results.

Site Preparation

Prepare drilling location. Locate all drainage tiles crossing lease area. Strip and stockpile all top soil from lease. Construct adequate berms around lease and access road as required. Cut, block and divert drainage tile as required.

Government Notification

Underground Storage to notify M.N.R.F. 48 hours prior to spud and prior to resumption of drilling activities.

<u>Signs</u>

Install rig sign on access road to lease.

Safety Meeting

Conduct a pre-spud safety meeting for all crews. Rig Manager and all crew members must be present.

Additional safety meetings shall be conducted at the Well Site Supervisor's discretion.

Union Waubuno 4, Moore 4-10-2

SURFACE HOLE - ROTARY

- Move in and rig up rotary drilling rig.
 Measure height of rig floor to ground and adjust drilling program
- 2. Drill minimum 15.5 m into Kettle Point / Bedrock (52.5 mKB) with a 508 mm bit. **One sample shall be collected every 3 m once Hamilton is reached.**
- 3. Hold Safety Meeting
- 4. Run 406.4 mm surface casing to bottom (52.5 mKB) with centralizers 2m above shoe and at joints 2 and 4. Tack weld casing.
- 5. Record surface casing OD, weight, grade, placement of cementing hardware and set depth.
- 6. Raise surface casing 0.5 m off bottom and set in slips. Cement 406.4 mm surface casing to surface as per cementing program.
- 7. Wait on cement (W.O.C.) for 24 hours.
- 8. Record cement top in casing.

Union Waubuno 4, Moore 4-10-2

INTERMEDIATE HOLE - ROTARY

- 1. Pressure Test entire BOP system and surface casing to 1225 kPag for 10 minutes and record results in log according to OGSRA Operating Standards v 3.0 sec. 4.5.21
- 2. Drill out cement with 374.4 mm bit.
- 3. Drill 0.5 m of new formation.
- 4. Hold safety meeting. Pressure Test surface casing and BOP in accordance with Pressure Test Program - Surface Casing-Pressure Test
- 5.

Drill until at the top of F Shale formation (390 mKB) with 374.4 mm bit, surveying every 30 m. **Note: Geologist must be on site to verify top of F Shale**

- 6. Drill 5.5m into the F Shale formation to 395.5m with 374.4 mm bit or as directed by company personnel
- 7. Hold safety meeting. Run the 298.5 mm intermediate casing to (395.5 mKB) with a float collar at top of bottom joint. Centralizers should be placed 2 m above shoe, at joints 2, 4 and 5 and every 5th joint to surface. Cement basket should be placed above Detroit River formation. Threadlock guide shoe on bottom.
- 8. The optimum makeup torque is 4170 N-m (3070 ft-lb) and the maximum makeup torque is 5210 N-m (3840 ft-lb). Land casing at proper elevation for thread-on type casing bowl.
- 9. Record intermediate casing OD, weight, grade, placement of cementing hardware and set depth.
- 10. Prepare to cement 298.5 mm intermediate casing to surface.
- 11. Hold safety meeting with all on-site personnel.
- 12. Pressure test surface equipment to 15 MPag for 1 minute. Ensure no leaks.
- 13. Pump citric acid followed by fresh water pre-flush. Cement to surface as per cementing program. Ensure cement returns to surface. Take a minimum of four cement samples. Record all circulating pressures and volumes.
- 14. W.O.C. for 48 hours.
- 15. Hold Safety Meeting. Cased Hole Logging. See LOGGING PROGRAM, Log Run 1.
- Pressure Test Pipe Rams to 1400 kPag for ten minutes. Pressure Test the entire BOP system to 7000 kPag for 10 minutes and record results in log according to OGSRA Operating Standards

(This pressure test also tests the casing and casing bowl requirement of 5,500 kPag.)

Union Waubuno 4, Moore 4-10-2

Production Hole - ROTARY

- 1. Drill a maximum of 0.5 m of new formation with 269.9 mm bit.
- 2. Prepare for Pressure Integrity Test (P.I.T.). Using a low volume, high pressure pump, pressure test the formationat a pressure equivalent to a gradient of 18 kPa/m for 10 min using an incompressible fluid.
- 3. Drill 0.5 m into the A-2 Anhydrite (553.2m) with 269.9 mm bit. Survey every 30m
- Note: Geologist will be onsite to verify top of A-2 Anhydrite formation.
 - 4. Run 219.1 mm production casing to 552.7mKB with insert float at top of bottom joint. Centralizers to be placed 2 m above shoe, at joints 2, 3, 4 and 5 and every 4th joint to surface. Tack weld guide shoeon bottom. The optimum makeup torque is 6140 N-m (4520 ft-lb) and the maximum makeup torque is 7670 N-m (5650 ft-lb). Ensure that a collar is not positioned where the wellhead seals need to be installed.
 - 5.

Record production casing OD, weight, grade, placement of cementing hardware and set depth.

- 6. Hold safety meeting.
- 7. Prepare to cement 219.1 mm production casing to surface.
- 8. Pressure test surface equipment to 15 MPag for 1 minute. Ensure no leaks.
- 9. Pump citric acid followed by fresh water pre-flush. Cement to surface as per Cementing Program - 219.1 mm PRODUCTION CASING. Displace cement with fresh water. Ensure cement returns to surface or arrange for remedial cementing from surface. Take a minimum of four cement samples to verify setup time and density. Record all circulating pressures and volumes.
- 10. Lift BOP and set casing slips.
- 11. W.O.C. for 48 hours.
- 12. Hold safety meeting. Cased Hole Logging. See LOGGING PROGRAM, Log Run 2.

Main Hole - Rotary Rig

- Note: Reservoir pressure must be below 700p.s.i. before proceeding to next step. Enbridge to notify Contractor when pressure is below 700 p.s.i.
 - 1. Drill out cement, shoe and 0.5 m of new formation with 200.0 mm bit.
 - 2. Prepare for Pressure Integrity Test (P.I.T.). Using a low volume, high pressure pump, pressure test the formation at a pressure equivalent to a gradient of 18 kPa/m for a duration of ten (10) minutes using an incompressible fluid.
 - Continue open hole section to 640 mKB MD
 One sample shall be collected every 3 m from the production casing to TD.
 - 4. P.O.O.H. Rig out seperator, flare stack and foam unit.
 - 5. Hold safety meeting. Open Hole Logging. See LOGGING PROGRAM, Log Run 3.
 - 6. Set wireline retrievable release plug in vertical section (~500 mKB MD). Check for gas.
 - 7. Rig out wireline company.
 - 8. Set primary seals. Cut off casing to proper height. Install casing spool.
 - 9. Install master valve.
 - 10. Rig out rotary drilling rig.
 - 11. Rig in service contractor and retrieve release plug.
 - 12. Install blind flange on top of master valve.
 - 13. Drilling department to notify M.N.R.F. within 48 hours of reaching TD.

CASING PROGRAM

Union Waubuno 4, Moore 4-10-2

CONDUCTOR CASING SUMMARY (Cable Tool: 1.9 m KB-GL) (CABLE TOOL ONLY)

| | Metric | ; | Impe | rial |
|--------------------------|--------------|----------|----------------|-------------|
| Description | Value | Unit | Value | Unit |
| Тор | 0.0 | mKB | 0.0 | ftKB |
| Bottom | 38.0 | mKB | 124.7 | ftKB |
| Outside Diameter | 508.00 | mm | 20.000 | inches |
| Weight | | kg/m | 0.0 | lb/ft |
| Drift Diameter | | mm | 0.000 | inches |
| Inside Diameter | 488.95 | mm | 19.250 | inches |
| Grade | Line pipe | | Line pipe | |
| Thread | N/A | | N/A | |
| Coupling | Welded | | Welded | |
| Burst | N/A | | N/A | psi |
| Collapse | N/A | kPa | N/A | psi |
| Pipe Body Yield Strength | N/A | daN | N/A | lb-f |
| Joint Strength | N/A | daN | N/A | lb-f |
| Torque - Optimum | N/A | N-m | N/A | ft-lb |
| Torque - Maximum | N/A | N-m | N/A | ft-lb |
| Condition | New | | | |
| Float Equipment | None | | | |
| Shoe | Drive | | | |
| Threadlock | Tack weld dr | ive shoe | on bottom join | t of casing |

SURFACE CASING SUMMARY (Cable Tool: 1.9 m KB-GL)

| | Metric | | Imperial | |
|--------------------------|--------------|---------------|------------|--------------|
| Description | Value | Unit | Value | Unit |
| Тор | 0.0 | mKB | 0.0 | ftKB |
| Bottom | 52.5 | mKB | 172.2 | ftKB |
| Outside Diameter | 406.40 | mm | 16.000 | inches |
| Weight | 96.73 | kg/m | 65.0 | lb/ft |
| Drift Diameter | 382.60 | mm | 15.063 | inches |
| Inside Diameter | 387.40 | mm | 15.252 | inches |
| Grade | H-40 | | H-40 | |
| Thread | 8 Rd. | | 8 Rd. | |
| Coupling | ST & C | | ST & C | |
| Burst | 11,310 | kPa | 1,640 | psi |
| Collapse | 4,620 | kPa | 670 | psi |
| Pipe Body Yield Strength | 327,400 | daN | 736,000 | lb-f |
| Joint Strength | 195,300 | daN | 439,000 | lb-f |
| Torque - Optimum | 5,960 | N-m | 4,390 | ft-lb |
| Torque - Maximum | 7,460 | N-m | 5,490 | ft-lb |
| Condition | New | | | |
| Float Equipment | None | | | |
| Centralizers | Joints 2 and | 3 | | |
| Shoe | Guide | | | |
| Threadlock | Threadlock g | juide shoe on | bottom joi | nt of casing |

CASING PROGRAM

Union Waubuno 4, Moore 4-10-2

INTERMEDIATE CASING SUMMARY

| | Metric | | Imperial | |
|--------------------------|----------------|-----------|------------------------------|--------------|
| Description | Value | Unit | Value | Unit |
| Тор | 0.0 | mKB | 0.0 | ftKB |
| Bottom | 395.5 | mKB | 1297.6 | ftKB |
| Outside Diameter | 298.50 | mm | 11.752 | inches |
| Weight | 62.50 | kg/m | 42.0 | lb/ft |
| Drift Diameter | 277.57 | mm | 10.928 | inches |
| Inside Diameter | 281.53 | mm | 11.084 | inches |
| Grade | H-40 | | H-40 | |
| Thread | 8 Rd. | | 8 Rd. | |
| Coupling | ST & C | | ST & C | |
| Burst | 13,650 | kPa | 1,980 | psi |
| Collapse | 7,380 | kPa | 1,070 | psi |
| Pipe Body Yield Strength | 212,600 | daN | 478,000 | lb-f |
| Joint Strength | 136,600 | daN | 307,000 | lb-f |
| Torque - Optimum | 4,170 | N-m | 3,070 | ft-lb |
| Torque - Maximum | 5,210 | N-m | 3,840 | ft-lb |
| Condition | New | | | |
| Float Equipment | Float Collar (| Top of 1 | st joint) | |
| Centralizers | Joints 2,4 & | 5; every | 4 th joint & 10 m | from surface |
| Cement Basket | Run above D | etroit Ri | ver formation | |
| Shoe | Guide | | | |
| Threadlock | Threadlock g | uide sho | pe on bottom joi | nt of casing |

PRODUCTION CASING SUMMARY

| | Metric | | Imperial | |
|--------------------------|----------------|-----------------------------|------------|--------------|
| Description | Value | Unit | Value | Unit |
| Тор | 0.0 | mKB | 0.0 | ftKB |
| Bottom | 552.7 | mKB | 1813.3 | ftKB |
| Outside Diameter | 219.10 | mm | 8.626 | inches |
| Weight | 47.62 | kg/m | 32.0 | lb/ft |
| Drift Diameter | 198.00 | mm | 7.795 | inches |
| Inside Diameter | 201.20 | mm | 7.921 | inches |
| Grade | K-55 | | K-55 | |
| Thread | 8 RD | | 8 RD | |
| Coupling | LT & C | | LT & C | |
| Burst | 27,100 | kPa | 3,930 | psi |
| Collapse | 17,440 | kPa | 2,530 | psi |
| Pipe Body Yield Strength | 223,700 | daN | 503,000 | lb-f |
| Joint Strength | 201,000 | daN | 452,000 | lb-f |
| Torque - Optimum | 6,140 | N-m | 4,520 | ft-lb |
| Torque - Maximum | 7,670 | N-m | 5,650 | ft-lb |
| Condition | New | | | |
| Float Equipment | Float Collar (| Top of 1 st joir | nt) | |
| Centralizers | Joints 2,4 & | 5; every 4 th jo | int & 10 m | from surface |
| Shoe | Guide | | | |
| Threadlock | Threadlock g | juide shoe on | bottom joi | nt of casing |

CEMENTING PROGRAM

<u>-10-2</u>

| | Union Waubuno 4, Moore 4-1 |
|---|-------------------------------|
| 406.4 mm SURFACE CASING Equipment Pumping unit Cementing head (plug loading type) One 406.0 mm wiper plug | |
| CEMENT SPECIFICATIONS | |
| Description | Value Unit |
| Тор | 0.0 mKB |
| Bottom | 52.5 mKB |
| Pre-sweep (Fresh Water) | 2.00 m ³ |
| Cement Excess (Openhole) | 100% |
| Cement Excess (Cased Hole) | 30% |
| | 0:1:0 Freeb |
| | |
| Additives | 3% CaCl ₂ |
| Density | 1901 kg/m ³ |
| Water Requirement | 0.440 m ³ /t |
| Yield | 0.757 m ³ /t |
| Cement Volume | 7.66 m ³ |
| Cement Yield | 10.12 tonnes |
| Displacement #1 (Fresh Water) | 0.50 m ³ |
| Displacement #2 (Brine) | 5.69 m ³ |
| Displacement Rate | 0.6 - 0.8 m ³ /min |
| W.O.C. | 24 hrs |
| 24 Hr. Compressive Strength | 20,684 kPa |
| | |

CEMENTING PROCEDURE

- 1. Run casing.
- 2. Pump pre-sweep, pump cement, drop top plug. DO NOT PUMP OUT LINES.
- 3. Displace plug with water. DO NOT OVERDISPLACE MORE THAN 1/2 SHOE JOINT VOLUME. Bump plug 3,500 kPa over pumping pressure.
- 4. Maintain a constant pump rate throughout the cement job.
- 5. Catch cement slurry samples while mixing and set aside.
- 6. Observe setting time and cement quality.
- 7. If no cement returns to surface, consult with Storage Operations Supervisor regarding re-cementing from top with macaroni string using Class 'G' cement + 3% CaCl₂.
- 8. Obtain a 1 litre sample of the dry cement used in the cement job. This will be used for testing if subsequent cement problems occur (i.e. flash setting).

CEMENTING PROGRAM

Union Waubuno 4, Moore 4-10-2

| 298.5 mm INTERMEDIATE | CASING |
|-----------------------|--------|
| Equipment | |

Pumping unit

· Cementing head (plug loading type)

 \cdot One 298.5 mm wiper plug

| NOTE: |
|---|
| Lead Cement: Surface to top of Bois Blanc |
| Tail Cement: Top of Bois Blanc to casing shoe |

| CEMENT SPECIFICATIONS | Lead | Tail Value Unit |
|-------------------------------|-------------------------------|-----------------------------------|
| Top | | |
| Pottom | 0.0 IIIKD 294.0 mKB | 204.0 IIIRB 205.5 mKB |
| | 204.0 IIIND | 595.5 HIKB |
| Pre-sweep #1 (Citric Acid) | 3.00 m° | N/A |
| Pre-sweep #2 (Fresh Water) | 1.00 m ³ | N/A |
| Cement Excess (Openhole) | 100% | 100% |
| Cement Excess (Cased Hole) | 30% | 30% |
| Cement Type | 0:1:8 Class 'G' | 0:1:0 Class 'G' |
| Mix Water | Fresh | Fresh |
| Celloflakes | 2 bags | N/A |
| Prehydrated Gel | 2% | N/A |
| Additives | 0.75% T-10 | 2% CaCl ₂ ; 0.75% T-10 |
| Density | 1604 kg/m ³ | 1901 kg/m ³ |
| Water | 0.864 m ³ /t | 0.440 m ³ /t |
| Yield | 1.212 m ³ /t | 0.757 m ³ /t |
| Cement Volume | 23.00 m ³ | 9.75 m ³ |
| Cement Yield | 18.98 tonnes | 12.89 tonnes |
| Pump Rate | 0.6 - 0.8 m ³ /min | 0.6 - 0.8 m ³ /min |
| Displacement #1 (Fresh Water) | N/A m ³ | 0.50 m ³ |
| Displacement #2 (Brine) | N/A m ³ | 23.50 m ³ |
| W.O.C. | 48 hrs | 48 hrs |
| 24 Hr. Compressive Strength | 1379 kPa | 15,858 kPa |

CEMENTING PROCEDURE

1. Run casing.

2. Pump pre-sweep, pump Lead cement, pump Tail Cement and drop wiper plug. DO NOT PUMP OUT LINES.

3. Displace plug with fresh water and then brine. DO NOT OVERDISPLACE MORE THAN 1/2 SHOE JOINT VOLUME. Bump plug 3,500 kPa over pumping pressure.

4. Maintain a constant pump rate throughout the cement job.

- 5. Catch cement slurry samples while mixing and set aside.
- 6. Observe setting time and cement quality.
- 7. If no cement returns to surface, consult with Storage Operations Supervisor regarding re-cementing from top with macaroni string using Class 'G' cement + 3% CaCl₂.
- 8. Obtain a 1 litre sample of the dry cement used in the cement job. This will be used for testing if subsequent cement problems occur (i.e. flash setting).
- 9. Run a Cement Bond Log (CBL) to evaluate the integrity of the cement bond and to locate the position of the cement top.

CEMENTING PROGRAM

Union Waubuno 4, Moore 4-10-2

| 219.1 mm PRODUCTION CASING Equipment Pumping unit Cementing head (plug loading type) One 219.1 mm wiper plug CEMENT SPECIFICATIONS | | | | | |
|---|----------------|-------------------|--|--|--|
| Description | Value | Unit | | | |
| Тор | 0.0 | mKB | | | |
| Bottom | 552.7 | mKB | | | |
| Pre-sweep (Citric Acid) | 3.00 | m ³ | | | |
| Pre-sweep (Fresh Water) | 1.00 | m ³ | | | |
| Cement Excess (Openhole) | 100% | | | | |
| Cement Excess (Cased Hole) | 30% | | | | |
| Cement Type | 0:1:0 | Class 'G' | | | |
| Mix Water | 10% Salt Water | | | | |
| Fluid loss/Dispersant | 0.75% T-10 | | | | |
| Gas Block (if required) | 0.4% D-24 | _ | | | |
| Density | 1901 | kg/m ³ | | | |
| Water Requirement | 0.440 | m ³ /t | | | |
| Yield | 0.772 | m ³ /t | | | |
| Cement Volume | 23.83 | m ³ | | | |
| Cement Yield | 30.87 | tonnes | | | |
| Pump Rate | 0.6 - 0.8 | m³/min | | | |
| Displacement (Brine) | 0.75 | m ³ | | | |
| W.O.C. | 48 hrs | | | | |
| 24 Hr. Compressive Strength | 6,895 | kPa | | | |
| NOTE: Cement program may be changed if well integrity conditions dictate | | | | | |

CEMENTING PROCEDURE

- 1. Run casing and set casing slips.
- 2. Pump pre-sweep, pump cement, drop top plug. PUMP OUT LINES.
- 3. Displace plug with brine. DO NOT OVERDISPLACE MORE THAN 1/2 SHOE JOINT VOLUME. Bump plug 3,500 kPa over pumping pressure.
- 4. Maintain a constant pump rate throughout the cement job.
- 5. Catch cement slurry samples while mixing and set aside.
- 6. Observe setting time and cement quality.
- 7. If no cement returns to surface, consult with Storage Operations Supervisor regarding re-cementing from top with macaroni string using Class 'G' cement + 3% CaCl₂.
- 8. Obtain a 1 litre sample of the dry cement used in the cement job. This will be used for testing if subsequent cement problems occur (i.e. flash setting).
- 9. Run a Cement Bond Tool to evaluate the integrity of the cement bond and to locate the position of the cement top.

PRESSURE TEST PROGRAM

Union Waubuno 4, Moore 4-10-2

SURFACE CASING - PRESSURE TEST

1. Pressure Test surface casing to 1380 kPag for 10 minutes and pressure test BOP system to a pressure equivalent to one- half its working pressure. Record results in log according to OGSRA Operating Standards v 3.0 sec. 4.5.21.

INTERMEDIATE CASING - PRESSURE TEST

1. Pressure Test Intermediate casing to 1380 kPag for 10 minutes and pressure test annular preventer to a pressure equivalent to one- half its working pressure. Record results in log according to OGSRA Operating Standards v 3.0 sec. 4.5.21.

PRODUCTION HOLE - PRESSURE INTEGRITY TEST (PIT)

- 1. Drill 0.5 m of new formation.
- 2. Using a low volume, high pressure pump, pressure test the formation at a pressure equivalent to a gradient of 18 kPa/m for a duration of ten (10) minutes using an incompressible fluid.

PRODUCTION CASING - PRESSURE TEST

- 1. Pressure test wellhead and production casing to 13,790 kPa for four (4) hours.
- Install Wellhead and Master Valve and 177.8 mm BOP. The lubricator and components shall have a minimum pressure rating of 120% of the formation pressure. Pressure test annular preventer to 1380kPa for 10 minutes. Pressure test annular preventer to 7000 kPa for 10 minutes

WELLHEAD

Union Waubuno 4, Moore 4-10-2



LOGGING PROGRAM

| Run | Logging | Hole Condition | | |
|-----|----------------------|---|---|--------------------------|
| # | Interval | Fluid Filled | Gas Filled | Comments |
| 1 | Intermediate-Surface | Gamma Ray Cement Bond Log | | Logs run after 48 hr WOC |
| 2 | Production - Surface | Cement Bond Log High Res Vertilog Gamma Ray | | Logs run after 48 hr WOC |
| 3 | TD-Surface | Gamma Ray Compensated Neutron Z-Density* | Gamma Ray Linear Porosity Neutron* Z-Density* | |

Union Waubuno 4, Moore 4-10-2

NOTE: * open hole section only

ABANDONMENT PROGRAM

Union Waubuno 4, Moore 4-10-2

If drilling results prove unsuccessful, the well will be plugged and abandoned as follows:

- 1 Notify MNRF by fax 48 hrs prior to commencing plugging operations
- 2 Run tubing to TD and cement to surface with 34.36 m³ of 0:1:0 Class 'G' neat cement.
- 3 Pull all tubing from well.
- 4 Wait on cement overnight.
- 5 Ensure cement top is at surface.
- 6 Cut all casing strings off a minimum of 1.0 m below grade and weld on steel plate.
- 7 Restore surface location to original condition.