Breaking Through

LARICINA ENERGY LTD.

Presented by Stephen Arseniuk, P.Eng.

Foamed Cement Solutions For Thermal Well Construction

October 17, 2011

Agenda

"The difficult we do immediately, the impossible takes a little longer"

Samuel C. Florman

- Pros and Cons of Foamed Thermal Cement
- Cyclic-Steam (California) Learnings
- Design and Development of Grosmont Cement Blend
- Field Installation
- Results / Bond Logs

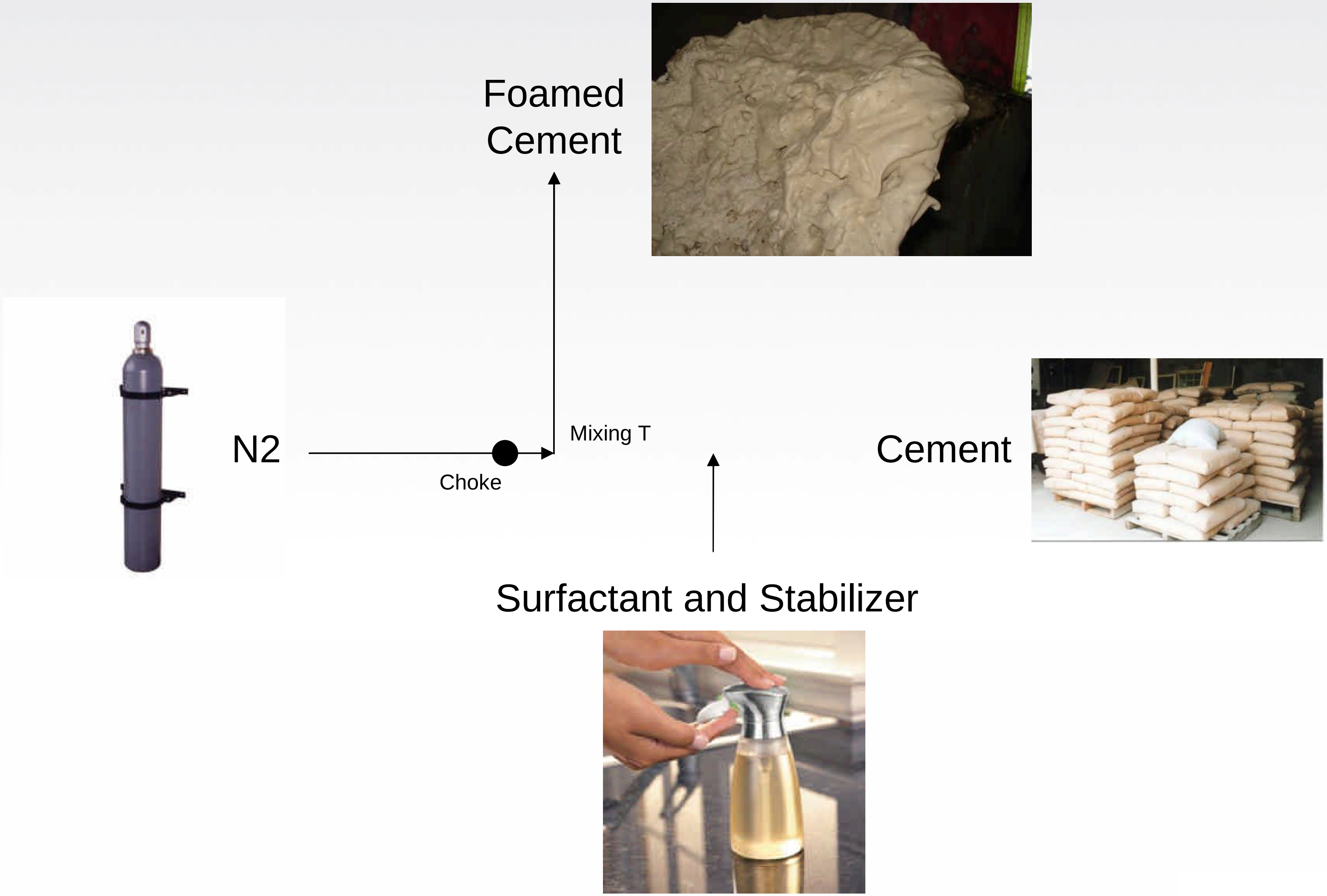
Foamed Cementing

- Issues while:
  - Healing losses
  - Cement returns to surface
  - Abandoning core holes

- Foamed cement addresses these issues

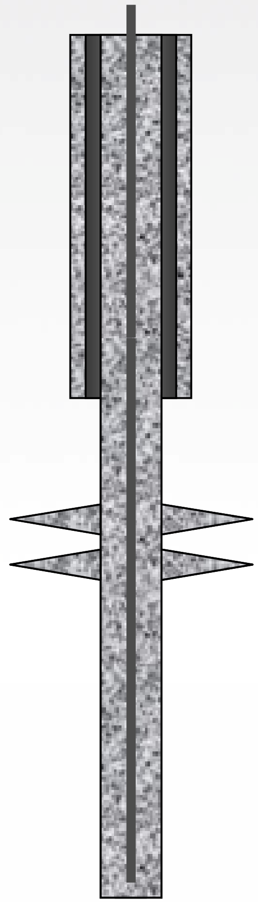
Image Courtesy of Halliburton

Foaming Cement



Foam Abandonments

- Run coil to TD
- Pump and pull
- Pause and continue to pump until cement returns to surface
- Pull coil to surface
- Control backpressure to ensure cement meets spec



California Case Study - SPE 46215 – Miller and Frank - Foam Cementing Cyclic-Steam, Producing Wells: Cymric Field Case Study

- Advantages
  - Tuned density
  - Low water to solids ratio (compared to water extended slurries)
  - Greater resistance to stress cracking cause by cycling
  - Better strengths than slurried lightweights
  - Foam matrix provides space for crystalline growth associated with retrogression
  - Better mud-displacement properties
- Disadvantages
  - More costly than slurry (can be less costly than flexible/rubberized cements)
  - Control of N2 Rate
  - Washout affects placement on variable rate jobs
  - Higher viscosities mean higher ECDs
  - Dealing with foamed returns

California Case Study SPE 46215 – Miller and Frank - Foam Cementing Cyclic-Steam, Producing Wells: Cymric Field Case Study

- Learnings
  - Class C Base Slurry
    - Lower base slurry density
  - Use of Calliper Data
    - Cement placement for constant density job
  - Inert and Reactive Spacers
    - Foamed water spacer for mud removal
    - Time to get all equipment up and on-line
  - Automated N2 Delivery
    - Foamed cement consistency and constant density

General SAGD Well Integrity

- Influenced largely by the thermo-mechanical properties of the formation and well operations
- Understand and model the relationship between the casing, cement, and rock
- Optimize cement (including foam cement) and casing designs for the Grosmont
- Use proven methods for High Temperature (HT) cement and casing design

Cement Design Criteria

- Goals
  - No strength retrogression concerns
  - meet Young's Modulus and tensile strength requirements
  - 3.5MPa in 48 hours
  - Target constant density foam at 750 – 1050kg/m3 (losses)
  - No cement failure
- Challenges
  - Complex formation-cement-casing interaction
  - Soft formations
  - Low temperature cure, high temperature operating
  - Low slurry density to alleviate stability concerns with safety factor

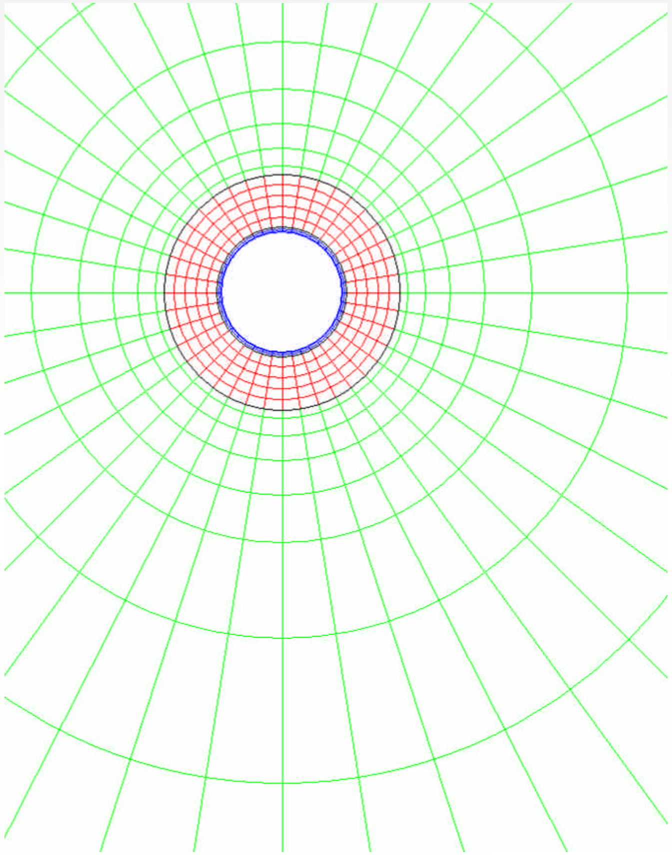
FEA Analysis

- Finite element analysis (FEA) model
  - 3D Stress, 2D Strain
  - Known geometry, casing, and formation properties
  - Qualify a candidate blend

- 2 slices
  - Cap rock – Clearwater/Wabiskaw
  - Reservoir rock - Grosmont formation

- Failure mechanisms considered
  - Radial cracking (tensile failure)
  - Shear deformation (compressive failure)
  - De-bonding at the casing,
  - De-bonding at formation

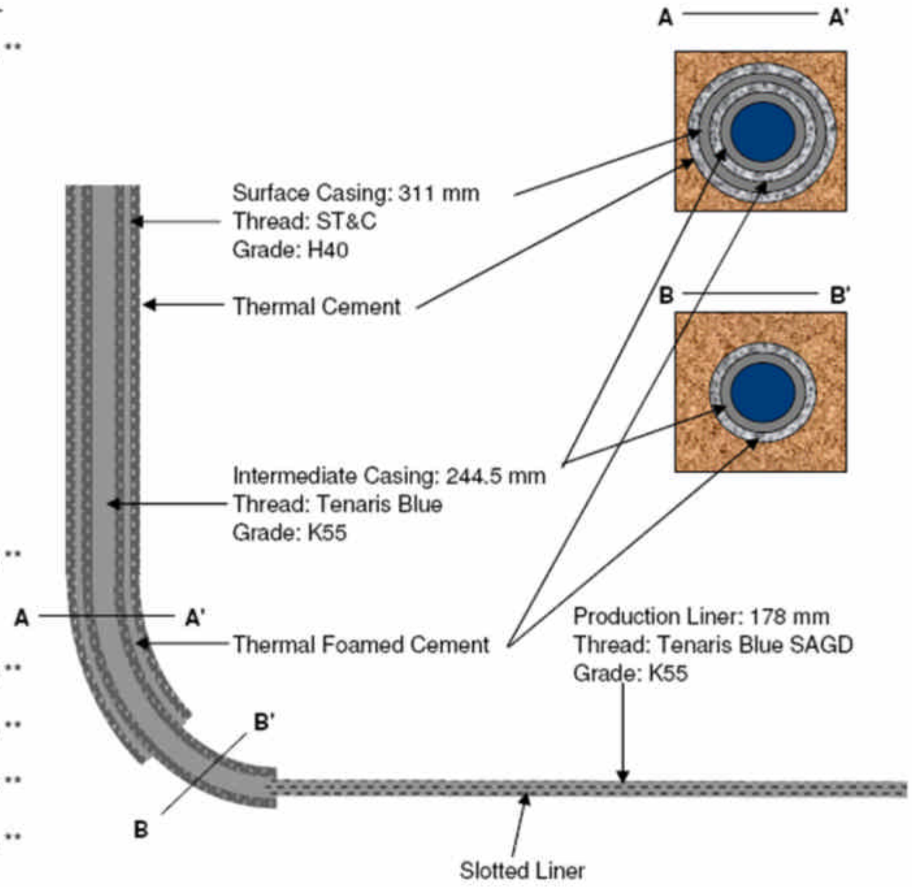
- Operations
  - Curing,
  - Pressure testing,
  - Completions,
  - Steam injection



Well Design

Production Well Construction Details
P1D (Proposed)

	ELEV (masl)	TVD (mKB)	MD (mKB)
Ground Level	577.1	0	5.6 **
KOP	447.1	130	130 **
Ground Water	345.2	231.9	
SCP	247.1	330	375 **
ICP	216.1	361	575 **
Heel	216.1	361	575 **
Toe	217.1	360	1380 **



** Depths are estimates and are subject to change upon receipt of direcitional plan

Property Testing

- Formation mechanical properties from logs and reservoir models
- Several candidate blends
- Simulate long cure at low temp (60C for 48h)
- Exposed to high temp (260C for 1 week)
- ASTM testing methodologies to collect
  - Young's Modulus
  - Poisson's ratio
  - Tensile strength (splitting/brazilian)
  - Cohesion and friction angle

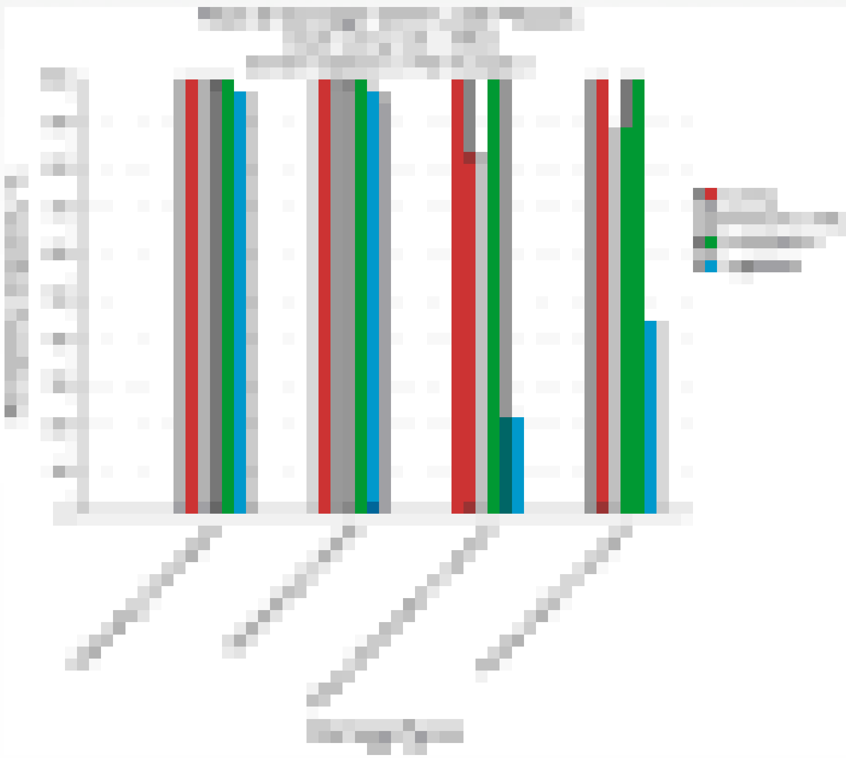
FEA Results

- Remaining capacity (RC) – similar to safety factor
  - 100% RC = cement sheath experienced little change in loading condition
  - 0% RC = cement sheath loaded to its failure point
  - >0% RC = cement sheath has not experienced failure

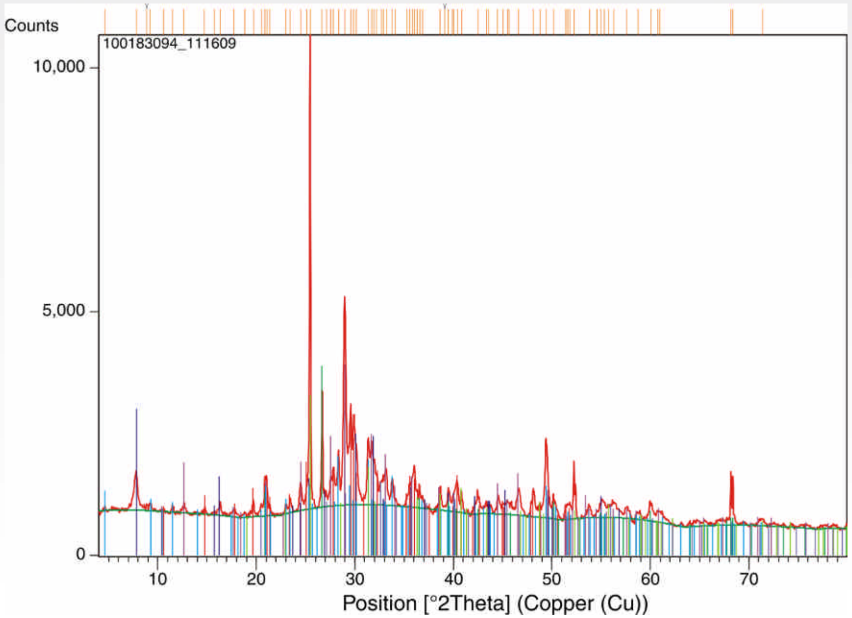
- No failure in any modelled operation

- Lowest RC >20%, SF > 1.25

- Microfine cement with glass microspheres and low temperature accelerators



Strength Retrogression



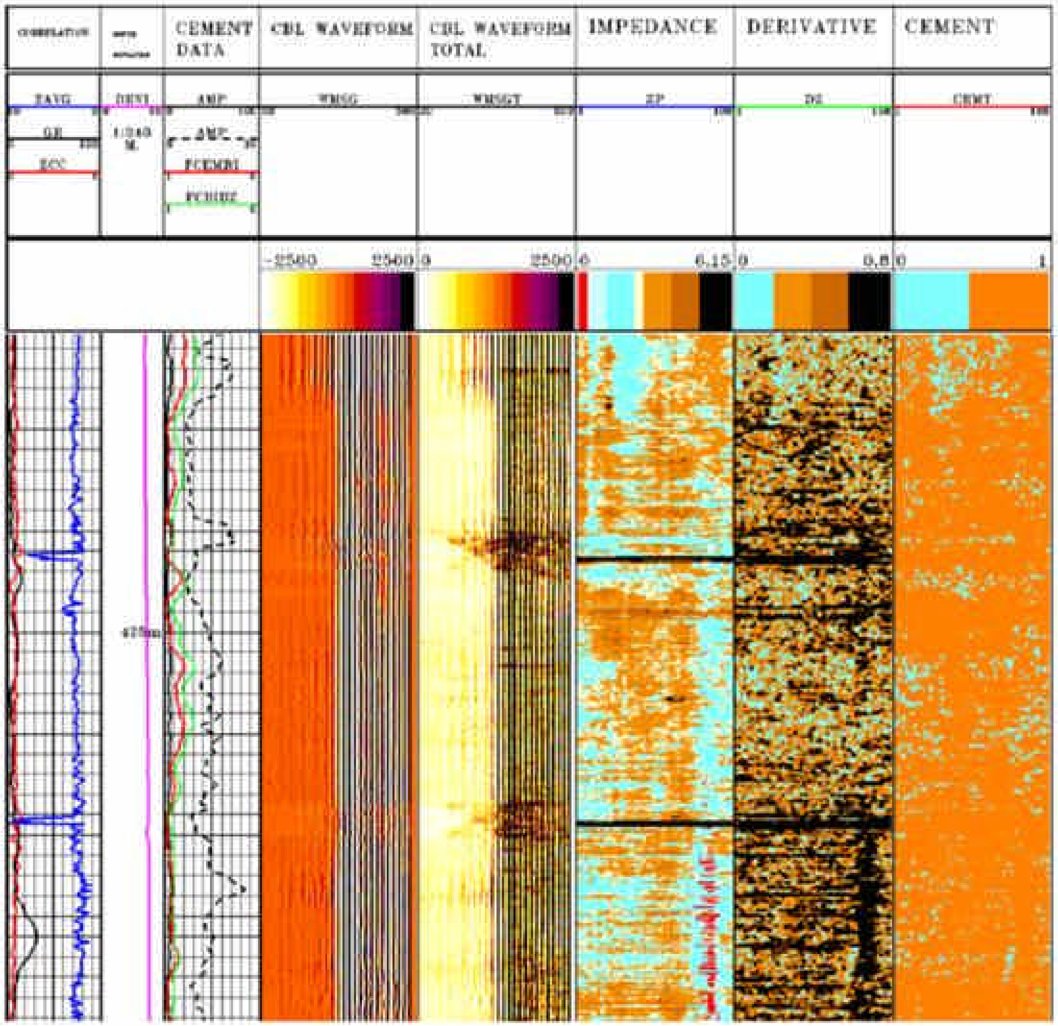
XRD COMPOUND RESULTS		
Visible	**Compound Name**	**Chemical Formula**
*Red	Scawtite	$Ca_7\ Si_6\ (CO_3)\ O18{\cdot}2\ H_2O$
*Blue	Tobermorite-11A	$Ca_5\ Si_6$ (O,O H,F)18 ·5 H_2O
*Green	Quartz	$Si\ O_2$
*Purple	Xonotlite	$Ca_6\ Si_6$ O17 (OH)2
*Aqua	Reyerite *	(Na,K) $Ca_7Si_{11}AlO_{29}$ (O H)4 · H_2O
*D. Green	Anhydrite	$Ca(SO_4)$
*Violet	Calcium aluminum Silicate hydroxide*	$Ca_3\ Al_2(SiO_4)$ (O H)8

- X-Ray Diffraction (XRD)
- Typical good (stable) compounds:
  - Quartz (crystalline silica)
  - Tobermorite
  - Xonotlite
- Typical bad compounds:
  - alpha dicalcium silicate hydrate
- No bad compounds formed
- Quartz indicates low risk of strength retrogression
- Low risk of cement failure

Operational Challenges

- Batch mixing on site
  - Separation in transport:
  - Water additions increase density
- Large volumes for batch mixing
  - Thickening time
  - Length of time to pre mix pre-flush
  - Length of time to batch mix
- Equipment
  - Layout
  - Crew and equipment availability
- Wait On Cement time
  - 48 hours to 3.5 MPa

Bond Logs



- Circumferential acoustic-scanning tool (CAST) –
  - cement-bond logs (CBL) and
  - ultrasonic scanning (US) logs
  - inspect casing and cement simultaneously
- Statistical variance processing (SVP) technique
- Good coverage, no channelling. Good Cement

Conclusion

- Foamed Cement
  - Has alleviated many cement placement challenges
- Design
  - An innovative blend created
  - Will not fail in this application
    - Tension, compression, or debond
    - During well operations
  - Can be foamed to 1000 kg/m3 as a stable foam
  - 3.5MPa in 48 hours
  - XRD indicates no strength retrogression
- Operational / Achievements
  - Properly mixed to desired density
  - Good bond logs

Foamed Cement Returns

More Foamed Cement Returns

Foamed Cement in Clastic SAGD

- Parting thoughts
  - Lure of
    - Improved mud displacement
    - Reasonable mechanical properties
    - Cost compared to some flexible blends
    - Fracture tip blunting
    - Low thermal conductivity
  - Potential challenges
    - Low thermal conductivity
    - Complicated placement
      - lack of callipers
      - N2 control

Forward-looking statements advisory

This Laricina Energy Ltd. (the "Company") presentation contains certain forward-looking statements. Forward-looking statements may include, but are not limited to, statements concerning estimates of exploitable original-bitumen-in-place, predicted recovery factors, steam-to-oil ratios and well production rates, estimated recoverable resources as defined below, expected regulatory filing, review and approval dates, construction and start-up timelines and schedules, company project potential production volumes as well as comparisons to other projects, statements relating to the continued overall advancement of the Company's projects, comparisons of recoverable resources to other oil sands projects, estimated relative supply costs, potential cost reductions, recovery and production increases resulting from the application of new technology and recovery schemes, estimates of carbon sequestration capacity, costs for carbon capture and sequestration and possible implementation schedule for carbon capture and sequestration processes or related emissions mitigation or reduction scheme and other statements which are not historical facts. You are cautioned not to place undue reliance on any forward-looking statements as there can be no assurance that the plans, intentions or expectations upon which they are based will occur. By their nature forward-looking statements involve numerous assumptions, known and unknown risks and uncertainties, both generally and specific, that contribute to the possibility that the predictions, forecasts, projections and other forward-looking statements will not occur. Although the Company believes that the expectations represented by such forward-looking statements are reasonable, there can be no assurance that such expectations will prove to be correct and, accordingly that actual results will be consistent with the forward-looking statements. Some of the risks and other factors that could cause results to differ materially from those expressed in the forward-looking statements contained in this presentation include, but are not limited to geological conditions relating to the Company's properties, the impact of regulatory changes especially as such relate to royalties, taxation and environmental changes, the impact of technology on operations and processes and the performance of new technology expected to be applied or utilized by the Company; labour shortages; supply and demand metrics for oil and natural gas; the impact of pipeline capacity, upgrading capacity and refinery demand; general economic business and market conditions and such other risks and uncertainties described from time to time in the reports and filings made with security regulatory authorities, contained in other disclosure documents or otherwise provided by the Company. Furthermore the forward-looking statements contained in this presentation are made as of the date hereof. Unless required by law the Company does not undertake any obligation to update publicly or to revise any of the included forward-looking statements, whether as a result of new information, future events or otherwise. The forward-looking statements contained in this presentation are expressly qualified by this advisory and disclaimer.

In this presentation "recoverable resources" includes the unrisked arithmetic sum of best estimate contingent resources and prospective resources and proved plus probable reserves as defined in the report of GLJ Petroleum Consultants Ltd. ("GLJ") regarding certain of Laricina's properties effective December 31st, 2010, referred to herein (the "GLJ Report"). "Exploitable OBIP" refers to original-bitumen-in-place that is targeted for development using thermal recovery technologies. The best and high estimate includes contingent and prospective resources. Contingent resource values have not been risked for chance of development while prospective resource values have been risked for chance of discovery but not for chance of development. There is no certainty that it will be commercially viable to produce any portion of the contingent resources. There is no certainty that any portion of the prospective resources will be discovered or, if discovered, if it will be commercially viable to produce any portion of the prospective resources. "2P" means proved plus probable reserves and "3P" means proved plus probable plus possible reserves. The SC-SAGD best estimate technology sensitivity (Laricina technology sensitivity) net economic forecasts were prepared on Saleski-Grosmont and Germain-Grand Rapids based on SC-SAGD technology and remaining properties based on SAGD/CSS technology". SC-SAGD" means solvent-cyclic steam-assisted gravity drainage. "CSS" means cyclic steam stimulation.

Contact us

Laricina Energy Ltd.
800, 425 – 1st Street SW
Calgary, Alberta T2P 3L8

403-750-0810

www.laricinaenergy.com
laricina@laricinaenergy.com