

Moving Dilbit in Pipelines

**12/2/14 Presentation to Citizens Committee on Pipeline Safety
("CCOPS")**

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Today's Presentation

The Legal Disclaimer –

Based on information readily available in the public domain

Will not violate various:

confidential agreements,
sensitive investigations assisted by Accufacts Inc., and/or
protective orders

Relying on many decades of experience concerning:

incident investigation, production/refinery
processing, blending, process safety management,
pipeline operation, and pipeline regulatory development

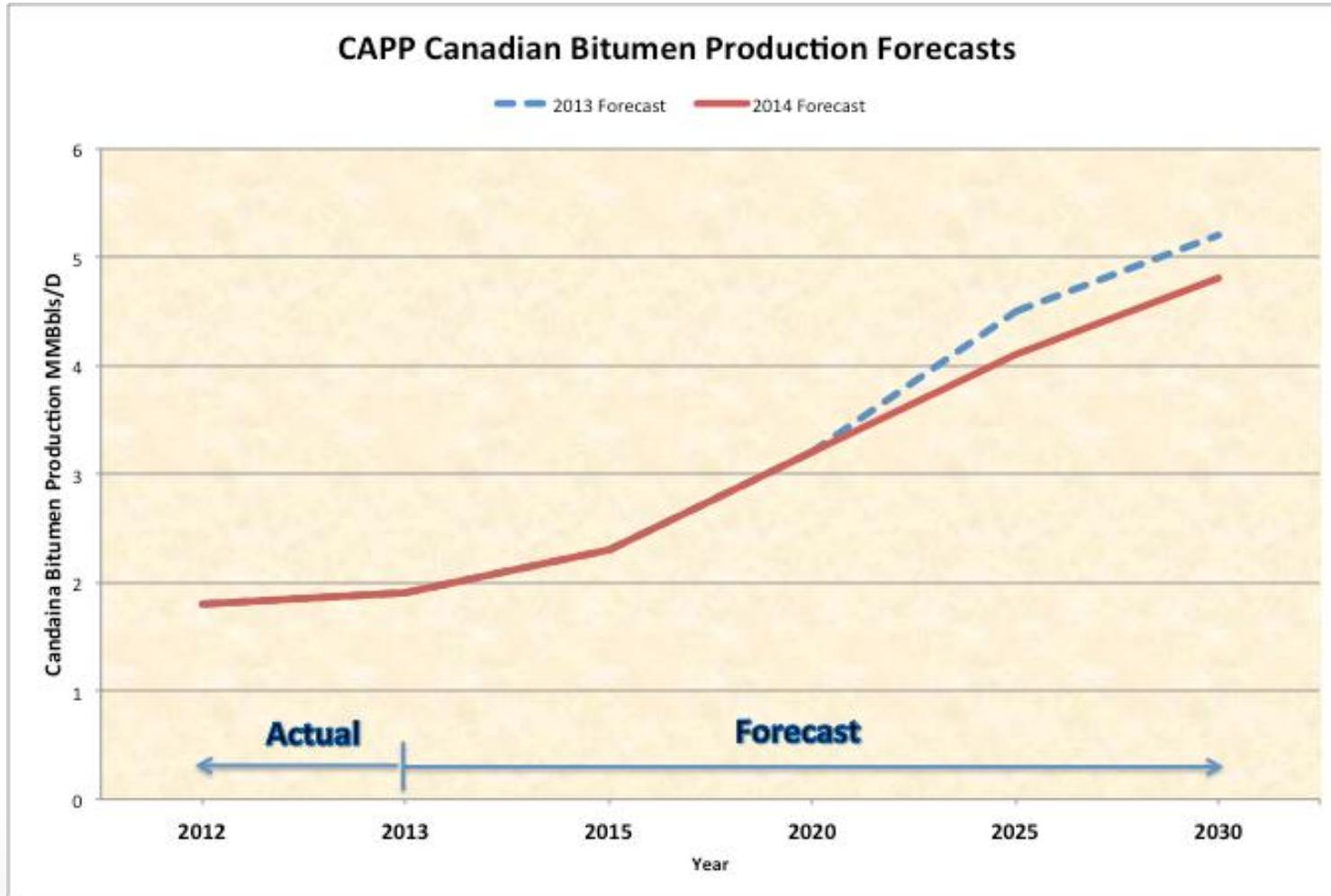
Today's Primary Focus on Pipelines

- Production factors driving dilbit pipeline movements
- General economics of bitumen
- Why integrity management must fully address crack threats on pipelines moving dilbit
- Suggested future efforts for CCOPS

What is Dilbit?

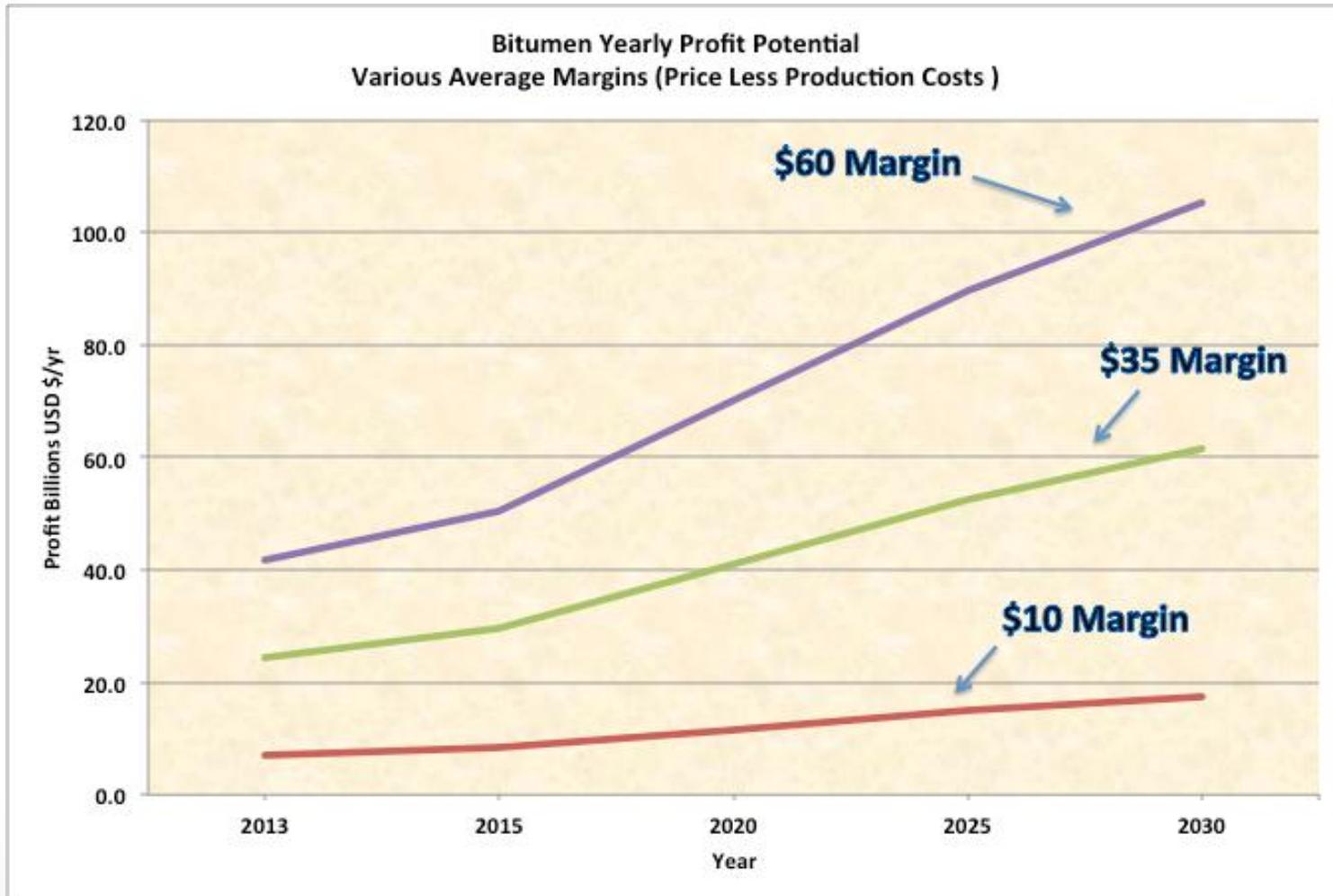
- **Bitumen is:**
 - A very viscous, extremely heavy, sticky “tar” from tar or oil sands
 - API Gravity ~ 7 to ~11, vs water API gravity of 10.0
 - Must be heated and/or diluted to flow in pipelines
- **Dilbit = Diluted Bitumen**
 - Bitumen blended or diluted with solvent/diluent to flow and meet certain pipeline tariff specs
 - Blended range of API gravities of ~ 18 to 22.0 (similar to heavy crude)
 - Usually a maximum viscosity pipeline spec with varying monthly temperature limit
 - “Cutter stocks” and other oils can be used as diluents
 - Most likely diluents are condensates (NGLs) because of availability/price
 - NGLs have varying compositions, but really reduce/cut viscosity
 - Bitumens require a wide range of diluent blends (on the order of 25 to 55%)
 - Dilbit not conventional heavy crude

Canadian Bitumen Production*



*from Canadian Association of Petroleum Producers, or CAPP, June 2014 Annual Report
Crude Oil Forecast, Markets & Transportation

Huge Economics Driving Bitumen



The Bitumen Bottleneck - Transportation

- Rail
 - Limited throughput capability competing with other major crudes (e.g., Bakken)
 - Less capital intensive and can use less diluent
 - More timely and flexible
 - More expensive per barrel than pipeline
- Marine Vessels
 - Need access to deepwater loading facilities
 - Really opens options, especially to non U.S., higher priced markets (\$\$)
 - Will be constrained by pipelines feeding ports
- Pipeline
 - Moves greater volumes, cheaper per barrel
 - New pipelines highly capital intensive (billions of \$)
 - Significant temptation to use existing older pipelines if conversion faster
- Time value of money on multi-billion \$ projects can drive risky or incomplete decisions
 - Space Shuttle Syndrome in Risk Management – misstating/denying the real risks

Already Many U.S. Pipelines Moving Dilbit

- At current Canadian bitumen production of ~2,000,000 bbls/d, actual dilbit movements much greater as bitumen production volume doesn't include the diluent
- Some Existing Pipelines
 - Enbridge Systems
 - e.g., Line 6, Alberta Clipper, etc.
 - Transcanada
 - Keystone
 - ExxonMobil Pipelines
 - e.g., Pegasus Pipeline, Silvertip Pipeline*
 - Others
 - Transmountain, Express, Platte,

*The July 2011 ExxonMobil 12-inch Silvertip Pipeline rupture spilled conventional crude oil affecting ~ 72 miles of the Yellowstone River, and could have easily become more expensive than the July 2010 Enbridge Line 6B Marshall, MI dilbit rupture cleanup (~ 1.21 Billion \$+) !

Silvertip rupture not caused by cracking, but Silvertip Pipeline known to also move dilbit.

To Ship Bitumen in a Pipeline

- Need to reduce Bitumen viscosity
 - Increase temperature and/or
 - Reduce/blend, cutting viscosity with solvent
- Pipelines set tariff specification
 - Gravity and maybe viscosity
- Three basic approaches to move via new or existing pipelines
 - Brute horsepower and limited diluent which may raise temperature along pipeline (e.g., Keystone)
 - Use more diluent to reduce viscosity and HP (e.g., Enbridge)
 - Partial refining to syncrude (looks more like light crude) with limited upgraders in Canada

The Gold Rush – Get Dilbit Out of Canada

- New pipelines can be designed to avoid certain dilbit threats
 - Not always prudently carried through
 - Shortest pipeline path seldom the cheapest or the safest
 - Time value of incredibly large sums of money drives sense of project “urgency” and “boom” rush
- Existing pipelines need to be carefully evaluated for certain threats associated with dilbit
 - Quicker to service than new pipeline, often drives potential flow reversals/change in service
 - Very different approaches between Canada and U.S. pipeline safety regulations!

Cracks – A Challenging Pipeline Integrity Risk

- **Pipelines with axial cracking threats (tend to fail as pipeline ruptures)**
 - **Environmental Cracking Threats**
 - 2010 30-inch Line 6B Marshall MI SCC/corrosion-fatigue cracking rupture on dilbit
 - Failed at ~ 56% SMYS, below expected failure pressures and well before predicted ECAs time to failure
 - **Vintage Manufacturing Cracking Threats (e.g., LFW/HFW/FW)**
 - 2013 20-inch Pegasus LF ERW seam cracking rupture on dilbit
 - Failed at ~ 54% SMYS
 - **Transportation/Construction Cracking Threats (Large D/T ratios)**
 - 2002 Enbridge 34-inch Line 4 Cohasset, MN transportation introduced cracking
 - Failed at ~ 55% SMYS
- All above ruptured **well below** the 79% SMYS allowed upper operating limits implied in U.S. minimum federal pipeline safety regulations
 - In the “negative safety margin” operating range!
 - Indicates integrity management (IM) programs seriously deficient/incomplete

SMYS = Specified Minimum Yield Strength

Why are cracks being mishandled in pipeline IM?

- **Cracking threats not well prescribed in U.S. pipeline safety regs**
 - **Even riskier approach allowed in Canadian pipeline safety regs**
 - Shifting to Engineering Critical Assessments, or ECAs, based on publicly unsubstantiated ILI technology claims and engineering assumptions
- **Crack Inline Inspection (ILI) tools and ECAs still in development**
 - Crack evaluation and assessment via ILI very challenging
 - Hoping ILIs can identify crack threats, and having them actually work are two different things
 - Benchmark against special “proof” hydrotest often warranted
 - Proof hydrotest used on Olympic Pipeline following Bellingham tragedy
- **PHMSA Advisory Bulletin (ADB) 2014-04 in Sept 2014 very relevant**
 - Guidance on existing pipeline flow reversals, product changes or change in service
 - PHMSA technically understands existing pipeline crack threats!
- **Expect more misinformation on “dangers” of hydrotesting to steel pipelines**
 - Proof hydrotesting is a strong assessment method for crack threats
 - If performed properly, hydrotests will either make the pipe fail or do no damage.

On Moving Dilbit in Pipelines

- **Pipeline integrity management needs to completely evaluate cracking rupture potential**
 - Dilbit's unusual viscosity sensitivity to small temperature changes makes crack threats riskier than even conventional heavy crude oils
- **ILI cracking measurements/field verification digs and related ECAs need to be made public**
 - Too many "premature" ruptures have occurred indicating inadequate transmission pipeline crack IM programs and ECAs
- **Emergency and Oil Spill Response plans must take into account the challenges associated with dilbit and associated massive NGL releases in sensitive areas**
 - Does dilbit float or sink in water?
 - Conventional crudes, even heavy conventional crudes, float
 - Large NGL releases can seriously delay oil spill response efforts
- **Dilbit can affect crack threat growth nonlinearly**
 - How can an IM program miss crack threats?
 - Are the right questions actually being asked, or
 - Is the process being tampered with by under representing the risks?
- **Some cracked pipeline systems are junk and need to be abandoned, or not placed in dilbit service**

Accufacts Recommendations to CCOPS

- **Request that PHMSA require ILI technology advancements and applications being relied on by operators in their IM programs be tested by confirming integrity digs and that it all be made public, subject to open review.**
 - API 1163 recommends a “unity” plot for ILI field digs
- **Monitor and provide input on PHMSA Integrity Verification Process (IVP) proposed regulations to advocate for more prescriptive tests for crack threats.**
 - Watch ECA application for possible misuse, especially beyond boundary conditions, or utilizing misguided assumptions
- **Pursue understanding of why hydrotesting above minimum federal pipeline safety MOP determinations is so important in crack IM.**
 - Hydrotest pressure of $1.25 * MOP$ is not relevant for cracking threats on pipelines moving dilbit (need to state tests as % SMYS range)
 - By letter, urge PHMSA to address the need to prescribe the parameters of spike hydrotests for crack threats in federal regs
- **Lastly, urge PHMSA and Ecology to strengthen requirements for Emergency and Oil Spill Response plans for dilbit in water environments.**
 - Two very different plans and requirements
 - Large NGL releases can really obfuscate oil spill responses plans
 - Key elements of both plans should be made public by both agencies
 - Ecology spill rule will be open for comments in 2015. **CCOPS should comment.**