SAGD Engineering: Back to the Fundamentals

Neil Edmunds, P.Eng.
Vice President, Enhanced Oil Recovery

11th Annual Athabasca Oil Sands Conference
Fort McMurray, Sept 13, 2011

Outline

1. The “Thermal Interval” concept for evaluations
2. Cooking with the original recipe: wellbore thermohydraulics and all that
3. The importance of and need for more and better engineering models

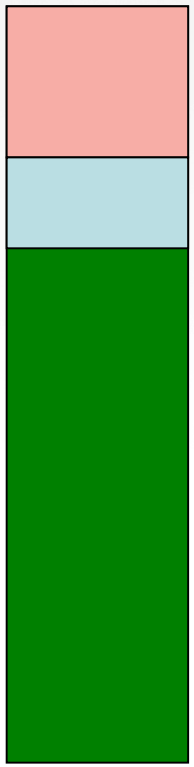
Net Pay vs. Thermal Interval

1) Net Pay Basis:

H=17m Φ=30% So=80%

OIP = 4.08m

CSOR @ 7.5y / 50%: **3.32**



2) Thermal Interval Basis:

H=25m Φ=30% So=54.4%

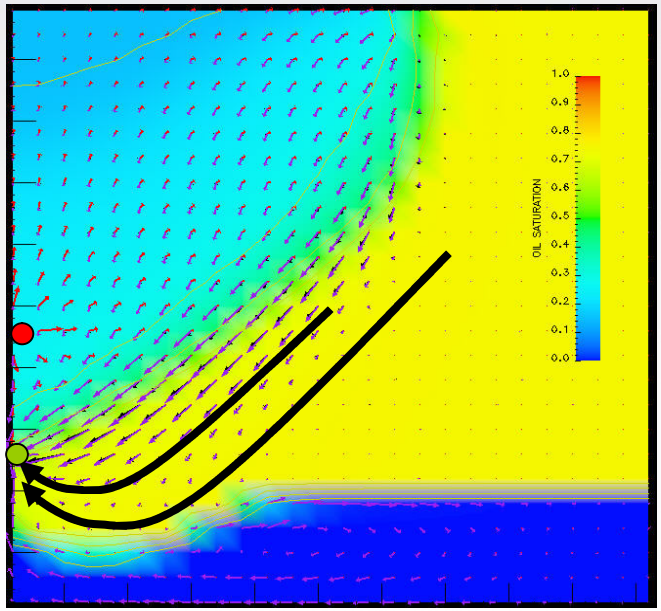
OIP = 4.08m

CSOR @ 7.5y / 50%: **4.27**

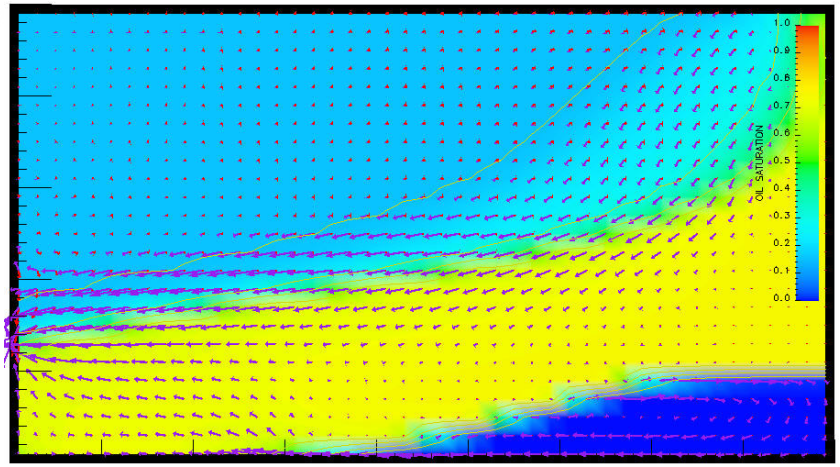
LARICINA ENERGY LTD.

Flow Around a Producer Well*

- It is impossible to operate a SAGD well pair near the oil-water contact without some interaction with basal water over life of the well pair



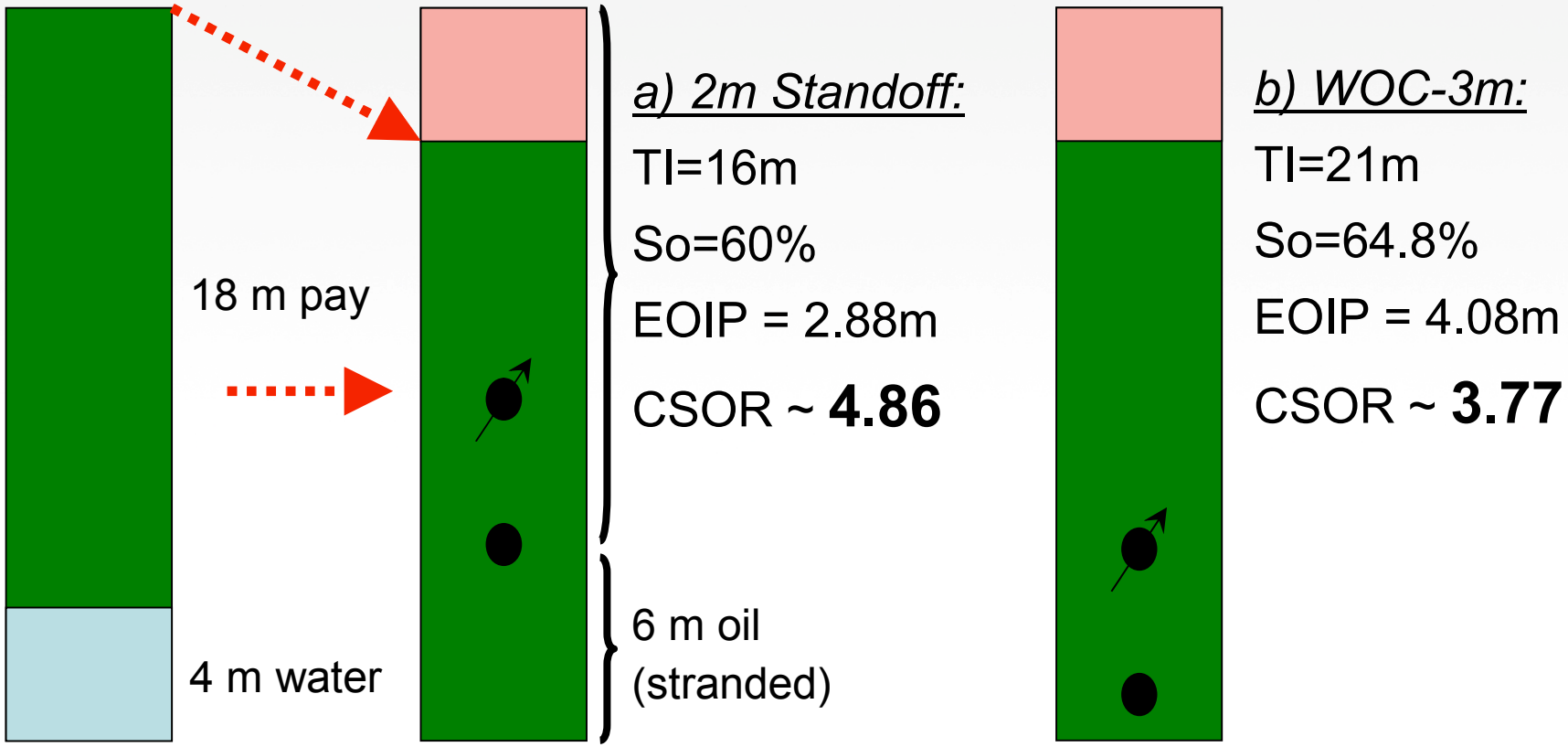
- Oil will drain below producer over time and be stranded



*CIPC 2009-128

LARICINA ENERGY LTD.

The Bottom Water Problem

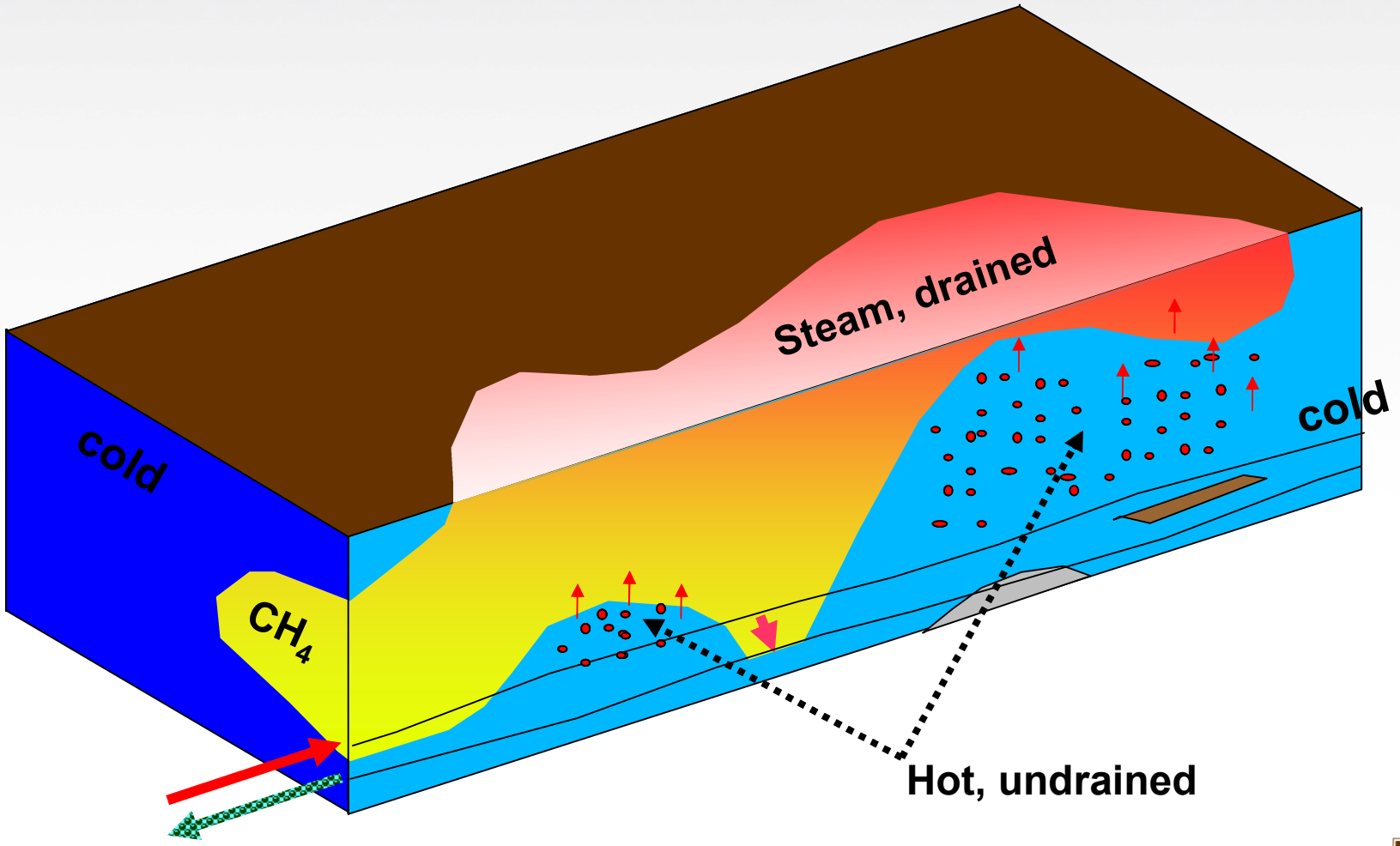


LARICINA ENERGY LTD.

Outline

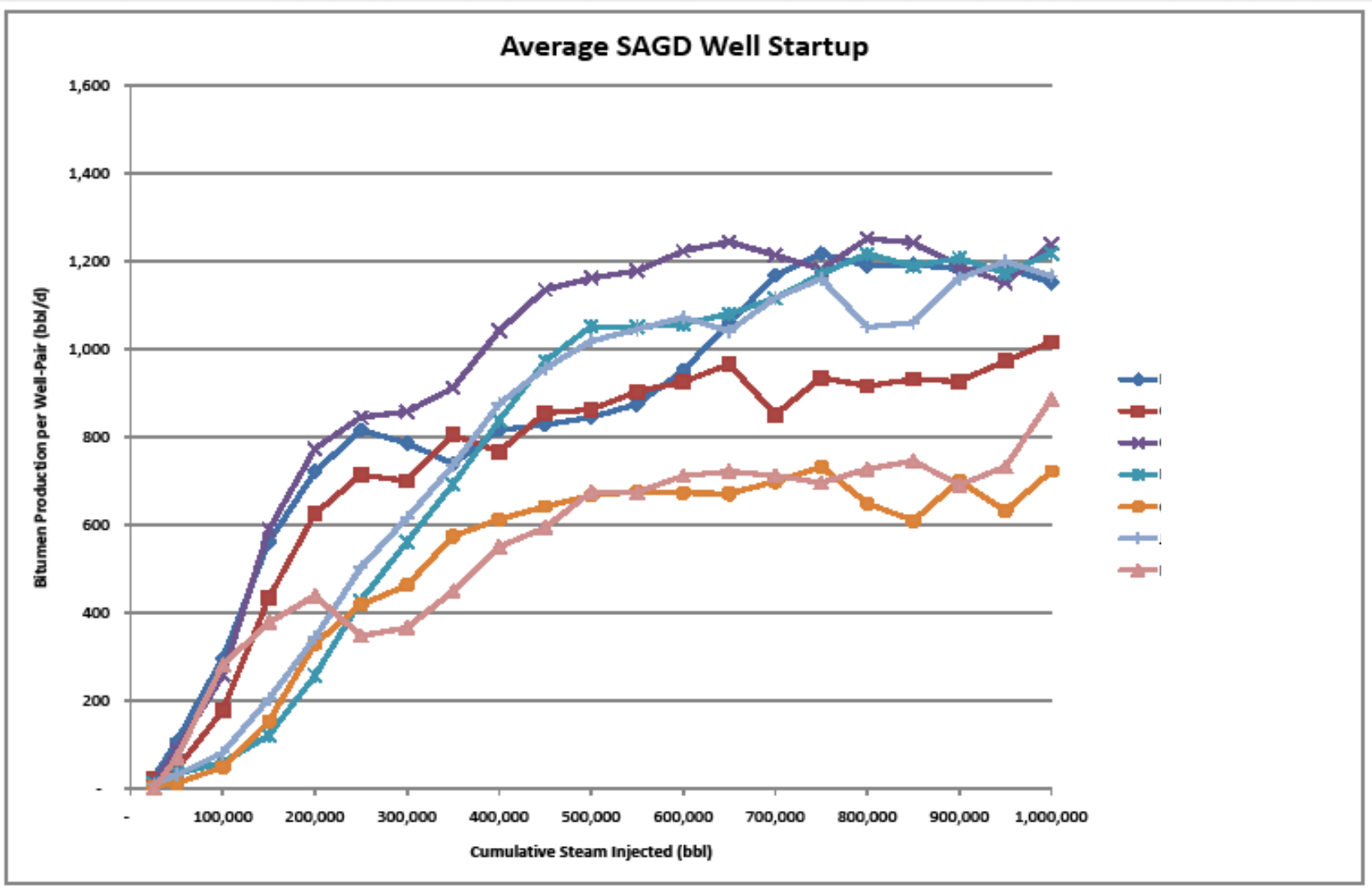
1. The “Thermal Interval” concept for evaluations
2. Cooking with the original recipe: wellbore thermohydraulics and all that
3. The importance of and need for more and better engineering models

Real World SAGD



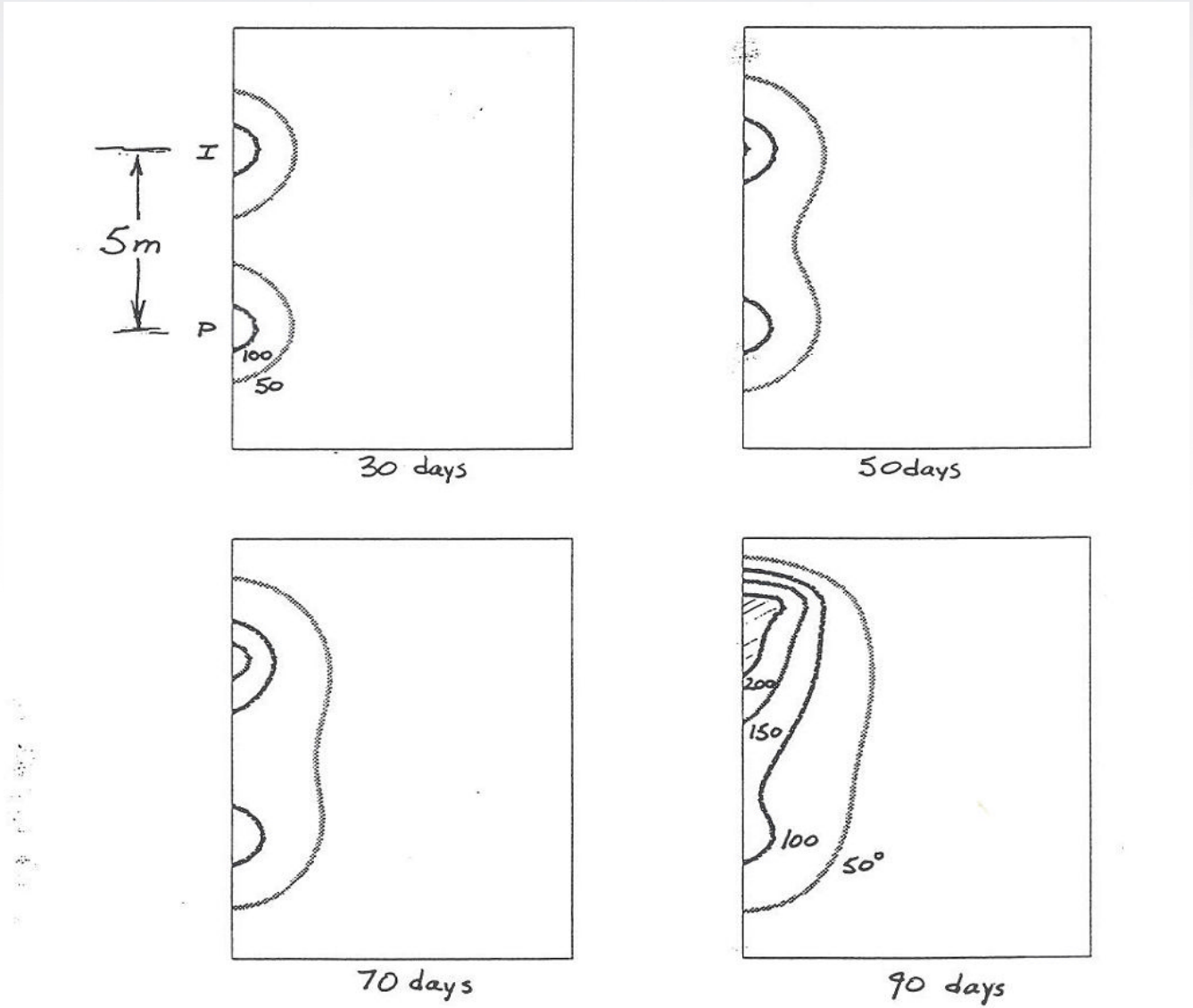
LARICINA ENERGY LTD.

A Good Startup is a Function of Engineering



LARICINA ENERGY LTD.

Twin-Well Conduction Startup (1990)



LARICINA ENERGY LTD.

The Original Recipe

Cdn Patent 1,304,287 (UTF Recovery):

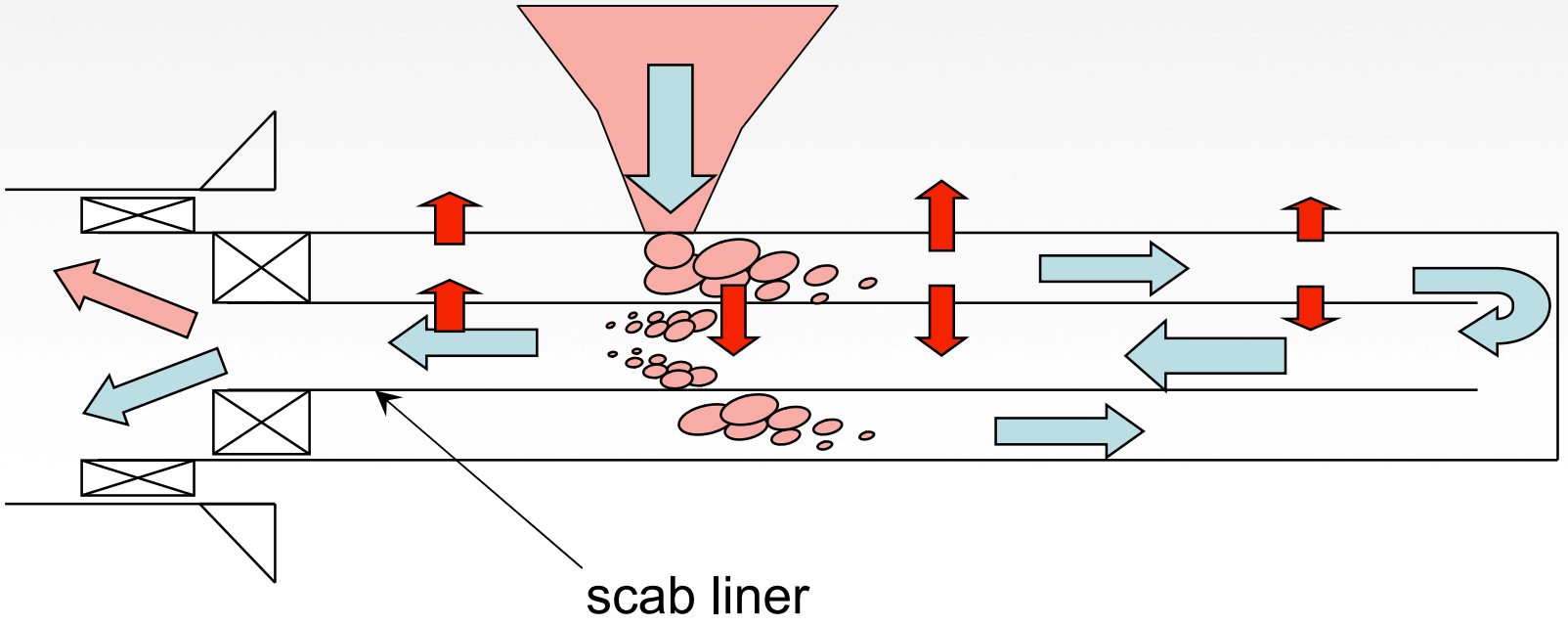
"Each well having a string of tubing …extending through substantially the full length of the liner…

"…producing…through the tubing of the lower well…"

**Note: the UTF was a zero-workover operation, simplified by underground production (separator before lift pump)*

LARICINA ENERGY LTD.

Fluid & Heat Flow in a SAGD Producer
(Early Production Phase)



- Keep ***(all)*** the steel hot **- *until the whole well is going***
- Keep the total pressure variation in both annulii low **(< *50 kPa*)**

LARICINA ENERGY LTD.

Outline

1. The “Thermal Interval” concept for evaluations
2. Cooking with the original recipe: wellbore thermohydraulics and all that
3. The importance of and need for more and better engineering models

Simulation and SAGD

- Reservoir simulators and other numerical tools are **an enabling technology** for *in situ* recovery
  - Non-linear, often counterintuitive physics
- Present Situation:
  - A small number of monolithic commercial codes, all things for all users (STARS, Eclipse)
  - Limited ability of developers to enhance or users to influence
  - Declining code reliability: too complicated to fully debug
  - These are barriers to adoption and/or risk management of new technology
- Value of, e.g., ΔSOR of -0.1 (-3%):
  - Steam @ $5/bbl x 0.1 x 100k bopd
  - Yields $17.5mm/year

Simulation Tools We'd Like to Have

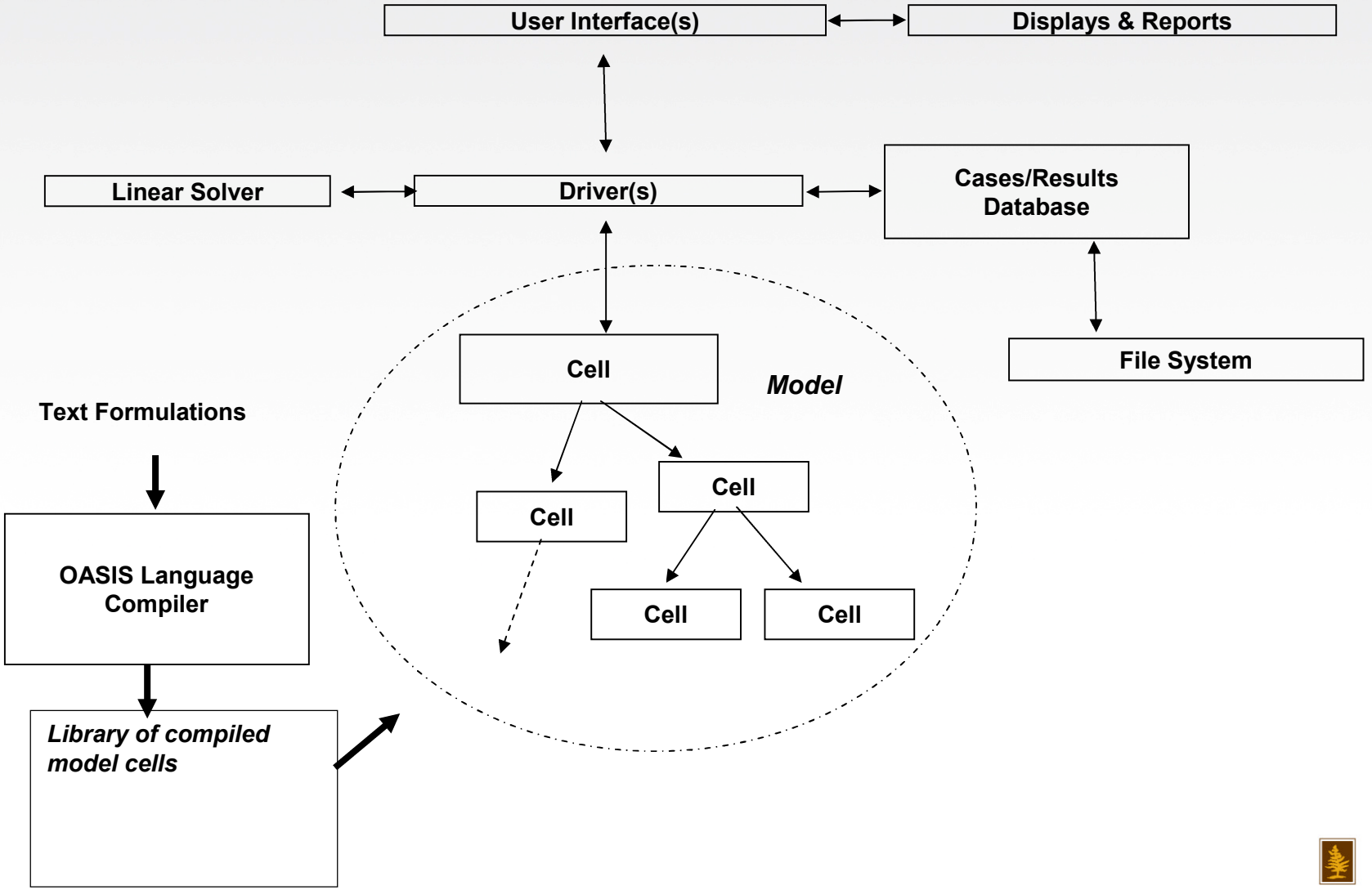
- Wellbore (riser) Heat Loss
  - Corrections, operations, insulated tbg.
- Coupled Wellbore (liner) Thermohydraulics
  - Rampup time & Max well rates vs. tubulars
  - Optimum length x diameter
  - Single-point injection wells w/splitters
- Solvents
  - Robust numerics
  - Vapor delivery to bottomhole
  - Distribution of multicomponents in the liner
- Coupled Electromagnetics (rapid startup, ESEIEH)
- Coupled Geomechanics (dilation, fracturing)
- Combustion (post-steam/solvent)
- Fluid Phase Behavior (incl. asphaltenes)
- ***Combinations*** of some or all of the above

OASIS Simulation Software

Solution: better software design

- Separate physics (5%, variable) from the numerics & interface (95%, generic)
- Specify physics with a simple custom language
  - Minimum effort to develop new applications
  - Maximize machine error checking to enable greater complexity, e.g. thermal reservoir+geomechanics
- Modular model structure
  - Maximum reuse of code
  - Interchangeable fluid models, gridding, etc.
  - Compatible stand-alone apps., e.g. flash calculator
- Modular (generic) engine structure
  - New/improved module applies immediately to all models

OASIS Architecture



LARICINA ENERGY LTD.

OASIS Status

- Pre-existing ‘Rosedale’ demo
- Laricina has begun ‘v 1.0’; approx. 1 year development
  - Emphasis on language and front end
  - Capable of basic 3D thermal simulation
- Joined iCORE Industrial Chair in Reservoir Modeling (Dr. John Chen); huge potential synergy
- Intend to seek consortia members next year

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.

LARICINA
ENERGY LTD.

Contact us

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

403-750-0810

www.laricinaenergy.com
laricina@laricinaenergy.com

LARICINA
ENERGY LTD.