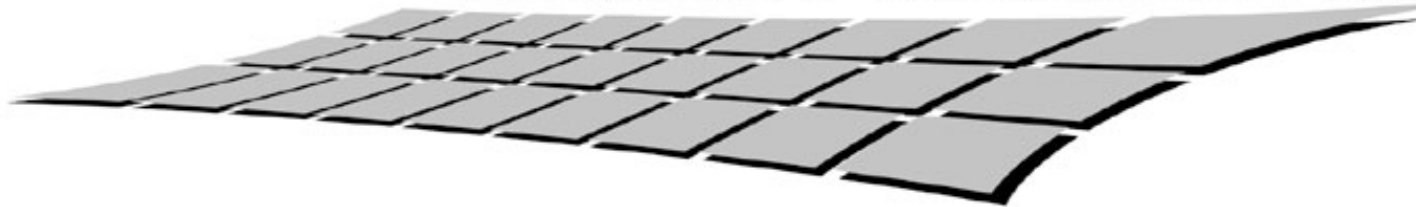


# TAURUS

**Reservoir Solutions Ltd.**



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## **Overview**

### **2011**



# Company mission

- Provide high-technology, high quality reservoir and geomechanical engineering consulting and software by
  - Personal involvement of principals
  - On-site consulting/training for clients
  - In house software development capability to meet demands of studies
  - Custom software development for clients or consortia for technology transfer to client

# Reservoir engineering

- Conventional reservoir engineering and simulation studies
  - Detailed studies of difficult/new problems
  - Integrated reservoir studies
  - Tight gas or tight oil multi-stage fracturing
    - Diagnosis with analytics and detailed numerical simulation
- Coupled reservoir/geomechanical studies
  - Compaction/subsidence
  - Injection into soft/unconsolidated reservoirs
  - Fractured reservoirs
  - Hydraulic fracturing
  - Heavy oil and thermal projects (Cold production, CSS, SAGD)

# Fracturing and Rock/Soil mechanics

- Unconventional fracturing processes
  - Waterflood induced fracturing
  - PWRI (produced water re-injection)
  - Cuttings and waste injection
  - Coalbed fracturing (CBM recovery)
- Tight gas development
  - Numerical and analytical PTA of fractured wells
  - Fracturing optimization (multi-stage fractured wells)
  - Field development, performance analysis, reserves determination
- Other
  - Wellbore stability during production
  - Sand production (onset and rate prediction)
  - Environmental impact (induced seismicity, effect of production on fresh water aquifers, ...)
  - Advanced acid fracturing

# Examples of Special Projects

## *Waterflood induced fracturing:*

- Design of first Canadian waterflood at frac pressure, Shell Canada, Alberta (1975)
- Evaluation of the first fractured pilot water injection, Valhall field, North Sea (Norwegian sector)
- Modeling of the pilot water injection area, Dan field, North Sea (Danish sector)
- Hibernia field, offshore Nova Scotia, Canada
- Slater Ranch waterflood, Texas
- Gullfaks field, Cook formation, North Sea (Norway)
- Feasibility study, Snorre field, North Sea (Norwegian sector)
- Thermal fracturing, Oseberg field, North Sea (Norway)

# Examples of Special Projects

## *Unconventional fracturing:*

- Development of new techniques (and software) for simultaneous modeling of fracturing and microseismic responses in waterfracs, Cotton Valley field, Texas (2001)
- Modeling and analysis of coal seam fracturing mine-back experiments in Dartbrook mine, Australia (in cooperation with CSIRO)
- Development of special fracture models for analysis of controlled roof collapse experiments in Moonee Colliery, Australia (in cooperation with CSIRO)
- Modeling waterfracs in Bossier play, Texas (Anadarko)
- Evaluation of the multiphase effects on productivity of waterfracs (Anadarko)
- Use of FracPack completions to reduce sand production in deep tight gas wells (Anadarko)

# Examples of Special Projects

## *Reservoir compaction and subsidence:*

- Wilmington field, California (thermal compaction)
- Brage field, North Sea (Norwegian sector)
- Lunskeye field, offshore Sakhalin Island (Shell)
- Demonstration study for chalk reservoirs, FORCE consortium (Joint Chalk Research)
- Lunskeye field, offshore Sakhalin Island (production-induced fault reactivation)
- Subsidence and fault reactivation study, Great White field, GOM (Shell)
- Compaction and environmental impact of shallow gas production, India (Niko Res.)
- Compaction and subsidence of the fractured Val d'Agri field (ENI, Italy)
- Compaction, subsidence and reservoir performance of Neptune field, GOM (BHP)

# Examples of Special Projects

## *Produced Water and Drilling Cuttings Re-Injection:*

- PWRI Joint Industry Project (sponsored by 15 major international companies) – TAURUS was one of the main contractors, leading the Tasks for injection in Soft Formations and Horizontal Wells
- Study of water re-injection in the Masila Block, Yemen (interpretation and design for frac injection at extremely high rates)
- Design of simultaneous drilling waste and produced water reinjection, Lunskeye field, Sakhalin
- PWRI analysis and optimization, ETAP field, North Sea (BP)
- PWRI field analysis, Peru (PlusPetrol)

# Examples of Special Projects

## *Thermal reservoir/geomechanics:*

- Thermal fracturing from horizontal wells in oil sands, Cold Lake, Canada (Imperial Oil)
- Geomechanical effects of shallow gas production on SAGD operations, Alberta
- Cyclic Steam geomechanical effects, Primrose/Wolf Lake, Alberta (CNRL)
- Geomechanical Effects of CSS on shallow aquifers, Cold Lake, Alberta (Imperial Oil)
- Determination of safe maximum operating pressures in SAGD (Suncor, StatOil, JACOS, Ivanhoe, Southern Pacific)
- Evaluation of surface heave in the Firebag SAGD project (Suncor)
- Evaluation of SAGD, CSS and related geomechanics effects, Zatchi field, offshore Congo (ENI)

# Examples of Special Projects

## ***Coupled reservoir/geomechanics/fracturing:***

- Fracturing, condensate blockage and geomechanical aspects of Khuff gas development, Saudi Arabia (Saudi Aramco)
- Demonstration project of disposal by fracturing, Jasper county, USA (Arco, DOE)
- Cuttings reinjection, Alaska North Slope (BP Amoco)
- Mt. Terri nuclear site geomechanical testing interpretation, Switzerland

# Software Development

## ***Past/Ongoing projects:***

- Geomechanical modeling of fracturing in jointed media
- Hydraulic fracturing in coalbed methane (CSIRO Australia)
- Parallel computing in geomechanics
- Coupling of GEOSIM with Open Eclipse
- Coupling of GEOSIM with POWERS (Saudi Aramco)
- Coupling of GEOSIM with MARS (Esso/Exxon)
- Fully coupled geomechanical fracturing model (U of C consortium)
- Geomechanics of fractured media (U of C)
- Sand production modeling (supported by Alberta Ingenuity Fund and Halliburton)
- Chalk mechanics model (Maersk)
- Quiklook IV development (Halliburton Energy Services)

## ***Available for:***

- Custom software development for clients
- Advising for in-house software development



# Principals

- **A. (Tony) Settari**
  - 40+ years of experience in many aspects of consulting
  - Reservoir simulation, reservoir and production engineering, fracturing, geomechanics ....
  - Extensive teaching, software and management experience
- **R. C. (Bob) Bachman**
  - 30+ years of experience in reservoir engineering and simulation
  - Experience in hydraulic fracturing
  - Software development and customization
- **D. W. (Dale) Walters**
  - Engineering experience in geomechanical and reservoir engineering and modeling
  - 17 years of experience in geotechnical and petroleum consulting
  - 15 yrs of software development experience

# Associates

- **Daniel H. Stright**
  - Integrated studies and reservoir simulation (40+ years of experience worldwide)
- **Radim Krampol**
  - Software GUI development (17+ years experience, Duke Energy)
- **G. Alda Behie**
  - Reservoir simulation development (30+ years experience, CMG, DRS, SIMTECH)
- **Peter J. Puchyr**
  - Software development (30+ yrs experience, Exxon, SIMTECH)
- **Paul Wawrzynek**
  - FEM Analysis (Fracture Analysis Consultants and Cornell University)
- **J. (Jin) Wang**
  - FEM support for sand production software
- **Tom Harding**
  - Reservoir simulation (30+ years of experience)