Fleet-Wide SAGD Well Production Data Analysis using OSIsoft PI System and TIBCO Spotfire

Presented by Keivan Khademi
Stephen Park
About Statoil Canada

• Part of Statoil's International Operations
• Forms part of the Development Planning – International Portfolio (DPI)
• Alberta onshore, SAGD operations ~ 20 Kbdp.
• SAGD: 50-70 year production time horizon
SAGD and Statoil's Leismer SAGD Operations

- By building a demonstration plant first, we have chosen a stepwise approach.
- Prioritizing learning before rapid project development and production.
- Leismer, our first production facility, provides valuable operational experience and a basis on which to adapt further work in line with technological developments.
- 80% of the Alberta oil sands resource will be developed using in-situ technology
- Leismer currently produces ~20,000 bbl/day of bitumen
- This production data dates back to 2010
- High sensor density due to inherent nature of SAGD and Statoil facility design
  - Great source of data for OSIsoft PI Server - corporate data infrastructure
### Tools
- PI Server 2012
- Asset Framework (AF) installed but not built out
- Good sensor coverage of steam injection and production wells
- TIBCO Spotfire 6.5 (Server)
- Good data catalogues (tag bindings for sensor data) to leverage

### Challenges
- PI System data sample rate very high
- Some errors in source data bindings
- No Development PI server & heavy use of PROD PI server by engineering & Ops
- Constrained budget
- Manual legacy ETL process
  - Took engineers 2-3 hours to compile -> biweekly loading

### Tasks
- Understand data density & PI System performance
- PoC SQL Interface into Spotfire
- Tag and AF data
- Construct an asset model for Steam Injection & Oil Producer wells
- Implement a pilot of 1 pad
- Tweak model, data scan rates
- Build out the model of remaining pads
- Compute & Backfill statistical data
- Build initial displays & KPI’s in Spotfire
- Release to users and solicit feedback
- Support training / uptake activities
Solution Exploration – Big Data Headaches...

1. Tried accessing archive data directly
   1. We could load 7 days’ of raw data (1 sensor, 30 wells)
      1. Using ~ 35 minutes of compute time on client machine
   2. Next we tried using Interpolation to calculate 1D data on the fly...
      1. Timeouts and null records out of PIOLEDB Enterprise layer...

Try Again
Solution Exploration Key Findings

• Spotfire is not well-equipped to deal with PI Tags directly
  – Need an asset modeling layer
• Spotfire is not a replacement for time series analysis tools like PI Coresight & PI ProcessBook
• Pre-computation of statistics will be required to meet system performance objectives
• Next iteration:
  – Asset Framework for data binding layer
  – Asset Analytics to pre-calculate daily averages
  – PI OLEDB Enterprise as connective tissue...
Where We Ended Up: Solution Architecture

Asset Framework

Field Data Capture System

Well Model: Steam Injectors Oil Producers

Scheduled Analyses

PI Data Archive

Calculated Daily Metrics

Oracle DB Views

PIOLEDB Enterprise Driver

Spotfire OLEDB Client

SAGD Data Template (.DXP)

Daily Well Allocations (Oil, Gas, Water, Steam)

Spotfire Oracle Native Client

Oracle DB Views for INJ / PRD wells

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Data Hierarchy and Pre-computation of Statistics

Data Density Comparison: Raw Data vs. Calculated Daily (31 days)

Model Coverage: All SAGD wells @Leismer
Data Fusion – Spotfire Data Model

End-state approach to data merges & calculation generation

Spotfire Unified Data View

- Wells
- Pads
- Field

KPIs

Unified IW Data
- Field Data Capture
- Steam Injection Data
- AF Injector Well Data

Unified PW Data
- Field Data Capture
- Producer Well Data
- AF Injector Well Data
Well Optimization Toolset: Sample Data Parameters

Producer Wells
- **Daily Cumulative / Instantaneous:**
  - Allocated Oil, Gas & water
  - SORs, WRR, PWSR, TFSR, etc...
- **Sensors:**
  - Wellhead / bottomhole pressures and temperatures
  - ESP Pump Speed & Amps
  - Sub cool (A-G + Minimum Daily)
  - Thermocouples (A-J)

Well Pads
- Pad-level KPI’s
- Product quality (produced water & oil) samples
- Downtime & available wells

Full Field Metrics
- Pad-level metrics plus:
  - Steam capacity & utilization

Sample Producer Well PIOLEDB Output
## Business Impacts

### Business Process Improvement

- Manual data loads eliminated
- The PI System & Spotfire are now used to drive production meetings & well reviews
- ~20 users now generating their own analytics using the data layer provided by AF
- Increased agility in implementing well targets, operating directives & monitoring results

### Key Technology Enablers

- Engineers Can see ~5 years data online; data always current
  - Both sensor data and allocated data
- Unified Analysis tool reduces training needs
- One-stop shop for analysis data improves user uptake
## ROI and Next Steps

### ROI

- Positive project ROI achieved just on data acquisition & cleaning time savings
- We expect tangible optimization results
- Significant training & system support savings also…

### Lessons Learned

- Don’t under-estimate data QA effort in the AF layer
- We may have benefitted from a standardized PI Server + Spotfire deployment package
- Reservoir engineer project ownership was a critical success criteria

### Next Steps

- Working on phase 2 to add Observation wells to our model & analysis
- A number of opportunities around Notifications & event frames surfaced by AF model investment
- Additional user training to ensure long-term uptake
OSIsoft PI System and TIBCO Spotfire

COMPANY and GOAL

1) Statoil seeks to increase SADG production @Leismer through optimization of our existing fleet of SAGD wells
2) To do this, we need to perform multi-year, fleet-wide SAGD well analysis
3) We require a single source of clean, consistent data for our analyses

CHALLENGE

Inability to efficiently analyze production and sensor data across all wells at our facility over multi-year time horizons

- High data sampling rates and analysis tag counts mean an inability to perform fleet analysis with existing toolsets
- Data loads being done on a manual, biweekly basis (best case)

SOLUTION

Marry PI Server with PI OLEDB Enterprise to create an on-demand data load template for Spotfire

- AF model of Steam Injection and Producer wells
- Pre-computation of daily statistics
- Spotfire in-memory rollups (Pad, Full Field) and KPI’s

RESULTS

Data friction eliminated
Common analytics platform for production engineering
Happy Users!

- Fresh, no-touch, on-demand data loads
- Model scales automatically as new wells & sensors come online
- Data QA greatly improved
Contact Information

Keivan Khademi
KEKH@statoil.com
Senior Reservoir Engineer
Statoil

Stephen Park
Stephen.Park@isolutions.com
Lead Consultant
iSolutions Inc
Please wait for the \textbf{microphone} before asking your questions.

State your \textbf{name} & \textbf{company}.

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\textbf{Name:} & \textbf{Company:} & \textbf{Quality and content of the presentations} & \textbf{Quality and organization of the seminar} \\
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\textbf{Welcome} & & \textbf{Poor} & \textbf{Good} & \textbf{Excellent} & \textbf{N/A} \\
\textbf{The Journey To Real Time Operational Intelligence} & & & & & \\
\textbf{The Power of Connection} & & & & & \\
\textbf{Tank Level Management System} & & & & & \\
\textbf{Using the PI System to Aid in Troubleshooting Operational Aspects of Oil and Gas Well Drilling and Completion} & & & & & \\
\textbf{Unleash your Infrastructure} & & & & & \\
\textbf{Information on the Spot} & & & & & \\
\textbf{Wrap-up/Seminar Conclusion} & & & & & \\
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Thank You

Take-Away: PI Server + Spotfire, done well, with a rich supporting suite of sensor and volumetric data is a game changer for Upstream oil and gas well optimization.