Dynamic modeling of Natural Gas Processing Facilities

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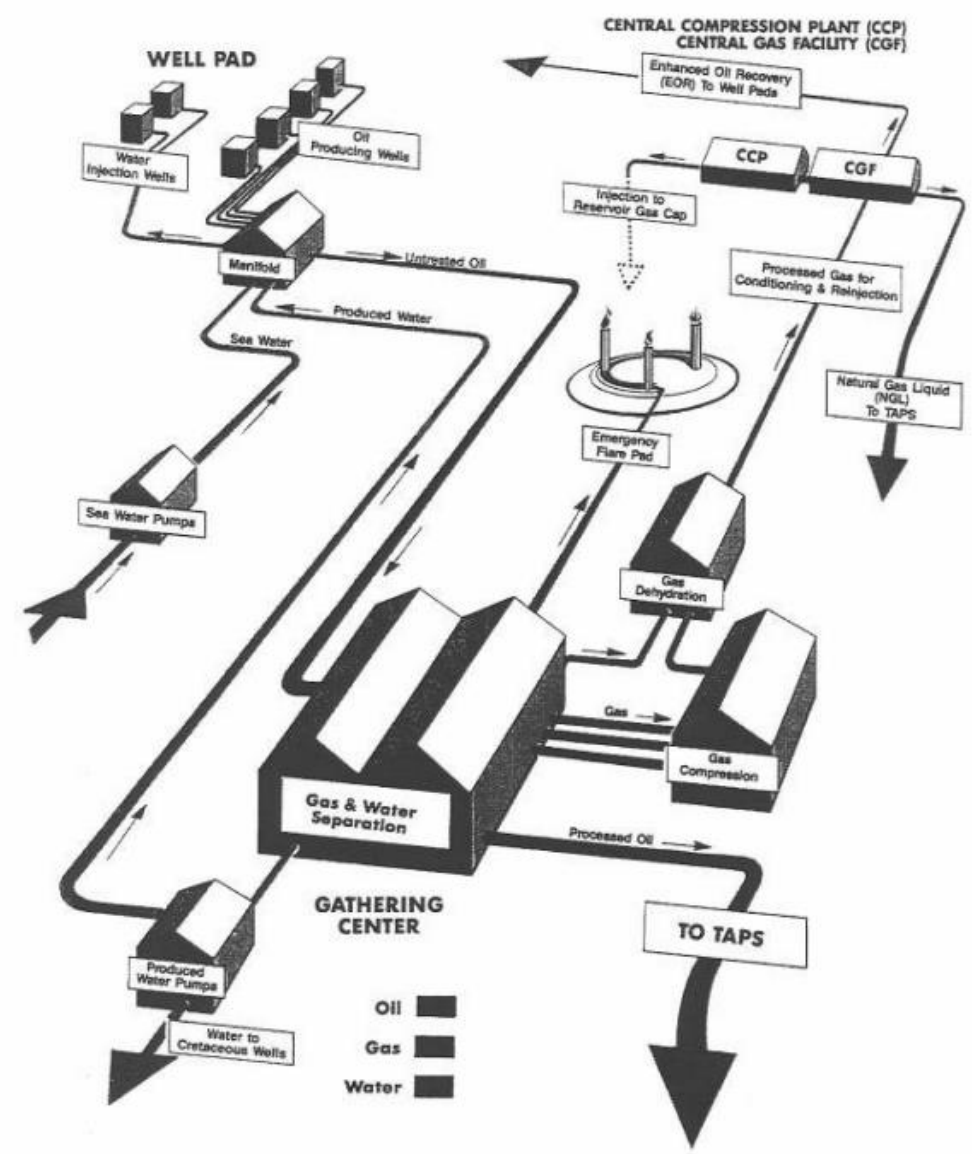
Contents

- Overview
  - BP Alaska
  - Modeling challenges
  - gPROMS based assessment
- Applications and benefits
- Future work

Overview

BP Alaska (BPXA) overview



- Crude oil and gas received in separation centers
- Gas
  - Compressed, dehydrated
  - Transported to Central Gas Facility (CGF)
  - Natural Gas Liquids (NGLs) recovered
- Dry gas
  - Central Compression Plant (CCP)
  - Reinjection
  - Fuel gas

Modeling challenges

- (Dynamic) modeling
  - Critical facility operational support tool
    - Efficient operation of facility
    - Safe utilization of flare
  - Connectivity of facilities
    - Events in one facility may impact others
- Historical challenges
  - Different tools
  - Non commercial tools
  - Limitations of tools
    - Speed, modeling basis (assumptions), applicability
  - Fast turnaround often required

gPROMS-based assessment

- Long term engagement to overcome some of these challenges
  - 2013
  - **Key requirement**: use models for future studies

- Pressure relief and blowdown analysis
  - Detailed single facility modeling
  - Low temperature assessment
    - Screening analysis
    - Detailed analysis
  - Connected process and flare system
    - Pressure relief scenarios
    - Full system Blowdown and Emergency Shutdown (BESD)

Majority of facilities completed (expected end date 2017)

- Full field modeling
  - Connected facility and pipeline model

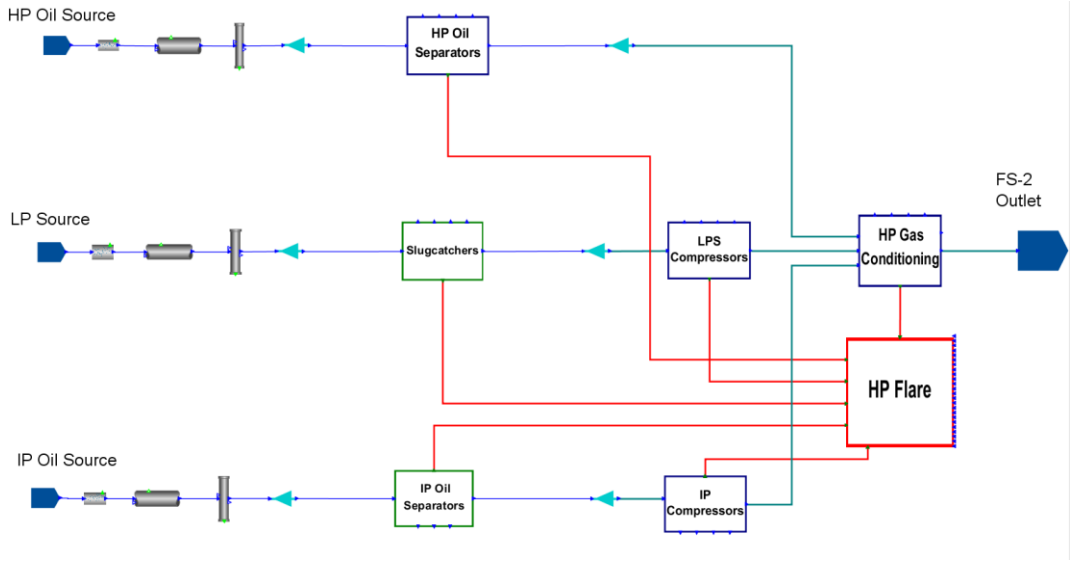
On-going

Application and benefits

Pressure relief and blowdown analysis

Pressure relief and blowdown analysis

- Long term project
  - 2013-2017
  - 10 facilities
- Currently ~80% complete



- Benefits already seen
  - Models used for variety of different types of studies
  - Cost of engagement paid back many times over
  - Helped to greatly reduced outage time
    - Large monetary savings

Types of studies - I

1. Incident investigations
   - Process upsets
   - Inputs for consequence modeling software
   - Concrete data
   - Reduced assumptions
2. Operational questions
   - Safe operating limits during changes in flare operations
     - Integrity issues, flare line blockages, maintenance, etc
   - Proposed process changes impact on relief system capacity

Types of studies - II

3. Project questions
   - Material selection
     - Process
     - Relief system
   - Impact of proposed changes on relief scenarios
   - Risk assessment inputs for TAR planning
4. Process Hazard Analysis / Risk Analysis
   - Evaluating scenarios
   - Relief conditions, event duration, timing, etc
5. Compliance
   - Regulatory requirement for up to date documentation
   - Models maintained through MOC process
     - Cost effective

Pressure relief and blowdown analysis: summary

"Our ability to now simulate a variety of conditions has enabled us to **reduce plant downtime** and production deferrals by **reducing uncertainty** in our understanding of our flare and relief systems."

"It has **reduced risk** in our operations by allowing us to perform numerous what if analyses, more **accurately** assessing our layers of protection"

Luke Hanzon, BP Alaska

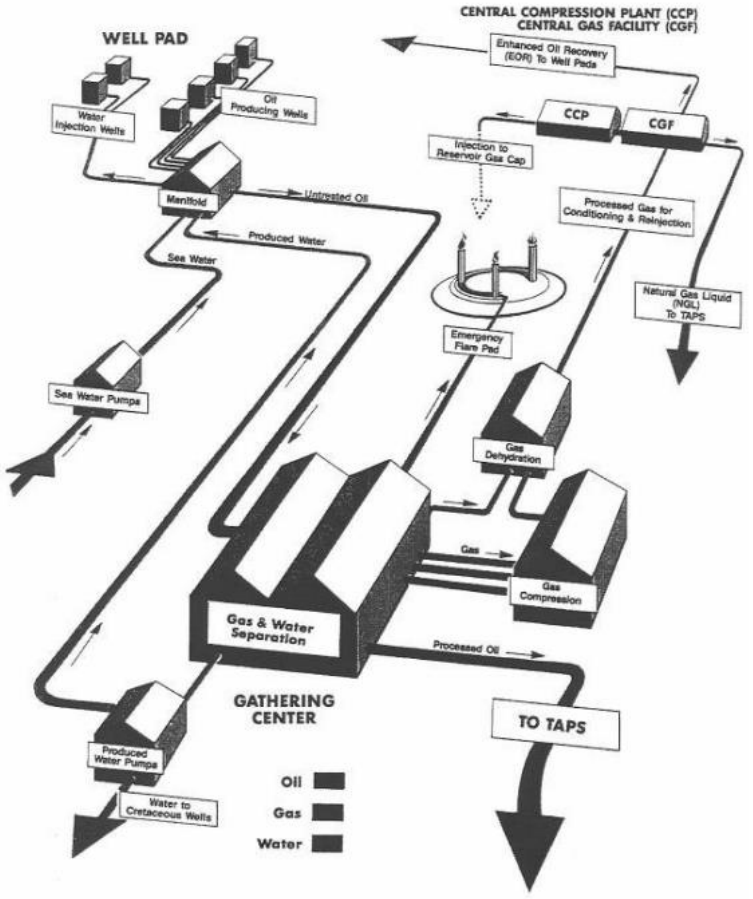
Future work

Connected facility and pipeline model

Connected facility and pipeline model: summary

- **Subject:**
  - Development of field interconnecting model for analysis of transient response within gas transit system: facilities and gas pipelines

- **Problem:**
  - Multiple gas receiving facilities
  - Connected to gas processing facilities
  - Network of pipelines
  - Conditions and process events can be communicated through network resulting in undesirable behavior
    - E.g. what happens in gathering centers when compressor in CGF is shut down



Connected facility and pipeline model: summary

- **Solution (under development):**
  - Dynamic gPROMS ProcessBuilder model
    - Hydraulic pipeline system
    - Gas receiving [8] facilities and gas processing facilities [2]
  - To enable BP to analyze impact of gas process upsets at any facility on entire network performance
  - Platform for future full gas-field production optimization