



Tulsa University & RPSEA Flow Assurance Workshop

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What is Flow Assurance?

My Definition:

Flow Assurance is the engineering and science of predicting and managing production behavior as it moves from a reservoir to market through the changing environment of the production system.



RPSEA Scope

- Increase barrels of production for the United States.
- The Deepwater Initiative is for reservoir production in water depths greater than 5,000 fsw and for XHPHT reservoirs on the continental shelf. Focus is on the Gulf of Mexico.
- Produce a draft Annual Plan within the next 60 days. This workshop is to help provide input to this draft Plan.



GOM Deepwater Trends

Subsalt

Deeper wells

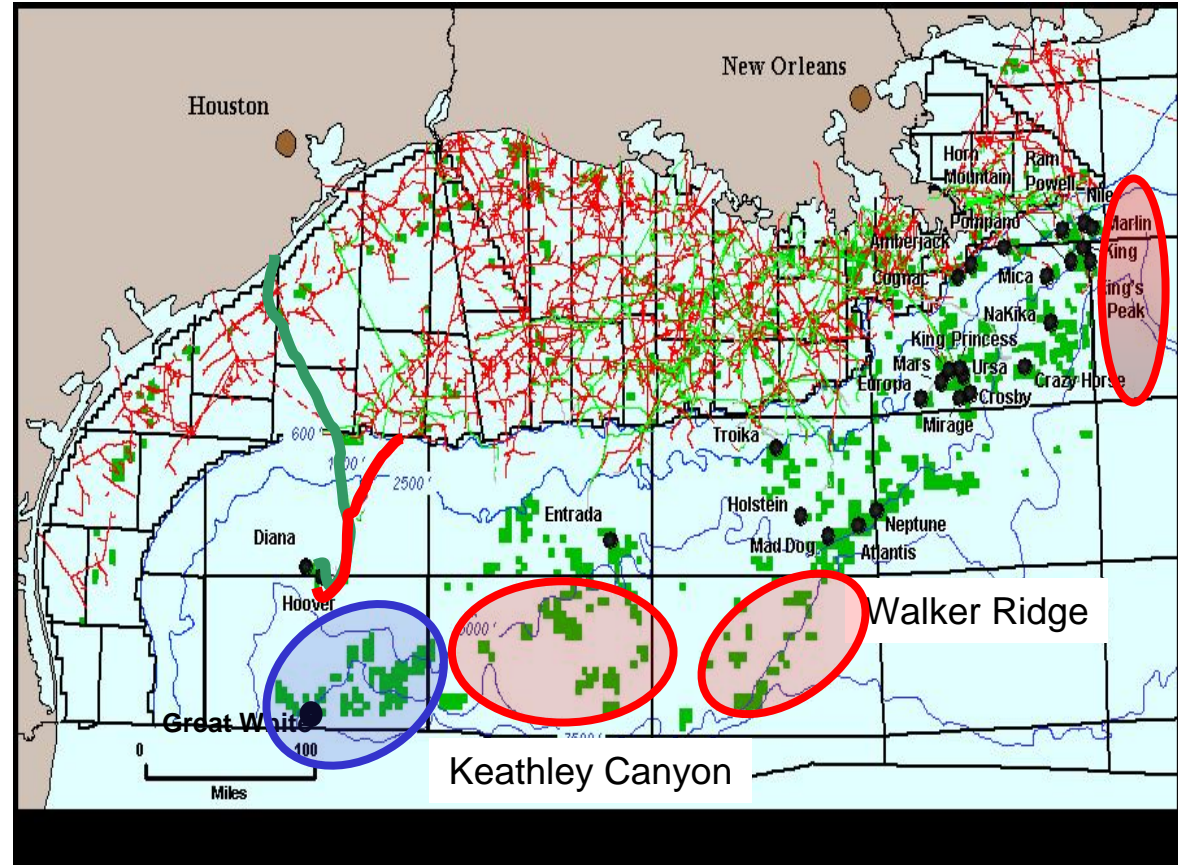
Higher Pressure &
Temperature

Higher Viscosities

Lacking infrastructure

Higher Drilling Costs

Challenging Economics



DeepStar/BP (Nov04)

Pedido Foldbelt

8-10,000 fwd, no salt, shallower reservoirs, lower pressure, + heavy oil horizon



Representative Fields

Reservoir Trends	GOM BOE	Design Basis	Development Scenarios
Canopy Field		Small Stand Alone Development (SSAD)	Semi with Wet Trees
			FPSO with Wet Trees
			FPSO EPS
			Produce to Beach
Gumout Field		High Viscosity Oil	Satellite Tieback to Host
Coyote Field		Small Reserve Fields	Satellite Tieback to Host
Diablo Field		XHPHT (22.5 ksi x 350+°F)	Semi w/ Gas Sweetening
			Produce to Beach thru Sour Gas Pipeline

Development Scenarios are based upon a balance of: Reliability; Risk; Consequence; and Economics.

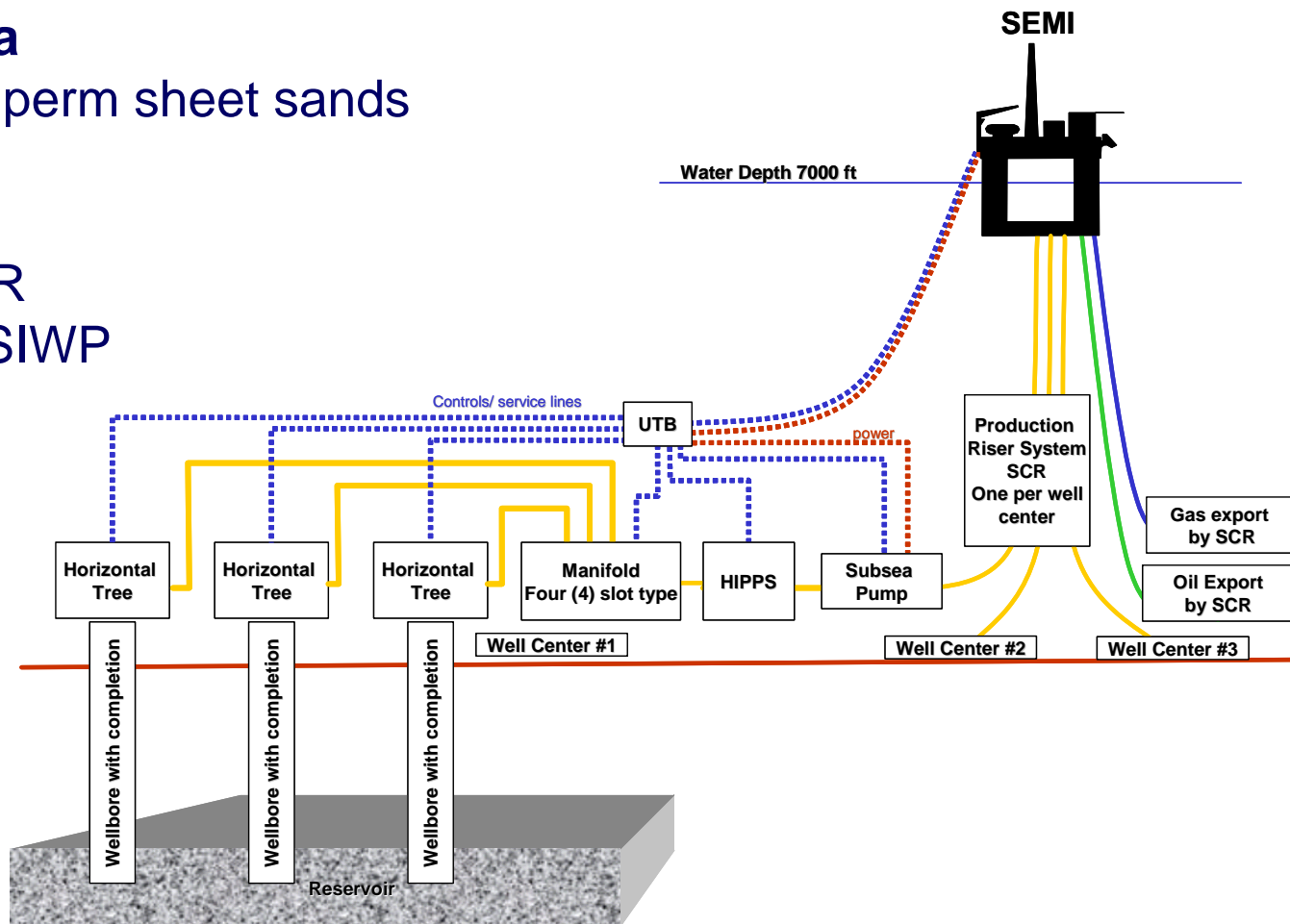
Thus, each new Development scenario builds upon prior field facility performance and experience.



Canopy GOM Sub Salt HPHT Oil

Walker Ridge Area

- Thick subsalt low perm sheet sands
- 7,000 fwd
- 30,000+ TVD
- Oil with ~300 GOR
- 14,500 psi initial SIWP
- 285°F BHT



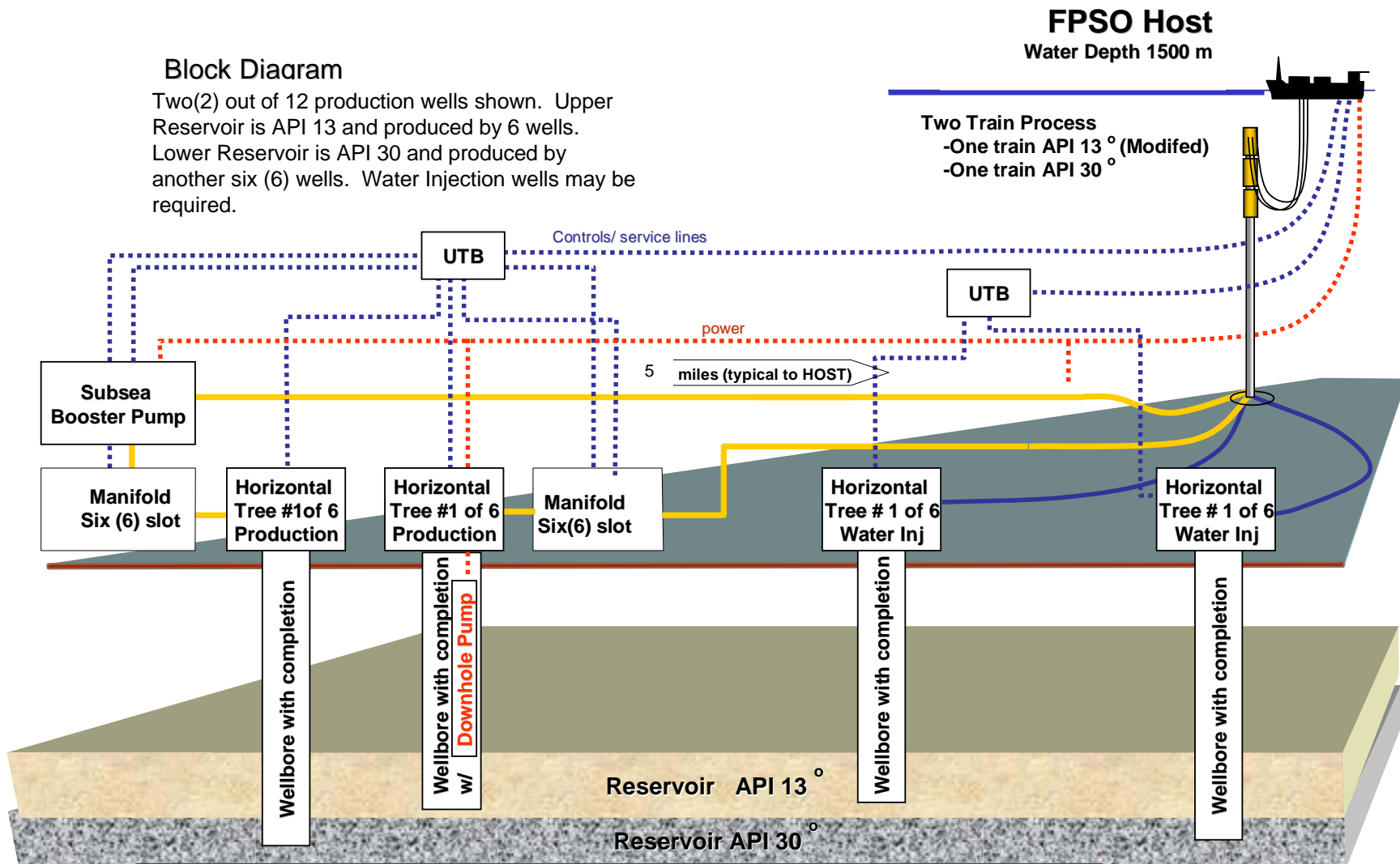
Key issue is well deliverability and high drawdown pressure



Gumout Field

Block Diagram

Two(2) out of 12 production wells shown. Upper Reservoir is API 13 and produced by 6 wells. Lower Reservoir is API 30 and produced by another six (6) wells. Water Injection wells may be required.

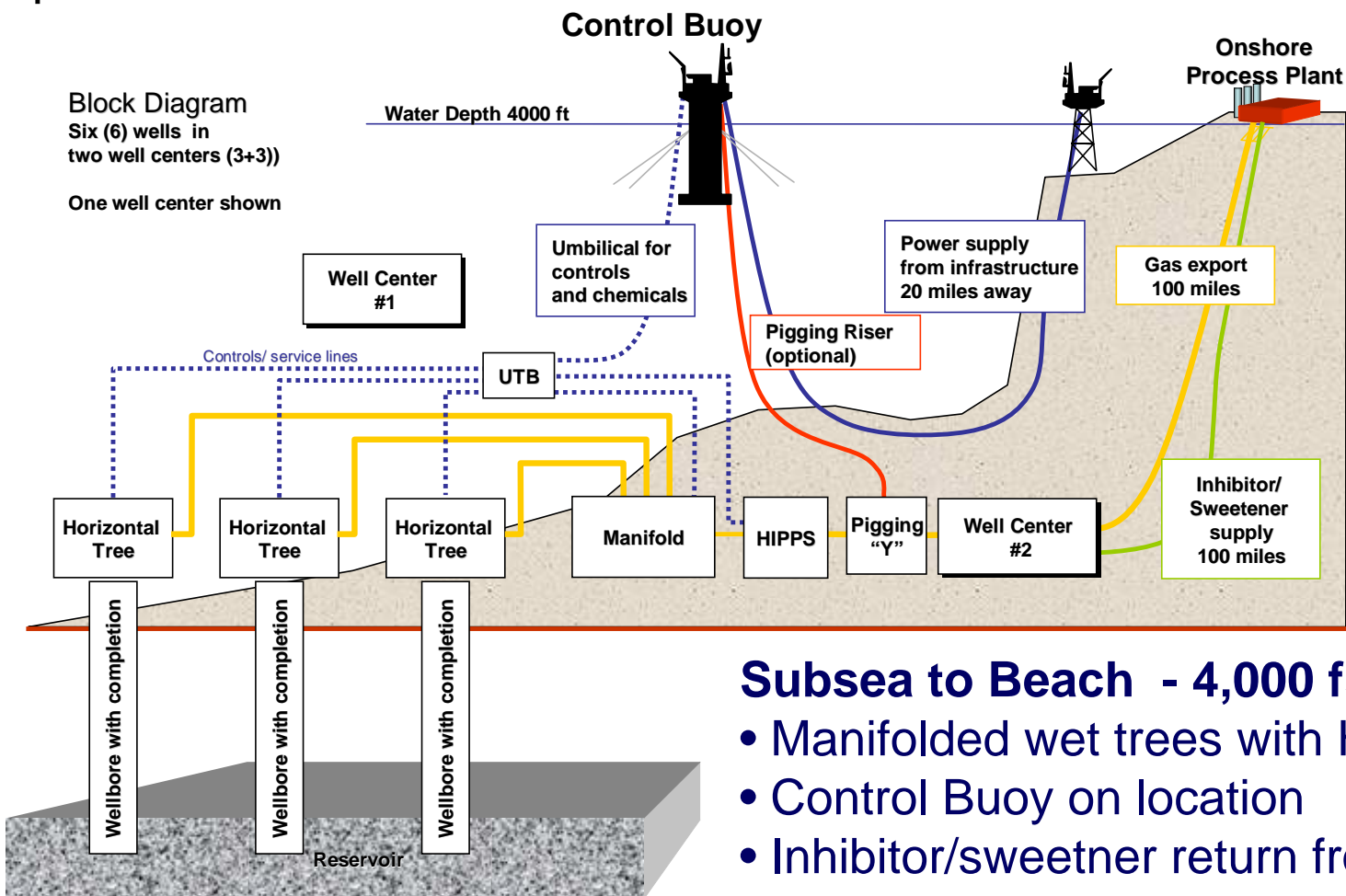


Key Issue is High Viscosity Production from 1 Zone



Diablo HPHT Sour Gas Field

DeepStar Systems Engineering CTR 7902
Case: GOM HPHT Gas Case Diablo
Optional Case B “Subsea to Beach”

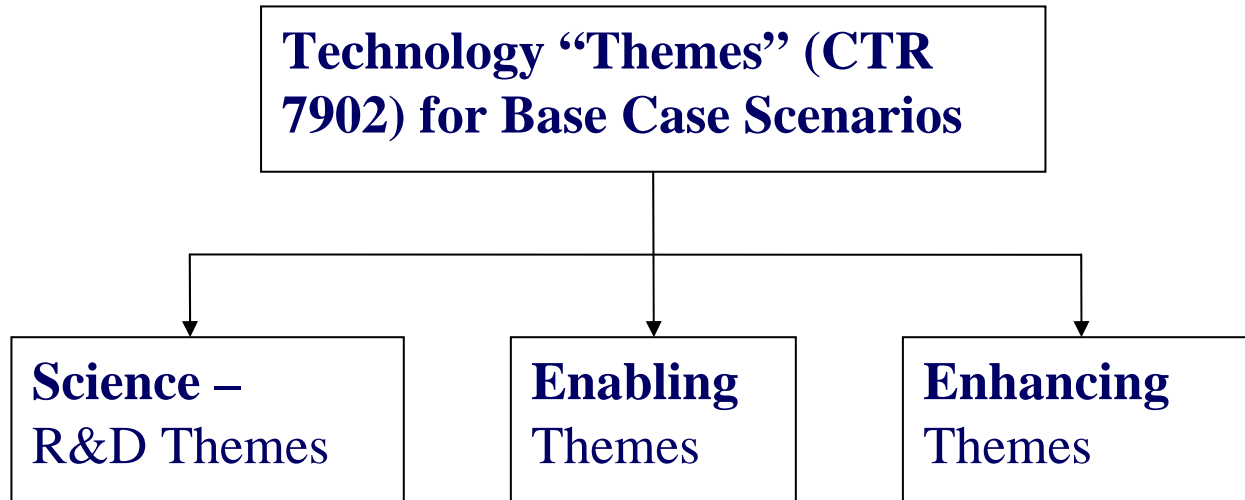


Subsea to Beach - 4,000 fsw

- Manifolded wet trees with HIPPSS
- Control Buoy on location
- Inhibitor/sweetener return from shore



What are the Scenario related Flow Assurance Themes?



For these field development scenarios, the FA Themes may be grouped into Science; Enabling and Enhancing Themes.



FA Theme Examples

Science – R&D Themes

- Production PVT at XHPHT conditions including H₂S and CO₂ (Diablo Field)
 - **Science delivers methods, procedures and tools that are subject to continuous improvement through R&D**

Enabling Themes

- High Viscosity Oil Management Technologies
- XHPHT Production Chemicals
 - **Enabling technology is required before the development may be realized.**

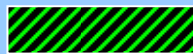
Enhancing Themes

- Improving “conventional” technologies

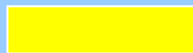
4200 Committee Flow Assurance Matrix

(Multiphase Systems, Deepwater Environment)

Prediction	Needs Work	Needs Work	Needs Work	Needs Work	Needs Work	Improvements Possible	Needs Work	Needs Work
Management	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible
Monitoring	Needs Work	Needs Work	Needs Work	Needs Work	Acceptable Technology	Needs Work	Improvements Possible	Needs Work
Remediation	Improvements Possible	Improvements Possible	Needs Work	Needs Work	Acceptable Technology	Improvements Possible	N.A.	Needs Work
Training	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible	Improvements Possible
	Paraffins	Hydrates	Asphaltenes	Scales	Emulsions	Corrosion	Multiphase Flow	Interactions



Acceptable Technology



Improvements Possible



Needs Work



Workshop Objectives

Using this background and field development scenarios, identify any FA Themes that should be included.

Based on review of the “conventional” FA technology matrix, identify areas where the current tools, models and technologies need further improvements.

To lead the discussion – we will use the SPE Forum format and segregate the discussion into:

- Multiphase Flow Technologies
- High Viscosity Oils (Heavy Oil)
- Extremely High Pressure and High Temperature Production
- “Conventional” FA Technology Improvements



Questions?