

The logo for Subsea Shuttle is located in the top left corner. It consists of a white oval with a red border. Inside the oval, the text "Subsea Shuttle" is written in a bold, black, sans-serif font. Below this text, in a smaller font, is the tagline "Fluids & facilities, delivered and operated as a service".

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TM

Rice Alliance for Technology and Entrepreneurship Energy Tech Venture Forum XVIII

2020-09-15

ENHANCING OFFSHORE RECOVERY BY ENABLING LONGER, SAFER, AND LOWER COST SUBSEA TIEBACKS

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Industry need, low cost tie-backs

ENERGY HUB
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ENERGY INC.

BP's Gulf of Mexico deepwater strategy centered on existing hubs

London-based BP PLC, which has its U.S. headquarters in Houston, plans to continue rebalancing its production portfolio toward natural gas and away from crude oil.

Despite being one of the few companies to have sanctioned a new deepwater project – Mad Dog 2 – in the Gulf of Mexico in 2017, London-based BP PLC's (NYSE: BP) strategy in the region still calls for a primary focus on tieback development.

The company, which has its main U.S. subsidiary based in Houston, is focused on getting the most out of the deepwater hubs it already has by developing subsea tiebacks, said Starlee Sykes, the company's vice president of upstream offshore projects, at a BP press conference Dec. 7.

"Why would you need the infrastructure you have?" Sykes said. "We are going to look to fill those wells with tiebacks."

Tiebacks can add production more quickly and economically than building a whole new platform. In fact, is considering some projects that haven't gotten a final investment decision yet that could bring oil to market by 2020, said David O'Connor, the head of Global Projects Organization, at the event.

BP is planning to add 800,000 barrels per day of production capacity by 2020, some of which will likely come from projects given the go-ahead next year, O'Connor said. Some of those projects will likely be Gulf of Mexico tiebacks.

"There are projects going on in the Gulf of Mexico," O'Connor said. BP has four main oil and gas hubs in the Gulf of Mexico – Atlantis, Thunder Horse, Mad Dog and Na Kika.

BP is shifting its upstream production mix to favor natural gas and advantaged oil.

THINKSTOCK

it had been redesigned into a \$9 billion project, according to a press release from BP at the time.

PRODUCTION SHIFTS TOWARD NATURAL GAS

Three years ago, about 60 percent of the company's produced volume was in crude oil, but by the end of the decade, BP plans to have reversed that, with natural gas making up roughly 60 percent of the portfolio worldwide, O'Connor said.

"We're still planning to develop oil fields going forward, they just need to be competitive oil fields," O'Connor said.

That doesn't translate to some kind of massive hiring spree, though, O'Connor said.

"We've kind of got ourselves at a fairly stable level," O'Connor said.

BP's attrition and recruitment are still progressing at normal rates, but its overall headcount isn't changing much, O'Connor said.

What the company is doing to its workforce, though, is moving it around. As it develops new projects in different parts of the world, it will shift its employees around to these locations, O'Connor said.

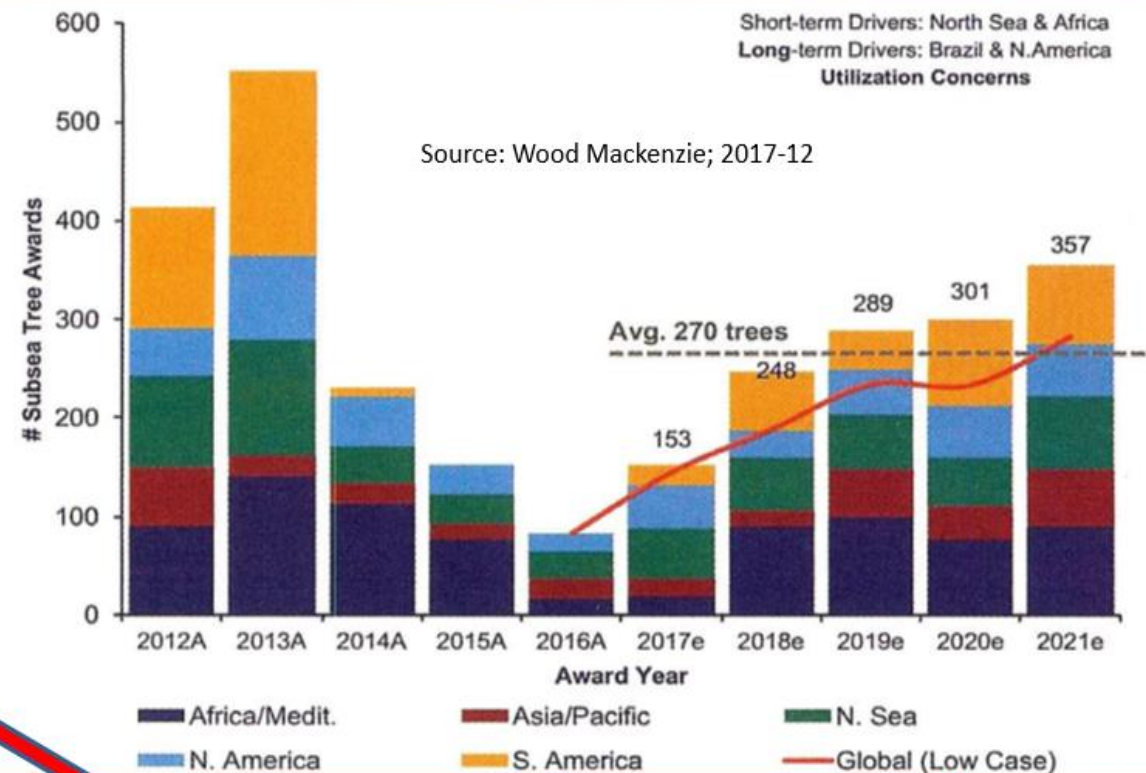
"If we can keep every one of those facilities full, that's a step in our strategy," O'Connor said. "And that's where the fast-paced tiebacks fit in really nicely."

BP and its joint-venture partners gave new offshore platform, Mad Dog 2, a definitive final investment decision earlier this year after about four years of deliberation and redesign.

"We basically went back to the drawing board," O'Connor said.

The Mad Dog 2 project started as a roughly \$20 billion investment. But by the time it made it to the investment decision,

Subsea Tree Awards Forecast to 2021



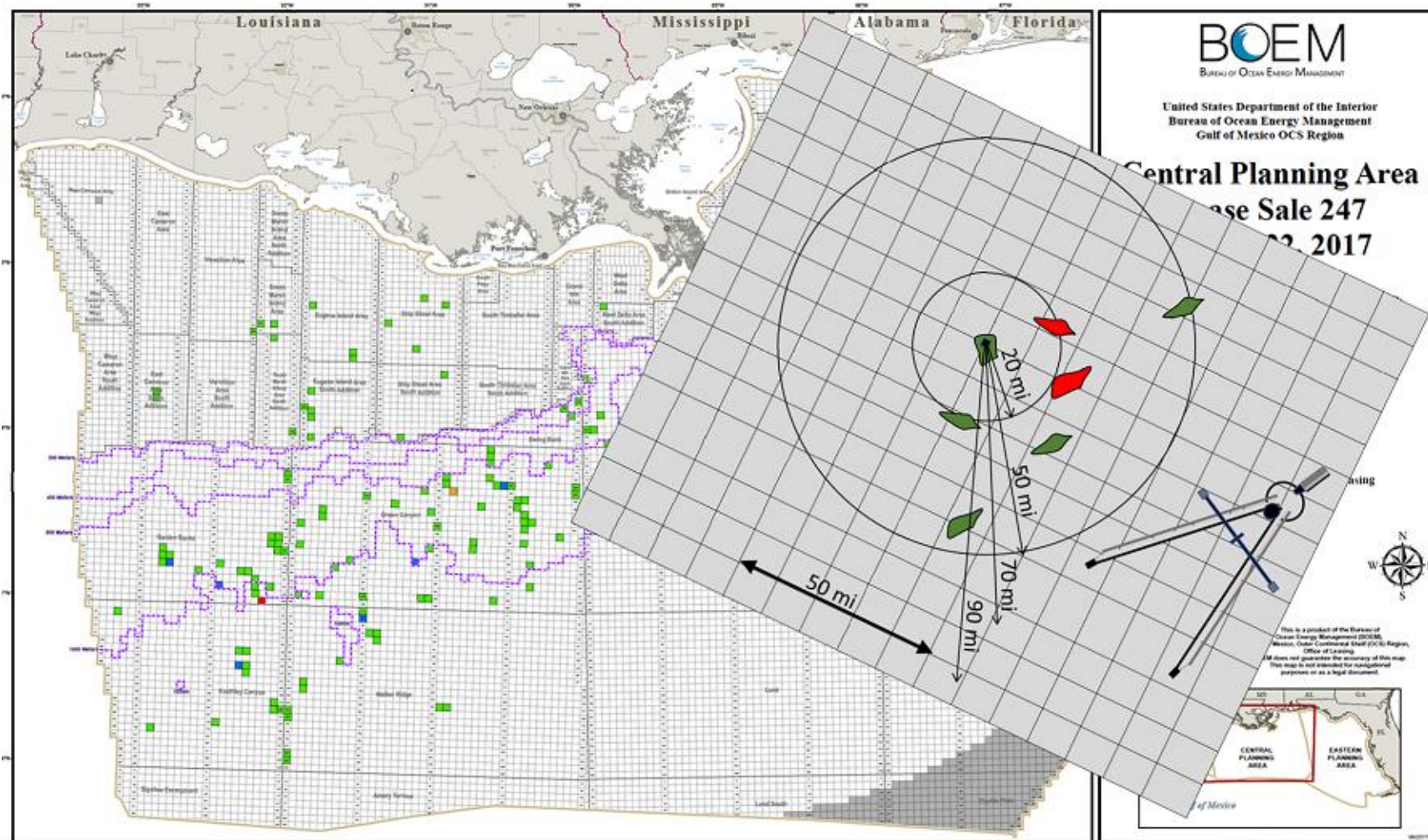
"... developing subsea tie-backs.... We are going to fill those (hubs) with tie-backs" Starlee Sykes, BP, VP Global projects

"If we can keep every one of those facilities (hubs) full.... That's our strategy...fast-paced tiebacks fit in really nice." David O'Conner; BP – Head of Global projects

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Subsea chemical storage & injection will **enable** longer tie-backs



How great would it be to 'expand the radius of opportunity' from your existing hub?

And cut up to 80% of costs!

Solution

Advantages of subsea chemical storage & injection

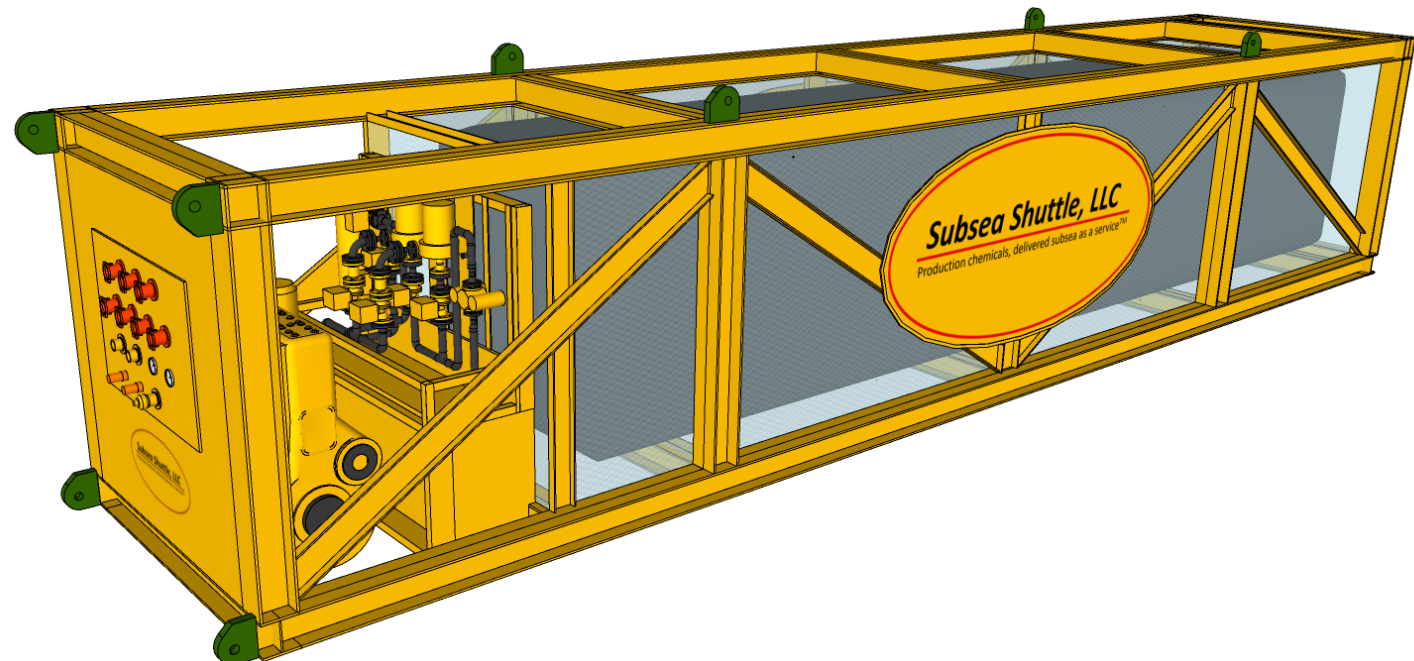
Old school - umbilical

- Logistical nightmare & high-cost
- Chemical stored on platform (PPE concerns)
- Umbilical tubes - subject to plugging, corrosion, etc.
- Recovery costs at end of field life

Subsea storage solution

- Pressure comp'd & dual barrier (pat'd)
- Design & engineer one; build many
- Eliminate umbilical tubes
- Enables long-distance tie-backs
- Cut significant (80%) costs
- Standard marine operations

Business model: **chemical delivery as a service**



Solution integration

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Subsea landscape

Host facility

Mooring
lines &
risers

Chemical
storage &
injection unit
(Subsea Shuttle
solution)

ROV

Flowlines

Umbilical

- Power
- Comms
- Chemical tubes

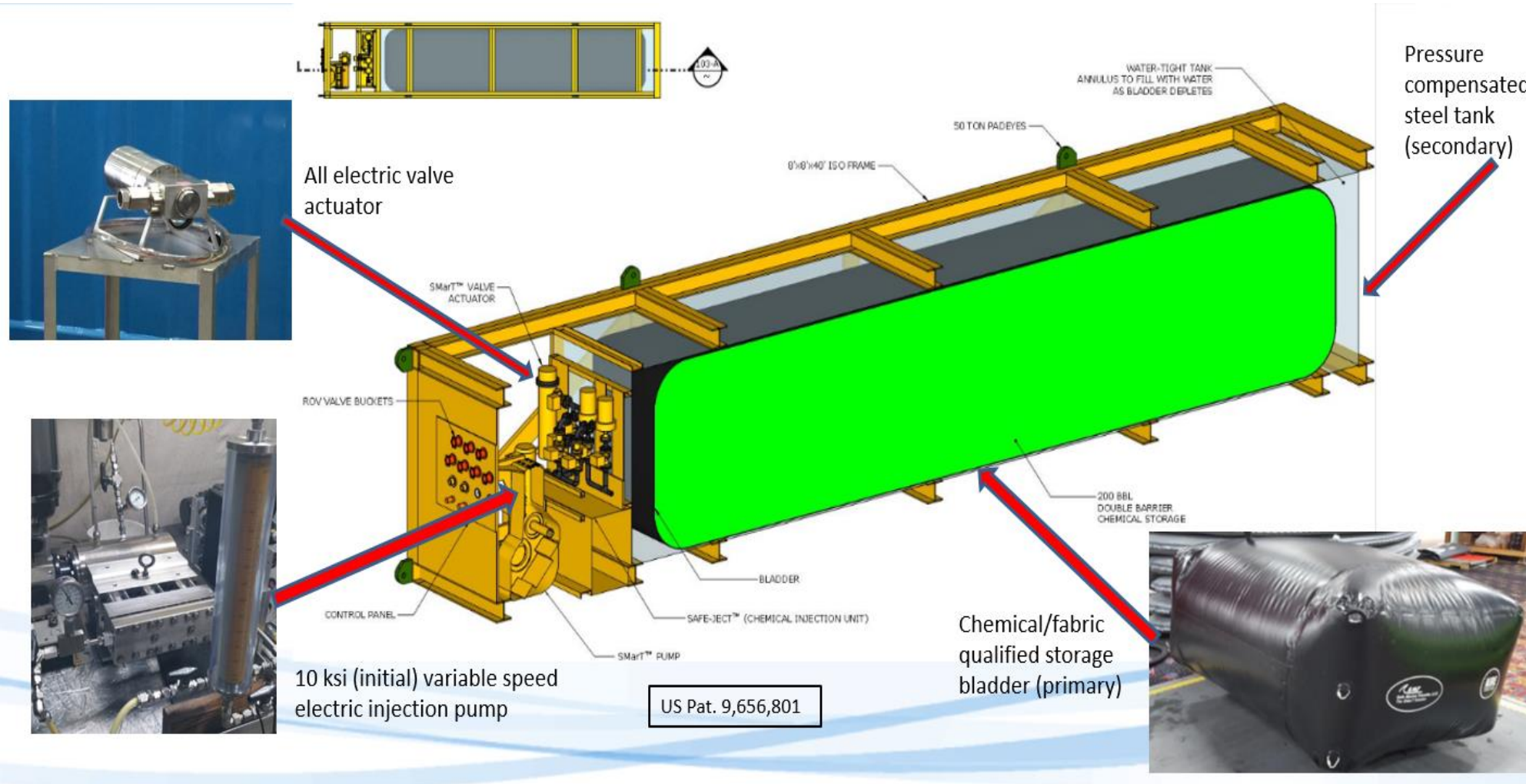
Subsea wells



Built on earlier successes

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Component	Description	Reference/standard
Overall system	• 'Touchless' chemical transfer, from mnfr to subsea • Pat'd dual barrier chemical containment • Qualified to 10,000 fsw / 10-year design life	Meets rqmts of hazardous environment IMDG
Frame	• 20' x 8' x 10'(tall) • Weight: 7 S. Tons tare 30 S. Tons (w/ payload)	API 2 CCU standard IMDG T11, ADR/RID & DOT
Storage tank	• 100 bbl (w/ 20 bbl reserve) • Working pressure: 4 BAR (58 psi) • External collapse: 10 psi	ASME, Sect VIII Div. 1
Bladder	• 120 bbl • Compatible with most std production chemicals	Mil spec MIL-PRF-32233 3 rd party performance tstg
Pump	• Stock onshore triplex pump, modified • 84 gpd of chemical @ DP up to 10,000 psi. • Electric driven, variable speed controlled	Custom, base on API RP 14 C
Valves & actuators	• Electric motor valve actuators, w/ battery back-up. • Smart Batteries for fail-to-close position	Safety Integrity Level (SIL)2 per IEC 61508
Controls & sensor	• Electronics; 1 Atmosphere cans (3)	API RP 17 F compliant & various IEEE
Piping	• Various sizes, SS w/ Swagelok fittings • Flexible flying leads, rated to 20ksi	API RP-1111 section 2.1.7 (c) Welding: API Specification 17D

Qualification process – System Integration Test (SIT)

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Test Tank Facilities

- 50' x 50' x 30' (deep)
- 560,000 gallons
- 2000 lbs./sf loading
- 10 T overhead crane
- HD video & LED lighting
- Remote monitoring
- ROV operations
- Oil Spill Collection System



2020-05-21

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Subsea Shuttle team*

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Art J. Schroeder, Jr.
Co-founder & CEO



Jim Chitwood
Co-founder & CTO



Dr. Tom Gay
Board member
& Sr. Advisor

Previous to Subsea Shuttle, Art worked in upstream operations, engineering and construction for major operators. Schroeder also has served on numerous professional, corporate and civic boards, and is the recipient of numerous awards, including the Offshore Technology Conference's Special Citation and SPE's Management and Information Award. He holds several patents and a B.S and an M.S. in chemical engineering from the Georgia Institute of Technology, and an M.B.A. in finance and international business from the University of Houston.

Chitwood has 48 years of industry experience in offshore engineering and research and development, working both domestically and internationally. His principal project from 1991 to 2014 was the Chevron-led DeepStar Project, where he managed joint industry R&D undertakings. Chitwood has worked for various engineering, manufacturing and production companies both as an employee and as a consultant throughout his career. He holds 14 patents and has an M.S. in mechanical engineering from Texas A&M University.

Dr. Gay has 40 years of industry experience, including 31 years with ExxonMobil in upstream roles in research, project engineering, commercial and facility integrity. Gay served as BG Group's technical authority for floating production systems and represented BG in several DeepStar projects. His experience includes assignments in the United States, Norway, the United Kingdom and France. Gay holds a B.S. in mechanical engineering from Oklahoma State University and an M.S. and Ph.D. in mechanical engineering from the University of Texas at Austin.

*A Berkshire Hathaway subsidiary also holds an equity position and participates in SSS governance

U.S. Department of Energy funds three EOR tech concepts



Department of Energy Secretary Rick Perry; Image source: DOE

The U.S. Department of Energy's (DOE) Office of Fossil Energy has selected three projects to receive around \$9 million in federal funding for cost-shared research and development projects.

DOE said on Tuesday that the projects aim to enhance the potential of enhanced oil recovery (EOR) in offshore wells by advancing promising proof-of-concept technologies.

According to the Department of Energy, the concepts could reduce subsea facility complexity, increase control and monitoring, and enable greater tieback distances to production facilities.

The second is for “**Enhancing Offshore Recovery by Enabling Longer, Safer, and Cheaper Subsea Well Tiebacks**” by **Subsea Shuttle**. The project aims to deliver a safe, effective, low-cost solution to assist with the monetization of economically stranded resources via subsea wells tied back to existing host facilities.

Subsea Shuttle, LLC

Production chemicals, delivered subsea as a service™

Lead Organization: Subsea Shuttle, LLC



U.S. DEPARTMENT OF
ENERGY



NATIONAL
ENERGY
TECHNOLOGY
LABORATORY



U.S. Department of the Interior

Stewarding Conservation and Powering Our Future



Project Partners:

- US Dept. of Energy
- US Dept. of Interior, BSEE
- Oil company subject matter experts
 - ExxonMobil Doug Turner
 - BP Trey Lynch
 - LLOG Glenn Mediamolle
 - Equinor Anish Simon
 - Others TBD

Contractors:

- Seanic Ocean Systems
- TechnipFMC, Genesis
- Argen Labs, LLC
- AEF, LLC
- Trelleborg
- ABS

Project w/ Penn State Univ. ARL & US Navy

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Subsea Shuttle, LLC is under contract to provide guidance and review



Penn State's ARL earns Navy research contract worth as much as \$2.1 billion

Posted Thu 1 Mar 2018

1. **Longer tie-backs**
2. **Lower costs** (reducing umbilical costs by up to 80%)
3. **Reduce host platform space and weight requirements**
4. **Eliminate hazardous chemical interaction** with personnel
5. **“Chemical Injection as a Service”**, mimicking successful onshore chemical delivery model
6. **Engineered for modular industrial fabrication**; minimizes spare parts, simplifies inspection, maintenance, and repairs, and lowers costs, & facilitates compliance with global ‘local content’ requirements
7. **Better match chemical** with changing reservoir conditions
8. Significant step towards **‘normally un-attended’ operations & subsea separation systems**

1. **Oil company operators,**
 - a) Offshore demonstration solving immediate needs;
 - Replace clogged and / or 'under tubed' umbilicals
 - Supplement / additional chemical treatment
 - b) Longer term needs;
 - Reduce development costs
 - Extend tie-back lengths
2. **Oil Field Services company to provide;**
 - a) Deployment, recovery, & IMR
3. **Chemical companies interested in establishing leadership / exclusive position in subsea;**
 - a) Production chemicals
 - b) Specialty fluids (e. g. hydraulic control)

- Subsea tie-backs will dominate deepwater;
 - Cost effective exploitation of smaller pockets
 - Keep existing hubs full, reduce costs on a per bbl basis
- Subsea chemical storage and injection;
 - Enable longer tie-backs
 - Lower costs
 - Facilitate development of additional resources
 - Helps facilitate normally unattended platform development / 'de-manning'
- Subject equipment;
 - Engineered for modular industrial fabrication
 - Common Off The Shelf (COTS) components where possible
 - Suite of 30+ patents issued and pending
 - Full scale prototype being built
 - SIT 2021-Q3
 - Offshore deployment 2022-Q2

