

SUMMARY

EARLY SHELL USA FLOATING DRILLING/SUBSEA WELL PROJECTS:

(Draft – 10/26/2019)

1. GULF OF MEXICO: “BLUEWATER 1” DRILLING/COMPLETION SYSTEMS (RUDAC).

Objectives:

- 1958 – 1965: Extend GoM exploration capability to 600’ +/- water depth to expand development opportunities.

Organizations:

- Technical Service Division (TSD) – Houston.
- Bellaire Research Center (BRC) – Houston.

Technical Participants:

- Ron Geer, Bruce Collipp, Frank Poorman, John Haeber, Lloyd Otteman, John Lacy, Ed Lagucki, De DeVries, Fritz Culver, Norm Montgomery, Finis Martin, Dillard Hammitt, Norm Kaelber.

Results:

- Designed, constructed, tested and deployed unique and innovative floating drilling and subsea well completion systems used by Shell in the GoM for years. Issues included: seasonal hurricanes, loop currents, vessel motions, diver-less design, soft soils, poor seawater visibility, design/execution secrecy, limited service company experience.
- 1958 – 1961: Developed a new Shell-designed floating drilling and subsea well completion system (RUDAC) which included: a subsea guide-base/foundation having five guidelines; a 13 5/8”x5ksi subsea wellhead/casing suspension assembly; a subsea BOP and hydraulic control system; a metal buoyancy-can drilling riser with clamp-type couplers and dead weight (drilling mud) riser tensioning system; a subsea TV; a subsea xmas tree assembly contained in a metal enclosure having hydraulic activated valves and flow piping to accommodate “through-the-flowline” (TFL) tools; a flowline connection assembly having a hinge-over frame lowered on guidelines into the guide-base frame to allow dual steel or flexible flowline connection to the xmas tree with hydraulic activated couplers.
- 1960: The RUDAC system was first tested on a live from a submersible drill rig (later “Bluewater 1”), bottom-supported in 50’+- of water in the West Cameron area.
- 1961 – 1962: Shell (Collipp) initiated/sponsored conversion of an existing submersible, bottom-supported drill rig to the first semi-submersible, floating drill rig (“Bluewater 1”) having a spread mooring system.
- “Bluewater 1”, using the RUDAC drilling system, continued exploration well service for years but the subsea xmas tree was not deployed again.
- 1963: Shell offered a “school” at BRC to give competing oil companies and service companies, for a \$100k fee, “Bluewater 1”/RUDAC and Pacific Coast “MOBOT” system technical details by oral presentations and documentation distributed to participants.
- 1965: “Bluewater 1” capsized in a hurricane (Hilda) ending service life.
- Shell’s “Bluewater 1”/RUDAC system proved to be a significant advancement in offshore oil and gas development technology. Elements of the systems were improved, evolved and employed worldwide.

2. PACIFIC COAST AREA, MARINE DIVISION – FLOATING DRILLING/SUBSEA WELL SYSTEMS.

Objectives:

- Develop a floating drilling and well completion system for exploration and potential development of anticipated leases in state and federal waters off the Pacific Coast.

Organizations:

- Shell Pacific Coast Area, Marine Division - Los Angeles, California.

Technical Participants:

- Bill Bates (GM), Howard Shatto, Bill Hayes, Glenn Johnson (contract employee), Ben Goephert, Bruce Watkins, Ron Dosier, Bill Petersen, Jim Fairbanks, Karl Brueckner, Ed Gallagher, Bruce Collipp, Norm Montgomery.

Results:

- 1960 +: Developed a unique Manipulator Operated (MO) subsea well floating drilling and completion system for Pacific Coast - - - deep (500' +/-) and clear water conditions. The MO system approach was to utilize land-type wellhead, BOP and xmas tree components configured to be installed, retrieved and operated by a manipulator or robot (MOBOT) tethered from a surface rig or vessel. MO components were largely designed by Shell (Glenn Johnson) and manufactured by Ventura Tool Company (later Vetco). Hughes Tool designed and manufactured MOBOT. Tests of the prototype MO system were conducted from the "CUSS "1 drill ship in the Santa Barbara channel in 1962.
- 1961 – '62: Drilled and completed 4 subsea wells (another added later), using Shell-developed MO system, from the moored "Glomar II" drillship in Shell's Santa Barbara Channel Molino field in 220' of water. Wells were linked by three steel flow/control lines pulled out from the seashore and diver-connected with pipe spools to the subsea wells and linked to a new-constructed, Shell onshore gas handling facility near the Gaviota shoreline.
- Drilled a few (?) exploration wells, with weather difficulties, offshore northern California with "Glomar II" using MO drilling system components.
- 1961 – Developed and employed core vessel "Eureka" featuring a prototype automatic dynamic positioning (DP) system. "Eureka" was tested and put into shallow-penetration coring operations along northwest coast in up to 4000' water depths. Fore and aft thrusters, controlled by a taught-wire position measuring device, allowed "Eureka" to be held in working location and alignment. "Eureka" had a small derrick for handling the coring string but did not employ a subsea wellhead, BOP or drilling riser. Eureka's automatic DP system, conceived by Howard Shatto, became widely used worldwide on drill rigs and support vessels.
- Sponsored design/construction of semi-submersible drill rig "Bluewater 2", equipped with the MO system drilling equipment, to drill multiple exploration wells in severe weather and rough water conditions offshore Northern California and Oregon.
- 1963 +/-: Utilized elements of the MO drilling system for use on "Glomar II" drillship to discover Middle Ground Shoals oil field in Cook Inlet, Alaska.
- Conducted deep-water flowline laying tests and subsea production manifolds concept studies.
- Sponsored building of a multiple-arm Universal Manipulator, named UNIMO, that was tested offshore but never put into useful service.

3. PACIFIC COAST AREA, MARINE DIVISION – MARINE TECHNOLOGY GROUP (MTG).

Objectives:

- 1964 – 1967; The MTG was established to extend floating drilling and subsea well technology suitable for West Coast and GoM exploration and development applications in up to 1000' water depths.

Organizations:

- Shell Pacific Coast Area, Marine Division located in Los Angeles, California.

Technical Participants:

- Ron Geer, Fred Gibbs, Lloyd Otteman, Charlie Peterman, Jim Albers, Bill Linder, Karl Brueckner, Chris Greentree, Jim Cooke, De DeVries (New Orleans), Jim Kubasta, Bill Petersen.

Results:

- 1964 +: Developed an improved floating drilling system having: a four guideline guidebase; a 13 5/8" x 5 ksi wellhead; a BOP/LMRP assembly having hydraulic connectors and with removable control pod; a 16" drilling riser with pin connectors and separately run choke & kill lines. The MTG drilling system was land-tested at Shell's Gasmer test facility in Houston and, after removal of MO drilling equipment and rig modifications, deployed onto "Bluewater 2" offshore Oregon about 1966.
- Developed a subsea xmas tree (2 1/2" x 2" x 5ksi) configured for TFL pump-down tools and interfaces with pull-in, funnel-type pipeline/control line connection hardware. The MTG xmas tree was tested from a jack-up rig on a GoM, South Marsh Island well and successfully flow tested for a limited time.
- Conducted land tests of a well-end, pull-in type flowline connection method.
- Tested tools and procedures to remotely locate and connect guidelines to a subsea tree using sonar-directed tooling.
- Completed and documented a 3000' water depth drilling and development feasibility study.
- Exploration drilling in northern California and Oregon was unsuccessful and following Shell's limited lease acquisition in the 1968 Santa Barbara lease sale, Shell discontinued the MTG effort and in 1967 transferred out staff.

4. BELLAIRE RESEARCH CENTER – SUBSEA SYSTEMS.

Objective:

- Establish on-going research at BRC relating to subsea development systems.

Organizations:

- 1967: Established a new Subsea Systems Department within BRC Production Engineering Research organization headed by Lloyd Otteman.

Technical Participants:

- Charlie Peterman, Bill Petersen – (others later).

Results:

- Identified/evaluated "step-wise" process options to achieve deep-water subsea development goals.
- Defined and evaluated multiple single and cluster well subsea concepts.

5. SOUTHERN REGION, MARINE DIVISION – EXPLORATION DRILLING AND SATELLITE SUBSEA WELL PROGRAM

Objectives:

- Evaluate, define and employ subsea wells as economic satellite producers to existing host platforms. Focus on utilizing subsea well equipment developed by traditional suppliers rather than Shell in-house designs.
- Provide on-going technical support for GoM floating drilling operations in increasing water depths.

Organizations:

- Southern Region -- Offshore East and West Divisions.

Technical Participants:

- Lloyd Ramirez, Karl Brueckner, Mike Sport, Burt Carlson, Paul Dodd, Ron Oglesbee, Bill Petersen.

Results:

- 1968 +: Modified and updated Shell-owned floating drilling equipment on contract semi-submersible rigs - "Ocean Explorer", "Ocean Queen", etc.

- 1968 - 1971: Planned and executed four subsea well completions as satellites to host platforms: Ship Shoal 274 field with Cameron Iron Works (CIW) wellhead/tree; Main Pass 290 field with CIW wellhead/tree; Eugene Island 259 field with CIW wellhead/tree; Ship Shoal 274 field with Vetco wellhead/tree. Wells were in 200'± to 370'± water depths, configured for use of TFL tools, had welded steel flowlines linked to platforms with J-tubes and connected to wells with diver, hinge-over and pull-in connection systems.
- The need for multiple zone completions, gas lift, gravel packs for sand control, TFL storm chokes and gas lift valves made wellhead hardware and completion operations complex. There were issues with wax deposits and hydrate formation. Successful development and deployment of an effective second-end flowline/control line connection system for limited visibility water conditions proved difficult. However, these installations were generally successful and produced several years.
- Although the contractor-supplied subsea wellhead and tree hardware was not significantly innovative, useful project and operational experience was gained from these installations.

6. SOUTHERN REGION, OFFSHORE WEST DIVISION – SHELL/LOCKHEED PROGRAM

Objectives:

- Execute a joint Shell/Lockheed industry program to evaluate the potential of man-rated, one-atmosphere chambers to install and service subsea installations.

Organizations:

- Subsea Systems Engineering Group in New Orleans and Shell Head Office Houston.

Technical Participants:

- Carl Wickizer, Burt Carlson, Jim Albers, Jerry Goll, Lou Wilkerson, John Kleinhans, Ron Oglesbee, Jeff Giles, Bill Petersen, Bruce Collipp, Claude Sellers, Jim Stevens.

Results:

- Phase 1: Installed a vertical One Atmosphere Chamber (OAC) on a subsea well in Main Pass 290 field in 370' ± water depth (c.1971). The OAC contained a simple Vetco supplied tree configured for TFL tool passage and an electro-hydraulic control module. Flowlines and control lines were first-end connected to a host platform and second end connected to the OAC using a man-operated, subsea pull-in system.
- Phase 2: Designed, fabricated and installed a manifold chamber (MC) in Eugene Island 331 Field - (1975). Prior to installation, the MC was land-tested with live wells. The MC contained: well control manifolds with valves and chokes and configured for TFL passage; a liquid/gas separator; an electro-hydraulic control unit. The MC was linked to two subsea wells equipped with horizontal OACs with steel flowlines and a hydraulic control line, to a well on the host EI platform with pipelines and to the host platform with two pipeline bundles and a control cable - (1975 – 1976).
- Phase 3: Conducted a conceptual study of applications of OACs in 3000' water depth (1977).
- The Shell/Lockheed was completed about 1977.
- Program results were documented and distributed to the 12 program participants.
- The Shell/LPS program was generally successful but the OAC concept had limited industry acceptance and was abandoned. Note: The OAC concept lost appeal with success of several industry new developments: reliable make-brake, wet signal and power electrical couplings; remotely installed pipeline connection spools; and improved ROV installation, operation and maintenance support. Cost and safety aspects of deepwater man intervention was a concern.

7. ATLANTIC COAST PRODUCTION GROUP - HOUSTON

Objectives:

- Carry out exploration drilling operations and define and prepare development options for potential discoveries in ultra-deep water (5000' - 7500') tracks obtained in 1981 in Baltimore Canyon, offshore New Jersey.

Organizations:

- Atlantic Coast Production Group – Two-Shell Plaza, Houston

Technical Participants:

- Lee Blanton, Carl Wickizer, Howard Shatto, Bruce Collipp, Gary Marsh, Early Denison, Burt Carlson, Robert Orleans, Bill Petersen.

Results:

- Leased Sonat's DP drillship "Discover Seven Seas" and designed/executed multiple upgrades (DP system, wellhead, BOPs, marine riser, etc.) for drilling in up to 7500' of water. Note: A Shell International (SIPM) program (1969 – 1972+-) to develop a DP drillship (SEDCO 445) for international exploration contributed to industry's ultra- deepwater drilling capability. SEDCO 445 drilled multiple wells offshore West Africa and in the Southeast Asia area using a Vetco-supplied deep water drilling system and a large drillship DP system. Several Shell US technical staff (Ron Norgren, Howard Shatto, Karl Brueckner, Jim Albers, others) worked in The Hague and on the drillship during the early phase of the SEDCO 445 program.
- Defined and evaluated a development option utilizing deep water subsea wells linked by long flowlines up the shelf slope to a shallow water host platform.
- Special completion-type well foundations, guide-bases and wellheads were designed, acquired and utilized for drilling of three ultra-deepwater wells.
- Vetco was contracted to design a guideline-less subsea xmas tree for 7500' of water applications and plans were made for ultra- deepwater flowline installations.
- The Baltimore Canyon exploration program did not discover hope-for reserves but gave Shell added confidence to drill and produce in ultra- deepwater.
- "Discover Seven Seas" was moved to the GoM to, along with other semi-submersible rigs, drill exploration wells on leases acquired in a 1984 lease sale ranging into ultra- deepwaters.

8. FRONTIER DIVISION – DEEPWATER SYSTEMS SELECTION GROUP - HOUSTON

Objectives:

- 1985 - Define, screen and recommend a preferred, large-scale development system for GoM ultra-deepwater conditions. A TLP concept was selected for further development.

Organization:

- Frontier Division; Two Shell Plaza, Houston

Technical Participants:

- Claude Sellers, Howard Shatto, Bruce Collipp, Burt Carlson, Early Denison, Curtis Lohr, Jim Stevens, David Huete, Robert Orleans, Paul Ritter, Bill Petersen.

Results:

- A TLP feasibility design was completed.
- In 1987, Shell Offshore established a Deepwater Division in New Orleans with John Krebs Manager and Carl Wickizer Engineering Manager. Also, a Subsea Systems Group headed by Lou Wilkerson was set up in New Orleans and a TLP Design Group organized in Head Office Civil Engineering (HOCE) managed by Pat Dunn. Paul Ritter, Robert Patterson and Bill Petersen transferred to HOCE TLP Design Group.
- Key Shell offshore engineers chose to retire fall of 1987 – Bruce Collipp, Howard Shatto, Burt Carlson, Claude Sellers.
