Part I

The Path to Tragedy

On April 20, 2010, the 126 workers on the BP *Deepwater Horizon* were going about the routines of completing an exploratory oil well—unaware of impending disaster. What unfolded would have unknown impacts shaped by the Gulf region's distinctive cultures, institutions, and geography—and by economic forces resulting from the unique coexistence of energy resources, bountiful fisheries and wildlife, and coastal tourism. The oil and gas industry, long lured by Gulf reserves and public incentives, progressively developed and deployed new technologies, at ever-larger scales, in pursuit of valuable energy supplies in increasingly deeper waters farther from the coastline. Regulators, however, failed to keep pace with the industrial expansion and new technology—often because of industry's resistance to more effective oversight. The result was a serious, and ultimately inexcusable, shortfall in supervision of offshore drilling that played out in the Macondo well blowout and the catastrophic oil spill that followed. Chapters 1 through 3 describe the interplay of private industry and public oversight in the distinctive Gulf deepwater context: the conditions that governed the deployment of the *Deepwater Horizon* and the drilling of the Macondo well.


Transocean
DEEPWATER HORIZON

Chapter One

“Everyone involved with the job . . . was completely satisfied. . .”

The *Deepwater Horizon*, the Macondo Well, and Sudden Death on the Gulf of Mexico

At 5:45 a.m. on Tuesday, April 20, 2010, a Halliburton Company cementing engineer sent an e-mail from the rig *Deepwater Horizon*, in the Gulf of Mexico off the Louisiana coast, to his colleague in Houston. He had good news: “We have completed the job and it went well.”[1]

Outside in the Gulf, it was still dark—beyond the glare of the floodlights on the gargantuan rig, the four decks of which towered above the blue-green water on four huge white columns, all floating on massive pontoons. The oil derrick rose over 20 stories above the top deck. Up on the bridge on the main deck, two officers monitored the satellite-guided dynamic positioning system, controlling thrusters so powerful that they could keep the 33,000-ton *Deepwater Horizon* centered over a well even in high seas. The rig’s industrial hum and loud mechanical noises punctuated the sea air as a slight breeze blew in off the water. The crew worked on

Pride of the Transocean fleet of offshore drilling rigs, *Deepwater Horizon* rides calmly on station 40 miles off the Louisiana coast. The $560-million-dollar rig, under lease to BP, was putting the finishing touches on the oil company’s 18,000-foot-deep Macondo well when it blew out and escaping methane gas exploded. Eleven workers died in the inferno. According to the government’s estimates, by the time the well was sealed months later, over 4 million barrels of oil had spilled into the Gulf.

< *Photo courtesy of Transocean*

the well bore, aiming always to keep the pressure inside the well balancing the force exerted by the surrounding seabed.[2]

By the time the Halliburton engineer had arrived at the rig four days earlier to help cement in the two-and-a-half-mile-deep Macondo well, some crew members had dubbed it "the well from hell."[3] Macondo was not the first well to earn that nickname;[4] like many deepwater wells, it had proved complicated and challenging. As they drilled, the engineers had to modify plans in response to their increasing knowledge of the precise features of the geologic formations thousands of feet below. Deepwater drilling is an unavoidably tough, demanding job, requiring tremendous engineering expertise.

BP drilling engineer Brian Morel, who had designed the Macondo well with other BP engineers including Mark Hafle, was also on board to observe the final stages of work at the well.[5] In an April 14 e-mail, Morel had lamented to his colleagues, "this has been [a] nightmare well which has everyone all over the place."[6] BP and its corporate partners on the well, Anadarko Petroleum and MOEX USA, had, according to government reports, budgeted $96.2 million and 51 days of work to drill the Macondo well in Mississippi Canyon Block 252.[7] They discovered a large reservoir of oil and gas, but drilling had been challenging.

As of April 20, BP and the Macondo well were almost six weeks behind schedule and more than $58 million over budget.[8] The *Deepwater Horizon* was not originally meant to drill Macondo. Another giant rig, the *Marianas*, had initiated work on the well the previous October.[9] Drilling had reached more than 9,000 feet below the ocean surface (4,000 feet below the seabed), with another 9,000 feet to go to "pay zone" (the oil and gas reservoir), when Hurricane Ida so battered the rig on November 9 that it had to be towed in for repair.

Both *Marianas* and *Deepwater Horizon* were semisubmersible rigs owned by Transocean, founded in Louisiana in 1919 as Danciger Oil & Refining Co. and now the world's largest contractor of offshore drilling rigs.[10] In 2009, Transocean's global fleet produced revenues of $11.6 billion.[11] Transocean had consolidated its dominant position in the industry in November 2007 by merging with rival GlobalSantaFe.[12]

Deepwater Horizon, built for $350 million,[13] was seen as the outstanding rig in Transocean's fleet; leasing its services reportedly cost as much as $1 million per day. Since *Deepwater Horizon*'s 2001 maiden voyage to the Gulf, it had been under contract to London-based BP (formerly known as British Petroleum). By 2010, after numerous acquisitions, BP had become the world's fourth-largest corporation (based on revenue)[14] producing more than 4 million barrels of oil daily from 30 countries.* Ten percent of BP's output came from the Gulf of Mexico, where BP America (headquartered in Houston) was the largest producer. But BP had a tarnished reputation for safety. Among other BP accidents, 15 workers died in a 2005 explosion at its Texas City, Texas, refinery; in 2006, there was a major oil spill from a badly corroded BP pipeline in Alaska.

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*A barrel equals 42 gallons.

Deepwater Horizon had arrived at the Macondo lease site on January 31, at 2:15 p.m. It was 55 degrees, chilly and clear—the night of a full moon. About 126 people were aboard: approximately 80 Transocean employees, a few BP men, cafeteria and laundry workers, and a changing group of workers contracted for specialized jobs. Depending on the status of the well, these might include Halliburton cementers, mud loggers from Sperry Sun (a Halliburton subsidiary), mud engineers from M-I SWACO (a subsidiary of Schlumberger, an international oilfield services provider), remotely operated vehicle technicians from Oceaneering, or tank cleaners and technicians from the OCS Group. The offices and living quarters were on the two bottom decks of the rig. Helicopters flew in and out regularly with workers and supplies, landing on the top-deck helipad, and service ships made regular visits.

At its new Macondo assignment, *Deepwater Horizon* floated in 4,992 feet of water just beyond the gentle slope of the continental shelf in the Mississippi Canyon.[15] The seabed far below was near-freezing, visible to the crew only via cameras mounted on the rig's subsea remotely operated vehicle. Another two and a half miles below the seabed was the prize BP sought: a large reservoir of oil and gas from the Middle Miocene era trapped in a porous rock formation at temperatures exceeding 200 degrees.[16] These deepwater hydrocarbon fields, buried far below the seabed—not just in the Gulf, but in other oil-rich zones around the world, too—were the brave new oil frontier. The size of some deepwater fields was so huge that the oil industry had nicknamed those with a billion barrels or more "elephants."[17]

Drilling for oil had always been hard, dirty, dangerous work, combining heavy machinery and volatile hydrocarbons extracted at high pressures. Since 2001, the Gulf of Mexico workforce—35,000 people, working on 90 big drilling rigs and 3,500 production platforms—had suffered 1,550 injuries, 60 deaths, and 948 fires and explosions.[18]

The rig never slept. Most workers on *Deepwater Horizon*, from BP's top "company man" down to the roustabouts, put in a 12-hour night or day shift, working three straight weeks on and then having three weeks off. Rig workers made good money for the dangerous work and long stints away from home and family. Top rig and management jobs paid well into six figures.

On the morning of April 20, Robert Kaluza was BP's day-shift company man on the *Deepwater Horizon*. On board for the first time, he was serving for four days as a relief man for Ronald Sepulvado, a veteran well-site leader on the rig. Sepulvado had flown back to shore April 16 for a required well-control class.[19]

During the rig's daily 7:30 a.m. operations conference call to BP in Houston, engineer Morel discussed the good news that the final cement job at the bottom of the Macondo well had gone fine.[20] To ensure the job did not have problems, a three-man Schlumberger team was scheduled to fly out to the rig later that day, able to perform a suite of tests to examine the well's new bottom cement seal.[21]

According to the BP team's plan, if the cementing went smoothly, as it had, they could skip Schlumberger's cement evaluation. Generally, the completion rig would perform this test when it reopened the well to produce the oil the exploratory drilling had discovered. The decision was made to send the Schlumberger team home on the 11:00 a.m. helicopter, thus saving time and the $128,000 fee. As BP Wells Team Leader John Guide noted, "Everyone involved with the job on the rig site was completely satisfied with the [cementing] job."[22]

At 8:52 a.m., Morel e-mailed the Houston office to reiterate: "Just wanted to let everyone know the cement job went well. Pressures stayed low, but we had full returns on the entire job…We should be coming out of the hole [well] shortly." At 10:14 a.m., David Sims, BP's new drilling operations manager in charge of Macondo, e-mailed to say, "Great job guys!"

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The rest of the day would be devoted to a series of further tests on the well—positive- and negative-pressure tests—in preparation for "temporary abandonment."* During the positive-pressure test, the drill crew would increase the pressure inside the steel casing and seal assembly to be sure they were intact. The negative-pressure test, by contrast, would reduce the pressure inside the well in order to simulate its state after the *Deepwater Horizon* had packed up and moved on. If pressure increased inside the well during the negative-pressure test, or if fluids flowed up from the well, that would indicate a well integrity problem—a leak of fluids into the well. Such a leak would be a worrisome sign that somewhere the casing and cement had been breached—in which case remedial work would be needed to reestablish the well's integrity.

At 10:43 a.m., Morel, about to leave the rig on the helicopter with the Schlumberger team, sent a short e-mail laying out his plan for conducting the day's tests of the well's integrity and subsequent temporary abandonment procedures. Few had seen the plan's details when the rig supervisors and members of the drill team gathered for the rig's daily 11:00 a.m. pre-tour meeting in the cinema room. "Basically [we] go over what's going to be taking place for today on the rig and the drill floor," said Douglas Brown, chief mechanic.[23]

During the rig meeting, the crew on the drill floor was conducting the Macondo well's positive-pressure test.[24] The positive-pressure test on the casing was reassuring, a success.[25] There was reason for the mood on the rig to be upbeat. Ross Skidmore, a subsea engineer explained, "When you run the last string of casing, and you've got it cemented, it's landed out, and a test was done on it, you say, 'This job, we're at the end of it, we're going to be okay.'"[26]

At noon, the drill crew began to run drill pipe into the well in preparation for the negative-pressure test later that evening.[27] By now, it was a sunny afternoon. Transocean's top men on the rig, Jimmy Harrell and Captain Curt Kuchta, were standing together near the helipad, watching a helicopter gently land. Kuchta had come in from New Orleans just

* Temporary abandonment describes the process, after successful exploration, for securing the well until the production platform can be brought in for the purpose of extracting the oil and gas from the reservoir.

that morning to begin his three-week hitch. Harrell was the top Transocean man on the rig when—as now—the well was "latched up." Captain Kuchta, who had served on the *Deepwater Horizon* since June 2008, was in command when the vessel was "unlatched" and thus once again a maritime vessel. [28]

The helicopter landed, the doors opened, and four Houston executives stepped out to begin their 24-hour "management visibility tour."[29] Harrell and Kuchta greeted the VIPs.[30] Two were from Transocean: Buddy Trahan, vice president and operations manager for assets, and Daun Winslow, a one-time assistant driller who had worked his way up to operations manager. BP's representatives were David Sims, the new drilling operations manager (he had sent the congratulatory e-mail about the cement just that morning), and Pat O'Bryan, vice-president for drilling and completions, Gulf of Mexico Deepwater.[31]

At about 4:00 p.m., Harrell began his escorted tour of the *Deepwater Horizon* for the VIPs.[32] He was joined by Chief Engineer Steve Bertone, on board since 2003, and senior toolpusher Randy Ezell, another top man on the rig. [33] Like Harrell, Ezell was an offshore veteran. He had worked for 23 years with Transocean[34] and was now the senior man in charge of the drilling floor. He had been on the rig for years. If any people knew this rig, they were Harrell, Bertone, and Ezell; they showed the VIPs around.

At 5:00 p.m., the rig crew, including toolpusher Wyman Wheeler, began the negative-pressure test.[35] After bleeding pressure from the well, the crew would close it off to check whether the pressure within the drill pipe would remain steady. But the pressure repeatedly built back up. As the crew conducted the test, the drill shack grew crowded.[36] The night crew began arriving to relieve the day shift, and Harrell brought the VIPs through as part of their tour.[37]

"There was quite a few people in there," said Transocean's Winslow. "I tapped Dewey Revette on the shoulder. He was the driller master. I said, 'Hey, how's it going, Dewey? You got everything under control here?'

"And he said, 'Yes, sir.'

"And there seemed to be a discussion going on about some pressure or a negative test. And I said to Jimmy [Harrell] and Randy Ezell, 'Looks like they're having a discussion here. Maybe you could give them some assistance.' And they happily agreed to that."[38] Bertone took over the tour, wandering on to look at the moon pool, down toward the pontoons and the thrusters.[39]

The two shifts continued to discuss how to proceed. It was about 6:00 p.m. Jason Anderson, a tool pusher, turned to Ezell and said, "Why don't you go eat?"[40]

Ezell had originally planned to attend a meeting with the VIPs at 7:00 p.m. He replied, "I can go eat and come back."[41]

Anderson was from Bay City, Texas, and had been on the rig since it was built; he was highly respected as a man who understood the finer points of deepwater well control. This was his final shift on the *Deepwater Horizon*: he had been promoted to teaching in Transocean's well-control school, and he was scheduled to fly out the next day. He told Ezell, "Man, you ain't got to do that. I've got this. Don't worry about it. If I have any problems at all with this test I'll give you a call."[42]

"I knew Jason well," said Ezell, "I've worked with him for all those years, eight or nine years….He was just like a brother. So I had no doubt that if he had any indication of any problem or difficulty at all he would have called me. So I went ahead and ate. I did attend the meeting with the dignitaries."[43]

Wheeler was "convinced that something wasn't right," recalled Christopher Pleasant, a subsea supervisor. Wheeler couldn't believe the explanations he was hearing. But his shift was up.[44]

Don Vidrine, the company man coming on the evening shift, eventually said that another negative test had to be done.[45] This time the crew members were able to get the pressure down to zero on a different pipe, the "kill line," but still not for the drill pipe, which continued to show elevated pressure.[46] According to BP witnesses, Anderson said he had seen this before and explained away the anomalous reading as the "bladder effect."[47] Whether for this reason or another, the men in the shack determined that no flow from the open kill line equaled a successful negative-pressure test.[48]* It was time to get on with the rest of the temporary abandonment process. Kaluza, his shift over, headed off duty.[49]

At 7:00 p.m., after dinner, the VIPs had gathered in the third floor conference room with the rig's leadership. According to BP's Patrick O'Bryan, the *Deepwater Horizon* was "the best performing rig that we had in our fleet and in the Gulf of Mexico. And I believe it was one of the top performing rigs in all the BP floater fleets from the standpoint of safety and drilling performance." O'Bryan, at his new job just four months, was on board in part to learn what made the rig such a stand-out.[50] Despite all the crew's troubles with this latest well,[51] they had not had a single "lost-time incident" in seven years of drilling.[52]

The Transocean managers discussed with their BP counterparts the backlog of rig maintenance. A September 2009 BP safety audit had produced a 30-page list of 390 items requiring 3,545 man-hours of work.[53] The managers reviewed upcoming maintenance schedules and discussed efforts to reduce dropped objects and personal injuries: on a rig with cranes, multiple decks, and complicated heavy machinery, errant objects could be deadly.[54]

Around 9:00 p.m., Transocean's Winslow proposed they all go visit the bridge, which had not been part of their earlier tour. According to David Sims, the bridge was "kind of an impressive place if you hadn't been there…[l]ots of screens…lots of technology."[55] The four

* The precise content of this particular conversation is disputed and is considered more fully in Chapter 4.

men walked outside. The Gulf air was warm and the water calm as glass. Beyond the glare of the rig's lights, the night sky glimmered with stars.

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After concluding that the negative-pressure test was successful, the drilling crew prepared to set a cement plug[56] deep in the well—3,000 feet below the top of the well. [57] They reopened the blowout preventer and began pumping seawater down the drill pipe to displace the mud and spacer* from the riser (the pipe that connected the rig to the well assembly on the seafloor below).[58] When the spacer appeared up at the surface, they stopped pumping because the fluid had to be tested to make sure it was clean enough to dump it in the Gulf, now that it had journeyed down into the well and back. By 9:15 p.m., the crew began discharging the spacer overboard.[59]

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Inside the bridge, Captain Kuchta welcomed visitors Sims, O'Bryan, Trahan, and Winslow.[60] The two dynamic-positioning officers, Yancy Keplinger and Andrea Fleytas, were also on the bridge.[61] Keplinger was giving the visitors a tour of the bridge while Fleytas was at the desk station.[62] The officers explained how the rig's thrusters kept the *Deepwater Horizon* in place above the well, showed off the radars and current meters, and offered to let the visiting BP men try their hands at the rig's dynamic-positioning video simulator.[63]

Winslow watched as the crew programmed in 70-knot winds and 30-foot seas, and hypothetically put two of the rig's six thrusters out of commission. Then they put the simulator into manual mode and let Sims work the hand controls to maintain the rig's location. Keplinger was advising about how much thrust to use. Winslow decided it was a good moment to go grab a quick cup of coffee and a smoke. He walked down to the rig's smoking area, poured some coffee, and lit his cigarette.[64]

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Senior Toolpusher Randy Ezell left the evening meeting with BP feeling pleased at their praise "on how good a job we had done…How proud they were of the rig." He stopped in at the galley to get a beverage before continuing to his office. At 9:20, he called Anderson up on the rig floor and asked, "'How did your negative test go?'"[65]

Anderson: "It went good. . . . We bled it off. We watched it for 30 minutes and we had no flow."
Ezell: "What about your displacement? How's it going?"
Anderson: "It's going fine. . . . It won't be much longer and we ought to have our spacer back."

* As described more fully in Chapter 4, a "spacer" is a liquid that separates drilling mud used during the drilling operations from the seawater that is pumped in to displace the mud once drilling is complete.

Ezell: "Do you need any help from me?"
Anderson: "No, man. . . . I've got this. . . . Go to bed. I've got it."
Ezell concluded: "Okay."[66]

Ezell walked to his cabin. He had worked with Anderson since the rig came from the shipyard. He had complete confidence in him. "Jason was very acute on what he did. . . he probably had more experience as far as shutting in for kicks than any individual on the *Deepwater Horizon*." So Ezell prepared for bed, called his wife, and then turned off the lights to watch a bit of TV before going to sleep.[67]

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Up on the bridge, O'Bryan was taking his turn on the simulator.[68] Sims had stepped to the opposite side of the bridge when he felt a distinct high-frequency vibration.[69]

Captain Kuchta looked up and remarked "What's that?" He strode to the port-side door and opened it.[70] Outside, O'Bryan could see the supply vessel *Bankston* glistening with what looked like drilling mud.[71] The captain shut the door "and told everybody to stay inside."[72] Then there began a hissing noise.[73]

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BP's Vidrine had headed back to his office to do paperwork. He had been there about 10 to 15 minutes when the phone rang. It was Anderson, who reported "they were getting mud back and were diverting to the gas buster." Vidrine grabbed his hard hat and started for the drill floor. By the time he got outside, "[t]here was mud and seawater blowing everywhere, there was a mud film on the deck. I decided not to continue and came back across."[74]

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Down in Ezell's cabin, he was still watching TV when his phone rang. It was assistant driller Steve Curtis calling, also from the rig floor. "We have a situation. …The well is blown out. . . . We have mud going to the crown." Ezell was horrified. "Do y'all have it shut in?"[75]

Curtis: "Jason is shutting it in now. . . Randy, we need your help."
Ezell: "Steve, I'll be—I'll be right there."[76]

He put on his coveralls, pulled his socks on, and opened the door to go across the hall to his office for his boots and hard hat. Once in the hall, "a tremendous explosion… blew me probably 20 feet against a bulkhead, against the wall in that office. And I remember then that the lights went out, power went out. I could hear everything deathly calm."[77]

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Up on the main deck, gantry crane operator Micah Sandell was working with the roustabouts. "I seen mud shooting all the way up to the derrick. . . . Then it just quit. . . I took a deep breath thinking that 'Oh, they got it under control.' Then all the sudden the. . . mud started coming out of the degasser. . . so strong and so loud that it just filled up the whole back deck with a gassy smoke. . . loud enough. . . it's like taking an air hose and sticking it in your ear. Then something exploded. . . that started the first fire...on the starboard side of the derrick."[78]

Sandell jumped up and turned off the crane cab's air conditioner, worried that the gas would come in. "And about that time everything in the back just exploded at one time. It. . . knocked me to the back of the cab. I fell to the floor. . . put my hands over my head and I just said, 'No, God, no.' Because I thought that was it."[79] Then the flames pulled back from his crane and began to shoot straight up, roaring up and over the 20-story derrick.[80]

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Down in the engine control room, Chief Mechanic Douglas Brown, an Army veteran employed by Transocean, was filling out the nightly log and equipment hours. He had spent the day fixing a saltwater pipe in one of the pontoons. First, he noticed an "extremely loud air leak sound." Then a gas alarm sounded, followed by more and more alarms wailing. In the midst of that noise, Brown noticed someone over the radio. "I heard the captain or chief mate, I'm not sure who, make an announcement to the standby boat, the *Bankston*, saying we were in a well-control situation."[81] The vessel was ordered to back off to 500 meters. [82]

Now Brown could hear the rig's engines revving. "I heard them revving up higher and higher and higher. Next I was expecting the engine trips to take over. . . . That did not happen. After that the power went out." Seconds later, an explosion ripped through the pitch-black control room, hurtling him against the control panel, blasting away the floor. Brown fell through into a subfloor full of cable trays and wires. A second huge explosion roared through, collapsing the ceiling on him. All around in the dark he could hear people screaming and crying for help.[83]

Dazed and buried in debris, he pulled himself out of the subfloor hole. In front of him appeared Mike Williams, chief electronic technician, blood pouring from a wound on his forehead, crawling over the rubble, screaming that he had to get out.[84]

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Steve Bertone, the rig's chief engineer, had been in bed, reading the first sentence of his book, when he noticed an odd noise. "As it progressively got louder, it sounded like a freight train coming through my bedroom and then there was a thumping sound that consecutively got much faster and with each thump, I felt the rig actually shake."[85] After a loud boom, the lights went out.[86] He leapt out of bed, opening his door to let in the emergency hall light so he could get dressed.[87] The overhead public-address system crackled to life: "Fire. Fire. Fire." [88]

The air smelled and tasted of some kind of fuel. A second explosion roared through, flinging Bertone across his room. He stood up, pulled on his coveralls, work boots, and hard hat, and grabbed a life vest. Out in the hall, clogged with debris from blown-out walls and ceilings, four or five men stood in shock. Bertone yelled to them to go out by the port forward or starboard forward spiral staircases and report to their emergency stations. He ran toward the bridge.[89]

He went to the portside back computer, the dynamic positioning system responsible for maintaining the rig's position. "I observed that we had no engines, no thrusters, no power whatsoever. I picked up the phone which was right there and I tried calling extension 2268, which is the engine control room. There was no dial tone whatsoever." It was then that Bertone looked out to the bridge's starboard window. "I was fully expecting to see steel and pipe and everything on the rig floor." "When I looked out the window, I saw fire from derrick leg to derrick leg and as high as I could see. At that point, I realized that we had just had a blowout."[90]

Fleytas hit the general alarm.[91] The alarm went off: "Report to emergency stations and lifeboats." The rig crew heard: "This is not a drill. This is not a drill."[92] Fleytas, realizing that the rig had not yet issued a Mayday call, sent it out.[93] Out in the dark of the Gulf, three friends on the 31-foot *Ramblin' Wreck* were out on the water for a day of tuna fishing.[94] Around 9:45 p.m., Bradley Shivers trained his binoculars at a brilliant light in the distance and realized it must be an oil rig on fire.[95] On their radio, they heard, "Mayday, Mayday, Mayday, this is the *Deepwater Horizon*. We are on fire."[96] At that moment they "heard and felt a concussive sonic boom."[97] The *Ramblin' Wreck* headed to the scene, their first tuna outing of the year cut short. [98]

Bertone was now back to his station on the bridge, thinking, "The engines should be starting up because in approximately 25 to 30 seconds two engines start up, come online. . . . There was still no power of any kind. No engines starting; no indication of engines starting."[99]

At that moment, the water-tight door to his left banged open and he heard someone say, "The engine room ECR [engine control room] and pump room are gone. They are all gone." Bertone turned around, "What do you mean gone?" The man speaking was so coated in blood Bertone had no idea who he was. Then he recognized the voice. It was Mike Williams. Bertone saw how badly lacerated Williams's forehead was, grabbed a roll of toilet paper from the bathroom, pressed it on the wound to staunch the bleeding, and ordered, "Hold this here."[100]

Then he went back to his station and looked at his screen. "There was still nothing, no engines starting, no thrusters running, nothing. We were still [a] dead ship."[101]

He heard the water-tight door slam again and saw another man soaked in blood, holding a rag to his head, repeating, "I'm hurt. I'm hurt bad, Chief. I'm hurt real bad." It was the voice of Brent Mansfield, a Transocean marine engineer. Bertone pulled back Mansfield's hand holding a rag, saw the head wound, and ran over to the bridge door and yelled down to the life-vessel area, "We need a medic up here now."[102]

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After the explosion, Randy Ezell lay buried under the blown-out walls and ceilings of the toolpusher's office. The room was dark and smoky, the debris atop him so heavy he could barely move. On the third try, adrenalin kicked in. "I told myself, 'Either you get up or you're going to lay here and die.'" Pulling hard on his right leg, he extricated it and tried to stand up. "That was the wrong thing to do because I immediately stuck my head into smoke. . . .I dropped back down. I got on my hands and knees and for a few moments I was totally disoriented." He wondered which way the door was. He felt air. He crawled through the debris toward the door and realized the "air" was methane. He could feel the droplets. He was crawling slowly atop the rubble in the pitch-black hall when he felt a body.[103]

Ezell then saw a bobbing beam of light. Stan Carden, the electrical supervisor, came round the corner. Carden had a light that bounced off shattered walls and collapsed ceilings in the pitch-black corridor, giving glimpses into rooms on each side wrecked by the power of the blast.[104] Stumbling into what was left of the hall was Offshore Installation Manager Jimmy Harrell, who had been in the shower when the rig exploded;[105] he had donned coveralls, and now was groping his way out of what was left of his room. "I think I've got something in my eyes," Harrell said. He had no shoes. "I got to see if I can find me some shoes."[106]

Carden and Ezell tugged debris off the man they now recognized as Wyman Wheeler. Chad Murray, Transocean's Chief Electrician, also appeared in the hall with a flashlight, and was immediately dispatched to find a stretcher for the injured man.[107]

Believing it would save time to walk Wheeler out, Ezell slung Wheeler's arm around his shoulder. Wheeler groaned, "Set me down . . . . Y'all go on. Save yourself."[108]

Ezell said, "No, we're not going to leave you. We're not going to leave you in here."[109]

Just then, they heard another voice from under the rubble: "God help me. Somebody please help me." Near the ruins of the maintenance office the flashlight picked out a pair of feet jutting from the rubble. It was the visiting Transocean manager, Buddy Trahan, badly injured. By now Murray was there with a stretcher. Ezell, Carden, and Murray dragged away the remains of ceilings and walls trapping Trahan and loaded him on the stretcher. Carden and Murray carried him through the smoke and dark to the bow of the rig and the lifeboats.[110]

Outside, the derrick fire roared upward into the night sky, an inferno throwing off searing heat and clouds of black smoke. The blinding yellow of the flames was the only illumination except for the occasional flashlight. The rig's alarms were going off, while over the public announcement system Keplinger yelled, "THIS IS NOT A DRILL!"[111] As the crew struggled out of the blasted quarters, galley, and offices, in various states of undress, they converged in a chaotic and panicked mass at the lifesaving vessels, putting on life vests.[112]

Sandell, the gantry crane operator, had escaped and come around the port side of the deck to the life vessels. "It was a lot of screaming, just a lot of screaming, a lot of hollering, a lot of scared people, including me, was scared. And trying to get people on boats. It was very unorganized—we had some wounded we was putting in the boat. Had people on the boat yelling, 'Drop the boat, drop the boat,' and we still didn't have everybody on the boat yet. We was still trying to get people on the boat and trying to calm them down enough to—trying to calm them down enough to get everybody on the boat. And there was people jumping off the side. We was trying to get an accurate count and just couldn't get an accurate count because people were just jumping off the boat." [113]

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On the *Bankston*, Captain Alwin J. Landry was on the bridge updating his log when his mate noticed the mud. Landry stepped out and saw "mud falling on the back half of my boat, kind of like a black rain." He called the *Deepwater Horizon* bridge to say, "I'm getting mud on me." Landry instructed his crew to get inside. The *Deepwater Horizon* called back and told him to move back 500 meters.[114] A crew member noticed a mud-covered seagull and egret fall to the deck.[115] Shortly after, Landry saw the rig explode. Before the ship could move away, his crew had to detach the long mud transfer hose connecting them to the rig.[116]

As they scrambled to disconnect, the *Bankston* slowly moved 100 meters back, then 500 meters. As the rig went dark, and secondary explosions rocked the decks, the *Bankston* turned on its searchlight. Landry could see the *Deepwater Horizon* crew mustering by the portside life vessels. "That's when I seen the first of three or four people jump to the water from the rig."[117]

One of those was Gregory Meche, a compliance specialist. After five minutes of the chaos around the lifeboats, and a series of large explosions, he headed down to the lower deck. He jumped into the water.[118]

Antonio Gervasio, the *Bankston's* relief chief, and two others began launching the ship's fast rescue craft.[119] Within a minute or two of the explosions, they got the boat lowered into the water, and noticed how calm the Gulf was.[120] "I saw the first person jump in the water. So I told one of the guys to keep an eye on him."[121] The rig life jackets were reflective, and as the fast craft made its first sweep round from one side of the burning rig to the other, they hauled Meche and two or three others out of the water.[122]

* * * *

Back on the rig, Transocean's Winslow had made his way from the coffee shop to the lifeboats, surviving the second blast's wave of concussive force, which blew in the corridor's walls and ceilings. On the deck, a firestorm of flames roared in the night sky above the derrick.[123]

Winslow directed the dazed crew toward the covered life-saving vessels, instructing the first arrivals, "We need to make sure we get a good head count." Seeing Captain Kuchta standing at the starboard bridge door, he ran up, and said people should evacuate. Kuchta answered, "Okay." Panic was building as the derrick fire roared. Winslow heard someone yelling that people were jumping overboard. As the lifeboats filled, crew members were screaming to lower the boats.[124] But not everyone was there.[125] Carden and Murray appeared with Trahan on the stretcher and handed him into the vessel, where he was laid out.[126] People in the boat screamed, "We've got to go! We've got to go!"[127]

A man in his life vest was hanging on the rig handrails, preparing to drop overboard. Winslow said, "Hey, where are you going? There's a perfectly good boat here. Do you trust me?" He and another crew member coaxed the man down and into one of the life vessels, where people were still screaming to leave. Down below in the water, the crew could see swaths of burning oil rising and falling with the gentle swell. The jumpers were visibly bobbing and swimming in their life vests shining with fluorescent strips. The *Bankston's* fast rescue craft was hauling them out of the water. [128]

By now, Winslow began to wonder why the derrick was still roaring with flames. Hadn't the blowout preventer been activated, sealing off the well and thus cutting off fuel for the conflagration? He headed to the bridge. Kuchta said, "We've got no power, we've got no water, no emergency generator."[129]

Steve Bertone was still at his station on the bridge and he noticed Christopher Pleasant, one of the subsea engineers, standing next to the panel with the emergency disconnect switch (EDS) to the blowout preventer.[130]

Bertone hollered to Pleasant: "Have you EDSed?"[131]

Pleasant replied he needed permission. Bertone asked Winslow was it okay and Winslow said yes.[132]

Somebody on the bridge yelled, "He cannot EDS without the OIM's [offshore installation manager's] approval."[133]

Harrell, still dazed, somewhat blinded and deafened, had also made it to the bridge, as had BP's Vidrine. [134] With the rig still "latched" to the Macondo well, Harrell was in charge. Bertone yelled, "Can we EDS?" and Harrell yelled back, "Yes, EDS, EDS."[135]

Pleasant opened the clear door covering the panel and pushed the button.
Bertone: "I need confirmation that we have EDSed."
Pleasant: "Yes, we've EDSed."
Bertone: "Chris, I need confirmation again. Have we EDSed?"
Pleasant: "Yes."

Bertone: "Chris, I have to be certain. Have we EDSed?"
Pleasant: "Yes." He pointed to a light in the panel.[136]

By now BP's O'Bryan, who saw red lights on the EDS panel, had put on a life vest. He looked at his colleague, Sims, and said they should head to the lifeboats. Outside, the conflagration continued to rage, a brilliant blinding yellow that threw off a deafening roar and blistering heat. As the fire raged on, new explosions rang out, spewing hot debris. O'Bryan, unsure of which life vessel he should board, recalled being given a notice at his safety orientation listing his boat. He pulled it out of his back pocket: Lifeboat 2. He figured out which one it was, stepped into the dark interior and squeezed into a seat.[137] Some people were screaming, "We've got to go. We've got to go."[138] BP's Robert Kaluza had made his way up from his cabin and had boarded a lifeboat.[139]

Winslow had returned to the lifeboats. He yelled over the noise to the panicked crew members, "We've got plenty of time." Then he looked up at the sky-high flames engulfing the derrick: "Right about that time is when the traveling equipment, the drilling blocks and whatnot on the derrick fell. They were probably 40 to 50 foot in the air, you know, weigh 150,000 pounds, and they didn't make any noise [when they fell]. So at that time, I instructed the boat to my right, which would have been the port survival boat, to depart. They did."[140]

Winslow then helped lower his own life vessel over approximately 125 feet to the Gulf.[141] Winslow discovered the lifeboat windows were obscured by mud.[142] He opened the hatch and pointed the coxswain toward the *Bankston* vessel; he then clambered out onto the outside so that he could grab the rope thrown to him by the *Bankston* crew.[143] The *Bankston* had made radio contact and Captain Landry instructed the vessels to come round to his starboard side, sheltered from the rig.[144]

* * * *

The rig life vessels were not the only small craft fleeing the firestorm. Four high-school buddies out fishing had sailed up to the rig around 7:30 p.m. on their 26-foot catamaran and settled in by the pontoons.[145] The rig's blazing lights attracted small fish, which in turn attracted tuna. About two hours later, the group noticed water flowing out of the rig's pipes, followed by blowing gas. One young man had worked on rigs and began yelling, "Go, go, go, go, GOOOOO!" The owner pointed the boat away from the rig and gunned the engine. Then the lights went out and the rig blew.[146]

* * * *

Back up on the *Deepwater Horizon* bridge, Bertone asked Captain Kuchta's permission to go to the standby generator room to try to manually start it. He assumed that the EDS had worked. "My thinking at that point was the BOP [blowout preventer] had unlatched, what remaining fuel would be in the riser it would burn away and we were going to need power, as well as fire pumps."[147]

As Bertone left, Mike Williams, his head wounds no longer bleeding, said, "You're not going alone, Chief."
"Well, come on."[148]

Paul Meinhart, a motorman, joined them. As Bertone ran to the standby generator room, he looked up at the derrick where the crown should be. "I could see nothing but flames way past the crown." The noise, heat, and smoke were ferocious. The deck was slick, almost an inch and a half deep with something thick like mucus. Bertone thought to himself as he tried not to slip, "Why is all this snot on the deck." They passed the blowout-preventer house, a huge door that seemed 80 to 90 feet tall and 50 feet wide; they looked down into the moon pool and saw only solid flames.[149]

Inside the standby generator room, Bertone flipped the switch from automatic to manual, hitting the reset and the start button. "There was absolutely no turning over of the engine. I tried it again, the reset button and the start. Again, nothing happened." He reset other functions, and turned the switch for the automatic sync on the standby generator to manual. "I ran back to the panel and again, tried the reset and the start. There was no turning over of the engine whatsoever." They made yet another effort using different batteries. Nothing. Bertone yelled, "That's it. Let's go back to the bridge. It's not going to crank."[150]

When they opened the water-tight door to walk back out to the bridge, the heat struck like a blast furnace. The derrick fire roared into the sky, billowing black smoke. The rig had not unlatched from the well. On the bridge, Kuchta was standing with the door open watching the lifeboat station. The first lifeboat had departed, while the second vessel was visible in the burning water just pulling away from the rig.[151]

Bertone returned to the bridge, looked through the open door, and yelled to Williams and Meinhart, "That's it, abandon ship. Let's go." He turned to Keplinger and Fleytas, still manning their radios. He shouted over the noise, "That's it. Abandon ship. Let's go, now."[152]

* * * *

Randy Ezell had stayed with Wyman Wheeler in the blasted-out hallway in the dark. "I told him I wasn't going to leave him and I didn't. And it seemed like an eternity, but it was only a couple of minutes before they [Murray and Carden] came back with the second stretcher. We were able to get Wyman on that stretcher and we took him to the bow of the rig." They emerged from the living quarters to feel the blast of the fire roaring skyward, the sound deafening, the heat roasting. "[T]he first thing I observed is both of the main lifeboats had already been deployed," said Ezell, "and they left. I also looked to my left and I saw Captain [C]urt and a few of his marine crew starting to deploy a life raft. And we continued down the walkway till we got to that life raft and we set the stretcher down."[153] They got a life vest onto Wheeler.[154]

Chief Mate David Young and Bertone "hooked the life raft up and proceeded to crank it up out of its lift, rotated [it] around to the side of the rig and then drop[ped] it—drop[ped] it out so that you could inflate the raft and you could be clear of the rig." A rope attached to a balky shackling device refused to give. Bertone yelled for a knife to cut the rope. Nobody had one. No pocket knives were allowed on the rig. Williams found a gigantic nail-clipper-like device and used it to unscrew the stuck shackle, freeing the rope. The life raft moved out over the side of the rig. Young got in. Behind them, explosions punctuated the heat, noise, and dark. Thick, acrid smoke was rolling over the deck.[155]

Bertone rushed over to the gurney and with Ezell's help maneuvered Wheeler toward the raft. The two men shoved Wheeler off and in. More explosions and searing heat engulfed them. The flames were spreading further up and around the rig toward them. Bertone leaped in the life raft. Even through his leather gloves he could feel the heat. Fleytas jumped in and the raft lurched back and forth. She cried out, "We're going to die. We're going to die." Bertone felt the same way as the raft filled with smoke and the flames leapt closer. "I honestly thought we were going to cook right there." The life raft rocked back and forth in the air between the rig decks, and then began—herky-jerky—to descend. [156]

They touched the water, which was ablaze. Someone yelled, "Where are the paddles?" Bertone jumped out and grabbed the rope and began swimming, pulling the life raft away from the rig. Murray and Minehart jumped into the water to help pull the raft along. Bertone looked up and saw "a tremendous amount of smoke bellowing out from under the rig." At that moment boots appeared out of the smoke: it was Captain Kuchta, jumping into the water. Unable to get into the raft in the confusion, he leaped over 100 feet. He splashed into the Gulf five feet from Bertone. Then a second person came flying through the air, out of the thick smoke, crashing into the water: Keplinger had jumped, too.[157]

By now, Bertone and his men had managed to pull the life raft far enough away from the rig that they could see the circular helipad silhouetted against the flames. Bertone could see someone running at full speed across the helipad deck and then leaping off the rig. It was Mike Williams, the electronics technician.[158] Williams splashed down nearby, resurfaced, and began swimming toward the *Bankston*.[159]

Bertone felt the life raft no longer moving forward.[160] So did Fleytas. She rolled out of the raft into the water and began to swim.[161] Someone hollered, "The painter line is tied to the rig."[162] Bertone could see the painter line go taut. Murray screamed, "Help. We need help over here."[163]

Bertone spotted the *Bankston's* fast rescue craft, its two lights flashing 50 or 60 yards away. The boat had stopped to haul two men from the water. Bertone and others screamed, "We need a knife. We need a knife." As the rescue craft neared, Kuchta swam to get a large foldable pocket knife, swam back, and cut the rope.[164] Heat and smoke boiled out from the rig.

Murray and Carden tied a rope to the fast rescue craft, which towed them to the *Bankston*. Bertone helped lift the injured man (whom he finally learned was Wheeler) onto a stretcher on the flat bottom of the rescue craft.[165] The *Bankston* crew then used its crane to gently lift the stretcher to the deck. By 11:45 p.m., the life boats were empty.

Captain Kuchta went directly to the bridge, where he worked with others "to see who had firefighting capacity," among other matters.[166] Sims and Winslow were already there, organizing BP's and Transocean's response.[167] Harrell remained on the main deck with the traumatized rig crew, many still half dressed, lacerated, or soaked from being in the sea. The crew filled the 260-foot *Bankston's* lounge, galley, and parts of the main deck, including a temporary medical area.[168] Some lay in the bunks.[169] The *Bankston* crew pulled out whatever dry clothes and boots they had, and handed them to the survivors.[170] With both life vessels and the life raft secured to the *Bankston*, the *Deepwater Horizon* leaders could try to take muster.[171] There had been 126 people on the rig when the well blew out.[172] In the confusion, no one yet knew exact counts, but conspicuously missing were those working the drill floor.

* * * *

The *Bankston* was now jammed with the survivors.[173] Some cried, others prayed—grateful to be alive. Bertone went out to the makeshift hospital on the main deck to tend to Mansfield, prostrate on the floor, his head swathed in bandages and gauze, his neck in a brace, his mouth covered with an oxygen mask. Bertone stayed with him, adjusting his oxygen mask and keeping him conscious. On a bed nearby was Buddy Trahan and Bertone talked to him, to keep him awake, too.[174]

When the first Coast Guard helicopter arrived at 11:22 p.m., it lowered a "rescue swimmer" to oversee medical evacuation of the injured.[175] Bertone helped to move Trahan, who was severely injured, onto a gurney.[176] More helicopters would be coming to evacuate the 16 injured crew members to hospitals on the mainland.[177]

On board the *Bankston*, the atmosphere was grim. The crew was forbidden to call home until there was more definitive information. [178] By 11:30 p.m., the managers had taken a final muster and 11 men were missing: Jason Anderson, Dale Burkeen, Donald Clark, Stephen Curtis, Roy Kemp, Gordon Jones, Karl Dale Kleppinger, Blair Manuel, Dewey Revette, Shane Roshto, and Adam Weise.

The survivors sat on the boat in shock and watched the firestorm on the rig rage unabated, its plume of black smoke boiling up high into the night. At 1:30 a.m., the rig listed and rotated in the wake of more secondary explosions. Work boats, which had begun arriving and spraying water on the rig in response to the Mayday call, moved back.[179] By 2:50 a.m., the *Deepwater Horizon* had spun 180 degrees and, its dynamic positioners dead, moved 1,600 feet from the well. By 3:15 a.m., when the U.S. Coast Guard cutter *Pompano* arrived on the scene,[180] the rig was listing heavily. Dennis Martinez realized his dead father's ring, which he removed only when working, was still on the rig.[181]

The three men in the *Ramblin' Wreck* had continued to scour the waters near the rig, looking for survivors or the dead. Several times, they spotted what they thought might be

"I could see nothing but flames way past the crown," chief engineer Steve Bertone recalled of the dramatic moments before he ordered crew members to abandon the rig. Of the 115 survivors, 16 were seriously injured and medevaced to hospitals. Ninety-nine others, including Bertone, were transported to the mainland by the rescue vessel Bankston. Roughly 36 hours after the first explosion, *Deepwater Horizon* sank to the bottom. It was April 22—Earth Day.

Gerald Herbert/Associated Press

a body, only to find it was debris.[182] They heard rumbling sounds coming from deep below the surface of the water—possibly underwater explosions as the rig burned, exploded, listed, and drifted. Frightened, they still kept to their search. After rescue boats came on the scene, they ferried medical supplies between one of those and the *Bankston*. At 3:00 a.m., the three fishermen headed home.

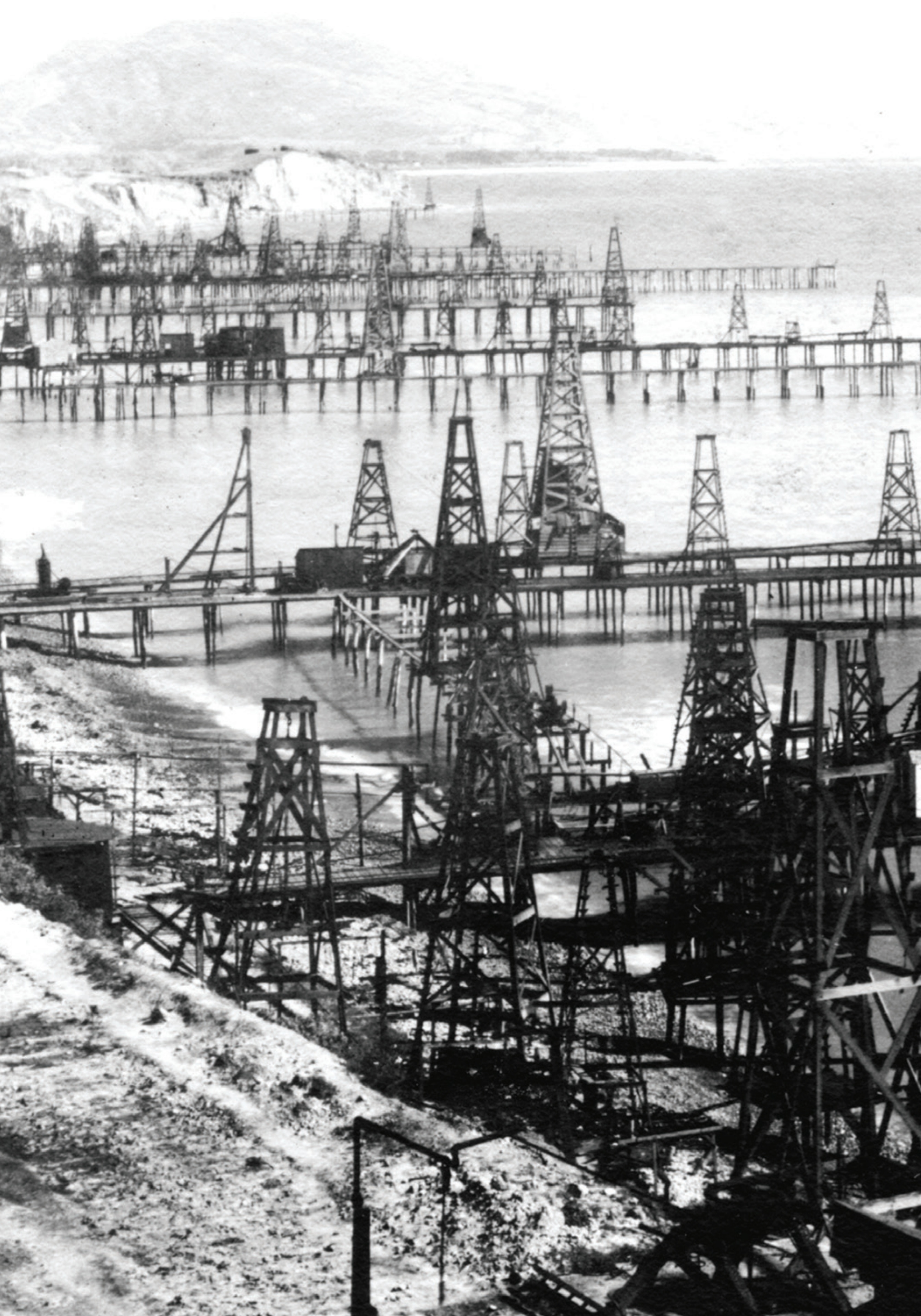
On the *Bankston*, the *Deepwater Horizon* crew deeply wished they could do the same. As the largest boat in the vicinity, the *Bankston* had been ordered by the Coast Guard to stay put while the search and rescue effort unfolded. The search helicopters buzzed overhead, methodically surveying one sector after another. Once the 16 injured were evacuated, said Bertone, "[I] made my way up to one of the upper levels and sat there and watched the rig burn."[183] As oil and gas exploded up and out of the riser, the towering flames set fire to tanks and pipes, sending yet more roiling black smoke high into the sky.

Sitting there hour after hour watching the conflagration with all its cascading smaller explosions was "one of the most painful things we could have ever done," said Randy Ezell. "To stay on location and watch the rig burn. Those guys that were on there were our family. It would be like seeing your children or your brothers or sisters perish in that manner. And that—that put some mental scarring in a lot of people's heads that will never go away. I wish that we could, to the bare minimum, have moved away from the location or something where we didn't just have to sit there and review that many hours. That was extremely painful."[184]

Not until 8:13 that morning, when many boats were on the scene, did the *Bankston* get permission to set sail with the 99 survivors on board for Port Fourchon, Louisiana, the sprawling oil-supply depot that was its home base. The Coast Guard's coordinated search had located no further crew—dead or alive. An hour into the *Bankston's* 114-mile journey back to shore, it stopped at the *Ocean Endeavor* rig to take on two medics.[185] BP's Sims and Transocean's Winslow, along with subsea engineers Mark Hay and Chris Pleasant, debarked to await the *Max Chouest*. They would return to the burning rig and dispatch a remotely operated vehicle down to the burning rig's blowout preventer. The plan was to activate it with a so-called "hot stab" of hydraulic fluid to finally close in the wellhead.[186]

It was a clear spring day as the *Bankston* sailed along through the Gulf, passing the many offshore platforms that dot its blue waters. At 2:09 p.m., the *Bankston* pulled in at the gargantuan Matterhorn production rig to take on more supplies: tobacco, water, and coveralls.[187] Officials from the Coast Guard and Minerals Management Service also boarded. There was still almost a 12-hour journey to Port Fourchon. Officials intended to gather information while memories were still fresh. At 6:35 p.m., the federal officials began conducting interviews, asking each crew member to write a witness statement describing the events they experienced leading up to the blowout and then the abandonment of the rig. The *Bankston* chugged toward the Louisiana coast as night fell. The crew, speaking among themselves, wondered how such a calamity had befallen their rig.

At 1:27 a.m. on Earth Day, Thursday, April 22, 27 hours after the crew had fled the exploding *Deepwater Horizon*, the *Bankston* berthed in slip 1 at the C-Port terminal at Port Fourchon.[188] The exhausted men and women walked on to land. Arrayed before them was a table stacked with forms and surrounded by uniformed officials and company managers. Beyond that stood a long row of portable toilets. As each crew member walked up, he or she was handed a small plastic cup. Per federal regulations, they would all be drug-tested.[189] The investigation of the *Deepwater Horizon* disaster had begun.



Chapter Two

"Each oil well has its own personality"

The History of Offshore Oil and Gas in the United States

March 1938 was an eventful month in the history of oil. Mexico nationalized its oil industry, establishing a precedent. Standard Oil of California (which later became Chevron) completed the first discovery well in Saudi Arabia—still the greatest oil find on record today. And during that same month, the first production of offshore oil took place in the Gulf of Mexico.

Beginning in the 1890s, oil companies had drilled wells in the ocean, but from wooden piers connected to shore. In the 1930s, Texaco and Shell Oil deployed moveable barges to drill in the south Louisiana marshes, protected from extreme conditions in the ocean. In 1937, two independent firms, Pure Oil and Superior Oil, finally plunged away from the shoreline, hiring Texas construction company Brown & Root to build the first freestanding structure in the ocean. It was located on Gulf of Mexico State Lease No. 1, in 14 feet of water, a mile-and-a-half offshore and 13 miles from Cameron, Louisiana, the nearest coastal community. In March 1938, this structure brought in the first well from what was named the Creole Field.[1]

Getting their feet wet for the first time, oil derricks march into the Pacific and the Summerland Oil Field near Santa Barbara, California, at the start of the 20th century. Over the next decades, innovation followed offshore innovation, propelling the industry and helping fuel the nation's remarkable economic expansion. Yet as companies drilled ever deeper and farther from shore, technological hurdles rose ever higher—and risks grew ever greater.

G.H. Eldridge/U.S. Geological Survey

The Creole platform severed oil extraction from land—and did so profitably, setting in motion the march of innovation into ever-deeper waters and new geological environments offshore. The Gulf of Mexico, where offshore drilling began, remained a vital source of oil and gas for the United States. The large, sand-rich depositional system of the Mississippi River that spilled onto the continental margin for tens of millions of years created a world-class petroleum province. The salt domes that pocked the Gulf basin provided excellent traps for hydrocarbons. Prior to 1938, oil hunters had made hundreds of discoveries on domes under the Louisiana and Texas coastal plain. There was no reason to believe that this geology would stop at the shoreline.

The Creole platform highlighted the risks as well as rewards encountered offshore. A hurricane knocked out many of the pilings during construction. The lack of crew quarters on the platform created hardship for workers commuting to and from shore on shrimp boats. Many more challenges lay ahead as the marine environment imposed unique hazards on oil companies trying to adapt land-drilling methods offshore. They would have to squeeze complex drilling and production facilities onto small standing or floating platforms in a region exposed to hurricane-force winds and waves. High costs intensified pressures to find speedy solutions to problems and get the oil flowing. The remoteness of facilities and their space constraints amplified the perils of working under adverse conditions with dangerous equipment and combustible materials. "Nobody really knew what they were doing at that time," recalled a member of Kerr-McGee's earliest offshore drilling crew. "It was blow-by-blow. And it wasn't easy living out there."[2]

As geologists and drillers made discoveries in deeper water, development would stall at a limiting depth, sometimes for several years, until advances were made in production technology to catch up with exploration. Blowouts, drilling-vessel disasters, and platform failures often forced engineers back to the drawing board. Steadily, the offshore industry pioneered ways to meet economic and environmental challenges offshore, first in the Gulf and then around the world. But the risks never went away.

Wading Into Shallow Water

On August 15, 1945, the day after the Japanese surrender in World War II, the U.S. government lifted gasoline and fuel-oil rations. In the first five years after the war, Americans bought an astounding 14 million automobiles, increasing the number of cars in service to 40 million. By 1954, Americans were purchasing 7 million tankfuls of gasoline per day.[3] This booming demand for gasoline, coupled with growing use of home heating oil, vaulted petroleum ahead of coal as the leading source of energy in the United States.

Early Technologies

To meet soaring demand, oil firms embarked on a quest to find new reserves. The intrepid ones returned to the Gulf to drill on leases offered by Louisiana—and made use of wartime technologies and equipment. Sonar and radio positioning developed for warfare at sea proved valuable for offshore exploration. The Navy trained schools of divers in underwater

FIGURE 2.1: Timeline of Major Events

History of Offshore Oil and Gas in the United States

1896	First offshore oil production in the United States—from wooden piers off Summerland, California
1938	First Gulf of Mexico discovery well in state waters; first free-standing production platform in the ocean—Creole field offshore Louisiana
1947	First well drilled from fixed platform offshore out-of-sight-of-land in Federal waters —Kermac 16 offshore Louisiana
1953	Submerged Lands Act & Outer Continental Shelf Lands Act
1954	First federal Outer Continental Shelf lease sale & Maiden voyage of the ***Mr. Charlie*** submersible drilling vessel, industry's first "day rate" contract
1962	First semi-submersible drilling vessel, ***Blue Water 1***, and first subsea well completion
1969	Santa Barbara blowout/oil spill (California)
1978	Shell Oil Company's Cognac production platform (first in 1,000 feet of water) & OCS Lands Act Amendments
1981	First Congressional Outer Continental Shelf leasing moratorium
1982	Creation of the Minerals Management Service (MMS)
1988	Piper Alpha disaster in the North Sea
1994	First production from Shell's Auger tension-leg platform in 2,860 feet of water
1995	Deepwater Royalty Relief Act
1996	First spar production facility in the Gulf of Mexico at the Neptune field
1999	Discovery of BP's Thunder Horse field in 6,000 feet of water; at 1 billion barrels of oil equivalent, the largest discovery in the Gulf of Mexico
2006	Successful test at the Jack 2 field, in 7,000 feet of water and more than 20,000 feet below the seafloor, establishing the viability of the deepwater Lower Tertiary play
2010	Arrival of ***Deepwater Horizon*** at Macondo well in January

salvage operations and introduced new diving techniques, seeding the diving business that became vital to offshore operations. Construction companies, such as Brown & Root and J. Ray McDermott, and numerous boat operators acquired war-surplus landing craft and converted them to drilling tenders, supply and crew boats, and construction and pipelaying vessels.[4]

In 1947, Kerr-McGee Oil Industries drilled the first productive well "out-of-sight-of-land," on a platform located in 18 feet of water, 10.5 miles off the Louisiana coast in the Ship Shoal area. The Kermac 16 platform used a war-surplus tender barge to house drilling mud and other supplies, plus the workers' quarters, thereby reducing the size and cost of a self-contained drilling and production platform—an important advantage in case of a dry hole. In 1948, Humble Oil (the Texas affiliate of Standard Oil of New Jersey, later renamed Exxon) introduced the concept of latticed steel templates, or "jackets," which provided greater structural integrity than platforms built with individual wood piles.[5]

Drilling Revived

To explore and develop their new leases obtained from the federal government (see Chapter 3 on the origin of federal leasing), oil firms tapped into the Gulf Coast oil-service sector, but they also promoted the formation of a distinct offshore industry by contracting out for specialized services in marine geophysical surveying, offshore engineering and construction, transportation (boats and helicopters), diving, and mobile drilling.[6]

Mobility in drilling was crucial to the offshore industry's long-term viability. The costs of drilling exploratory or "wildcat" wells from fixed platforms, most of which would not discover oil, were prohibitive. In 1954, the Offshore Drilling and Exploration Company capitalized on a novel approach to the quest for mobility, using its $2 million *Mr. Charlie* "submersible" drilling barge. *Mr. Charlie's* hull could rest submerged on the bottom in 30 feet of water for drilling, and then be refloated and moved to other locations, like a bee moving from flower to flower to extract nectar. Working for Shell Oil on the industry's first "day-rate" contract ($6,000 per day), *Mr. Charlie* drilled and developed two of the Gulf Coast's largest oil fields, in the East Bay just off the South Pass outlet of the Mississippi River. "That's a great rig you have there!" exclaimed Shell's New Orleans vice president after the first well. "I can see the day when you will need several more of them."[7]

Giant salt-dome fields discovered offshore Louisiana—Shell's East Bay and West Delta, the California Company's (Chevron) Bay Marchand and Main Pass, Magnolia's (Mobil) Eugene Island, and Humble Oil's Grand Isle, all under less than 30 feet of water—encouraged operators to move farther out in the Gulf. As Offshore Drilling and Exploration expanded its submersible fleet, other companies such as the Zapata Offshore Company (formed in 1954 by future U.S. President George H.W. Bush), experimented with "jack-up" rigs. These rigs jacked their platforms out of the water by extending a series of cylindrical or truss-type legs to the bottom, taking drilling into water depths exceeding 100 feet. By 1957, 23 mobile units were operating along the Gulf and 11 more were under construction.[8]

Drilling offshore was a relatively costly proposition in the 1950s (a Gulf oil executive described it as "a billion-dollar adventure in applied science"[9]), but it was astoundingly successful. In 1956, 26 percent of offshore exploratory wells struck oil and gas, compared to just 11 percent onshore. Of these wells, 1 in 20 discovered fields with more than 50 million barrels of reserves—more than five times the equivalent success rate of onshore wells. By 1957, there were 446 production platforms in federal and state waters. Wells offshore Louisiana and Texas were producing 200,000 barrels a day, feeding the vast refinery complexes that already existed along the Mississippi River between New Orleans and Baton Rouge, in the "Golden Triangle" of coastal East Texas (Beaumont–Port Arthur–Orange), and along the Houston Ship Channel. Offshore wells accounted for 3 percent of total U.S. production, but the percentage was rising.[10]

Pushing Beyond Limits

In the late 1950s, the frantic pace of Gulf offshore exploration slowed. Costs increased significantly in water depths beyond 60 feet (then the definition of "deepwater"). A few jack-up rigs capsized in rough seas. After Glasscock Drilling Company's *Mr. Gus* drilled a $1 million dry hole for Shell in 100 feet of water in 1956, the vessel sank in transit a year later during Hurricane Audrey. Beyond the damage to offshore infrastructure, Audrey destroyed the support center of Cameron, Louisiana, where an estimated 500 people tragically perished. Underwater pipelines, necessary for bringing oil to shore, were expensive and tricky to place in deeper water. A national recession in 1958, an oversupply of crude oil from growing imports, and declining finds in deeper waters tempered enthusiasm for new exploration. At the same time, Louisiana's legal challenge to the state-federal boundary offshore delayed federal lease sales for several years beginning in 1955. Some people in industry thought this did not matter: they believed offshore exploration had reached its limits.[11] Others were more optimistic.

Shell's Frontier Technology and the 1960s Boom

In August 1962, after seven years of research and development, Shell announced it had successfully tested a new kind of "floating drilling platform," redefining the marine geography of commercially exploitable hydrocarbons. The *Blue Water 1* was a converted submersible consisting of three large columns on each side that connected the drilling platform to a submerged hull. Giant mooring lines kept the vessel on position. Until then, companies had been experimenting with ship-shaped vessels called "drillships" to explore in water depths beyond 150 feet, but these could not withstand heavy wave action. Because the *Blue Water 1's* hull could be ballasted to rest safely below wave level, the vessel was remarkably stable. Classified as the first "semisubmersible," the *Blue Water 1* made its successful test in 300 feet of water, and it was equipped to operate in 600 feet. Complementing the new floating platform, Shell tested the first successful subsea wellhead completion using remote controls. As one Shell representative told reporters, "We're looking now at geology first, and then water depths."[12]

The achievement was akin to John Glenn's space orbit the same year. Even more astonishing was Shell's decision, in early 1963, to share its technology with other companies. At its three-week "School for Industry," seven companies and the U.S.

Geological Survey paid $100,000 each to learn about Shell's "deepwater" drilling program—thereby ensuring that suppliers and contractors were up to speed and that there would be at least some competition from other oil companies for deepwater leases (which otherwise would not be awarded at auction). The diffusion of Shell's technology led to the construction of semisubmersibles in Gulf Coast shipyards and enabled the industry to move into deeper water.[13]

Federal policies also helped accelerate offshore exploration and development. Oil import quotas went into effect in 1959 and were tightened in 1962. These measures protected the domestic market for higher-cost offshore oil. In 1960 and 1962, sensing pent-up demand after the hiatus in federal leasing during the late 1950s, the Bureau of Land Management auctioned large swaths of Gulf acreage. The response was overwhelming: in the historic March 1962 sale, 411 tracts, totaling nearly two million acres, were leased—more than in all previous sales combined. The sale opened up new areas off western Louisiana and Texas and extended the average depth of leases to 125 feet. Because so much land was put up for auction, the "cash bonus" price for the average lease was driven down, enabling more companies to participate in the Gulf.[14]

Drilling on that vast inventory of leases set off one of the greatest industrial booms the Gulf Coast had ever seen. By September 1963, nearly 90 drilling operations were in progress. Workers flocked from around the Gulf region to take high-paying jobs offshore or in the growing support centers of New Orleans, Morgan City, Lafayette, Beaumont, and Houston. Although exploratory success offshore Louisiana in the immediate years after 1962 could not match the extraordinary record of the late 1950s, the discovery rate for large fields of 100 million barrels or more was impressive: 155 for offshore Louisiana versus 3,773 for the United States as a whole. By 1968, 14 of the 62 large fields discovered in the United States were offshore Louisiana, and 11 of those 14 lay either wholly or partially within federally administered areas. Total offshore production from the Gulf of Mexico rose from 348,000 barrels per day in 1962 (4.8 percent of total U.S. production) to 915,000 barrels per day in 1968 (8.6 percent of the U.S. total), and most of this increase came from federal areas, especially acreage leased in 1962.[15]

The March 1962 sale had another consequential effect onshore: the $445 million in cash bonuses earned by the government alerted many officials to the importance of outer continental shelf leases as a source of federal revenue. The next year, the Bureau of Land Management opened an office in Los Angeles and offered the first oil and gas leases off the coasts of Oregon and Washington. Three years later, the Bureau offered the first leases in California's Santa Barbara Channel. The federal outer continental shelf leasing program thus took on national scope.[16]

Pushing Technological Frontiers—and Physical Limits

Meanwhile, technological innovations revitalized the Gulf offshore industry and generated interest in other ocean basins. New well designs and well-logging techniques resolved deep subsurface drilling problems and reduced well costs. Drilling experiments in extreme water depths, such as Project "Mohole" funded by the National Science Foundation, set the stage for dramatic advances in future oil exploration. In 1962, Shell equipped the drillship

Eureka with the first automatic dynamic positioning system and embarked on a core-drilling program in 600 to 4,000 feet of water in the Gulf. *Eureka's* cores confirmed for the first time that oil had been generated in the sands that the Mississippi River had deposited over eons in the broad alluvial valley extending beyond the continental shelf into the deep Gulf. Then, beginning in 1968, the Joint Oceanographic Institutions for Deep Earth Sampling project launched the famous voyage of the *Glomar Challenger* drillship, whose core samples gave further evidence of oil generation in extreme ocean depths.[17]

Although exploratory drilling capabilities raced ahead of commercial producing depths—a recurring theme in the history of offshore oil—the industry nevertheless made great advances during the 1960s in all phases of offshore exploration and production. Among other innovations, digital sound recording and processing greatly enhanced the quality of seismic data and fortified geoscientists' ability to interpret subsurface geology. Improvements in soil-boring techniques led to greater understanding of seabed soil mechanics and foundations. Higher-strength steel yielded stronger jacket construction and the use of larger equipment to install larger rigs. Digital computers made possible the three-dimensional modeling of platform jacket designs. Together, these developments moved production operations into 350-foot water depths by 1969.[18]

Toward the end of the decade, however, the cost of bringing in productive leases began to outrun the price of oil, which had remained at $2 to $3 per barrel in the United States since the end of World War II. Many of the large, easy-to-identify structures in the Gulf had been picked over and drilled. Some companies were fooled by geology into making costly mistakes. At a federal offshore Texas sale in 1968, for example, a Humble-Texaco partnership staked $350 million on leases that yielded nothing. Offshore Texas, it turned out, proved to be largely gas-prone, but regulated prices made natural gas less profitable than oil.[19]

Hurricanes wreaked havoc with production. In 1961, Hurricane Carla triggered soil movements in the Mississippi Delta that destroyed a large number of pipelines. Hilda (1964) and Betsy (1965) knocked out 20 platforms and damaged 10 others, as 70-foot wave heights, far exceeding earlier estimates, overwhelmed platform decks. Camille (1969), a Category 5 hurricane, passed directly over 300 platforms, most of which survived the waves, but the storm caused violent mud slides that wiped out three large platforms in 300 feet of water.[20]

On top of the business failures and natural disasters, the sheer technological challenges and the necessity to complete work as quickly as possible compromised safety. Project profitability depended on how soon production could be brought online. Drilling vessels were contracted on day-rates, increasing time pressures. Production processes were highly interdependent: delay in one place could cause delays elsewhere. So there were relentless demands to drill the wells, install the platforms, and get the oil and gas flowing. "When I first started working, they didn't care whether they killed you or not!" remembered one offshore veteran. "In other words, 'we are going to get it done, regardless.' There was no suing like people are suing now. Back then, if you got hurt, they just pushed you to the side and put somebody else in."[21]

Accident rates for mobile drilling vessels remained unacceptably high, especially for jack-ups. Blowouts, helicopter crashes, diving accidents, and routine injuries on platforms were all too common. Facilities engineering on production platforms was a novel concept. Platforms often had equipment squeezed or slapped together on the deck with little concern or foresight for worker safety. Crew quarters, for example, could sometimes be found dangerously close to a compressor building.[22]

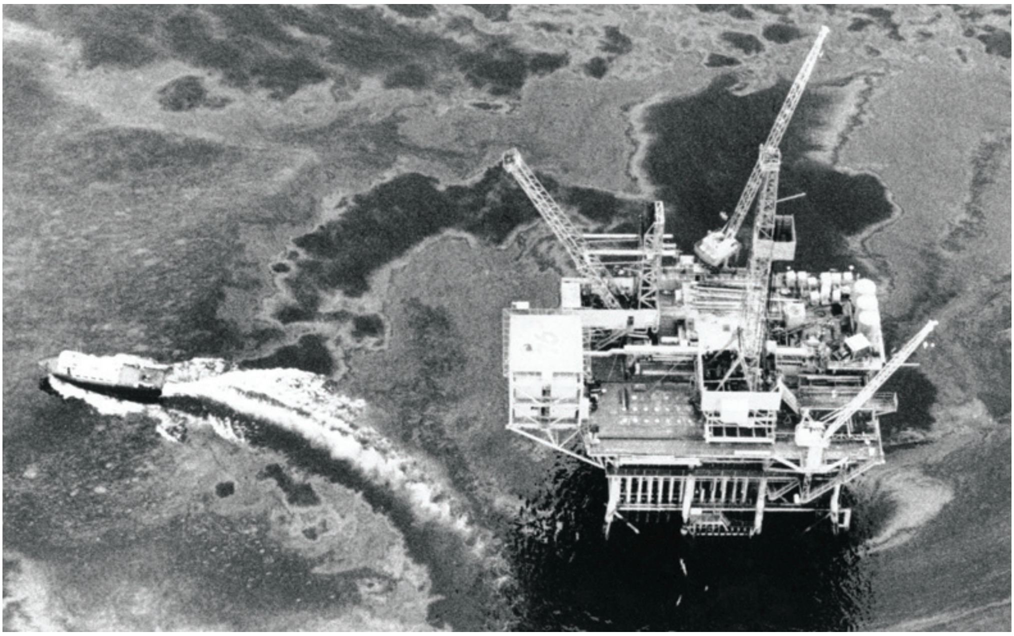
Federal oversight followed the philosophy of "minimum regulation, maximum cooperation."[23] Between 1958 and 1960, the U.S. Geological Survey Conservation Division, the regulatory agency then overseeing offshore drilling, issued outer continental shelf Orders 2 through 5, requiring procedures for drilling, plugging, and abandoning wells; determining well productivity; and the installation of subsurface safety devices, or "storm chokes." But the Offshore Operators Committee (representing leaseholders) persuaded regulators to dilute Order 5 to permit waivers on requirements for storm chokes. Significantly, the orders neither specified design criteria or detailed technical standards, nor did they impose any test requirements. Companies had to have certain equipment, but they did not have to test it to see if it worked.[24] In general, as a 1973 National Science Foundation study concluded, "the closeness of government and industry and the commonality of their objectives have worked against development of a system of strict accountability."[25]

Lax enforcement contributed to the lack of accountability. The U.S. Geological Survey freely granted waivers from complying with orders and did not inspect installations regularly. Federal and state regulatory bodies were underfunded and understaffed. In 1969, the Gulf region's lease management office had only 12 people overseeing more than 1,500 platforms. Even those trained inspectors and supervisors often lacked experience in the oil business and a grasp of its changing technological capabilities. "Each oil well has its own personality, is completely different than the next, and has its own problems," observed one consultant in 1970. "It takes good experienced personnel to understand the situation and to cope with it." Too often on drilling structures, he complained, one found inexperienced supervisors; employees who overlooked rules and regulations (the purpose of which they did not understand); and, perhaps most troubling, even orders from bosses to cut corners—all of which created conditions for an "explosive situation."[26]

Explosive Situations

On January 28, 1969, a blowout on Union Oil Company Platform A-21 in the Santa Barbara Channel released an 800-square-mile slick of oil that blackened an estimated 30 miles of California beaches and lethally soaked sea birds in the gooey mess. Although the well's blowout preventer worked, an inadequate well design allowed the hydrocarbons to escape through near-surface ruptures beneath the seafloor. Union Oil had received a waiver from the U.S. Geological Survey to set casing at a shallower depth than required by Order 2, highlighting the lack of accountability that had come to characterize offshore operations.[27] The 11-day blowout spilled an estimated 80,000 to 100,000 barrels of oil[28]—

SANTA BARBARA OIL SPILL



Oil from a ruptured well surrounds a platform six miles off the coast of Santa Barbara. The 1969 spill, an estimated 100,000 barrels, was the largest in U.S. waters prior to 2010. Some 30 miles of shoreline were fouled, and thousands of birds died along with fish, dolphins, and sea lions. The incident drew public outcry and triggered environmental-protection legislation. Today, Platform A-21 is still operating.

Associated Press

the largest offshore drilling accident in American waters until the Macondo blowout. It generated intense opposition to offshore oil in California, but the fallout also reverberated nationally, setting the stage for the passage of the National Environmental Policy Act (NEPA), a symbol of the growing strength of the national environmental movement, as well as a host of other increasingly demanding environmental protection laws throughout the 1970s (See Chapter 3).[29]

Offshore operators suddenly faced a potentially hostile political and regulatory climate. Ten days after the accident, Secretary of the Interior Walter Hickel, with the support of President Richard Nixon, issued a moratorium on all drilling and production in California waters. In April, Secretary Hickel completed a preliminary assessment of the leases affected by the moratorium and allowed 5 of the 72 lessees to resume drilling or production. In August, the Interior Department issued completely revised outer continental shelf Orders 1–7—the first update since the orders were established—with more specific requirements about company plans and equipment for prevention of pollution and blowouts. It also issued new Orders 8 and 9 on the installation and operations of platforms and pipelines. These were the first rules in which the department claimed authority to prohibit leasing in areas of the continental shelf where environmental risks were too high.[30]

The industry protested the new outer continental shelf regulations, but calamities in the Gulf undermined its case. In February 1970, Chevron's Platform C in Main Pass Block 41 blew out and caught fire. The spill forced a postponement of a federal lease sale, damaged wildlife, and drew a $31.5 million suit against the company by Louisiana oyster fishermen and a $70 million suit from shrimp fishermen. Chevron was also fined $1 million for failing to maintain storm chokes and other required safety devices—the first prosecution under the 1953 Outer Continental Shelf Lands Act. The Justice Department also obtained judgments against other major oil and gas companies for similar violations. Then, in December, Shell suffered a major blowout on its Platform B in the Bay Marchand area, killing four men and seriously burning and injuring 37 others. Investigators attributed the accident to human error resulting from several simultaneous operations being performed without clear directions about responsibility. It took 136 days to bring 11 wild wells under control, at a cost of $30 million. The failure or leaking of subsurface-controlled storm chokes contributed to the size of the conflagration.[31]

In the wake of these disasters, the government further strengthened its regulatory program. The Interior Department again revised and expanded outer continental shelf orders to mandate new requirements: surface-controlled storm chokes; the testing of safety devices prior to and in use; more careful control of drilling and casing operations; prior approval of plans and equipment for exploration and development drilling; and updated practices and procedures for installing and operating platforms. To enforce the new regulations, the U.S. Geological Survey tripled its force of inspectors and engineers, ceased using industry-furnished transportation for inspections, and introduced a more systematic inspection program based on newly developed criteria.[32]

In response, the Offshore Operators Committee and the industry's Offshore Safety and Anti-Pollution Equipment Committee worked closely with the U.S. Geological Survey both in advising changes in the outer continental shelf orders and in promptly drafting a new set of American Petroleum Institute (API) "recommended practice" guidance documents for the selection, installation, and testing of safety devices, as well as for platform design. The major offshore operators revamped personnel training for offshore operations, and they formed an organization called Clean Gulf Associates to upgrade oil-spill handling capabilities.[33] Certifying agencies issued new standards and guidelines for mobile drilling.[34] In addition, the industry's annual Offshore Technology Conference, first held in 1969, became an important forum for publishing and sharing technical information that led to safer designs and operations.[35]

The industry's safety record in the Gulf improved significantly after the new regulations and practices were introduced: the reported incidence and rate of fatalities and injuries decreased, as did the rate of fires and explosions.[36] During the 1970s and 1980s, the frequency of blowouts did not decline significantly, but there was a sharp drop in the number of catastrophic blowouts, and fewer casualties and fatalities were associated with them.[37]

Design and equipment problems were steadily being solved. But reducing accidents caused by human error, poor safety management, or simultaneous operations continued to be a vexing challenge.

Constrained Expansion

As new regulations brought more caution to offshore oil development, countervailing forces emerged to speed it up. Domestic oil supply could not keep up with demand. In the postwar period, Americans' consumption of petroleum—largely for operating automobiles—climbed dramatically, rising steadily from 243 gallons of motor gasoline per capita in 1950 to 463 gallons per capita in 1979.[38]

U.S. oil production peaked, however, in 1970. Along with the OPEC oil embargo of 1973 and consequent skyrocketing price of oil products, this event spurred the quest to develop new offshore reserves. With crude oil prices tripling to $10 per barrel, oil companies could justify more expensive offshore drilling and development. Under the mandate of "Project Independence," the Nixon Administration announced a dramatic increase in the pace of leasing in the Gulf and a resumption of sales off the Atlantic, Pacific, and Alaskan coasts. At the March 1974 federal lease sale of offshore Louisiana acreage, the industry spent a record $2.17 billion in cash bonuses for leases covering 522,000 acres, including a few tracts ranging beyond 1,000-foot depths.[39]

The First Deepwater Play

In June 1975, Shell made a monumental discovery on one of those new leases. Shell geophysicists had employed an innovative seismic technique called "bright spot" to lead drillers to an attractive prospect, code-named Cognac, in 1,000 feet of water in the Mississippi Canyon, not far from the mouth of the great river. The drilling uncovered an estimated 100-million-barrel reserve.[40] Cognac pioneered other discoveries in what would come to be known as the "Flex Trend," an area in the Gulf that reaches just beyond the edge of the continental shelf, where there is a flex in the seafloor. The Flex Trend would be the world's first true oil play in 1,000-foot water depths, the modern definition of "deepwater."[41]

When Shell purchased its leases, it did not yet have a design concept for deepwater production. Barges were not big enough to launch a 1,025-foot steel jacket in one piece. Therefore, adapting Exxon's precedent—the company installed its Hondo jacket in 850 feet of water in the Santa Barbara channel in 1976—Shell chose to build the Cognac structure in three pieces and assemble them vertically in place. The complex, nerve-wracking installation inflated total development costs to nearly $800 million. But Cognac was both a technical and commercial success. It won the American Society of Civil Engineers 1980 award for "Outstanding Civil Engineering Achievement," the first ever received by an oil company. Production commenced in 1979, just as the supply shock caused by the Iranian Revolution drove the price of oil to nearly $40 per barrel.[42]

Along with Hondo and major developments in the North Sea pioneered by Phillips, Conoco, and BP, Cognac paved the way for truly enormous offshore engineering-construction projects. In 1976, Brown & Root and J. Ray McDermott opened giant new construction yards at Harbor Island, near Corpus Christi Bay, to accommodate the assembly and load-out of deepwater structures. In these yards, they built jackets lighter and cheaper than Cognac and launched them in single pieces. In the late 1970s, Brown & Root built a 700-foot structure for Chevron's Garden Banks field, and a 650-foot jacket for Atlantic Richfield. In 1980–1981, McDermott built two platforms for Union Oil in the 1,000-foot waters of the East Breaks area, 100 miles south of Galveston. During 1979–1983, Brown & Root built and installed a novel "guyed tower" for Exxon in 1,000 feet of water just southwest of Cognac.[43]

Even as rising oil prices and declining onshore production in the late 1970s spurred them on, Gulf oil operators encountered economic and geological constraints. Bonus bids soared beyond the estimated value of the oil that might be discovered and produced: the September 1980 sale in New Orleans, for example, brought in $2.8 billion in cash bonuses, shattering all previous records. During the 1970s, the bonus paid per barrel of oil equivalent discovered by the largest producing companies increased four- to five-fold, undermining the economics of deepwater.[44] Furthermore, initial production rates from some of the early producing wells in the Flex Trend proved disappointing. Many industry exploration managers came to believe that after 25 years of development, only lean prospects remained in the Gulf. The best hope for increasing national reserves, they concluded, was from other parts of the U.S. outer continental shelf.[45]

Beyond the Shelf

Rising lease bonuses still did not deter major companies (such as Chevron, Exxon, Mobil, and Amoco), along with some of the larger independents (such as Pennzoil, Union, and Tenneco), from drilling and developing fields in the deepwater Flex Trend. But discoveries could not offset overall production declines in the Gulf. Oil production on the shelf had peaked at just above 1 million barrels per day in 1972; by 1978, it had fallen below 800,000 barrels per day. Because discoveries in the Flex Trend play were relatively small, with fairly low flow rates, most Gulf oil and gas still came from shallow water, despite declining overall production there. In 1970, the average production-weighted depth of oil extracted from the Gulf was just 100 feet, and by 1980 it was still less than 200 feet.[46] Many managers had concluded that there would never be economic developments more than 60 miles from shore. Other experts became convinced that significant oil-bearing sands would never be found beyond the continental shelf. "But what conventional wisdom really tells you," as one Shell geophysicist explained, "is that you just don't know what you don't know."[47]

At just that time, some scientists from industry and academia had begun to piece together a regional picture of the geology deep underneath the Gulf by combining information from cores with a regional seismic survey shot out into deepwater. This picture showed that massive salt pillars, or diapirs, had squeezed up from the mother layer of salt deposited beginning 165 million years ago, when the Gulf of Mexico was slowly forming. As the diapirs pinched up, sandstone overlaying the salt slowly subsided, forming cup-shaped "mini-basins" featuring different kinds of configurations for trapping oil. These sandstone formations were named "turbidites" (they had been deposited when ancient underwater rivers, called turbidity currents, channeled huge volumes of sediment onto the continental margin). The structural anomalies in these mini-basins looked similar to productive features on the shelf, but the spotty seismic coverage allowed for only speculative knowledge of their potential, at best. Shell, always the leader in Gulf frontier exploration, had drilled a number of wells in similar rocks along the margin of the continental shelf. Turbidites in deepwater were potentially much larger, less faulted, and might have prolific flow rates. At least in theory, they would require fewer wells, making them more attractive as economically exploitable reservoirs of oil.[48]

During 1978–1980, hoping to test its theories about the regional geology, Shell nominated deepwater tracts for auction. But no other companies seconded its nominations, so the government never selected the tracts for sales.[49] Then, in 1982, the Interior Department announced a new system of area-wide offshore leasing. This policy put into play entire planning areas (e.g., the central Gulf of Mexico) up to 50 million acres, rather than rationing tracts through a tedious nomination and selection process. Companies could bid on any tract they wanted in a lease sale for a given planning area, thus giving them access to far more extensive offshore acreage at significantly less cost.[50]

Strong political opposition to area-wide leasing by some coastal states and environmental organizations stymied its effective use in other parts of the nation (see Chapter 3), but not in the Gulf, where oil companies had long operated. Established infrastructure and abundant geological information there could be put to more flexible use under a more open system. Oil companies responded to area-wide leasing by bidding aggressively for attractive blocks on the continental shelf, while making a number of speculative bids on acreage ranging into 3,000-foot depths beyond the edge of the shelf. The May 25, 1983 sale harvested a record $3.47 billion in high bonus bids. All told, in seven lease sales held from 1983 to 1985, the Interior Department, through the newly formed Minerals Management Service (see Chapter 3), leased 2,653 tracts, more than had been leased in all the federal sales since 1962 combined. About 600 of these tracts lay in deepwater beyond 1,000 feet.[51]

Shell acquired the lion's share of deepwater tracts in the March 1983 sale and immediately started drilling. In 1982, it had leased Sonat Offshore Drilling's *Discoverer Seven Seas*, one of the few vessels rated for 6,000-foot depths. Shell then spent more than $40 million to extend the vessel's depth capability with a larger marine riser, enhanced dynamic positioning, and a new remote-operated vehicle to enable sophisticated work where human divers could not venture. In October 1983, the *Seven Seas* made a major discovery at Shell's Bullwinkle prospect, establishing the deepwater "Mini-Basin Play," which targeted the turbidite sandstones in the basins flanking the salt structures.[52]

In the next central Gulf area-wide sale, in April 1984, many different operators jumped in to compete for deepwater tracts. This prompted Shell to move quickly in deploying the *Shell America*, a $45 million custom-designed, state-of-the-art seismic vessel that provided company geophysicists with high-quality, proprietary seismic data. Armed with these data and other intelligence gained from drilling its 1983 leases, Shell dominated the May 1985 sale, winning 86 of 108 tracts on which it bid, in water depths ranging to 6,000 feet. For

Shell, pushing deeper was an imperative for its operations in the United States, as onshore reserves continued to decline. “Exploration has been called a poker game,” explained one Shell official. “But there’s more to it than that. In this game, we don’t have chips or coins or dollar bills that can change hands over and over again. We’re dealing with a declining resource base, and every barrel we find is never going to be found again.”[53]

The Era of Uncertainty

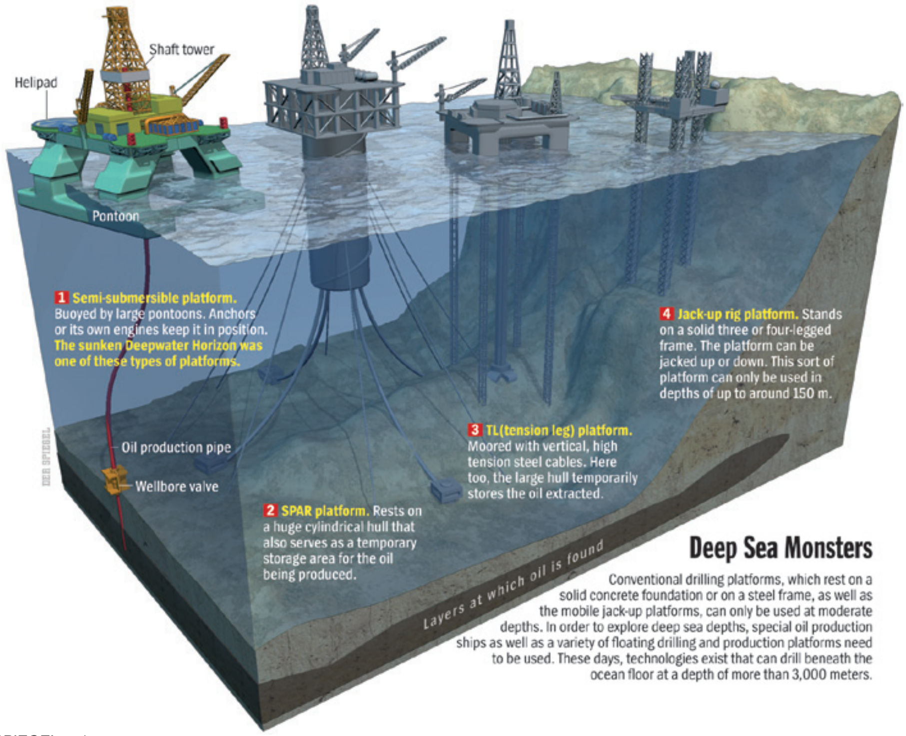
The long cycles of oil exploration and development do not always align well with the shorter cycles of the economy. Just as Shell bet heavily on deepwater, the severe recession in 1981 further depressed falling oil demand. For the first time in 34 years, U.S. oil consumption hit a plateau and began declining.[54] The now “forgotten victory” of energy conservation and efficiency measures passed in the mid-1970s, in response to historically high oil prices, reversed the long trend of an increasingly petroleum-intense U.S. economy. During 1985–1986, oil prices collapsed to $10 per barrel, as international producers saturated the global market with crude.[55]

Expensive Gulf development projects were canceled or shelved. Construction of mobile drilling vessels and other kinds of offshore-servicing equipment fell sharply. Unemployed oilfield workers transitioned into new trades, or migrated from southern Louisiana in search of better opportunities. This human and capital flight marked the beginning of what one scholar called “the inevitable disassembly of the offshore system and its onshore support network for the Gulf of Mexico.”[56]

The offshore projects that went forward faced intimidating challenges. Shell drilled some dry holes costing more than $10 million apiece. Development stretched the limits of technological and financial resources. To produce oil from the Bullwinkle field, the company installed in 1988 a $500 million fixed platform, 162 stories high—taller than Chicago’s Sears Tower (now the Willis Tower), the tallest building in the world at the time. The Bullwinkle platform was the largest and last conventional jacket of its kind. The scale and costs of constructing anything bigger were simply prohibitive.[57]

Moving deeper would require alternative production methods: subsea wells, tension-leg platforms, or floating systems. Operators had put subsea wells to use in the North Sea, but they were still extremely expensive. The tension-leg platform was an innovative concept consisting of a production facility situated on a floating hull held in place by long tendons that kept the hull from bobbing like a cork but allowed some degree of side-to-side motion. In 1984, Conoco installed the first full-scale design of this type in the North Sea, in 485 feet of water, and in 1989 the company placed its Jolliet mini-tension-leg platform in 1,760 feet of water in the Gulf.[58] But tension-leg platforms would have to be scaled up for major projects in deepwater. In 1987–1988, Placid Oil developed a field in 1,500 feet of water with a floating production facility converted from a semisubmersible drilling vessel. But Placid soon abandoned the development, sold the semisubmersible, and sought bankruptcy protection.[59]

Deep Sea Monsters



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The deepwater costs were matched by the safety and environmental risks. In 1985, an Office of Technology Assessment study of Arctic and deepwater oil drilling highlighted the "special safety risks" of "harsh environments and remote locations." It identified "a need for new approaches to preventing work-related injuries and fatalities in coping with new hazards in the hostile Arctic and deepwater frontiers." It also presciently warned of the glaring deficiencies in safety oversight offshore, observing that "there is no regulatory requirement for the submission of integrated safety plans which address technical, managerial, and other aspects of offshore safety operations."[60]

Setbacks in the Arctic

As the study indicated, deepwater was not the only frontier that captured the industry's interest. In the 1980s, companies also had their sights set on the Arctic region, then thought to have the highest resource potential in the United States. Since the 1960s, major firms had produced oil from Alaska's Kenai Peninsula and Cook Inlet. In 1977, the massive onshore Prudhoe Bay field on the North Slope started pumping oil through the Trans-Alaska Pipeline. Many explorers expected to find the next great oil frontier to the north of Prudhoe Bay, in the Bering, Beaufort, and Chukchi Seas. Although the industry lost a contentious struggle to gain access to the Bering Sea's Bristol Bay, home to the world's largest commercial salmon fishery, they did win the right to lease and drill in the Beaufort and Chukchi Seas.[61]

Everywhere operators drilled offshore Alaska, however, they came up empty. Either they found no source rocks or the deposits they did find were not large enough at that time to turn a profit in the Arctic's forbidding environment. After a costly dry hole at a prospect called Mukluk in the Beaufort Sea and some futile efforts to explore in the Chukchi Sea, the industry temporarily lost its craving for the Arctic. The public-relations fallout from the *Exxon Valdez* oil spill in 1989, which resulted in congressional and presidential moratoriums on leasing in Bristol Bay, contributed to the industry's suspended interest in offshore Alaska.[62]

Renewed Focus on the Gulf of Mexico

The mid-1980s collapse in oil prices also ruined many companies' appetite for further leasing in the deepwater Gulf of Mexico. But Shell and others chose to take a longer-term view—a decision reinforced by the failures in Alaska. Additional reinforcement came in 1987, when the Minerals Management Service reduced the minimum bid for deepwater tracts from $900,000 to $150,000—enabling companies to lock up entire basins for 10 years for only a couple million dollars.[63] During the next five years, despite flat oil and gas prices, the industry acquired 1,500 tracts in deepwater.[64]

Shell's December 1989 announcement of a major discovery at a prospect called Auger, located in the Garden Banks area 136 miles off the Louisiana coast, spurred further interest. Two years earlier, Global Marine's new, giant semisubmersible, the *Zane Barnes*, struck oil for Shell after drilling through 2,860 feet of water and another 16,500 feet beneath the seafloor. Shell kept the discovery quiet as it delineated the extent of the field, which turned out to contain an estimated 220 million barrels of oil equivalent, the company's third-largest offshore discovery in the Gulf. Underpinning Shell's decision to go forward with Auger was the discovery of relatively high flow rates from the turbidite sands at Bullwinkle, where engineers found they could open the wells to 3,500 barrels per day (three times the rate considered good for a well on shallower parts of the Gulf continental shelf). If Auger had similar flow rates, the field could be profitably developed, even in water more than twice as deep as Bullwinkle's. Few people knew that Auger was only one of a number of Shell deepwater discoveries.[65]

As the company formulated an ambitious strategy to launch a series of major platforms, a gloomy economic outlook tempered Shell's euphoria over the Auger discovery and production breakthrough at Bullwinkle. The projected cost of developing Auger exceeded $1 billion. In appraising the next prospect, code-named Mars, Shell's exploration managers looked for ways to save money and offload some of the financial risk; accordingly, in 1988, they brought in British Petroleum (BP) as a partner with a 28.5 percent interest in the project.[66]

At the time, Mars seemed like a risky endeavor, with low probability for a major discovery. Furthermore, BP posed little threat. The company had been kicked out of Iran and Nigeria in 1979 and was struggling with a bloated management structure, poorly performing global assets, and uninspired leadership. Shell viewed BP as merely a banker.[67]

All that changed in 1989, when Sonat's *Discoverer Seven Seas* drilled into Mars. The field, located due south of the mouth of the Mississippi, lay in nearly 3,000 feet of water. The discovery well encountered multiple oil- and gas-bearing layers stacked on top of each other over several hundred meters. Mars was more than twice the size of Auger—the largest field discovered in the Gulf in 25 years. For Shell, Mars promised a big payoff for large bets on deepwater leases. For the industry, Mars confirmed the Mini-Basin trend in the Gulf as a bona fide play. For BP, Mars allowed the company's managers, engineers, and scientists to go to school on Shell's deepwater technology. Perhaps just as importantly, according to BP's chief in the United States, "Mars saved BP from bankruptcy."[68]

During the next several years, major oil companies—and even more significantly, contractors in the offshore service industry—propelled the evolution of technology in innovative new directions. The 1970s revolution in digital, three-dimensional (3-D) seismic imaging, pioneered by Geophysical Services Inc. (GSI), and the 1980s move to computer workstations, which enabled faster processing of the data generated in such surveys, combined to enhance dramatically the industry's accuracy in locating wells for field development—a critical factor when drilling a single well in deepwater could cost as much as $50 million. Beyond development drilling, 3-D seismic imaging boosted the success of wildcat discovery wells from less than 30 percent to 60 or 70 percent. As the major companies began to divest from older producing properties in favor of new deepwater prospects, smaller firms purchased older properties and redeveloped them with significant reserve additions using 3-D seismic imaging. In all, 3-D seismic imaging effectively tripled or even quadrupled the estimated amount of oil and gas reserves in the Gulf of Mexico.[69]

Drilling and subsea engineering advanced in similar fashion. Drilling contractors developed a new generation of vessels that took drilling from 5,000 to 10,000 feet of water, and from 20,000 to 30,000 feet of sub-seafloor depth. New directional drilling techniques, made possible by "downhole steerable motors," allowed engineers to maneuver a well from vertical to horizontal to achieve greater accuracy and more fully exploit reservoirs. Drillers also found ways to obtain information from deep inside wells, using "measurements-while-drilling" tools and sensors that provided position, temperature, pressure, and porosity data while the borehole was being drilled. Improvements in marine risers using lightweight composite materials and tensioners, along with new methods for preventing oil from cooling and clogging in deepwater pipelines, enabled the industry to make long tiebacks between subsea wells and production facilities. To support subsea installation and operations, the industry turned to sophisticated remote-operated vehicles mounted with TV cameras and umbilical tethers containing fiber-optic wire for the transmission of vivid images.[70]

Even as the major operators pushed into deepwater, they outsourced more of the research and development (R&D) of new technologies. The bust of the 1980s had driven the exploration and production companies to decrease internal R&D and adopt policies of buying expertise as needed, rather than cultivating it from within. R&D investments in oil exploration and production by the major companies declined from nearly $1.3 billion in 1982 to $600 million by 1996. According to a National Petroleum Council study, "This 'buy versus build' strategy resulted in a significant reduction in the number of skilled people within operating companies who understood technology development and deployment."[71] Service companies (Schlumberger, Halliburton, Baker Hughes, and Oceaneering) became the major source of technology development. An illustration of this trend was the Texaco-initiated "Deep Star" consortium, established in 1992, through which offshore operators funded contractor-generated R&D.[72]

Rapid technological advances in the early 1990s did not immediately translate into more economically feasible practices. Cost overruns, delays, and strained relationships with contractors plagued the fabrication and installation of Shell's giant tension-leg platform for Auger, the industry's bellwether deepwater project. Further, Shell discovered that crude oil from the Auger field was sour (containing sulfur, which had to be separated out at the refinery) and thus had to be discounted. The company's only salvation on the project depended on Auger's wells flowing at a higher rate than Bullwinkle's.[73]

Auger Pays Off

Fortunately for Shell and the offshore industry, the wells did not disappoint. In the spring of 1994, Shell began to bring in wells at Auger that flowed at more than 10,000 barrels per day. Even with oil prices at $20 per barrel or less, deepwater now promised handsome profits. The Auger wells confirmed the reservoir model for turbidites in deepwater and even exceeded Shell's most optimistic estimates. Engineers designed Auger to handle 42,000 barrels of oil (and 100 million cubic feet of gas) per day from 24 wells, but by July the first three wells were already producing 30,000 barrels per day. "Debottlenecking" efforts eventually raised Auger's capacity to 105,000 barrels of oil and 420 million cubic feet of gas per day by the late 1990s.[74]

Auger's prodigious output also made subsea completions (with the wellhead located on the ocean floor rather than on a surface production platform) economic in the Gulf, as they had been in the North Sea. With tension-leg platforms like Auger, subsea completions became important as a component of an early production system or as a remote subsea development. Large fields or clusters of smaller fields, which otherwise would not justify the expense of multiple or larger platforms, could thus be profitably developed.[75]

Auger's many blessings came at a cost to Shell and the environment. Expanding production at Auger was extremely challenging. At the start of production in April 1994, Shell continuously flared or vented between one and six million cubic feet of natural gas per day, without the required federal permission. The flaring and venting continued for more than four years until the Minerals Management Service announced it had discovered this violation as well as Shell's failure to record and report the releases. In a 2003 civil settlement, Shell agreed to pay $49 million, an amount equivalent to the value of about two weeks of production from Auger. If the company was chastened after having to admit to these serious violations, Shell management also must have been tempted to look at this charge as an incidental cost of doing business in the deepwater Gulf. [76]

AUGER TENSION-LEG PLATFORM

Like a giant alien creature, a scale rendering of a tension-leg drilling platform is superimposed over New Orleans. Built by Shell to tap its Auger deepwater field some 200 miles southwest of the city, the huge platform uses steel mooring cables to stabilize its 3,000-foot legs and can drill 20,000 feet below the seafloor. The platform augured well for Shell in the late 1990s, delivering 100,000 barrels of oil a day.

Courtesy of Shell

Deepwater Treasures

The productivity of the Auger wells made the Gulf of Mexico the hottest oil play in the world. And it was mostly about oil. Deepwater proved to be largely oil-prone. The source rocks for most of the deepwater region are an Upper Jurassic kerogen that generates natural gas only when subjected to very high temperatures. But subterranean thermal gradients and source-rock temperatures in the deep Gulf are quite modest, despite the enormous pressures exerted several miles below the seabed. The massive amounts of salt (see below) has acted like a heat sink, keeping hydrocarbons from getting too hot and thus cooking up large amounts of natural gas.[77]

Despite downward pressure on oil prices in the late 1990s, the promise of prolific production from deepwater was too much to resist. Exploration and production firms with deepwater leases consolidated their positions. Companies that had sat on the sidelines during the 1980s stampeded into unclaimed areas. Newly developing or commercialized exploration and production technologies found vibrant new markets. Contractors all along the Gulf Coast and, indeed, around the world, geared up for a surge of activity. Port Fourchon, Louisiana's southernmost port on the tip of Lafourche Parish, came to life as the jumping-off point for supplying and servicing deepwater operations in the Gulf.[78]

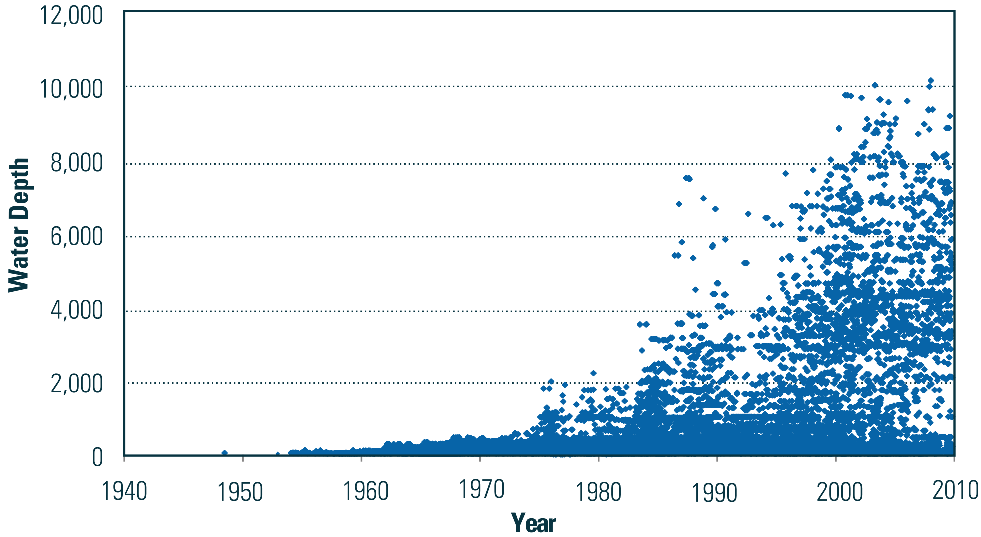
The next landmark on the horizon for deepwater drilling was Mars. In July 1996, Shell began producing from its Mars platform, six months before NASA launched its Pathfinder probe to the planet Mars. At a total cost of $1 billion, Shell's Mars was more than three times as expensive as the Mars Pathfinder, and its remote technologies and engineering systems were arguably more sophisticated. The investment of money and technology paid dividends: the Mars platform tapped into the largest field discovered in the United States since Alaska's Prudhoe Bay. Creating a system to produce the field also established a new paradigm for large projects and revealed how exploration and production strategy was being reshaped in the Gulf.[79]

To reduce costs and avoid the headaches experienced at Auger, Shell introduced a different contracting model at Mars based on "alliances," including the sharing of technology and patents. Shell ended up giving away more than BP, which had little deepwater experience. But the costs and risks were too large to go it alone, as Shell had usually preferred to do. The partners carried the alliance concept over to their relationship with contractors, who built the tension-leg platform hull, fabricated the topsides, and integrated the two. The project team brought in contractors early on to collaborate on developments and share risks and rewards. The key advantage of this approach was that it reduced the so-called "cycle time" of design, bidding, and contracting by an estimated six to nine months.[80] On a platform such as Mars, where the first well came in at 15,000 barrels per day, the time-value of money made at the beginning rather than at the end of the platform's life was quite significant. Shell's contracting model at Mars, replicated on its subsequent tension-leg platforms, established the growing importance of alliance networks for global oil and gas developments in technologically complex frontier regions characterized by high costs and risks.[81]

In the late 1990s, having control of one-third of all Gulf leases in depths greater than 1,500 feet, Shell rolled out one tension-leg platform after the other.[82] In 1997, a Mars "clone" called Ram-Powell, developed in a joint venture with Exxon and Amoco, went on-stream in 3,200 feet of water 80 miles southeast of Mobile, Alabama. In March 1999, Shell and its minority partners, BP, Conoco, and Exxon, started up the massive Ursa, on a lease two blocks to the east of Mars. Nearly double the weight of Mars, Ursa was designed to accommodate astounding initial well-production rates of 30,000 barrels per day; in September 1999, a well at Ursa broke all records with a production rate of nearly 50,000 barrels of oil equivalent per day. Finally, in 2001, Shell brought in production from the Brutus platform, which tapped into a 200-million-barrel field in 3,000 feet of water in the Green Canyon.[83]

Shell's new technologies solidified the company's position as the leader in the Gulf. Its tension-leg platforms, as well as major fixed platforms such as Bullwinkle and West Delta 143, not only produced hydrocarbons from the fields beneath them, but also served as hubs used to take and process oil and gas production from satellite subsea wells, thus extending the life of those platforms once their own production declined. Deepwater output from Shell's platforms and subsea wells, and eventually from other companies in the vicinity, fed into network of Shell-owned or operated crude-oil trunk pipelines, gathering systems, and natural-gas pipelines. Shell also made special arrangements to

FIGURE 2.4: Wells Drilled in the Gulf of Mexico by Water Depth, 1940-2010



Source: Commission staff, adapted from Bureau of Ocean Energy Management, Regulation and Enforcement

transport crude oil production from its growing deepwater properties into the Clovelly storage facilities owned by the Louisiana Offshore Oil Port in South Louisiana. By 2001, Shell operated 11 of the 16 key oil trunk pipelines servicing deepwater.[84]

Shell's lead in the deepwater Gulf was substantial but not unassailable. During the latter half of the 1990s, many companies gained ground, including a rising percentage of small and midsized independents. But the only company that chased down and eventually overtook Shell was BP.

Deeper Still

In the 1990s, technological breakthroughs in imaging and drilling through massive salt sheets opened a new "subsalt" play, first on the shelf and then ranging into deepwater. Discoveries in at least four different "fold belts" across the Gulf of Mexico extended the search for oil into "ultra-deepwater" and led to another wave of innovation in floating production. In 1990, most oil and gas from the Gulf had still come from shallow water; average production-weighted depth had barely reached 250 feet. By 1998, the weighted average passed the 1,000-foot milestone, at which point deepwater production (at about 700,000 barrels per day of oil and 2 billion cubic feet per day of gas) surpassed that from shallow water for the first time.[85]

As the industry moved deeper, the abandonment and decommissioning of older platforms on the shelf became a thriving business. During the 1990s, 1,264 platforms were removed, more than twice the total prior to 1990; after 2000, removals continued at a rate of 150 per year.[86] Some obsolete platforms found use as "artificial reefs" through a creative program, coordinated by the Minerals Management Service and the states of Texas and Louisiana, to place old platforms in specially designated locations on the sea bottom, where they attracted marine life much like natural reefs.[87]

Meanwhile, another relaxation in the terms of access to Gulf of Mexico leases, in the form of the Deepwater Royalty Relief Act (see Chapter 3), helped sustain the oil industry in deepwater. Deepwater royalty relief no doubt enticed some oil companies, especially non-majors, into deepwater. But judging from the huge upswell in bidding at the May 1995 Central Gulf of Mexico sale, before royalty relief was enacted, the race appeared to be already under way.[88] Oil explorers were clearly gunning for fields like Auger with high flow rates and high ultimate reserves. Many of them were also on the hunt for petroleum in a new geological location: beneath the Gulf's massive sheets of salt.

Subsalt Discoveries

Salt is the dominant structural element in the Gulf of Mexico petroleum system. Oil explorers had long ago discovered oil trapped against the flanks of salt domes or between the salt diapirs in the deepwater mini-basins. But geologists had typically assumed that there could be no oil reservoirs lying beneath any salt they encountered. By the 1970s, advancing knowledge about the basin's regional geology suggested that oil *could* be found under the salt. In many places, the salt pillars that extruded upward into sandstone and shale flowed horizontally in elastic plumes over vast expanses of younger, potentially oil-bearing sediment that extend more than 35,000 square miles across the Gulf. Geologists invented new terminology to describe different kinds of salt formations in the picture they pieced together—canopies, tongues, nappes, egg crates, and turtle domes—and established a special subfield of geology to explain how the salt moves. What they were really interested in, however, was what lay beneath the salt.[89]

The subsalt play began in 1990, when Exxon (with partner Conoco) made the first discovery at a prospect called Mickey. Located in 4,352 feet of water on the Mississippi Canyon 211 lease (about 10 miles northeast of where BP would later drill Macondo), Mickey was not then large enough to put into production.* Two years later, Chevron drilled a well in Garden Banks 165 through almost 7,000 feet of salt and another 5,000 feet of subsalt sediment. The well found no oil, but was a milestone because it demonstrated that the technology existed to drill through an enormous body of salt.[90]

Finally, in 1993, Phillips Petroleum announced the first commercial subsalt oil discovery. Years earlier, Phillips had begun to look systematically for places where salt sheets might be obscuring oil reservoirs. In 1989, the firm acquired 15 leases including one at a location called Mahogany. It was a speculative move. Salt plays tricks with seismic sound waves, which travel through salt at a much higher velocity than through the surrounding sediments and also get refracted, much as the image of a pencil is bent when it is stuck in a glass of water. Obtaining clear images of rocks in their proper location under the salt seemed almost impossible. To get a better focus, Phillips shot a 3-D seismic survey over

* Ten years later, Exxon developed the prospect as a subsea natural gas development called Mica.

the prospect. And to share the substantial expenses of conducting the survey and drilling through the salt—twice the cost of a normal well—the company took on Anadarko and Amoco as partners. Phillips's geophysicists then processed the seismic data with a newly developed computing algorithm, yielding a picture sufficiently improved to make an informed stab at the target. The first well, drilled by a Diamond Offshore semisubmersible, passed through 3,800 feet of salt, at one point encountering unstable rock that threatened to collapse the well. Eventually, the drill hit a 100-million-barrel field. In 1996, Phillips's Mahogany platform began producing at 20,000 barrels per day.[91]

The subsalt play progressed, haltingly, from Mahogany. Drilling through salt involved myriad technical complications. Under high temperature and pressure, salt masses flow, creep, and deform like plastic; this movement can shift the well casing and production tubing. These wells also had to be drilled to great depths, escalating costs. And limitations on computer power made it difficult to obtain reliable seismic images from beneath the salt, adding risk to exploration. Subsalt wells missed hydrocarbons a lot more often than they hit them.[92]

As operators drilled a string of dry holes, the post-Mahogany euphoria ebbed. In the 1995–1997 lease sales, companies began to turn from shallow subsalt prospects, pursuing instead ultra-deepwater (greater than 5,000 feet) prospects, looking for easier-to-image drilling targets in foldbelts formed by the lateral movement of salt and sediment. In 1995, Oryx Energy made a discovery at Neptune, opening a new play in the Western Atwater Foldbelt. The next year Shell announced a strike at its Baha prospect in the far western Gulf. This discovery initiated the Perdido Foldbelt play in more than 8,000 feet of water.[93] A deeper ocean frontier, once again, beckoned the industry.

An Industry Restructured—and Globalized

As geologists and geophysicists in Houston dedicated themselves to solving the riddles presented by depths of the Gulf of Mexico, the world oil industry began a radical restructuring. Oil and gas companies had not yet recovered from the 1980s bust when oil prices swooned again in the late 1990s, driven in large part by the drop in global demand precipitated by the Asian financial crisis. Increased shareholder pressure on oil firms to improve short-term financial results and longer-term profitability spurred one of the greatest merger movements in history. In 1998, BP acquired Amoco. The next year, Exxon merged with Mobil in an $80 billion deal to create the world's largest company. BP-Amoco countered by acquiring ARCO; Total merged with Fina and Elf (renamed Total in 2003); Chevron combined with Texaco; and, finally, Conoco and Phillips joined to create the sixth "super major" (along with Royal Dutch Shell). During these consolidations, many companies relocated staff from New Orleans and elsewhere to Houston, reinforcing that city's claim as the international oil capital.[94]

Mergers boosted results as management pared away overlapping functions and laid off employees, reinforcing the trend toward outsourcing R&D and reducing internal technological expertise. Mergers benefitted the oil industry, on the other hand, by equipping firms with new capital reserves needed to finance long-term growth strategies—some of them dependent on riskier, but potentially higher-return, ventures. The deepwater Gulf figured significantly in the growth strategies of all the "super major" oil companies—albeit as only one among several frontier provinces worldwide. They took renewed interest in Arctic and sub-Arctic regions and began to invest in other deepwater basins from the northeast Atlantic west of the Shetland Islands, to the Campos Basin off Brazil, to West Africa's Gulf of Guinea and offshore Angola, to northwest Australia. By the early 2000s, analysts regarded the three provinces rimming the central Atlantic Ocean—the Gulf of Mexico, Brazil, and West Africa—as the "New Golden Triangle," the place where the largest future reserves were likely to be found.[95]

Echoing the oil companies, consolidation also swept through offshore contractors. After half of the world's seismic crews were idled in 1999 due to a price collapse early in the year, the ensuing shakeout left only handful of seismic contractors, led by Western-Geco, owned by Schlumberger and Baker-Hughes; Petroleum Geo-Services; and CGG and Veritas (which merged in 2007). The major oil-service companies, which provided a variety of drilling, evaluation, well-completion, and production services, began to combine at the same time (notable was the 1998 merger between the oilfield giants, Halliburton and Dresser Industries). Most significantly, the drilling-contractor industry—continuously in the process of mergers, acquisitions, and bankruptcies—consolidated further. In 1999, Sedco-Forex and Transocean, themselves the products of earlier mergers, became Transocean Sedco Forex, later simplified as Transocean. In 2000, it acquired R&B Falcon, whose assets included a semisubmersible under construction in Korea by Hyundai Heavy Industries called the *Deepwater Horizon*. In 2001, Global Marine merged with Santa Fe, and six years later this firm became part of the modern Transocean, by far the largest offshore drilling firm in the world.

During this era, offshore oil exploration and production became an increasingly global enterprise. U.S. operators searched for oil in deepwater basins outside the Gulf of Mexico, and more than ever, companies such as Norway's Statoil, Brazil's Petrobras, and France's Total were drilling in the Gulf. Shipyards along the Gulf Coast—the pioneers in design and construction of mobile offshore drilling units—had by the 1990s almost totally surrendered this work to competitors in Korea and Singapore. Many of the largest offshore engineering, construction, and pipelaying firms (Heerema Marine Contractors, Technip, Worley Parsons, and others) were globally oriented companies based outside the United States.[96]

Offshore contractors headquartered in the Gulf survived by expanding internationally. Morgan City's J. Ray McDermott branched out around the world more aggressively after the 1980s industry depression and eventually moved its headquarters to Houston. Louisiana-based Gulf Island Fabricators, Chet Morrison Contractors, Global Industries, and even Frank's Casing Crew and Rental Tools grew from small, family-owned firms servicing operations in the Gulf to become major offshore contractors active worldwide.

BP's Moment

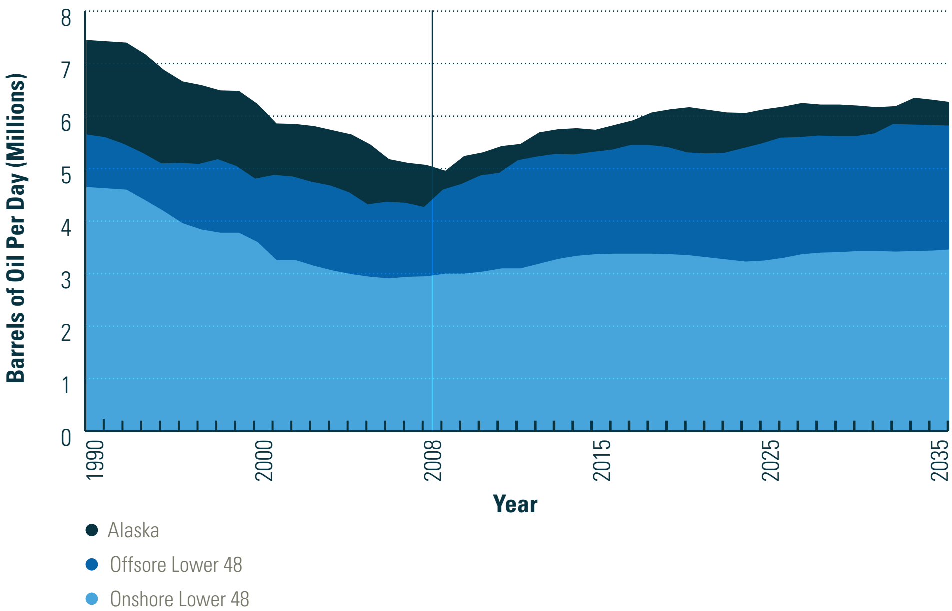
In the late 1990s, the global company making the biggest news in the Gulf of Mexico was BP. Founded in 1908 and since 1954 named British Petroleum, it had for decades built its business around access to crude oil from Iran and neighboring Middle Eastern countries. In the 1960s and 1970s, BP achieved great success in discovering and developing oil reserves in the North Sea and in Alaska's Prudhoe Bay. By the early 1990s, however, BP had been exiled from the Middle East and Nigeria. Production from Prudhoe and the North Sea were in decline. Billions of dollars had been invested in unprofitable nonpetroleum ventures. And an ambitious exploration program had yet to bear fruit. The company tottered on the brink of bankruptcy.[97]

Sir John Browne, a forceful exploration manager whose father had also worked for BP, orchestrated its stunning turnaround. In the 1980s, as executive vice president of Sohio, BP's American subsidiary, he reined in spending and cut staff in order to place the company on better footing. Returning to London in 1989, he reorganized BP's exploration arm; Browne slashed expenditures, established a rigid—if not ruthless—performance ethic, and refocused on high-risk but potentially high-reward opportunities. Upon becoming chief executive in 1995, he directed a major part of BP's upstream focus to the deepwater Gulf. In the deals he negotiated to acquire Amoco and ARCO, BP emerged with a greatly expanded portfolio of Gulf leases and assets.[98]

In the late 1990s, BP's Gulf exploration team made a series of remarkable deepwater discoveries. Once the fields came online, they vaulted BP ahead of Shell as the Gulf's largest oil producer. BP prided itself as a "fast follower," rather than an "early adopter," in exploiting technological innovations. BP had closely followed Shell at Mars and quickly applied what it had learned to develop the Marlin field with a tension-leg platform in 3,400 feet of water. BP also joined with Exxon in developing deepwater discoveries at the Hoover and Diana fields in the western Gulf. After the string of subsalt dry holes in the mid-1990s, some of BP's competitors began looking for other kinds of plays the Gulf might still present. Shell shifted to managing production from its large number of deepwater developments. But BP sprang faster than anyone to confront the Gulf's nagging exploration challenge—the salt. [99]

In a costly and complex undertaking, BP combined new advances in computer processing for 3-D seismic imaging with new methods of acquiring seismic data from multiple directions to gather a better understanding of the salt history, stratigraphy, and the sources and migration pathways of oil in deepwater. BP's scientists and engineers found geographically promising areas just as large as those discovered and profitably exploited on the shallower continental shelf. Based on their analyses, they began to believe that the deepwater frontier could ultimately hold 40 billion barrels of commercially exploitable oil—four times the prevailing estimates. Said Dave Rainey, BP's deepwater exploration manager, "One of the lessons we have learned about the Gulf of Mexico is never to take it for granted."[100]

FIGURE 2.5: U.S. Crude Oil Production, 1990-2035 (projected)



Source: Commission Staff, Adapted from U.S. Energy Information Administration

As this chart makes clear, overall production of crude oil in the U.S. has been declining for decades. However, production from deepwater wells in the Gulf of Mexico (Offshore Lower 48) is on the rise.

A new generation of drilling vessels coming onto the market, along with advances in drilling, encouraged BP to take the risk to explore those prospects. Outpacing most of the industry by a year, the company shifted its sights to prospects in much deeper waters. Rich rewards followed with a historic string of giant oil finds in subsalt formations ranging out to 7,000 feet of water. In 1998, BP struck oil in the deepwater subsalt of the Green Canyon's Mississippi Fan Foldbelt at Atlantis (minority partner BHP Billiton) and Mad Dog (minority partners BHP Billiton and Chevron), two of the largest fields ever discovered in the Gulf of Mexico. Atlantis's original reserves estimates were 400–800 million barrels of oil equivalent and Mad Dog's were placed at 200–450 million barrels. In 1999, working for BP (and minority partner Exxon) in 6,000 feet of water in the Mississippi Canyon, Transocean's *Discoverer Enterprise* drilled the largest Gulf field of all time, a subsalt prospect called Crazy Horse (subsequently renamed Thunder Horse), containing more than 1 billion barrels of recoverable reserves. That find alone catalyzed yet another rebirth of offshore oil in the Gulf of Mexico.[101]

The discoveries kept coming. A month later, BP made another oil and gas hit at Horn Mountain (150 million barrels of original reserves) in the Mississippi Canyon. In 2000, BP and Shell discovered a major above-the-salt deposit at Holstein (more than 200 million barrels) near the Mad Dog and Atlantis fields in the Green Canyon. The same year, those two partners announced their Na Kika project, a joint subsea development of five independent fields tied back to a central semi-submersible floating production facility, an industry first for the Gulf of Mexico. In 2001, BP found another giant oilfield, containing

500 million barrels, called Thunder Horse North.[102] Also that year, BP and yet another partner, Chevron, discovered a 100 million barrel field in 7,000 feet of water at their Blind Faith prospect in the Mississippi Canyon. (In the harsh glare of hindsight following the Macondo blowout, the executive director of the Natural Resources Defense Council commented that, in the name Blind Faith, "It would be hard to find a more fitting symbol of the oil industry's steady and assertive advance into the Gulf's deep waters, or the corporate thinking behind it."[103])

In August 2002, BP's Browne boldly announced that the company would spend $15 billion during the next decade on drilling and developing these discoveries. BP had become the largest-acreage holder in the deepwater Gulf, with more than 650 tracts in water depths greater than 1,500 feet, and in possession of one-third of all deepwater reserves then discovered. The deepwater Gulf of Mexico, Browne asserted, would be the "central element" of BP's growth strategy.[104] "The question is how they will manage the embarrassment of riches they have," said one analyst at the time. "They have a bunch of projects and they need to coordinate people and contractors. There is the sheer scale of the facilities and the size of the investment required—all this before a drop of oil ever comes out of the ground."[105]

Clouds on the Horizon

After BP's impressive discoveries, the industry dove into deeper waters across the Gulf. From 2001 to 2004, operators found 11 major fields beneath water 7,000 feet deep or more. Most deepwater discoveries were made in relatively young sandstones of the lower Miocene era. But companies increasingly explored down into the deeper and older Paleogene or "Lower Tertiary" strata found in the foldbelts near the edge of the Sigsbee Escarpment, a salt sheet that resembles a near-surface moonscape extending to the base of the continental slope. In 2006, Chevron and its partners Devon Energy and Statoil disclosed promising test results from a two-year-old discovery at its Jack prospect, proving that Lower Tertiary reservoirs could produce oil at pressures encountered at great depths, creating excitement that the Lower Tertiary play might ultimately yield between 3 billion and 15 billion barrels of hydrocarbons—collectively rivaling the size of the great Prudhoe Bay discovery. This implied a future for ultra-deep drilling, ranging out to 10,000-foot water depths and 25,000 feet beneath the seafloor. Reported the *Oil & Gas Journal*, "The Jack-2 test results boost confidence in that potential and highlight the central role technology plays in future supply."[106]

The industry was in need of a confidence booster after the previous three years of development challenges that had sorely tested BP's and the industry's confidence and conviction about deepwater.

BP's decision to develop multiple deepwater fields at once was an incredibly ambitious undertaking. Its program focused on the major fields at Holstein (a discovery above the salt), Mad Dog, Atlantis in the Green Canyon, and Thunder Horse in the Mississippi

BP Thunder Horse Platform

BP's mighty Thunder Horse platform was out-muscled by Hurricane Dennis in 2005 as it was being readied for service. Evacuated crews returned to find the semi-submersible production facility listing badly. After repairs and thorough analysis, additional problems were discovered that put the platform further behind schedule. For BP it was worth the wait: By 2009 Thunder Horse was producing a whopping quarter-million barrels a day.

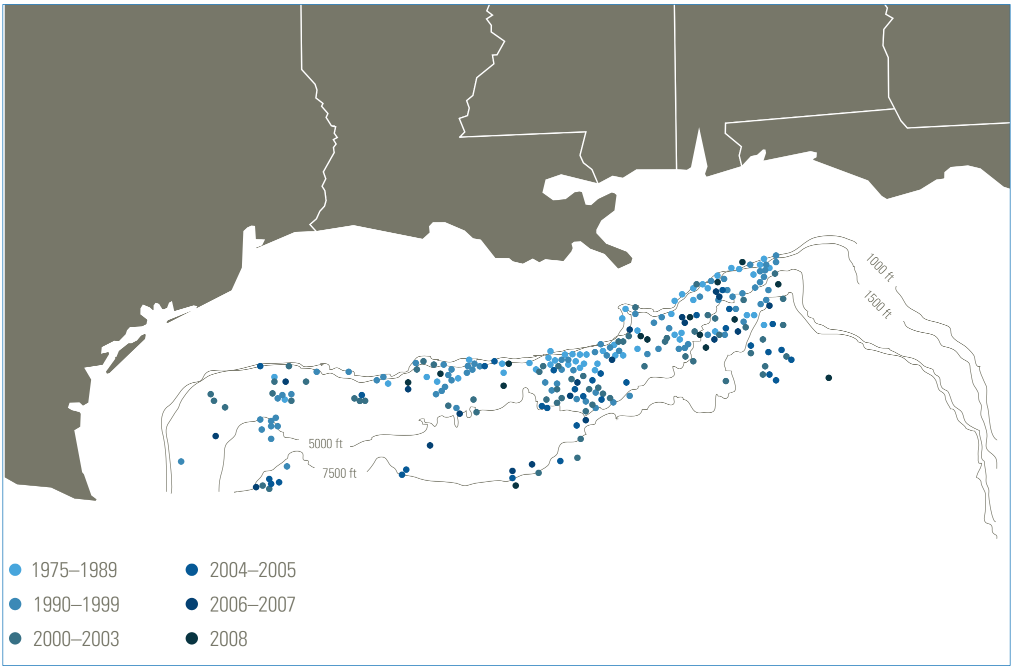
Getty Images/U.S. Coast Guard photo/PA3 Robert M. Reed/digital version by Science Faction

Canyon—with total potential reserves of 2.5 billion barrels of oil, in water ranging from 4,000 to 7,000 feet deep, requiring wells reaching 30,000 feet in total depth. To produce oil at these places, BP selected "truss spars" for Holstein and Mad Dog, and semisubmersibles (such as the one BP and Shell had introduced at Na Kika), for Thunder Horse and Atlantis.[107]

Beyond about 4,000-foot depths, the weight of tension cables was too great, so BP could not employ tension-leg platforms, the workhorses at Shell's first deepwater projects. The spar, successfully demonstrated in 1996, is a giant buoy consisting of a large-diameter, vertical cylinder supporting a deck for drilling and processing. Its deep-draft floating caisson keeps about 90 percent of the structure underwater, giving the structure favorable motion characteristics. During 2000–2005, Kerr-McGee (acquired by Anadarko in 2006) went on to pioneer several innovations in spar designs.[108]

BP's choice between spars and semisubmersible production facilities depended upon different economic, functional, and safety factors at each field. All four projects would be linked by pipeline to a platform hub, where crude oil would be transferred into a 390-mile pipeline, the Cameron Highway, and transported to refineries at Texas City and Port Arthur. All four projects, as well as Na Kika, also would connect to the BP-operated Mardi Gras transportation system, itself a billion-dollar project that integrated five different

FIGURE 2.6: Deep Discoveries



pipelines covering a total of 450 miles, with capacity to transport 1 million barrels of crude and 1.5 billion cubic feet of natural gas per day. The selection and development of technology on all these projects was a major challenge at every step, given the extreme water depths, reservoir conditions, and associated environmental issues. Thunder Horse had an unusually high pressure/high temperature reservoir. Atlantis was located under complex seafloor topography near the steep Sigsbee escarpment, and a large portion of the field was subsalt. Mad Dog lay under a massive salt canopy, causing large uncertainties in describing the actual reservoir. The Holstein geology forced BP to use a spar with wells housed on the platform. As BP production managers admitted in 2004, "None of the projects can be categorized as 'business as usual.'"[109]

The $5 billion Thunder Horse project was especially challenging. A major incident in drilling occurred even before the semisubmersible facility was put in place. In May 2003, the top of the drilling riser on the *Discoverer Enterprise* broke loose from the vessel, ripped apart again 3,000 feet under the surface, and left the lower marine riser package to collapse on and around the top of the blowout preventer, where the riser and drill pipe snapped off. The blowout preventer's blind shear rams were activated and worked as designed, averting any spill. "No one was hurt, and the well was secure," BP reported, "but the initial scene was daunting."[110]

An even bigger scare awaited the Thunder Horse semisubmersible production facility, which was towed to the field and moored on location in April 2005. As work proceeded to connect the predrilled subsea wells and commission all the facilities above and below the water, Hurricane Dennis neared in July, forcing the evacuation of all personnel and leaving the production facility unmanned. "No one could have anticipated the major shock that awaited the first helicopter flights after the storm had passed," according to one official BP account. The columns and other areas of the hull had filled with water, causing the facility to list to one side. Investigations later revealed that a valve in the bilge and ballast system had been installed backward, allowing seawater to move into the hull, a failure exacerbated by electrical pathways that were not watertight. Had BP not arrived when it did, the structure might have been lost. Crisis management crews were able to right the facility within a week, but reworking Thunder Horse's hull systems delayed commissioning for a year. Similar work on the Atlantis semisubmersible production platform pushed its installation back several months, too, until July 2006.[111]

Nor was that the end of BP's major shocks—it discovered that a weld had cracked open on one of the Thunder Horse manifolds that collected oil from the network of satellite subsea wells. The company made the difficult decision to pull out all the manifolds and subsea equipment that had a similar weld configuration— adding hundreds of millions of dollars to the cost of the project. After a lengthy investigation, engineers found that minute cracks had formed in the thermal insulation on the manifold pipe work, leading to reactions that embrittled the weld interface. BP and contractors developed new weld techniques, created more rigorous inspection and assurance procedures, and refurbished all the affected subsea equipment on Thunder Horse and at Atlantis. Thunder Horse finally delivered its first oil on June 2008, three years behind schedule.[112] By March 2009, production ramped up to 250,000 barrels per day, 4.5 percent of total U.S. daily production. (Atlantis went online a year before Thunder Horse, in 2007, but BP has been dogged by accusations that Atlantis has not been in compliance with safety and environmental regulations.[113])

Damaging Hurricanes

BP was not alone confronting environmental challenges. During 2002 and 2004–2005, hurricanes ravaged the Gulf Coast, with major impacts on offshore infrastructure and operations. In September 2002, Hurricane Lili blew into the heart of the Ship Shoal, Eugene Island, and South Marsh Island areas, damaging platforms and pipelines. Two years later, Ivan—a Category 4 storm—swept through the alley east of the Mississippi River delta, causing mudflows and anchor-dragging by mobile drilling units that tore up undersea pipelines. The following year, Hurricane Katrina flooded New Orleans and points east, with horrible effects. Offshore, Katrina destroyed 47 platforms and extensively damaged another 20. The 1,000-ton drilling rig on Shell's Mars platform collapsed, prompting an around-the-clock onsite recovery effort.

A month later, Hurricane Rita, storming farther west, wiped out 66 platforms and broke up another 32. Rita capsized Chevron's Typhoon, an unfortunately named mini-tension-leg platform. The majority of the platforms obliterated in these two storms were from an early generation of Gulf facilities, more than 30 years old. The two hurricanes also damaged more than 70 vessels and nearly 130 oil and natural gas pipelines, as they hit more prolific and sensitive areas than previous storms and, accordingly, caused much more extensive damages. Ominously, the short interval between the two storms exhausted the resources available for normal recovery and overwhelmed support bases.[114]

The Oil Industry and Deepwater Technology at Decade's End

As the end of the decade approached, the offshore industry in the Gulf had recovered from hurricane devastation and pressed on with deepwater and ultra-deepwater developments. Although many independent companies (such as Anadarko, Hess, BHP, Newfield, Marathon, and Mariner) had substantial deepwater leases and were actively exploring and developing them, the edge of the frontier was mainly the playground of the super-majors and firms with partial government ownership, such as Norway's Statoil and Brazil's Petrobras.[115]

In September 2009, Transocean's *Deepwater Horizon* semisubmersible made a historic discovery for BP at the company's Tiber prospect in the Keathley Canyon. Drilling in 4,000 feet of water and to a world-record total depth of 35,055 feet, *Deepwater Horizon* tapped in a pool of crude estimated to contain 4 to 6 billion barrels of oil equivalent, one of the largest U.S. discoveries. Six months later, in March 2010, Shell (with partners Chevron and BP) started production at its Perdido spar in 8,000 feet of water in the Alaminos Canyon. A hub for the development of three fields, Perdido was the world's deepest offshore platform, and the first project to pump oil and gas from the Lower Tertiary. Other Lower Tertiary developments were coming onto the horizon. Later in the year, Petrobras planned to develop the Gulf's first floating production, offloading, and storage facility to produce from Lower Tertiary reservoirs at its Cascade and Chinook prospects. By 2010, the industry had announced 19 discoveries in the Lower Tertiary trend, 14 of them containing more 100 million barrels of oil equivalent.[116]

Technical Tests

The fanfare around these discoveries and developments could not disguise the fact that the technical challenges of ultra-deepwater drilling and production and the subsalt geology remained unique and formidable. Water depths are extreme, down to 10,000 feet. Total well depths, as Tiber demonstrated, can go beyond 30,000 feet. Well shut-in pressures can surpass 10,000 pounds per square inch. Bottom-hole temperatures can exceed 350 degrees Fahrenheit. Salt- and tar-zone formations can be problematic. The sandstone reservoirs are tightly packed, and ensuring hydrocarbon flow through risers and pipelines can be difficult. According to a 2008 report from Chevron engineers for the Society of Petroleum Engineers, all these factors "separate many [Gulf of Mexico] deepwater and ultra-deepwater wells from deepwater and ultra-deepwater wells in other parts of the world."[117]

Drilling in extreme water depths poses special challenges. Risers connecting a drilling vessel to the blowout preventer on the seafloor have to be greatly lengthened, and they are exposed to strong ocean currents encountered in the central Gulf. Managing higher volumes of mud and drilling fluid in these long risers makes drillers' jobs more demanding. Connecting and maintaining blowout preventers thousands of feet beneath the surface can only be performed by remote-operating vehicles. A 2007 article in *Drilling Contractor* described how blowout preventer requirements got tougher as drilling went deeper, because of low temperatures and high pressures at the ocean bottom. The author discussed taking advantage of advances in metallurgy to use higher-strength materials in the blowout preventers' ram connecting rods or ram-shafts. More generally, he suggested "some fundamental paradigm shifts" were needed across a broad range of blowout-preventer technologies to deal with deepwater conditions.[118]

Under such conditions, methane hydrates raised a host of serious problems. Methane gas locked in ice ("fire ice") forms at low temperature and high pressure, and can often be found in sea-floor sediments. Temperature and pressure changes caused by drilling, or even by natural conditions, can activate the release of 160 cubic feet of gas from one cubic foot of methane, collapsing surrounding sediment, and thus destabilizing the drilling foundation. Hydrates can also present well-control problems. As hydrocarbons are produced and transported in cold temperatures and high pressures, hydrates can form and block the flow through deep pipelines and other conduits. Government, academic, and industry research programs on hydrates and associated flow problems begun in the 1990s are continuing.[119]

More broadly, knowledge about localized geology, types of hydrocarbons, and pressure profiles in ultra-deepwater wells is still not thoroughly developed. Geological conditions are complicated and vary from prospect to prospect, and from well to well. Each well, indeed, has its own "personality" that requires maintaining an extremely delicate balance between the counteracting pressures of the subsurface formation and drilling operation. Beneath the salt, pressures in the pores of the sediment are exceedingly hard to predict. Reservoirs in the Lower Tertiary are thicker and with higher viscosity than the fluids found in younger rock. Finally, ultra-deepwater developments are far removed from shore and thus from established infrastructure. As a BP technical paper prepared for the May 2010 Offshore Technology Conference noted, "the trend of deepwater discoveries in the [Gulf of Mexico] is shifting toward one with greater challenges across many disciplines represented by the conditions of Lower Tertiary discoveries."[120]

Nevertheless, the challenges seemed manageable and the rewards appeared worth the perceived risk. The offshore industry had enjoyed a long run in the Gulf without an environmental catastrophe. The hurricanes of mid-decade had caused widespread damage, but not a major offshore spill. In recent years, the industry had touted its relatively clean record in the Gulf as a justification to allow exploration elsewhere. As oil prices climbed from 2003 to 2008, peaking at over $140 per barrel, so did the industry's interest in exploring other frontier areas, especially offshore Alaska. In 2007, Shell and Total bid aggressively for federal leases offered in the Beaufort Sea, and in 2008, Shell spent $2.1 billion for leases in the Chukchi Sea. The following year, however, a lawsuit in a federal appeals court challenging the Minerals Management Service's environmental studies preceding the sale held up applications for permits to drill on these leases.[121]

Still, from 2008 through early 2010, both government and industry were largely bullish about the potential of offshore drilling for the nation's future. Not incidentally, both were earning even greater revenues from ever-more ambitious exploration. In 2008, President George W. Bush and Congress ended the leasing moratoriums on vast stretches of the U.S. outer continental shelf, and Bush proposed opening new areas for exploration. In a March

31, 2010 announcement, President Barack Obama scaled back Bush's plan, but he left open the possibility of expanding offshore leasing beyond the Gulf of Mexico and Alaska. The President defended his position by observing, "oil rigs today generally don't cause spills."[122]

As President Obama spoke, Transocean's *Deepwater Horizon*—fresh from completing BP's spectacular find at Tiber a few months earlier—was busy drilling on BP's Mississippi Canyon 252 lease, in approximately 5,000 feet of water. BP had named the prospect Macondo, after the fictional town in Gabriel Garcia Marquez's novel, *One Hundred Years of Solitude*. The fate of the town of the Macondo, as described in a memorable passage by Marquez, presaged the fate of the Macondo well and summed up the challenges facing the industry as a whole as it plumbed the depths of the Gulf:

> *It was as if God had decided to put to the test every capacity for surprise and was keeping the inhabitants of Macondo in a permanent alternation between excitement and disappointment, doubt and revelation, to such an extreme that no one knew for certain where the limits of reality lay.*[123]


DEPARTMENT OF THE INTE

Chapter Three
"It was like pulling teeth."

Oversight—and Oversights—in Regulating Deepwater Energy Exploration and Production in the Gulf of Mexico

The *Deepwater Horizon* rig sank on April 22, 2010, two days after the Macondo well blowout and explosion that killed 11 workers. Not long after the tragedy, its repercussions shifted to the Minerals Management Service (MMS), the federal agency responsible for overseeing the well's drilling and operation. Nineteen days after the rig sank, Secretary of the Interior Ken Salazar announced his intention to strip MMS's safety and environmental enforcement responsibilities away from its leasing, revenue collection, and permitting functions, and to place the former within a "separate and independent" entity.[1] A week later, he announced MMS would be reorganized into three separate entities with distinct missions: a Bureau of Ocean Energy Management; a Bureau of Safety and Environmental Enforcement; and an Office of Natural Resources Revenue.[2] And, by June 19, the Secretary had discarded the "MMS" name altogether.[3] Like the *Deepwater Horizon*, MMS had ceased to exist.

The rig's demise signals the conflicted evolution—and severe shortcomings—of federal regulation of offshore oil drilling in the United States, and particularly of MMS oversight of deepwater

The often competing goals of energy independence and environmental protection collide at the Department of the Interior, which historically has held broad regulatory authority in both realms. For nearly three decades a single departmental agency, the Minerals Management Service, was at the center of the offshore-oil saga.

Mark Wilson/Getty Images

drilling in the Gulf of Mexico. The regulatory context for the leasing procedures and safety and environmental oversight that led up to the Macondo blowout took shape in the 1970s, when two conflicting priorities dominated the political landscape. The first to appear, in the early 1970s, was the public mandate for environmental protection, which prompted enactment of an extraordinary series of sweeping regulatory laws intended, in the language of the National Environmental Policy Act, to "create and maintain conditions under which man and nature can exist in productive harmony."[4] The second was the nation's drive for energy independence; it led to new policies designed to increase domestic production and decrease American reliance on foreign energy supplies. Oil served as a catalyst for both: the Santa Barbara oil spill in 1969 helped to promote passage of demanding environmental protection mandates, and the OPEC oil embargo of 1973 amplified the urgency of efforts to make the nation more energy self-sufficient.

The federal regulation of offshore drilling awkwardly combined the two priorities, as a series of Congresses, Presidents, and Secretaries of the Interior—responding to competing constituencies in explicitly political ways—sought to reconcile the sometimes conflicting goals of environmental protection, energy independence, and revenue generation. In some offshore regions, oil drilling was essentially banned in response to environmental concerns. Elsewhere, most notably in the Gulf, some environmental protections and safety oversight were formally relaxed or informally diminished so as to render them ineffective, promoting a dramatic expansion of offshore oil and gas production and billions of dollars in federal revenues.

The origins of MMS vividly illustrate that political compromise. Secretary of the Interior James Watt created the agency with great fanfare in January 1982, aiming from the outset to promote domestic energy supplies by dramatically expanding drilling on the outer continental shelf. He combined, in one entity, authority for regulatory oversight with responsibility for collecting for the U.S. Treasury the billions of dollars of revenues obtained from lease sales and royalty payments from producing wells.[5] From birth, MMS had a built-in incentive to promote offshore drilling in sharp tension with its mandate to ensure safe drilling and environmental protection.

Revenue generation—enjoyed both by industry and government—became the dominant objective. But there was a hidden price to be paid for those increased revenues. Any revenue increases dependent on moving drilling further offshore and into much deeper waters came with a corresponding increase in the safety and environmental risks of such drilling. Those increased risks, however, were not matched by greater, more sophisticated regulatory oversight. Industry regularly and intensely resisted such oversight, and neither Congress nor any of a series of presidential administrations mustered the political support necessary to overcome that opposition. Nor, despite their assurances to the contrary, did the oil and gas industry take the initiative to match its massive investments in oil and gas development and production with comparable investments in drilling safety and oil-spill containment technology and contingency response planning in case of an accident.

On April 20, the inherent risks of decades of inadequate regulation, insufficient investment, and incomplete planning were realized in tragic fashion. MMS no doubt can fairly boast of many hardworking individual public servants who have in good faith sought to achieve their agency's important safety mission over sustained industry opposition. But, notwithstanding their individual efforts and accomplishments, the overall picture of MMS that has emerged since April 20 is distressing. MMS became an agency systematically lacking the resources, technical training, or experience in petroleum engineering that is absolutely critical to ensuring that offshore drilling is being conducted in a safe and responsible manner. For a regulatory agency to fall so short of its essential safety mission is inexcusable.

This chapter is divided into three parts. The first part describes the emergence of MMS as the dominant federal regulatory agency responsible for overseeing the offshore oil and gas industry. The second part examines the performance of MMS over time, with particular focus on its efforts to promote drilling safety and the institutional, political, and cultural impediments to its success. Finally, the third part explores in more detail the application of environmental protection requirements to offshore drilling, highlighting the particular ways in which the requirements were effectively diminished or ignored.

Creation of a Cross-Purposes Regulator

The federal government's authority to regulate oil and gas leasing activities on the outer continental shelf is not merely an expression of the government's traditional authority to regulate private activities affecting public health, safety, and welfare. Its authority is even more sweeping in nature and further arises out of the nation's *ownership* of the natural resources on the outer continental shelf and the federal government's corresponding power and responsibility to manage and protect those invaluable resources on behalf of current and future generations of Americans. As described by the Constitution's Property Clause, it is the "power to dispose and make all needful rules and regulations respecting the territory or other property belonging to the United States."[6] The federal government, accordingly, has plenary authority, essentially "without limitations,"[7] "to prescribe the conditions upon which others may obtain rights in" natural resources located on properties that belong to the nation as a whole.[8] Because, moreover, of the national security implications of those resources, especially energy resources, that national power further implicates the President's broad authority as Commander-in-Chief to ensure the maintenance of sufficient energy supplies to keep the nation secure.[9]

Rights and Riches: The Early Skirmishes over the Outer Continental Shelf

The foundations of federal regulation of offshore oil and gas development were laid in the Outer Continental Shelf Lands Act of 1953.[10] That initial legislation gave the Department of the Interior diverse and potentially contradictory responsibilities for offshore mineral development. The vigorous debates preceding enactment of the new law and its early implementation gave the impression that it was all about the money.[11]

The potential windfall from leasing public land offshore to private companies for mineral development provoked an intense dispute between coastal states and the federal government. In 1945, President Harry Truman had proclaimed federal authority over the subsoil of the U.S. continental shelf. California, Texas, and Louisiana defied this proclamation and continued to lease offshore land, prompting suits by the U.S. Department of Justice. The Supreme Court ruled against California in 1947 and against Louisiana and Texas in 1950, declaring that the federal government possessed "paramount rights" that transcended the states' rights of ownership.[12] Offshore leasing and exploration stalled for three years, as Congress and the 1952 presidential candidates postured around proposals to return submerged coastal lands to the states.[13] That conflict was largely resolved in the Submerged Lands Act, passed in 1953, two months before the Outer Continental Shelf Lands Act: states would control three nautical miles out from the shoreline (9 nautical miles for Texas and western Florida due to historic claims).[14] The "outer continental shelf"—seaward of state lands—was claimed by the federal government. Estimates of the value of federal land offshore ranged from $40 billion to $250 billion.[15]

President Truman had called on the nation to postpone mineral development in the federal offshore area, foregoing the revenues immediately available. He argued that setting the federal offshore area aside, in the Naval Petroleum Reserve, would ensure that the oil and gas would be there later when needed for strategic purposes.[16] But the congressional debates in 1953, under President Dwight Eisenhower, focused on what to do with this attractive new source of revenue. Various senators proposed dedicating the funds to deficit reduction or to education. But in the end, the new money from lease sales, rents, and royalties would flow into the general treasury.[17]

The first leases. During the first week of September 1954, Secretary of the Interior Douglas McKay announced the first federal lease sale: rights to explore 748,000 acres off the coast of Louisiana.[18] When the sealed bids were opened on October 13, half the available acreage was leased with winning bids totaling $130 million. The next month, a similar sale off the Texas coast yielded $23 million.[19] The promise of a new stream of federal revenue had come to pass.

The Rise of Environmental Law

At the outset, environmental restrictions on offshore drilling were very limited. The 1953 legislation governing offshore mineral development authorized the Interior Department to prescribe rules "for the prevention of waste and conservation of natural resources" of the outer continental shelf,[20] but "conservation" at that time mostly referred to the desire not to waste the resource physically by destroying the oil and gas reservoir. The Department did announce, however, that the Fish and Wildlife Service would have to approve all offshore drilling in wildlife refuges and that oil and gas leasing there that endangered "rare" wildlife species (like whooping cranes or trumpeter swans) would not be allowed.[21]

Federal offshore leasing policy remained largely unchanged until a Union Oil Company well located in the Santa Barbara Channel blew out on January 28, 1969 (described in Chapter 2). The Interior Department toughened its rules in response to the spill (after first issuing a moratorium on offshore drilling and production in California waters pending those new rules), the first changes since 1953.[22] And, at that time Congress was already taking up legislation in response to heightened awareness of a host of environmental problems, now punctuated by the Santa Barbara spill. Starting with the National Environmental Policy Act (NEPA), signed into law on January 1, 1970,[23] Congress enacted sweeping new environmental protection and resource conservation laws that dramatically changed the federal role in overseeing activities that polluted the air or water or that exploited the nation's natural resources on public lands—including offshore oil and gas development.[24]

Given its bold promises of preserving the environment for future generations, NEPA is often referred to as the *Magna Carta* of the nation's environmental laws. It requires federal agencies to prepare "environmental impact statements" for all proposed "major Federal actions significantly affecting the quality of the human environment" in order to ensure that decisions are based on full consideration of their environmental consequences.[25] Although it is far from clear that either Congress or the President appreciated NEPA's full import, federal courts quickly embraced the law, applying its procedural requirements strictly and enjoining agency actions found to be in violation.[26]

In order to provide the science needed for the environmental reviews and consultations directed by these statutes, the Department of the Interior created the "Environmental Studies Program" in 1973.[27] The program was established to provide information on the geological, physical, biological, and chemical characteristics of offshore oil and gas leasing areas. It was initially focused on scientifically characterizing areas and providing baseline environmental data, but later shifted its focus to research directly linked to resource management decisions by the offshore leasing program.[28]

NEPA was just the first among approximately 20 new laws enacted during the 1970s that aimed to advance environmental protection by curbing pollution of the nation's waters, air, or land; manage commercial activities that sought to exploit the nation's natural resources, including mining and forestry; manage the coastal zone prudently; control noise; regulate toxic substances; and protect endangered species—among other goals.[29] Amid this rapid, extensive transformation of the nation's environmental protection and natural resource management laws, one had particular significance for federal oversight of offshore drilling: the Outer Continental Shelf Lands Act Amendments of 1978. It was the last major natural resource law that Congress passed during the 1970s—and so embodies the shifting nature of national politics from the decade's beginning to its end.

Energy Independence vs. Environmental Protection: Conflicting Aims in High Relief

Although Americans' embrace of environmental protection persisted throughout the decade, the 1973 oil embargo prompted ambitious efforts to promote the nation's energy independence. President Richard Nixon proposed a dramatic expansion of offshore oil and gas development, including in frontier areas around most of the nation's coast. President Jimmy Carter created the Department of Energy in 1977 and secured passage of the National Energy Act of 1978, consisting of five separate laws, some designed to promote development of domestic energy supplies and others to encourage energy conservation.[30]

The Outer Continental Shelf Lands Act Amendments, also enacted that year, not surprisingly reflected the tension between the nation's environmental and energy independence goals. Those skeptical of accelerated offshore leasing—including many coastal states, local governments, fishermen, and environmentalists—sought, to that end, opportunities to ensure that offshore oil and gas leasing complied with strict safeguards and a greater voice in the decisionmaking process. They were concerned about the broad discretion the Act conferred on the Secretary of the Interior over control and management of offshore energy resources.

By contrast, advocates for expanded domestic production wanted to ensure that the new legislation did not allow environmental protection laws to stifle exploration, development, and production of significant offshore oil and gas reservoirs. They were aware that environmental organizations had used NEPA successfully to challenge a proposed lease sale, covering almost 380,000 acres offshore Louisiana and Mississippi, on the grounds that the Interior Department had failed to first prepare an adequate environmental impact statement. The federal courts had agreed and enjoined the sale in January 1972.[31] Coastal states and environmentalists had since launched challenges against other lease sales.

Congress began to hold hearings on revamping the federal offshore leasing program in 1974—just after the oil embargo and not long after those early environmental challenges.[32] The law that emerged in 1978[33] included findings on the need to reduce the nation's dependence on "imports of oil from foreign nations," the potential to increase production of oil and gas on the outer continental shelf significantly "without undue harm or damage to the environment," and the need to review "environmental and safety regulations relating to activities on the Outer Continental Shelf . . . in light of current technology and information."[34] The Act's purposes included "expedited exploration and development of the Outer Continental Shelf" and the "development of new and improved technology for energy resource production which will eliminate or minimize risk of damage to the human, marine, and coastal environments."[35]

The 1978 Act fundamentally transformed federal offshore leasing. The law added detailed procedures governing the leasing of rights to explore, develop, and produce the resources of the outer continental shelf. The offshore program was divided into four distinct stages:

- Development by the Secretary of the Interior of a "schedule of proposed lease sales indicating, as precisely as possible, the size, timing, and location of leasing activity which he determines will best meet national energy needs for the five-year period following its approval or reapproval";[36]
- Lease sales by the Secretary pursuant to that five-year schedule;
- Submission by lessees of exploration plans for the Secretary's approval; and
- Upon discovery of oil and gas in commercial quantities, submission of development and production plans by lessees for the Secretary's approval.

The Act further requires lessees to apply for the Secretary of the Interior's permission prior to drilling *any* wells, pursuant to an approved exploration plan[37] or, in most areas, pursuant to a development and production plan.[38]

FIGURE 3.1: Outer Continental Shelf Oil and Gas Leasing, Exploration & Development Process

Four major steps guide the Outer Continental Shelf leasing and development process, from the decision to open an area to drilling, to the operations during oil and gas production. Before a lease is granted, Stage I establishes the "5-Year Program," setting the schedule and possible locations for individual lease sales, and Stage II lays out the details by which each individual lease sale is conducted. After a company acquires a lease, Stage III plans and executes the oil and gas exploration activities, and Stage IV plans and executes the oil and gas development and production operations.

At the same time, the statute also made clear that environmental safeguards are a relevant, important part of the Secretary's decisionmaking. For instance, it charged the Secretary "to obtain a proper balance between the potential for environmental damage, the potential for discovery of oil and gas, and the potential for adverse impact on the coastal zone."[39] The law also expressly required the Secretary to prepare a series of "environmental studies" to assess the environmental impacts of activities on the outer continental shelf,[40] and "the Secretary of the Department in which the Coast Guard is operating" (currently the Department of Homeland Security) to promulgate "safety regulations."[41] Such regulations were to include "the use of the best available and safest technologies which the Secretary [of the Interior] determines to be economically feasible, wherever failure of equipment would have a significant effect on safety, health, or the environment."[42] But this potentially demanding requirement included an exception "where the Secretary determines that the incremental benefits are clearly insufficient to justify the incremental costs of utilizing such technologies."[43]

The Gulf of Mexico exemption. Offsetting the apparent interest in environmental review, the Act reflected a carefully calibrated political compromise designed to promote offshore drilling: it expressly exempted leases in the "Gulf of Mexico" from the law's requirement that development and production pursuant to an oil and gas lease must be based on and consistent with a "development and production plan" submitted by the lessee and approved by the Secretary of the Interior.[44] (No comparable exception applied to "exploration plans," which all lessees were required to submit for approval prior to conducting such drilling, which naturally occurs prior to development and production.[45]) The telling compromise lay in the details: the law specified that a development and production plan must set forth "the environmental safeguards to be implemented"[46] and the Secretary must at least once declare the approval of a development and production plan in any area "to be a major Federal action"—language which triggers NEPA's requirement for an impact statement detailing the environmental consequences of development and production.[47] Therefore, by exempting leases in the Gulf from the required "development and production plan," the Act was also exempting such leases from the related requirement of at least one NEPA impact statement.[48] And the Act included one further bit of congressional horse-trading. It authorized the Secretary of the Interior to reinstate the development and production plan requirements, including NEPA review, for an oil and gas lease located in the *eastern* planning area of the Gulf abutting the western coastline of Florida, leaving only the *central* and *western* Gulf planning areas off limits from such requirements.[49]

The legislative history makes clear that this was a deal brokered between the Carter administration, the oil and gas industry, Congress, and Gulf states. Industry had argued that NEPA and similar requirements could lengthen the interval between leasing and production by three to six years. In response to this concern, Congress amended the bill to draw a distinction between the Gulf of Mexico, where such consultation would not be required, and other offshore areas where it would. The rationale for singling out the Gulf of Mexico for less environmental oversight than other parts of the nation's offshore was that the oil and gas industry in the Gulf was already mature and therefore the environmental risks were already better known than they were in "frontier" areas. This rough geographically-defined generalization took no account of the Gulf's remarkable fisheries, or the economic importance of the region's beaches to the tourism industry. Secretary of the Interior Cecil Andrus sought administrative discretion to require the full environmental review even in some non-frontier areas if drilling in those areas proved to present heightened environmental risks,[50] but the final legislation made that further concession only for a part of the Gulf.[51]

A compromise comes undone. Whatever compromise Congress and President Carter may have thought they had struck in the 1978 legislation quickly unraveled. In the first five-year leasing schedule issued in June 1980, Secretary Andrus offered 55 million acres, and proposed Lease Sale 53 along the Pacific Coast. Unlike previous sales, which had been concentrated on one geographic region, Lease Sale 53 called for nominations of tracts from the Santa Barbara Channel all the way up the California coast to the Oregon border. Fierce opposition immediately greeted the proposed leasing schedule and Lease Sale 53. California and Alaska filed lawsuits challenging the legality of the leasing schedule under the 1978 law. After huge public rallies, Secretary Andrus formally withdrew the entire northern and central California portion of the proposed sale.[52]

The Creation of the Minerals Management Service (MMS)

Against a backdrop of rising inflation, record interest rates, further turbulence in the oil market following the 1979 Iranian revolution, and a severe recession, the politics of offshore drilling became even more volatile early in the administration of President Ronald Reagan, who was inaugurated in January 1981. Perhaps not surprisingly, after the upwelling of new regulatory powers under Presidents Nixon, Ford, and Carter, the new President made clear from the outset his view that government regulation was a leading cause of the nation's problems—a drag on the nation's economy in general and the development of its rich natural resources in particular.

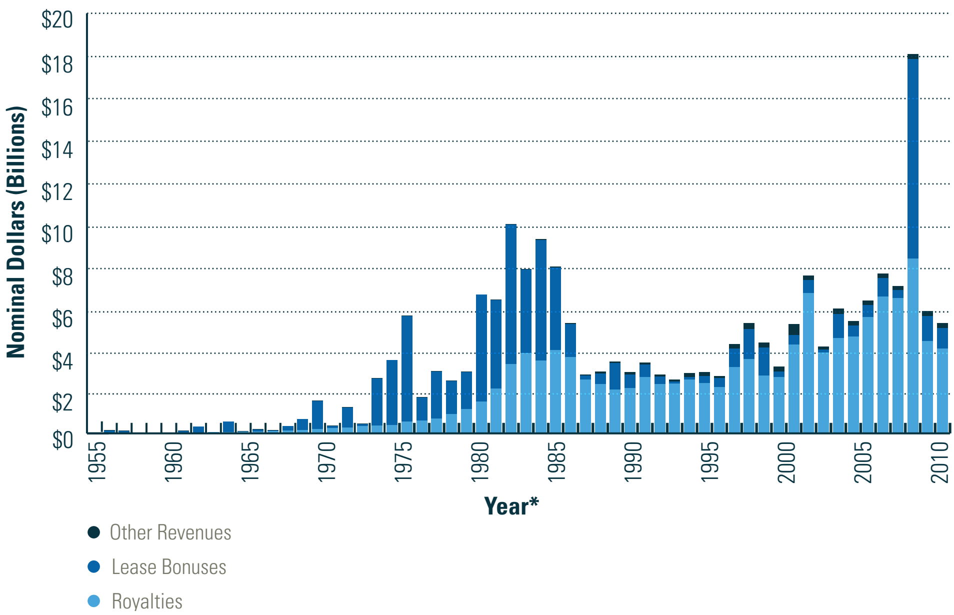
Secretary of the Interior James Watt shared that outlook and focused his early regulatory reform efforts on offshore drilling. He quickly vowed to lease a billion acres of the outer continental shelf—virtually the entire area—for oil and gas exploration.[53] And he made clear his commitment to maintaining that objective, notwithstanding enormous criticism: "If the press is here," he declared during a National Ocean Industries Association meeting in April 1982, "I hope they will write this down. We will offer one billion acres for leasing in the next five years. We will not back away from our plans to have 42 lease sales."[54]

MMS originated in this context, driven by the administration's desire to ensure that it obtained the financial fruits of its plan for this massive expansion in offshore drilling. With the dramatic increase in oil prices over the previous decade, royalties and revenues from federal oil and gas resources had already become the second largest revenue source for the U.S. Treasury. (A September 1980 lease sale in New Orleans had demonstrated the sums potentially at stake, bringing in a record $2.8 billion of cash bonuses, far more than any prior lease sale; see Chapter 2.) Clearly, this was a consequential way to secure revenue without needing to raise taxes.

Revenue collection and regulation, separated. Until this time, the Interior Department's Bureau of Land Management and Bureau of Indian Affairs had been responsible for collecting royalties for mining and drilling on federal and Indian lands, respectively—and regulatory oversight of offshore exploration and energy production had been vested in the U.S. Geological Survey's Conservation Division.

But the department's management of royalties was subjected to frequent criticism. In July 1981, the administration created a Commission on Fiscal Accountability of the

FIGURE 3.2: Federal Revenues from the Outer Continental Shelf, 1955-2010



Sources: Minerals Revenue Management, *Total Federal offshore mineral revenue collections, Calendar Years 1953-2000*, 2001, 7, http://www.onrr.gov/Stats/pdfdocs/coll_off.pdf; Office of Natural Resources Revenue, *Total Federal Offshore Reported Royalty Revenues*, http://www.onrr.gov/ONRRWebStats/Home.aspx.

Revenues from lease bonuses can occasionally dwarf royalties. A single 2008 lease sale in the Chukchi Sea, Alaska, brought in a record cash bonus of $2.6 billion.

* Calendar year from 1955-200; fiscal year from 2001-2010

Nation's Energy Resources, charged with reviewing and recommending changes in the system for collecting royalties. Reporting the next January, the commission concluded that "[m]anagement of royalties for the nation's energy resources has been a failure for more than 20 years. . . . [T]he oil and gas industry is not paying all the royalties it rightly owes. The government's royalty recordkeeping . . . is in disarray."[55] It accordingly called for a complete overhaul, including a wholesale reorganization of Interior Department responsibility for overseeing royalty collection from federal and Indian lands.

Mixing oil and water: revenue-collection and regulation combined. Using the discretion conferred on him in the 1978 Outer Continental Shelf Lands Act Amendments, Secretary Watt moved quickly, issuing Secretarial Order No. 3071 on January 19, creating the Minerals Management Service. Moving beyond the commission recommendations for reform of royalty collection, he provided that the new agency would also absorb offshore leasing and oversight responsibilities from the U.S. Geological Survey. There is no available formal record of his reasoning for this further step, but the most likely reasons are revealed by a memorandum written by the Chief of the Conservation Division, Don Kash, dated December 11, 1981, just a few weeks earlier. In that memo, Kash vigorously argued in favor of relocating responsibilities for lease management from the Conservation Division into a new independent agency within the Interior Department—precisely what the Secretary then did.

But Secretary Watt's decision did not fully reflect Kash's concerns. The latter had worried that the controversial politics of lease management were "sullying the [U.S. Geological] Survey's scientific reputation" and threatened its "science ethos" and "scientific virtue." The collision of cultures between those engaged in scientific research and those engaged in lease management was a "continuing source of irritation" and "bitterness" within the U.S. Geological Survey. He was concerned that lease management would increasingly take priority, draining resources from the research that should be the hallmark of the U.S. Geological Survey. Finally, Kash described problems that leasing management would face going forward—foremost among them a tendency toward myopic thinking and inadequately trained personnel. On that last issue, he pointed out that the government could not retain "geologists and geophysicists associated with [outer continental shelf] activities" because they "can move to an industrial or business concern for a substantial increase in pay, almost at will." Kash recommended a series of steps to attract and train personnel capable of overseeing the management of offshore oil and gas activities.[56]

Secretary Watt organized two distinct programs within his newly-minted MMS: the Offshore Energy and Minerals Management program and the Minerals Revenue Management program. (He rejected the General Accounting Office's recommendation, which industry had opposed, that MMS also assume responsibility for *onshore* oil and gas leasing; the Bureau of Land Management retained that regulatory authority.[57]) The result was that the same agency became responsible for regulatory oversight of offshore drilling—and for collecting revenue from that drilling.

The Billion-Acre Leasing Land Rush

It did not take long for Secretary Watt to make sure that his new agency was fully engaged. In July 1982, just after MMS's birth, he issued a new five-year plan that envisioned leasing nearly one billion acres of the outer continental shelf from August 1982 to June 1987—18 times the 55 million acres offered by the first five-year plan of June 1980. To meet this ambitious program, he scheduled 41 sales over the ensuing five years; divided the billion acres into 18 planning areas, ranging in size from 8 million to 133 million acres; and established a streamlined process for leasing in those areas. Under this new process, MMS would no longer lease just those tracts previously designated by industry to be of interest, but would instead offer vast acreage on an "area-wide" basis.[58]

As described in Chapter 2, area-wide leasing promoted significant new discoveries of large oil-bearing formations in contrast to the smaller fields found in shallower depths. Those additional discoveries in fact led to major technological advances and increased exploration of oil and gas reservoirs in Gulf waters. But the federal revenues generated fell short of expectations. With such a large increase in supply, the price offered for leases declined. The Sierra Club claimed that Secretary Watt's plans for accelerated leasing would cost the U.S. Treasury $77 billion over the five-year period.[59] Moreover, the Gulf states persuaded Congress to increase their share of leasing revenues as compensation for physical drainage of oil and gas from reservoirs within state jurisdiction by offshore activities of federal lessees. In 1986, Congress amended the federal law to guarantee that the Gulf states would receive 27 percent of the revenues from leases in the federal zone three nautical miles

Watt and Reagan

In January 1982, President Reagan's Interior Secretary, James Watt, created the Minerals Management Service (MMS) in support of his goal to open unprecedented reaches of U.S. territorial waters to oil and gas exploration. MMS had a conflicting and ultimately disastrous mandate: to both regulate offshore energy leases and collect the revenue they generated.

Frank Johnston/The Washington Post via Getty Images

beyond state waters.[60] Previously the law had provided only that states should receive a "fair and equitable" portion of those revenues, an ambiguous standard that invited disagreement between the federal and state governments concerning what that portion should be.

The Gulf of Mexico's still-more-special status. The distinction first drawn in the 1978 Act between offshore drilling in the Gulf of Mexico and in other parts of the nation was widened further during the 1980s and 1990s. What began as a policy allowing offshore drilling in the Gulf under a more relaxed regulatory regime than applied elsewhere gradually became a policy of allowing offshore drilling, as a practical matter, almost *only* in the Gulf.

Court challenges quickly greeted Secretary Watt's efforts to expand offshore leasing throughout the United States. But decisively, Congress, not court rulings, ended the Secretary's plan and effectively singled out the Gulf for offshore drilling. In a series of recurring one-year moratoriums imposed on the Interior Department's annual budgets, the House Appropriations Committee effectively prohibited everything from new leasing activities to exploration and development on existing leases in areas all over the outer continental shelf outside the Gulf of Mexico and a few sub-regions off of Alaska.[61] From 1982 to 1993, the area covered by these moratoriums expanded from 0.7 million acres to 266 million.[62] The persistent unpopularity of offshore drilling outside the Gulf was underscored by President George H.W. Bush. Despite his background as a former Gulf state (Texan) oil-industry executive, he issued a memorandum in June 1990 that canceled all scheduled sales off of the California, southern Florida,* North Atlantic, Washington, and Oregon coasts and withdrew those areas from leasing until after 2000 (Alaska was not mentioned). At the same time, the President began a process to buy back existing leases in the eastern Gulf of Mexico; he established the proposed Monterey Bay Marine Sanctuary, banning oil and gas leasing there; and he prepared legislation to provide coastal communities directly affected by outer continental shelf development with a greater share of revenues from development and more voice in decisionmaking.[63]

Secretary Watt's promise of offshore drilling throughout the outer continental shelf was never realized. But he succeeded in creating an agency (MMS) and a method of leasing (via area-wide sales) that dramatically expanded the reach of offshore drilling in one place: the Gulf of Mexico. In that one oil- and gas-rich region, that same agency would increasingly struggle to keep up with the pace of industry expansion, while juggling four distinct responsibilities—offshore leasing, revenue collection and auditing, permitting and operational safety, and environmental protection—requiring different skill sets and cultures.

Impediments to Safety Regulation

The federal government has never lacked the sweeping authority required to control whether, when, and how valuable oil and gas resources located on the outer continental shelf are leased, explored, or developed. As described at the outset, the government's authority is virtually without limitation, traceable to both its authority as proprietor and as sovereign, then further bolstered by the President's inherent authority as Chief Executive and Commander-in-Chief to ensure the security of the nation. The root problem has instead been that political leaders within both the Executive Branch and Congress have failed to ensure that agency regulators have had the resources necessary to exercise that authority, including personnel and technical expertise, and, no less important, the political autonomy needed to overcome the powerful commercial interests that have opposed more stringent safety regulation.

* Although Florida's jurisdiction offshore extends to 9 nautical miles, Florida has not joined those other states in favoring significant offshore oil and gas drilling. Florida has instead supported continuing moratoriums on drilling in the outer continental shelf off the Florida coast. Nor has the State sought to promote such drilling within its territorial jurisdiction offshore. Florida's principal reason has been to protect its coast from the potential adverse environmental consequences of drilling activity, including oil spills. See Robert Gramling, *Oil on the Edge: Offshore Development, Conflict, Gridlock* (Albany, NY: SUNY Press, 1996), 13.

Safety on the Outer Continental Shelf: Increasing Risk, Absence of Necessary Regulatory Reform, and Decreasing Government Oversight Capacity

Modern oil and gas drilling rigs and producing platforms are, in effect, enormous floating machines, densely equipped with powerful engines and responsible for keeping within geologic formations large volumes of highly combustible hydrocarbons at high temperatures and pressures. For all their productivity, the rigs expose their crews to the risks of injury or death if not properly operated and maintained—risks compounded for operations conducted in progressively deeper waters, ever farther from shore.

From its creation until the Macondo well blowout, MMS was the federal agency primarily responsible for leasing, safety, environmental compliance, and royalty collection from offshore drilling.* In carrying out its duties, MMS subjected oil and gas activities to an array of prescriptive safety regulations: hundreds of pages of technical requirements for pollution prevention and control, drilling, well-completion operations, oil and gas well-workovers (major well maintenance), production safety systems, platforms and structures, pipelines, well production, and well-control and -production safety training.[64] As required by the 1978 Act, MMS also attempted to conduct both annual and periodic unscheduled (unannounced) inspections of all offshore oil and gas operations to try to assess compliance with those requirements. Agency officials have tried to meet the requirement for annual inspections of the operation of safety equipment designed to prevent blowouts, fires, spills, and other major accidents. In both annual and unannounced inspections, MMS officials used a national checklist, covering categories such as pollution, drilling, well completion, production, crane, electrical, and personal safety. Most inspections tend to cover a subset of the elements on the list. Roughly 20 percent of the matters for inspection (those for the production meters) are not related to safety.[65]

But over time, MMS increasingly fell short in its ability to oversee the offshore oil industry. The agency's resources did not keep pace with industry expansion into deeper waters and industry's related reliance on more demanding technologies. And, senior agency officials' focus on safety gave way to efforts to maximize revenue from leasing and production.

The "Safety Case" and MMS's Inability to Adopt New Practices

By the early 1990s, some MMS officials had begun to rethink the agency's approach to safety oversight of the offshore industry. In the wake of an accumulation of accidents in U.S. waters, and several devastating accidents elsewhere around the globe, they had come to appreciate that a command and control, prescriptive approach to regulation did not adequately address the risks generated by the offshore industry's new technologies and exploration, development, and production activities, including industrial expansion into deeper waters.

In March 1980, the *Alexander Kielland*—built as a drilling rig but under lease to Phillips Petroleum Company to house offshore workers at the Ekofisk Field in the Norwegian North Sea—capsized, killing 123 of the 212 people on board the "flotel." Two years

* Other federal agencies, including the United States Coast Guard, Department of Transportation, Occupational Safety and Health Administration, Environmental Protection Agency, and National Oceanic and Atmospheric Administration possess regulatory authority over discrete aspects of oil and gas operations offshore.

later, during preparation for an approaching North Atlantic storm, the *Ocean Ranger* semisubmersible drilling the Hibernia field for Mobil Oil of Canada, sank off the coast of Newfoundland; all 84 crew members were lost in the freezing-cold waters. And in July 1988, the Piper Alpha production platform operated by Occidental Petroleum 120 miles northeast of Aberdeen, Scotland, exploded and sank, killing 167 people, including 2 rescuers.[66] Although the causes of the three accidents varied, they all involved international operations of U.S.-based oil and gas companies. Common contributing factors included inadequate safety assurance, worker training, and evacuation procedures. Poor communication and confusion about lines of authority amplified the death toll in at least two of the accidents.

The Norwegian government responded to the loss of the *Alexander Kielland* by transforming its approach to industry operations. Under the new regime, rather than relying solely on prescribed operational and safety standards, the government required the industry to demonstrate thorough consideration of all risks associated with the structures and operations for a drilling or production plan. The regulator no longer "approved" operations. Shifting the burden of demonstrating safety to the operator, the regulator would instead now "consent" to development activity proceeding only upon the operator's demonstration that sufficient safety and risk management systems were in place.

The Piper Alpha accident and the subsequent investigation led by Lord Cullen had a similar impact on United Kingdom regulation. As in Norway, the previous prescriptive regulatory approach evolved into one where regulations were supplemented with a requirement for companies to demonstrate to the regulator that they had undertaken a thorough assessment of risks associated with an activity and they had adequate safety and risk management systems to address those risks.

All these foreign regulators—the United Kingdom, Norway, and Canada—had previously relied on the kind of prescriptive approach used in the United States, but in the aftermath of these fatal accidents in harsh, remote offshore environments, authorities elsewhere concluded that adding a risk-based approach was essential. They faulted reliance on the "prescriptive regulation with inspection model" for being fundamentally reactive and therefore incapable of driving continuous improvement in policies and practices.[67] According to Magne Ognedal, the Director General of the Norwegian Petroleum Safety Authority, the prescription-only model engendered hostility between the parties and put the risk—legal and moral—onto the *regulator* to accommodate changing technology, geology, and location, rather than onto the *operator*, where the responsibility rightly belonged.[68] Under the new safety-management model, minimum standards for structural and operational integrity (well control, prevention of fires and explosions, and worker safety) remained in place. But the burden now rested on industry to assess the risks associated with offshore activities and demonstrate that each facility had the policies, plans, and systems in place to manage those risks. In the United Kingdom, such risk-management plans were called a "Safety Case."

On March 19, 1989, while the Piper Alpha accident was still under review, a platform operated by ARCO exploded in the South Pass Block 60 off the Louisiana coast. An uncontrolled release of liquid hydrocarbons ignited, destroying the platform and killing seven people. An MMS investigation concluded that poor management of a repair operation was to blame: not only was there an "absence of detailed and coordinated planning for the project," there was a dearth of much-needed "oversight over contractor activities."[69]

After South Pass Block 60, the latest in the series of tragic accidents involving U.S-based companies, MMS convened an internal task force to review its offshore drilling inspection and enforcement program by October 1989. That same year, the agency also commissioned the Marine Board of the National Research Council to make recommendations for overhauling MMS's regulatory program to best fulfill its safety mission at current levels of staffing and budget.[70] The Marine Board's report, delivered in January 1990,[71] concluded that MMS's emphasis on a list of "potential incidents of non-compliance" could lead to an attitude on the part of an operator that compliance with the list equals safety, thereby diminishing "recognition of [the operator's] primary responsibility for safety."[72] The report recommended that MMS place its primary emphasis on the detection of potential accident-producing situations—particularly those involving human factors, operational procedures, and modification of equipment and facilities—rather than scattered instances of noncompliance with hardware specifications.

The Marine Board found that MMS needed to upgrade its program to address changes in the operating environment on the outer continental shelf—including its aging platforms, more complex systems and operations, activities in deeper water at greater distances from shore, and changing characteristics of operating companies. Further, the Board urged continuation of frequent and comprehensive inspections of facilities engaged in drilling and workover operations, including the conduct of the operations themselves, because of "(1) the high frequency of events per unit for these facilities as compared to production facilities, and (2) the large population of workers on each facility. . . ." Overall, the Board recommended that MMS cultivate a more proactive inspector corps and develop a greater focus on identifying emerging safety risks.[73]

Safety reform run aground. Unfortunately, by the time the Marine Board delivered its report, hardly anyone was listening. Five days after the South Pass Block tragedy in March 1989, the *Exxon Valdez* ran aground in Prince William Sound, spilling an estimated 11 million gallons of crude oil on the Alaskan shore. The Board's calls for change were thus presented to a government still preoccupied with cleanup duties in Prince William Sound and to a nation attuned to demands for requiring double-hulled tankers. Ironically, Congress enacted the Oil Pollution Act of 1990, but failed to address *any* of the regulatory deficiencies identified by the Marine Board, while *adding* to MMS's regulatory responsibilities (the agency was charged, under the Act and a supplementary Presidential Executive Order[74] with overseeing offshore pipelines and oil-spill response planning and prevention).[75] The agency's already scarce regulatory resources were stretched even thinner.

MMS nonetheless tried to take the initiative for regulatory reform. In July 1991, in response to the Marine Board report and MMS's own internal task force report, MMS published a notice requesting comments on alternative strategies to promote safety and environmental protection, specifically a requirement that outer continental shelf lessees and/or operators develop, maintain, and implement "a safety and environmental management program (SEMP), similar to the United Kingdom's Formal Safety Assessment or Norway's Concept Safety Evaluation programs."[76] Declaring that lessees and operators already had "full responsibility to plan and prepare for the overall safety and reliability of Outer Continental Shelf operations," MMS asserted that requiring SEMP would help to enhance offshore safety and environmental protection.[77] Acknowledging the difference in scale and scope of the activities between the Gulf of Mexico and the North Sea—as the Gulf consists of many more, but smaller facilities[78]—MMS sought in its request for comments "to determine the degree to which such programs exist and to draw upon that experience in establishing the requirements for a management control program."[79]

Reform indefinitely frozen in time. At the time of the Macondo blowout—almost 20 years after its original proposal—MMS had still not published a rule mandating that all operators have plans to manage safety and environmental risks. The agency's efforts to adopt a more rigorous and effective risk-based safety regulatory regime were repeatedly revisited, refined, delayed, and blocked alternatively by industry or skeptical agency political appointees.[80] MMS thus never achieved the reform of its regulatory oversight of drilling safety consonant with practices that most other countries had embraced decades earlier.

Industry served as an initial impediment to MMS reform efforts—and has largely remained so. In late 1991, the American Petroleum Institute asked the agency to postpone action in order to allow the institute itself to develop an offshore safety standard.[81] MMS agreed, and actively participated in the institute's committee-based process over the next two years. The American Petroleum Institute's "recommended practice" guidance document was published in May 1993—the same month that the UK Safety Case regulations came into force.[82] Missing from the first edition of the Institute's guideline, however, was a key element of standard process safety management[83]—nor did it even cover drilling rigs,[84] clearly an integral element in operating offshore.

MMS announced in June 1994 that it would continue evaluating the new safety concept for two additional years in order to determine whether it should be mandated[85]—a deadline it soon extended by yet another year, delaying a final decision until late 1997.[86] In the meantime, the agency urged companies to adopt safety and environmental management systems voluntarily, and hinted that wide industry participation might prevent a formal rulemaking.[87]

By this time, there appears to have been a working assumption within both the agency and the industry it was charged with overseeing that technological advances had made equipment remarkably reliable. As one MMS official put it in 1996, conceding that the best the agency could do with available resources was to encourage voluntary compliance with SEMP, "We want to approach our relationship with the offshore industry more as a partner than a policeman. We need to create an atmosphere where the primary concern is to fix the problem, not the blame"—an apt characterization for a period of "regulatory reform" in Congress and fiscal restraint nationwide.[88]

Holy Grail or Poisoned Chalice? The MMS voluntary approach to risk assessment was met with skepticism by regulators in the North Sea. At a May 1996 industry forum in Houston, Texas, an official with the UK Health and Safety Executive (HSE) compared the two safety regimes in a presentation titled *US Voluntary SEMP Initiative: Holy Grail or Poisoned Chalice?* "Last year, with the safety cases of most UK rigs already accepted well ahead of the deadline, IADC [the International Association of Drilling Contractors] told us they were pleased to be operating a premium fleet in North Sea and that HSE was not to think of relaxing the safety case requirements." By contrast, he described the voluntary SEMP scheme as an unrealistic halfway position, while noting that "both the US and the UK need more time to find out which way provides the best lasting effect."[89]

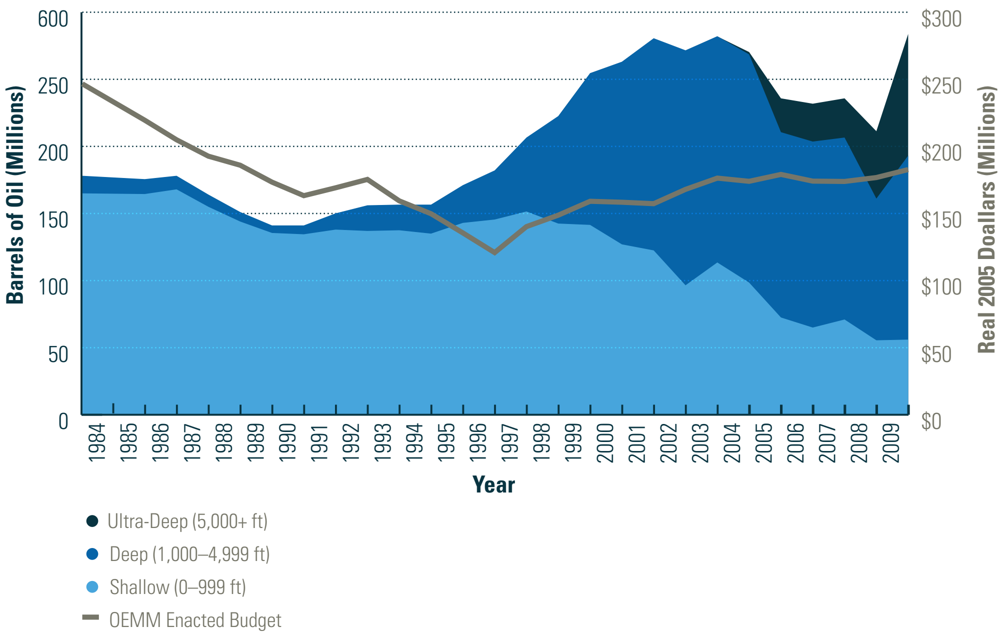
Almost a decade later, MMS was no more successful when it tried to resurrect movement toward even a weakened version of a safety and environmental management rule. In May 2006, when MMS finally proposed a rule on "Safety and Environmental Management Systems"—the successor to the long-moribund SEMP initiative—its proposed rule was limited in its reach. The proposal would have required that only 4 of the 12 widely accepted elements of industrial process safety management be put into place. Industry opposition even to this watered-down proposal was swift. And, ultimately, it was only after the Macondo well blowout four years later that the federal agency finalized a more comprehensive, mandatory SEMP rule.

Other MMS regulatory initiatives critical to safety faced strong and effective opposition. In 2003, the White House stiffly opposed MMS's efforts to update its requirements for the reporting of key risk indicators.[90] (MMS had proposed that *all* unintentional gas releases be reported, because even small gas leaks can lead to explosions.[91]) "It was like pulling teeth," one senior MMS official involved with the process told the Commission: "We never got positive cooperation" from either industry or the Office of Management and Budget.[92] The Offshore Operators Committee, an industry association, vehemently objected that the requirement would be too burdensome and not conducive to safety; MMS disagreed, yet the final rule in 2006 mandated that a gas release be reported to MMS only if it resulted in an "equipment or process shut-in," or mechanical closure—a much less complete standard.[93]

Safety Regulation on a Starvation Diet

During the 1990s, the resources available to MMS decreased precipitously just as it faced a dramatic increase in the offshore activity it was charged with overseeing—and matters only deteriorated thereafter. Perversely, MMS's budget reached its lowest point in November 1996,[94] just as major development activities in deepwater were expanding. That December, the *Houston Chronicle* reported with tragic detail an 81 percent increase in offshore fires, explosions, and blowouts in the Gulf since 1992.[95] The oil and gas industry drilled a record number of Gulf wells in 1997—many in deepwater.[96] By 1999, oil production from deepwater eclipsed production from shallow water for the first

FIGURE 3.3: MMS Budget and Gulf of Mexico Crude Oil Production, 1984-2009



Sources: "Budget Division: Congressional Budget Justifications," Bureau of Ocean Energy Management, Regulation, and Enforcement, http://www.boemre.gov/adm/budget.html; Minerals Management Service, *Deepwater Gulf of Mexico 2009: Interim Report of 2008 Highlights,* (May 2009), 71-72, http://www.gomr.boemre.gov/PDFs/2009/2009-016.pdf; U.S. Energy Information Administration, *This Week in Petroleum: Production, Proved Reserves and Drilling in the Ultra-Deepwater Gulf of Mexico,* (May 26, 2010), http://www.eia.gov/oog/info/twip/twiparch/100526/twipprint.html.

In the last twenty years, MMS's leasing, environmental, and regulatory budget decreased or remained static while deepwater oil production in the Gulf of Mexico boomed. Note: OEMM (Office of Energy and Minerals Management) has responsibility for renewable energy, leasing and environmental, resource evaluation, regulatory, and information management programs. It does not include revenue management or general administration.

time.[97] Oil production in the Gulf grew from 275 million barrels in 1990 (when only 4.4 percent of that volume came from deepwater wells) to 567 million barrels in 2009 (when deepwater wells yielded more than 80 percent of the total).[98]

Changing technology and changing industry structure outpacing regulations. As MMS's resources lagged behind the industry's expansion into deepwater drilling—with its larger-scale and more demanding technology, greater pressures, and increasing distance from shore-based infrastructure and environmental and safety resources—the agency's ability to do its job was seriously compromised.[99] Of particular concern, MMS was unable to maintain up-to-date technical drilling-safety requirements to keep up with industry's rapidly evolving deepwater technology. As drilling technology evolved, many aspects of drilling lacked corresponding safety regulations. The regulations increasingly lagged behind industry and what was happening in the field.

When industry contended that blowout-preventer stacks—the critical last line of defense in maintaining control over a well—were more reliable than the regulations recognized, warranting less frequent pressure testing, MMS conceded and halved the mandated

Drill Pipe

Waiting their turn, lengths of colored drill pipe stack up aboard a Transocean rig. Independent studies suggest that failures of crucial blowout preventer components could be caused in part by industry-driven changes to drill-pipe strength and configuration.

Derick E. Hingle/Bloomberg via Getty Images

frequency of tests.[100]* Soon afterward, a series of third-party technical studies raised the possibility of high failure rates for the blowout preventers' control systems, annular rams, and blind-shear rams under certain deepwater conditions and due to changes in the configuration and strength of drill pipe used by industry.[101] Two studies commissioned by MMS found that many rig operators, by not testing blowout preventers, were basing their representations that the tool would work "on information not necessarily consistent with the equipment in use."[102] Yet, MMS never revised its blowout-preventer regulations nor added verification as an independent inspection item in light of this new information.[103]

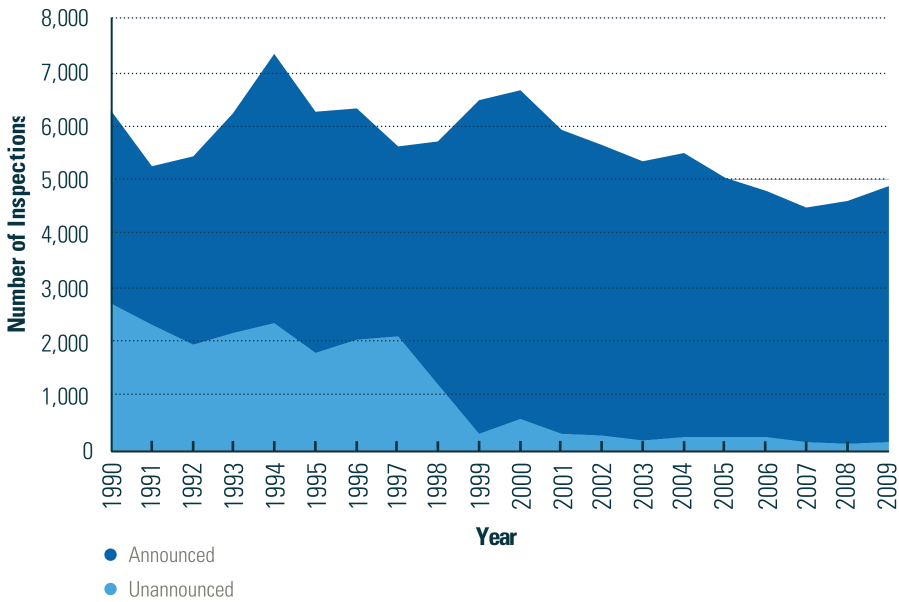
Nor did MMS adapt its regulatory framework in response to significant ways in which the oil and gas industry has changed over time. In particular, the industry has witnessed a rise in specialized service contractors, such as Halliburton and Transocean that serviced BP at the Macondo well. When the lessee directly regulated by the government is itself not performing many of the activities critical to well safety, that separation of functions poses heightened challenges for the regulator. But there was no apparent effort by MMS to respond to those challenges by making the service companies more accountable.

Permit "shopping." With increasing industry activity, MMS regulators could not possibly keep pace. The oil and gas industry works 24/7, but MMS regulators generally work regular office hours, requiring "on-call" responsibility to be assigned to individual senior engineers. Those engineers, however, work at a marked disadvantage because they cannot gain access to the permit database from off-site locations due to security concerns.[104] Even during normal business hours, the Gulf of Mexico office lacks a sufficient number of engineers to process permit reviews with necessary scrutiny. From 2005 to 2009, the number of applications for drilling permits in just the MMS New Orleans District increased 71 percent: from 1,246 to 2,136.[105] Without enough engineers in the Gulf of Mexico district office to process all the applications, some operators literally "shop around." They "contact district offices outside the appropriate jurisdictional area . . . to find an engineer who will eventually give approval."[106]

Inspections forgone. Not surprisingly, with diminished resources, MMS inspections became less effective, as the Interior Department's Inspector General reported in 1999.[107]

* "The MMS said the revised testing requirements could save industry $35-46 million per year without compromising safety." See "MMS eases rule for BOP testing," *Oil & Gas Journal*, June 8, 1998, 32.

FIGURE 3.4: MMS Inspections in the Gulf of Mexico, 1990-2009



Source: Bureau of Ocean Energy Management, Regulation, and Enforcement data upon National Commission Staff request to the Department of the Interior.

"Unannounced" or surprise inspections of offshore oil and gas activity grew increasingly rare over time. Less than 3% of MMS inspections conducted in 2009 were unannounced.

The frequency of unannounced inspections plummeted.[108] Although the raw incident data are online, MMS last produced an analysis of offshore incidents—critical data for promoting the safety of offshore operations—for calendar year 2000.[109] And MMS's progressive reduction in oversight relative to the level of industry activity occurred just as the industry struggled to find highly trained staff needed to work the expanding population of deepwater drilling rigs.[110] Precisely when the need for regulatory oversight intensified, the government's capacity for oversight diminished.

Overlaps and "underlaps." The lack of resources extended beyond MMS. The United States Coast Guard is responsible for regulating the "safety of life and property on Outer Continental Shelf (OCS) facilities, vessels, and other units engaged in OCS activities."[111] Because most drilling rigs and even some production platforms fall under the definition of "vessels," part of the responsibility for regulating their safe operation (and full authority for certifying their seaworthiness) is within the jurisdiction of the Coast Guard.[112] But just when the need for Coast Guard oversight increased during the 1990s—as industry drilled in deeper waters farther offshore and used more ambitious floating drilling and production systems—it, too, faced more severe budgetary restraints. Accordingly, the Coast Guard failed to update its marine-safety rules—the last major revision was in 1982[113]—to reflect the industry's new technology. The resource plight worsened further following the terrorist attacks of September 11, 2001, given the nation's overriding need to focus on border and port security. The Coast Guard's "solution"—to transfer much of its responsibility for fixed platform safety to MMS in 2002[114]—eerily echoed earlier cycles of expanding MMS's mandate in the face of inadequate resources, stretching its capabilities thinner still. The practical effect of the Coast Guard and MMS's shared responsibility for offshore safety has been the presence of "overlaps" in jurisdiction that have required the renegotiation of informal interagency agreements ever since 1989—the continuance of which has left MMS with "underlaps" in resources.[115]

The Culture of Revenue Maximization

When Interior Secretary Watt moved regulatory oversight of offshore energy exploration and production to a new entity that was also responsible for collecting revenue from the activity it regulated, he created a new agency that inexorably came to be dominated by its focus on maximizing that revenue.

For at least the past 15 years, every former MMS Director has freely acknowledged that the royalty issues have taken most of the Director's time—at the expense of offshore regulatory oversight.[116] In 1995, as the United States faced global competition for oil exploration and development capital during a period of low prices, Congress enacted the Deep Water Royalty Relief Act.[117] It provided a suspension of royalty payments on a portion of new production from deepwater operations.

But when prices and volumes increased, the sheer amount of money at stake—literally billions of dollars (MMS total onshore and offshore revenues for 2008 were $23 billion[118])—compelled even greater attention, as the White House, members of Congress, and certainly the states each advanced competing notions of how those sums might best be spent.* Litigation, new regulations, and legislation designed to increase one party's relative share of such massive sums have been a constant feature of managing the flow of royalties from onshore and offshore energy production. Such disputes have invariably been controversial, politically sensitive, and time-consuming for MMS decisionmakers.[119]

Agency leadership and technical expertise. Agency personnel naturally look to agency leadership to signal what constitutes their primary mission, including the expertise and experience that such leaders bring with them. In the case of MMS, those signals were profoundly disturbing, yet nonetheless consistent over time. No one who has led MMS since it was created almost 30 years ago has possessed significant training or experience in petroleum engineering or petroleum geology, or any significant technical expertise related to drilling safety.

In the absence of a clear statement from the top about the necessity for such expertise to ensure drilling safety, it should be no surprise that MMS personnel have suffered from the loss of essential expertise throughout their ranks. Indeed, the lack of requisite training is abysmal. According to a recent survey conducted at the request of the Secretary of the Interior, "[a]lmost half of the [MMS] inspectors surveyed do not believe they have received sufficient training." MMS, unlike Interior's Bureau of Land Management (which

* Because of a bureaucratic mistake within Interior, however, federal lease sales held in 1998 and 1999 failed to include price thresholds in each lease, meaning that those lessees received relief from royalty payments even though higher oil prices made such relief wholly unnecessary. The Government Accountability Office has estimated that the error could cost the government at least $10 billion and perhaps as much as $80 billion. Government Accountability Office, "Oil and Gas Royalties – Royalty Relief Will Likely Cost the Government Billions, but the Final Costs Have Yet to Be Determined" (January 18, 2007), 3, 5.

inspects onshore oil and gas drilling operations), has no "oil and gas inspection certification program" and no exam "is required of each inspector in order to be certified." MMS "does not provide formal training specific to the inspections process, and does not keep up with changing technology. Some inspectors noted that they rely on industry representatives to explain the technology at a facility."[120]

The Macondo well blowout makes all too clear the cost of such a departure from the standards of excellence that the nation expects from its public servants. As described in Chapter 4, the MMS personnel responsible for reviewing the permit applications submitted to MMS for the Macondo well were neither required nor prepared to evaluate the aspects of that drilling operation that were in fact critical to ensuring well safety. The regulations did not mandate that MMS regulators inquire into the specifics of "rupture disks," "long string" well designs, cementing process, the use of centralizers, lockdown sleeves, or the temporary abandonment procedures (see Chapter 4). And, no doubt for that same reason, the MMS personnel responsible for deciding whether the necessary drilling permits were granted lacked the expertise that would have been necessary in any event to determine the relative safety of the well based on any of these factors.*

Agency integrity and pockets of corruption. The preoccupation with revenues did not merely divert MMS leaders' attention from drilling safety. It also allowed the ethical culture to degenerate in a few isolated offices, leading to serious charges of abuse of government authority and even charges of criminal misconduct by a few individuals. This conduct was far removed from the daily work of almost all those agency personnel who performed regulatory oversight of offshore drilling. But the conduct of a few working elsewhere in the agency unfairly cast a cloud over the agency as a whole, especially in the immediate aftermath of the Macondo well blowout, providing a ready reminder of the critical importance of public trust in the management of the nation's resources.

The most notorious example arose from the "royalty in kind" program, based in Denver, Colorado. Under the program, MMS exercised its option to accept royalty payments "in kind" rather than in cash.† A September 2008 Inspector General's report implicated more than a dozen employees in the Denver royalty-in-kind office in unethical and criminal conduct.[121] Those MMS staff had also socialized with, and received a wide array of gifts from, companies with whom they were conducting business. The Inspector General further acknowledged that although "99.9 percent of [Interior] employees are hard-working, ethical, and well-intentioned[,] . . . the conduct of a few has cast a shadow on an entire bureau."[122]

Nor was unethical conduct limited to MMS's revenue collections. It extended to some of those who worked on overseeing offshore oil and gas activities in the Gulf of Mexico. An Inspector General's investigation in 2010 revealed that prior to 2007, "a culture of

* See, *e.g.*, Written submission to the National Commission from MMS permitting official, November 5, 2010 ("I did not know they were using nitrogen foamed cement. . . . [I]t would not have mattered under the regulations. We do not do any evaluations of types of cement.") *id.* ("I do not recall them informing me as to why they decided not to drill to that length. . . . We do not need an explanation as to why a well is not drilled to the proposed depth.").; *id.* ("At the time I reviewed the APD [drilling permit application], my knowledge of rupture disks was limited to what I had learned from the previous drilling engineer when working with him learning the review process."); *id.* ("I did not receive training on lock down sleeve setting procedures.").

† The royalty-in-kind program allowed MMS to market the natural gas or oil to establish a reference against which it could evaluate industry reports of their market value.

accepting gifts from oil and gas companies was prevalent throughout the MMS Lake Charles[, Louisiana] office." "[A] number of MMS employees at th[at] district office admitted to attending sporting events prior to 2007 in which oil and gas production companies sponsored teams, as well as receiving lunches and accepting gifts." The investigation found that one employee had conducted inspections on a company's oil platforms while in the process of negotiating (and later accepting employment) with the company.[123] Here again, the actions of a few damaged the reputation of the agency as a whole, and demoralized the vast majority of MMS employees who avoided such conflicts.[124] In January 2009, only days after taking office, Secretary Salazar met with MMS employees and announced an ethics reform initiative in response to the problems identified at MMS and elsewhere in the agency.[125]

Mismanagement and Misdirection

Perhaps because of the cumulative lack of adequate resources, absence of a sustained agency mission, or sheer erosion of professional culture within some offices, MMS came progressively to suffer from serious deficiencies of organization and management: the fundamental traits of any effective institution. According to the Outer Continental Shelf Safety Oversight Board,* MMS lacks "a formal, bureau-wide compilation of rules, regulations, policies, or practices pertinent to inspections, nor does it have a comprehensive handbook addressing inspector roles and responsibilities." As a result, the Board concluded, "policies and enforcement mechanisms vary among the [Gulf of Mexico] districts and the regions, and there is no formal process to promote standardization, consistency, and operational efficiency."[126]

The Safety Oversight Board singled out MMS's handling of inspections for pointed criticism. For example, management promoted inspections by single inspectors in order to increase the total number of inspections, even though "most inspectors interviewed said that two-person teams would increase efficiencies, eliminate reliance on an operator representative for observations on safety tests, improve the thoroughness of the inspection, and reduce the ability of operators to successfully pressure an inspector not to issue [a citation]." The Board's interviews revealed "staff concerns regarding a perceived emphasis on the quantity rather than quality of inspection."[127]

The agency's management shortcomings were underscored, and compounded, by lack of communication and inconsistencies among its three regional offices for the Gulf of Mexico, the Pacific, and Alaska. The directors of each regional office naturally adapted practices to best suit the specific characteristics and needs of the region. But by acting in parallel fashion, with little coordination in decisionmaking and resource allocation, program implementation, regulatory interpretation, and enforcement policies became inconsistent, undermining the integrity of MMS's work.[128] For example, the Safety Oversight Board found that "the Pacific Region employs 5 inspectors to inspect 23 production facilities—a ratio of 1 inspector for every 5 facilities. By contrast, the [Gulf of Mexico Region] employs 55 inspectors to inspect about 3,000 facilities—a ratio of 1 inspector for every 54 facilities." [129]

* Secretary Salazar created the Outer Continental Shelf Safety Oversight Board in the immediate aftermath of the Macondo well blowout and charged the Board with reviewing the effectiveness of MMS's management. The Board issued its report on September 1, 2010.

Ultimately, MMS was unable to ensure that its staffing capabilities and competencies kept pace with the changing risks and volume of offshore activity. As the Safety Oversight Board concluded, the Gulf of Mexico "district offices did not have a sufficient number of engineers to efficiently and effectively conduct permit reviews."[130] As the Chief of the U.S. Geological Survey's Conservation Division had warned nearly 30 years earlier,[131] salaries—for engineers stuck in the midranges of the federal pay scale—were far too low to attract individuals possessing the experience and expertise needed to oversee the increasingly complicated oil and gas drilling activities in the deepwater Gulf.[132] At the most elementary level, MMS frequently lacked defined qualifications that new employees must meet before they start performing their jobs, or clear procedures for on-the-job training. The Board report further observed that the "amount of time and the structure of this training vary from office to office and from inspector to inspector," and it concluded that the on-the-job training "does not address the need for substantive, consistent training in all aspects of the job."[133]

An Environment Unfavorable to Responsible Drilling

Erosion of Environmental-Protection Safeguards in the Gulf of Mexico

Even as oversight of drilling safety became less effective while the industry pursued more demanding deepwater plays in the Gulf of Mexico, environmental safeguards eroded, too—putting the rich natural resources of the Gulf waters and the surrounding coasts at increasing risk.

The legislative promise. The 1978 Outer Continental Shelf Lands Act Amendments promised full consideration of concerns for environmental protection. The Act provides that "[m]anagement of the outer Continental Shelf shall be conducted in a manner which considers economic, social, and environmental values of the renewable and nonrenewable resources contained in the outer Continental Shelf, and the potential impact of oil and gas exploration on other resource values of the outer Continental Shelf and the marine, coastal, and human environments."[134] It further requires that the timing and location of exploration, development, and production of oil and gas take environmental factors into consideration, including: existing ecological characteristics; an equitable sharing of development benefits and environmental risks among the regions; the relative environmental sensitivity and marine productivity of areas; and relevant environmental and predictive information.[135] Based on an evaluation of these and other factors, the Act directsthe Secretary of the Interior to select the "timing and location of leasing, to the maximum extent practicable, so as to obtain a proper balance between the potential for environmental damage, the potential for the discovery of oil and gas, and the potential for adverse impact on the coastal zone."[136]

A host of other laws, many enacted by Congress during the 1970s surge of environmental legislation, buttress these promised priorities. Of particular relevance to oil and gas leasing on the outer continental shelf is the National Environmental Policy Act requirement that federal agencies prepare environmental impact statements for all major federal actions significantly affecting the human environment.[137] Those detailed statements must include not only discussion of the immediate adverse impacts on the natural environment that might result from the federal action, but also the "socio-economic"* effects of those impacts.[138] The Magnuson-Stevens Fishery Conservation and Management Act requires agencies to analyze the potentially adverse impacts of oil and gas activities on fish habitat and populations, and provide conservation measures to mitigate those impacts.[139] The Endangered Species Act requires federal agencies to determine the potential adverse impact of oil and gas activities on endangered and threatened species, limits activities that harm individual members of such species, and bars altogether activities that place such species in jeopardy.[140] The Marine Mammal Protection Act imposes limits on activities that injure or even harass marine mammals.[141] The National Marine Sanctuaries Act requires consultations to guard against harm to marine sanctuary resources from oil and gas leasing activities.[142] The federal Clean Water Act imposes permitting requirements on any discharge of pollutants into navigable waters from such activities.[143] And, the Oil Pollution Act of 1990,[144] supplemented by a Presidential Executive Order,[145] imposes a panoply of oil-spill planning, preparedness, and response requirements on fixed and floating facilities engaged in oil and gas exploration, development, and production on the outer continental shelf.

Promise vs. practice. But some of these apparent statutory promises dim upon closer examination. The Outer Continental Shelf Lands Act routinely requires consideration of environmental protection concerns in leasing location and timing—but ultimately gives the Secretary of the Interior tremendous discretion in deciding what weight to give those concerns.[146] The balance ultimately struck depends largely on the politics of the moment. The Secretary can assign significant weight to environmental protection concerns—or not.

And in fact, parts of the 1978 Act arguably stack the deck *against* full consideration of environmental concerns. For instance, the law provides that the Secretary must approve a lessee's exploration plan within 30 days of submission.[147] If environmental review is to occur after plan submission, that timetable effectively precludes the kind of exacting review necessary to ensure that the Act's environmental safeguards can be achieved. It would, in effect, be a statement by Congress that the rush to energy exploration is too important to be delayed.

The Act also expressly singles out the Gulf of Mexico for less rigorous environmental oversight under NEPA. As a result of political compromise with oil and gas interests, the Act exempts lessees from submitting development and production plans (which include environmental safeguards) for agency approval. Accordingly, Gulf leases, unlike those applicable to other offshore areas, are not subject to the requirement of at least one NEPA environmental impact statement for development plans for a particular geographic area.[148]

None of the other statutes includes such a stark exception, but their effects still are more limited than it might at first seem. For instance, both the Endangered Species Act and the

* As the Macondo well blowout makes clear, the socio-economic effects of an oil spill are hardly an incidental concern. As described in Chapter 6, the economic costs of the spill to the Gulf states can be measured in the billions of dollars. Yet absent careful NEPA review, there are no assurances that these potential consequences of a decision to lease, explore, develop, or drill in any given location will be carefully considered by the governmental decisionmaker before the decision is made.

Clean Water Act impose tough substantive limits on activities. But each has only a narrow, discrete focus and statutory trigger: threats to endangered or threatened species or their critical habitat under the Endangered Species Act or, under the Clean Water Act, only the incidental aspects of oil and gas activities that discharge pollutants into navigable waters (unless, of course there is an oil spill).

Neither the Magnuson-Stevens Act nor the Marine Sanctuaries law imposes any mandatory substantive limitation on oil and gas activities offshore. Each instead authorizes the National Oceanic and Atmospheric Administration (NOAA) to make recommendations to MMS about possible adverse environmental impacts (to fish habitat and marine sanctuaries) and appropriate conservation measures. Congress clearly assigned NOAA this central role because it is the federal agency most expert on ocean science and has a clear mission to serve as the steward safeguarding the nation's ocean resources. But, notwithstanding that assignment, neither law provides any corresponding obligation on the part of MMS to heed NOAA's advice. MMS can, and has, on occasion given little or no weight to NOAA's views; according to NOAA officials, that causes some NOAA scientists to expend fewer resources on generating such views.

As a result, although the various laws create the potential for comprehensive environmental protection in oil and gas drilling on the outer continental shelf, neither alone nor in combination do any of the laws come close to *ensuring* a reasonable level of overall environmental protection applicable to all aspects of oil and gas activities on the outer continental shelf. Whether they have achieved their statutory objectives has therefore historically depended instead entirely on the discretionary determinations of MMS officials.

Limiting NEPA. The Department of the Interior and MMS also took a series of steps that further limited the potential for NEPA to ensure government decisions were based on full consideration of their environmental consequences. Erosion of NEPA's application to offshore oil and gas activities began, as noted, when Congress exempted a category of leasing activities in the Gulf of Mexico from NEPA review. The Interior Department, however, subsequently took that legislative exemption and unilaterally expanded its scope beyond those original legislative terms.

Although the 1978 Act exempted only the Interior Department's review of a lessee's "development and production plan" from the environmental impact statement process, Interior unilaterally extended that exemption. In January 1981, the Department promulgated final rules declaring that exploration plans in the central and western Gulf of Mexico were "categorically excluded" from NEPA review.* At that same time, the Department also categorically excluded from NEPA review applications to drill wells (for exploration or subsequent development and production of oil and gas) "when said well and appropriate mitigation measures are described in an approved exploration plan, development plan, or production plan."[149] In 1986, MMS scaled back the categorical

* The President's Council on Environmental Quality, which is responsible for the administration of NEPA, has promulgated a regulation that permits agencies to create "categorical exclusions" from NEPA review for categories of minor activities that can be reasonably assumed in advance not to have significant environmental impacts. See 40 C.F.R. § 1508.4.

exclusion to account for the possibility that NEPA review would be needed for these activities in certain narrowly defined "extraordinary circumstances." Extraordinary circumstances include those actions that have highly uncertain and potentially significant environmental effects or involve unique or unknown environmental risks.[150]

But because MMS personnel were apparently reluctant to conclude that such extraordinary circumstances were present, the rule in practice in the Gulf of Mexico was the categorical *exclusion*—rather than the *exception* to that exclusion. MMS staff have reported that leasing coordinators and managers discouraged them from reaching conclusions about potential environmental impacts that would increase the burden on lessees, "thus causing unnecessary delays for operators." The Safety Oversight Board also noted that "[s]ome [MMS] environmental staff also reported that environmental assessments for smaller operators may be minimized if the [Regional Office of Field Operations] manager determines that implementing the recommendation may be too costly."[151]

With regard to NEPA specifically, some MMS managers reportedly "changed or minimized the [MMS] scientists' potential environmental impact findings in [NEPA] documents to expedite plan approvals." According to several MMS environmental scientists, "their managers believed the result of NEPA evaluations should always be a 'green light' to proceed." In some cases, there may also have been built-in employee financial incentives that "distort[ed] balanced decision-making" to the extent that "[e]mployee performance plans and monetary awards [were] . . . based on meeting deadlines for leasing or development approvals."[152]

Finally, just as a matter of sheer practicality, MMS personnel plainly lacked the substantial resources that would have been required to engage in meaningful NEPA review in light of the extraordinary expansion of leasing activity in the Gulf. There were literally hundreds of exploration, development, and production plans, as well as individual permit drilling applications to be processed. No President ever sought for MMS the level of resources that would have been required to prepare individual assessments concerning whether each of those activities required an environmental impact statement, let alone such a statement for those that did. Nor did Congress. It should be no surprise under such circumstances that a culture of complacency with regard to NEPA developed within MMS, notwithstanding the best intentions of many MMS environmental scientists.

The Macondo Well

The gap between the protections promised by environmental statutes and regulations and actual practice is fully illustrated in the review and permitting of the Macondo well itself. MMS engaged in no NEPA review of the well's permitting, and neither MMS nor other federal agencies gave significant attention to the environmental mandates of other federal laws.

NEPA. MMS performed no meaningful NEPA review of the potentially significant adverse environmental consequences associated with its permitting for drilling of BP's exploratory Macondo well. MMS categorically excluded from environmental impact review BP's initial and revised exploration plans—even though the exploration plan could have qualified for an "extraordinary circumstances" exception to such exclusion, in light of the abundant deep-sea life in that geographic area and the biological and geological complexity of that same area.[153] MMS similarly categorically excluded from any NEPA review the multiple applications for drilling permits and modification of drilling permits associated with the Macondo well. The justification for these exclusions was that MMS had already conducted NEPA reviews for both the Five-Year Program and the Lease Sale that applied to the Macondo well. The flaw in that agency logic is that both those prior NEPA reviews were conducted on a broad programmatic basis, covering huge expanses of leased areas of which the Macondo well was a relatively incidental part. Neither, moreover, included a "worst case analysis" because the President's Council on Environmental Quality had eliminated the requirement for such analysis under NEPA for all federal agencies in 1986.[154] As a result, none of those prior programmatic reviews carefully considered site-specific factors relevant to the risks presented by the drilling of the Macondo well.*

Fishery conservation and management. Under the Magnuson-Stevens Fishery Conservation and Management Act, federal agencies must consult with NOAA on all activities (or proposed activities) authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat. For the Gulf of Mexico, accordingly, NOAA prepared a "programmatic" Essential Fish Habitat Consultation for the entire Gulf.[155] To similar effect, MMS complied with the Magnuson-Stevens consultation requirement by preparing Essential Fish Habitat Assessments that looked at offshore oil and gas leasing activities in the Gulf broadly.[156] Neither NOAA nor MMS considered the possible adverse impacts of any one well, such as the Macondo well, in isolation. Nor would it have been practical for them to do so in light of their understandable focus on possible cumulative impacts on fish populations from many offshore leasing activities. What is more telling, however, is that to the extent that the MMS Assessment identified potential threats to essential fish habitat and marine fishery resources from oil spills, both NOAA and MMS ultimately relied exclusively on conservation measures included in oil-spill response plans prepared by the oil and gas industry pursuant to the Oil Pollution Act of 1990 to address those threats.[157] For the Macondo well, both agencies assumed that BP's plan would adequately address those threats and therefore there was no need to seek to do so directly through the Magnuson-Stevens Act. There was, however, little reason to assume that those plans were in fact up to the task.

Oil Pollution Act of 1990 and Oil Spill Response Plans. Under the Oil Pollution Act of 1990, as supplemented by a Presidential Executive Order, MMS is responsible for oil-spill planning and preparedness as well as select response activities for fixed and floating facilities engaged in exploration, development, and production of liquid hydrocarbons and for certain oil pipelines. The agency requires all owners or operators of offshore oil-handling, storage, or transportation facilities to prepare Oil Spill Response Plans. MMS regulations detail the elements of the response plan (an emergency-response action plan, oil-spill response equipment inventory, oil-spill response contractual agreements, a

* For instance, bluefin tuna are both commercially vital and biologically significant as predators in the Gulf. But in the relevant Five-Year (2007–2012) Programmatic Environmental Impact Statement on the entire offshore leasing program—covering the *entire* outer continental shelf of the United States—MMS discusses potential impacts of leasing activities on bluefin tuna in one sentence. Subsequent MMS environmental impact statements for lease sales within the Gulf of Mexico contained *no* significant or geographically-focused analysis of the potential impacts on bluefin tuna. And, in finally permitting the drilling of the Macondo well, MMS categorically excluded the action from any NEPA review, and thus conducted no analysis of the potential impacts of drilling on bluefin tuna, based on the rationale that it had already adequately reviewed environmental impacts in its prior reviews.

calculation of the worst-case discharge scenario, plan for dispersant use, in-situ burning plan, and information regarding oil-spill response training and drills).[158] The emergency-response plan is supposed to be the core of the overall plan, and in turn is required to include information regarding the spill-response team; the types and characteristics of oil at the facilities; procedures for early detection of a spill; and procedures to be followed in the case of a spill.[159]

But neither BP, in crafting its Oil Spill Response Plan for the Gulf of Mexico applicable to the Macondo well, nor MMS in approving it, evidenced serious attention to detail.[160] For instance, the BP plan identified three different worst-case scenarios that ranged from 28,033 to 250,000 barrels of oil discharge and used identical language to "analyze" the shoreline impacts under each scenario.[161] To the same effect, half of the "Resource Identification" appendix (five pages) to the BP Oil Spill Response Plan was copied from material on NOAA websites, without any discernible effort to determine the applicability of that information to the Gulf of Mexico. As a result, the BP Oil Spill Response Plan described biological resources nonexistent in the Gulf—including sea lions, sea otters, and walruses.*

Even more troubling, the MMS Gulf of Mexico Regional Office approved the BP plan without additional analysis. There is little in that approval to suggest that BP and MMS gave close scrutiny to the contents of the Oil Spill Response Plan. The Regional Office's routine practice was to review and approve oil-spill response plans within 30 days of their receipt. Absent any legal requirement to do so, the office did not distribute submitted plans to other federal agencies for review or comment, nor did it seek public review or comment.

The inescapable conclusion is striking, and profoundly unsettling. Notwithstanding statutory promises of layers of required environmental scrutiny—by NEPA, the Magnuson-Stevens Act, the Outer Continental Shelf Lands Act, and the Oil Pollution Act—and the potential application of some of the nation's toughest environmental restrictions—the Endangered Species Act and Clean Water Act—*none* of these laws resulted in site-specific review of the drilling operations of the Macondo well. The agency in charge, MMS, lacked the resources and committed agency culture to do so, and none of the other federal agencies with relevant environmental expertise had adequate resources or sufficient statutory authority to make sure the resulting gap in attention to environmental protection concerns was filled.†

Federal oversight of oil and gas activities in the Gulf of Mexico—almost the only area where substantial amounts of drilling were taking place—took a generally minimalist approach in the years leading up to the Macondo explosion. The national government failed to exercise the full scope of its power, grounded both in its role as owner of the natural resources to be developed and in its role as sovereign and responsible for ensuring the safety of drilling operations. Many aspects of national environmental law

* The BP plan does not appear to be an aberration. It was prepared by a contractor who also prepared the Gulf of Mexico plans for Chevron, ConocoPhillips, ExxonMobil, Shell, and other companies operating in the Gulf. The result is four nearly identical plans that repeat the same mistakes found in the BP plan applicable to the Macondo well.

† The President's decision in March 2010 to expand offshore oil and gas leasing is a more recent example of the absence of full consideration of environmental protection concerns. According to their testimony before the Commission in August 2010, the White House did not ask either the Chair of the President's Council on Environmental Quality or the Administrator of NOAA to be directly involved in reviewing the plans before the President's decision. See Testimony of The Honorable Nancy Sutley, Chair, Council on Environmental Quality, and The Honorable Jane Lubchenco, Administrator, NOAA, Hearing before the National Commission, August 25, 2010.

were ignored, resulting in less oversight than would have applied in other areas of the country. In addition, MMS lacked the resources and technical expertise, beginning with its leadership, to require rigorous standards of safety in the risky deepwater and had fallen behind other countries in its ability to move beyond a prescription and inspection system to one that would be based on more sophisticated risk analysis.

In short, the safety risks had dramatically increased with the shift to the Gulf's deepwaters, but Presidents, members of Congress, and agency leadership had become preoccupied for decades with the enormous revenues generated by such drilling rather than focused on ensuring its safety. With the benefit of hindsight, the only question had become not whether an accident would happen, but when. On April 20, 2010, that question was answered.