OFFSHORE ENERGY CENTER

ORAL HISTORY PROJECT

Interviewee: HOWARD SHATTO

Date: October 2, 1999

Place: Houston, Texas

Interviewer: Tyler Priest

Side A

TP: We are conducting this interview of the Offshore Hall of Fame 1999 inductees. I thought we would start with your background, your educational experience, how you came to Shell Oil, and how you got involved in offshore technology.

HS: We're going way back to the beginning! I was born in Minnesota. I ended up in Houston. I went to college at Georgia Tech and Yale. I finished Yale, electrical engineering, in February, 1946, and interviewed with a couple of companies. Humble, now Exxon, was one. They offered a job in the pipeline department. I went to Shell's pipeline department. They said they weren't hiring but they thought there was some opportunity in the production department where they were interviewing.

TP: This would have been about what year?

HS: March, 1946. They offered me a job and offered to pay a little bit more than Humble. And they had a two-year training program in the mechanical engineering department, in equipment engineering. I thought that would be very worthwhile, so I went to work for Shell.

By that time, I had gone through college with a bachelor's. I had become an officer in the Marine Corps and I had been away from home for three years. I had to get my parents' consent to go to work for Shell because I hadn't quite reached 21 yet. I went to college in the Marine Corps during the war, and they did it pretty fast.

Anyway, I started with Shell and went through the training program.

TP: And you were down in Houston?

HS: I started at Houston but went to the training program in west Texas, east Texas and Louisiana. My first job assignment was New Orleans, working offshore. In 1948, my first job with Shell was to build/put together Shell's first diesel electric rig, because I was an electrical engineer. It was designed as a swamp rig to work in dredge canals, inland canals, but floating vessels sitting on bottom to drill. Shell had some leases offshore and decided this would be their first try. So the barge itself was 10 feet deep, top to bottom -- main deck to keel. And the water depth we were going into was 10 feet. We had to build up a pad of oyster shells to put the rig down on, so we had a couple of feet of preboard. And we sank three LSMs, landing ships,

surplus, to the seaward of this rig and anchored it with anchor chains and driven piling, H-beams as piling. And we drilled. I think it was the third one . . . made a discovery . . .

TP: This would have been on the East Bay, or was this in even more shallow water?

HS: No, it was in Main Pass. It is actually a little bit east of East Bay around the site of the Mississippi Delta. On the third well it was drilling, it had a blowout. It was blowing from a gas sand at about 2000-2500 feet. It blew for 21 days. My boss, John Pittman, came running down the hall of the New Orleans office. He said, "Get out to the airport, get the airplane." We had a Pusher Republic CB and a pilot, Ed Miramon. He said, "Get out there, there was somebody hurt on the rig. Go down, pick him up, bring him back to the hospital." So I got out to the airport. We took off at New Orleans airport and 85 miles south, we saw this pillar of smoke. So we headed straight for that. The California company had picked up the fellow that was slightly burned, not seriously, near PVY and brought him back. So we just flew around the top of the flames at about 500 feet.

The well burned for 21 days and, at the end of that time, the well cratered. The rig, the landing ships, and all sank below the surface. After things settled down, we went in with a sounding line. There was a cone-shaped hole just over 100 feet deep in the center, almost a perfect cone shape 1500 feet in diameter. And there was no sign of the rig or the ships. The fire made the cover of Life magazine in March or so of 1949. But that was my first effort at deep water, which was 10 feet deeper than the barge also.

TP: Deep water is always the water depth past the deepest platform!

HS: That is true. Present technology, yes.

TP: That is kind of an inauspicious start.

HS: It was. The cover of Life magazine, all bad, of course.

TP: That's right! And did you stay in New Orleans? Were you in the Delta division at this point? Were you working in the Delta division?

HS: Actually, I was in the area office, and it was before we even started the district office. It was my first offshore operation. Later, it was organized and people

were put into it. East Bay was a big discovery. I worked on Rig 10 a bit after that.

At the end of 1950, I went back into the Marine Corps again. This was during the Korean war and I went to Quantico to learn to become the officer that I already the commission for. While there, they immediately took all of us out of the class I was in and put us to teaching, as they had six thousand trainees coming through that summer. For a few months after that,I was working in the Public Works office at Quantico. They had a lot of electrical reconstruction work and needed an electrical engineer. They found out I was one, so they got me to do that.

When I left the Marine Corps, Shell moved me to New York to head office, and I worked there for about four years. Then I worked on gas gasoline plants. Incidentally, I was working on control systems for gas gasoline plants along with production operations automation of oil fields. And in the course of it,I learned about controls, control systems, and proportional integral-derivative controllers that were used for controlling pressure and level temperature and whatnot in gas plants. Those were refinery type controls which later turned out to be very useful in production operations where you don't often get to use that type of controller.

TP: So you had a wide ranging experience within Shell.

HS: Yes. It was still oil production and gas plants. From head office, I went to Houston to the lab for a couple of years and set up a little group there on instrumentation. After about two years, I was moved to the west coast to become Division Engineer in Long Beach. It was conventional, for the most part, except that they were just starting steam floods. We put in the first steam flood operations there. That was interesting and new.

After I had been in Long Beach for only about one year, I was asked to come to the Marine Division in Los Angeles because they were starting some work to build a ship that was going to be dynamically positioned. They were going to start developing the underwater completion. So I went up there and was asked to become the Division Engineer in the Marine Division, and that is what I did.

TP: Was this a really secretive operation?

HS: Extremely secretive.

TP: I remember Collid(telling me about the work he was doing

in New Orleans at the time and that it was ultra-secret.

HS: Ours was at least that secret and maybe more. We had grocery shopping carts into which we put all the things we were working on at night, and wheeled them into a bank vault. We had a big bank vault door with a combination lock on it. We would get it all out in the morning and would go to work. It was an unusual time. They took our names out of the telephone book. We had just disappeared altogether, I guess. We were working in the basement in the Shell office in Los Angeles.

TP: So were you working on developing a dynamic positioning system, or had dynamic positioning already been developed at that point?

HS: No, it hadn't. The AMSOC Committee of the National Science Foundation -- American Miscellaneous Society I think it was called, Willard Bascum was active in it -- had conceived the idea of using propellers to hold still.

TP: This is with Mohole?

HS: That was the first idea towards Mohole and they wanted to see if they could do that. And eventually, they didtut four on the Cus 1, Global Marine's Cus 1. They did prove that with ma al controls, you could old a vessel still in very deep water. This was 11,000 feet of water. They had buoys out about 400 yards, on all sides of the ship. All we had to do was stay between the buoys, so it was kind of like boating. They had people there driving the ship all the time to hold it still.

When I first got into our Los Angeles office to work on this underwater completion development, they had already decided to build a ship, had contracted to build a little core drill ship, called the "Eureka", I had 400 ton displacement, 400 horsepower on one, 200 horsepower asmuthing thruster at the bough and one at the stern. They were going to control it manually also. They were going to have a lever to tell the bough thruster to turn right or turn left, and a Selzer repeater that would tell which way it happened to be pointing at any given time. The same thing went for the stern propeller. Then each one would have a throttle that would control how fast the propeller ran, stern and bough. A tilt meter scope with a blip in the center of it would tell us where we were in X and Y position, and a compass to tell us which way the vessel was pointed. All the operator had to do was look at the compass and the blip on the XY and tell where the ship was with respect to where it should be. Then they could look at which way each of the thrusters happened to

be pointed and turn them to a more correct position and control their throttles. I thought that was beyond human comprehension.

TP: It seemed like a tough task to ask someone to do.

HS: In reasonable water depths like a couple of hundred feet instead of 11,000 feet, I thought we were just whistling Dixie! So I convinced our manager, Bill Bates, and his boss, Sam Bolby, vice-president, that we had to go for the automatic control which I had already conceived and had a bid from Hughes Aircraft to build for us. It was going to cost us $50,000. At first, they said, "Well, we've already got too much electronic stuff on this ship. We really don't think we need that." They said, "We have such good operations people. They will need to take their shoes off and with their toes _____, a piece of cake."

TP: Was it much of a technological leap to go from manual to automatic controls?

HS: Yes. We had to figure out a way to combine what we needed to do in the way of rotation. We needed to control three things: heading, longitudinal position and lateral position. The dynamics of each is quite different. Sideways, you have to move a lot of water. Front and back, you don't. So the mass of the vessel is different. But how do you get a system to decide which way to point the thrusters and how hard to push? That was the trick. Once I had done that, it was easy to put controllers on it. Again, those were the controllers I learned about in the gas plant business that controlled temperature, pressure and that sort of thing. Instead of that, we just had a control heading in X and Y position, three controllers. We hooked it up and put it to work. And it was smashingly successful but not very reliable. It was all single thread. If any one thing out of all the stuff that needed to be working failed, then the system wouldn't hold position.

TP: But it was the first automatically dynamically positioned

HS: It was incredibly successful. That ship, that little core drill vessel, drilled as many as nine core holes in one day in different locations, in 500 feet into the ocean floor for the geologist, and got cores in water as deep as 4,000 feet. Anchored vessels at that time couldn't go any deeper than just a couple of hundred feet. So it outran its anchored competitors by an order of magnitude or more.

TP: Now, Mohole was going on at the same time. Were they working on some of the same stuff that you were?

HS: The system with the cus£ 1 that I described working between the buoys in 11, feet of water, they had put that system together and started working it. It was successful. They held it between the buoys and they drilled in 11,000 feet of water and got some cores and, in fact, proved that that could be done. That was done in March, 1961, and for the "Eureka," we built the automatic control system starting in January. We had it in operation when the ship started operation in May, 1961. So we were two months behind the Mohole effort with Cusp 1. But we had started the automatic system. We conceived it in 1960, had the bid on it in 1960, got the OK to go ahead with it in 1960, and it started operation in automatic control in May, 1961, just two months after the manual.

TP: Then you were asked to teach the industry about this at the famous course in 1962?

HS: Yes. I guess you heard why that school was necessary?

TP: I have heard a lot of reasons, some of them conflicting.

HS: Really?

TP: It seems overdetermined that the course was necessary.

HS: It was necessary. Shell went to the governments to get leases to drill on, with all this new technology, the government said, "Who are you going to bid against?" We thought we knew a whole lot more than anybody else did about all of this. They said, "Well, we can't give you leases until you can bid on them. And if there is nobody else to bid on them, we can't give you the leases." So, we had to teach a school to get some people to bid against.

TP: What was it like for you, having developed this and put all this work in. Then you had to teach competitors about what you were doing?

HS: It was all in a day's work. It hurt a little bit. It was a lot of effort to put the course material together. It was good in a way because a lot of things got documented that we probably wouldn't have bothered about otherwise.

TP: You were able to license a lot of these things, too.

HS: Yes. Unfortunately, after having developed all that good stuff, I was next sent to our licensing division in New York to license the competitors in this technology. That was a difficult assignment. I enjoyed the engineering far more than the licensing effort.

TP: Where did you move after you were in New York with the licensing division?

HS: After the licensing effort, I went to a wholly owned subsidiary of Shell's called Sunoco Research and Development of High Energy Resonant Mechanical Systems. I did that for about four years and learned some things that turned out to be very useful in deep water offshore. But that wasn't deep water offshore. We did all kinds of things like developing rock crushers, cable plows, pile driving equipment, and that sort of thing.

While I was working on that one Thursday, my boss came in and said, "Could you be in The Hague on Monday morning?" "Why, what is going on?" "Well, it is a big secret," again, "but it is deep water offshore and they want somebody to help them design the world's first dynamically positioned controlled ship for drilling oil wells." That was the Sedco 445. So, I went to The Hague. I didn't have a passport but they got one for me, and I was there on Monday morning. I stayed there for 3-1/2 years while we built and debugged the Sedco 445. That was the world's first dynamically positioned oil drill rig in 1970. It started operation in November, 1971.

TP: Where did it operate mostly?

HS: It started operation off Borneo. Labuan Saba is where we did some of the integration work. We took it out of the shipyard a bit prematurely. A lot of things still weren't working and we did debugging on anchors for months. We had a lot of failures to start with, but ultimately, it was a very successful vessel. It did a lot of drilling off Borneo for the first couple of years, and then Gabon and various other places in the world. It set world records for some years up to about 2,400 foot water depth.

TP: Was the automatic dynamic positioning also used in semi-submersibles?

HS: Yes, ultimately. I think Saipan was one of the first.

TP: But Shell didn't work on outfitting their semi-submersibles?

HS: No, not that one. But it was licensed under Shell's dynamic positioning patent. I had a patent on the use of the Boyd Snyder propeller that was part of the dynamic positioning patents we had. And Saipan bought a patent and became licensed to do that. That was one of the few patents in dynamic positioning that the Shell group in London had filed outside the U.S. and Canada. Of course, dynamic positioning systems work all over the world. So it is good to have patents that cover the world. Most of the patents we had were just U.S. and Canada. It made licensing a big difficult.

TP: I'11 bet! You were also involved for a while with Project Cognac?

HS: Yes. I was actually, at that time, manager of Shell's computer control engineering group which was making automation in the oil fields using computers. I was moonlighting on this other work. My boss asked me if I would. The experience I had offshore would help in work on the Cognac project. One of the things we were doing there was assembling that big structure underwater, in effect. We had to put down a base structure that was about 200 feet high and then moved another structure in over it. It had to be docked into cones at each corner. So it was an enormous reentry project. I had done reentries on drilling in deep water with the Sedco 445 any number of times. So it was part of the same sort of thing. One of the most interesting and useful things was in maneuvering the barges unanchored. We had to lower these big sections to build the platform underwater for Cognac. There were being lowered from two barges, tied together at the end, and anchored with 12 mooring lines. We asked the McDermott marine people how long it would take once we knew where we were, where this hanging structure was and where it needed to be docked on to the lower structure. We had to do the maneuvering with these barges unanchored. We asked them how long they thought it might take to move, say, 50 feet from point A to point B. We knew how far and in what direction they needed to move, how long would it take. They said, "You will have to have patience." "How much patience?" "A minimum of 12 hours to make that move." "Great gosh! It can't be that much of a problem." They said, "Well, it is an iterative process. You have to pick up and let out and keep wiggling, adjusting the position on anchors until it finally gets where it needs to be."
So I figured out a way to do it on a slide rule, and that was just about the time Hewlett-Packard had come out with their little programmable HP69 calculator. I said, "This is a piece of cake. We will do it on the calculator.

We'll put in the heading bearing of each of the anchor lines and then on those lines that are straight towards the direction we want to move, we will take up whatever amount we want to move. We will let out the same amount on the opposite side, and we will take a portion of the cosine of the angle between where you want to move and the anchor line for all the other lines." We did that and we could make a move in 15 minutes. It saved time on the Cognac project from 12 hours for each move to a matter of minutes. And it was extremely simple. I wanted to publish this so everybody could use it. Shell's licensing people said, "Yes, but wait -- we can sell this." So we sold those little magnetic strips to quite a few oil companies and drilling contractors for $10,000 a copy.

TP: It seems like so many things came out of the Cognac project.

HS: Yes.

TP: So many firsts.

HS: Of course, they could get their money back easily with the first move they made with the drilling rig. We put that same calculating capability on all of them. We had five anchored rigs working offshore at the time. We could make a move in 15 minutes which used to take several hours.

TP: Wow! Let's go back and talk about wellheads.

HS: In January, 1960, I moved to the Marine Division and started the highly secret development of underwater completions for drilling and production. The whole effort was based on the idea that we didn't need and didn't want guidelines. We wanted a guideline-less system. We didn't want to have to use divers because we expected to go to water depths a great deal deeper than divers were able to go, at least at that time. But we needed something like divers. So Bill Bates and Glen Johnson had squirreled up some schemes and sold Ned Clark, who was the executive vice-president of E&P in New York, on the idea of running a parallel development to the one that was going on at the lab in Houston. And I was the Division Engineer for that project starting in January, 1960. What we did was based on some work that Hughes Aircraft had done. They were doing work in atomic energy plants with remotely operated arms, and they had developed some electrically operated arms. So we contacted them and they were willing to work with us under great wraps of secrecy. So we started working on

two efforts for underwater vehicles. One was heavy and meant to operate with little railroad wheels around a circular track made around the wellhead, so we could land it on this track using propellers to swim it into position and a television camera to see where we were going.

TP: Is this what you would call Mobot?

HS: That was called Mobot, which was a Hughes Aircraft name for Mobile Robot. That first vehicle also had a scanning sonar that could see where a wellhead was. We could see a wellhead from 1,000 feet away. So we could lower whatever we got out to a wellhead. If we had the leave one, we could lower the Mobot, turn on the scanning sonar, pick up the wellhead, move the ship in that direction, pick it up on television, land the Mobot on the wellhead and use it to operate all kinds of things. Most of it at the start was to lock down or unlock the wellheads, or to lock the blowout preventer onto the wellhead or to unlock it, to override the rams on the blowout preventer, and to operate lock down screws to hold down the blowout protection sleeve. It had a lot of functions. And we even developed ways that it could be used to attach a flowline to the wellhead.

TP: You were working on this in New Orleans or in California?

HS: This was in California. This was an effort that was really in competition with the one going on .

TP: So the marine division in California, you say?

HS: Right, the marine division in California. I was Division Engineer for that. My boss was the division manager, Bill Bates. I had four guys working for me. Ron Dozier was looking at building the ship that became the first dynamically positioned ship. Bruce Watkins was working for me. He was developing the blowout preventer and some of the wellhead equipment. I think he is an honoree tonight. Bill Peterson came to work for us. He was interviewed here just a bit ago. Who else? Ben Gethfort was one. A couple of others.

TP: You were in competition with what shell . . .

HS: We were in competition with the group that was working in Houston at the Shell lab at Bellaire Research, which was developing underwater completions and had started maybe a year before we did, maybe less. We actually had a wellhead on the ocean floor before they did. It was supposed to be a diverless system. There was a lot of

money made by divers working on diverless underwater completions. Ours was meant to work with the robot instead of divers. The system in Houston had guidelines and we were trying to get rid of guidelines.

TP: Was Shell pushing these two developments just to hedge itself, because they saw the technology could possibly be going in two different directions? You had to deal with the fact that the E&P organization on the west coast and east of the Rockies were really distinct entities in some

HS: Very. The people in the Gulf Coast, the ones in Houston said we have to use guidelines. We can't use a robot or anything that depends on television to see or even divers because the water is so muddy from the Mississippi that people can't see out there. We were drilling in the Gulf of Mexico in very deep water and the television worked just fine with ROVs. We were right there working on that development. The old diverless systems are no more. They all worked with ROVs.

TP: To follow up a little bit on Mobot, how was it deployed?

HS: We actually had two of them we developed. One was the wellhead Mobot, and it was the heavy one that landed on a track and went around. It had no arms but it had a hydraulically-operated screw drive with an-inch-and-an-eighth hex head wrench socket, which we could put over the nuts on the wellhead and turn them right or left to operate valves or whatever it was we wanted to do. It had a telescopic extension. It could raise or lower the head which included the television cameras. That was the wellhead Mobot.

At the same time, we began development of what they called the Unimo, or universal mobot, and its purpose was, more than the wellhead mobot, to take the place of divers to do the kinds of unexpected things that divers could do that the wellhead mobot was really not going to be able to do with just a simple socket wrench. It could do the heavy stuff that you could plan for well ahead of time, but the Unimo was equipped with arms and was nearly neutrally buoyant. So the idea with it was very much like present day ROVs to be able to swim to where it needed to be to work on something, and then with its arms, to get a hold of it and do what it needed to do -- untangle something, tie something, or cut cables or lines, pick up something and then drop or loss, whatever. Things a diver might be able to do.

TP: It seems ahead of its time.

HS: It was. It was in a couple of ways. One was that the reliability of both the systems was very poor. They used vacuum tubes. You are probably too young to remember how often you had to replace those in radios! But they were not very reliable. Our development got superseded when the man in charge of the effort in Houston was promoted to take Ed Clark's place in New York as Executive Vice-President of Production.

TP: McAdams?

HS: No, it was Bert Easton.

TP: McAdams was exploration, right?

HS: Right. They decided that they wanted to combine these two very different systems into one, and in the process, they did away with the robots and mobots and just went to a guideline operated system. It was rather like the one being developed in Houston. That is when I went to licensing and head office and Ron Geer came to be the manager of the group that developed a combined system. He had come out of the Houston effort, so the system ended up looking like the Houston effort. And the ROVs got superseded.

TP: It was ahead of its time, but it still was a precedent. Can you maybe talk about how the industry went from Shell's development of the mobot back in the early 1960s to what they are using today in deep water and the ROVs?

HS: ROVs had just begun to be used for drilling support. A couple of people have used them in shallow water. In 1981, when Shell wanted to drill in deep water on the east coast, we took a contract then with the offshore company who had The Discover Seven Seas. We modified it to go to deeper water -- high currents, rough seas, off the Atlantic coast. Up until that time, they had been using a little two-man submarine to find their wellheads if they lost them, and they were their only contact with the ocean floor and on the way down. I thought that could be done much better with ROVs. In the meantime, people had begun development of ROVs for the Navy. Not Honeywell but an outfit in La Jolla.

TP: Lockheed?

HS: No. A little company in Sorrento Valley there developed a little flying eyeball ROV for the Navy. Hydroproducts. I found out about that and decided that Shell ought to be able to use something like that. So we contacted what is now Oceaneering. I saw you talking to Mike Hughes. Mike

bought Solis. Solis was the company with Dick Brisby, whom you also ought to interview. Dick Brisby was working on ROVs. They had used them for drilling support for shallower water. They were ready to build one for 7,500 foot water depths, which more than doubled what their capability at that time. They said they could, and I worked with them on developing that system. We put fiberoptics on it, which turned out to be a real boon in the ROV business and was very successful. In fact, we built two of them just for reliability's sake and had both of them aboard. We used one to cannibalize to keep the other one outfitted properly. We put that to work and got rid of the submarine after a lot of haggling. Some people didn't want to see the submarine leave and an ROV come into operation. There were some people who said ROVs had no place in the drilling business, and that there were some companies that said that for many years. But now, they all are happy to use ROVs in their operations.

TP: What was the bias against them? They didn't think they could work?

HS: They thought guidelines would work O.K., and they could use divers if they had to. Of course, we are drilling up where divers can't possibly go now. Citgo held out for many years. I remember I got a call one day from Earl Shanks who was with Citgo at that time. They were drilling in the Gulf of Mexico and had dynamic positioning of one of their rigs. It moved off location and had stretched the riser. They couldn't get loose from the wellhead. He asked me if there was any place I knew of that they could get hold of an ROV in a hurry. They weren't using them at the time. They do now on all their rigs.

TP: You developed something 40 years ago but only really saw it come into use on a widespread basis within the last 10 or 15 years?

HS: Yes. We started that work with dynamic positioning and ROVs in 1960. Dynamic positioning wasn't used on a drilling rig until we did it with the Citgo 445 10 years later. It was another 10 years later or more, in 1981, when we took the Seven Seas to go to very deep water using ROVs. I have been working for the past 12 years. Since I have retired from Shell, I have been working on almost all of the new rigs, doing a lot for the oil companies, some for Shell, BP, Amoco, Chevron, Global Explorer and several others such as Exxon. Vastar has a new rig coming up. And for several of the drilling contractors . . .

TP: You are working mostly with drill ship dynamic positionings on deep water drill ships?

HS: Dynamic positioning on deep water drill ships, and the use of ROVs and ROV interfacing. I mentioned to you that some of the work I had done with that mechanical resonant energy research outfit in La Jolla turned out to be useful. One of the problems with running ROVs in deep water is that the cages run as a heavy thing on a long cable. Then the ROV comes out of the cage on a tether to do a tour. A heavy cage is used to keep it under the ship so it doesn't drift away in the current. It doesn't give the ROV such a heavy, long thing to work with, I guess. But if you are working with a small vessel and the vessel is going up and down with the wave action and heave, you can get into a resonant condition between the ship and .

End of Side A

Side B

HS: . . . gets too active, then the cable can go slack. And then when the ROV comes down, it will jerk against the plot cable when it becomes taut. The question is how much are the forces induced in the cable and can the cable stand that kind of a beating? The work I had done with the resonance systems seemed to fit in perfectly. I could analyze that kind of stuff. Piece of cake!

TP: Looking back at all the innovative things that you have been involved in, what was the source of your inspiration for coming up with a new concept, or applying things to certain areas that no one had thought of before?

HS: The need was almost always there, and it seemed when we started in 1960, everything we wanted to do was new. Nobody had done it before. So we got a lot of patents. I ended up with 35 patents in the U.S. and Canada, and a lot of them are also filed overseas in various countries. So the need is there. Once the need is there, if you can just keep thinking, a solution somehow or other will come to you. Sometimes, a lot of ways arise that it could be done. The concept for dynamic positioning control, to solve the vectors that needed to be solved so you could direct each of two as,itomg thrusters, came while I was on the freeway. I had been thinking about it. I had thought up all kinds of wrong ways to do it -- ways that would not be right. All of a sudden, driving down the freeway one sunny afternoon, the answer just suddenly was there. And it makes goose bumps stand up when it happens.

TP: It seemed like Shell was very good at both the theoretical side in basic research and communication between the people who were doing pure research and the operating side -- being able to get this feedback from what is happening in the field and developing things they need for the field.

HS: It was an exceptional time when everything we thought of was brand new. Communication, in a way, was shut down because . . .

TP: Because of the secrecy?

HS: They had taken us out of the telephone book. People thought we had died or gone away. But we did communicate with our competitors in the research group in Houston. We were reasonably free to do that, although the systems that we were developing were very much in competition. We did communicate among each other pretty well.

TP: It was quite an interesting career. Is there anything else you would like to add?

HS: I can't think of it.

TP: Well, that's good. We will conclude here.

HS: O.K.

THE END

Offshore Energy Center-Oral History Project

Interview of Howard Shatto

October 2, 1999