BOEM DEEPWATER GULF OF MEXICO HISTORY PROJECT

Interviewee:	Lawrence Buck Curtis
Date:	January 21, 2009
Place:	Conroe, Texas
Interviewer:	Jason Theriot
Ethnographic preface:	Lawrence B. "Buck" Curtis graduated from the Colorado School of Mines in 1949 and promptly went to work for Conoco in its Wyoming oil fields. Curtis soon wounds up leading a burgeoning engineering group for the company in its New York City office, overseeing international efforts. At the Fetah area in Dubai, Curtis helped to pioneer the use of underwater oil storage domes in the 1960s. In 1972, Curtis was transferred to Houston, Texas, to head up Conoco's Production Engineering Services (PES) group. Curtis, widely heralded as the "father" of the tension-leg platform, or TLP, recounts his efforts to pioneer the system at the North Sea Hutton field as well as at the Gulf of Mexico's Jolliet development.

JT: My name is Jason Theriot. This is an interview with Mr. "Buck" Curtis for the MMS Deepwater History Project. It is January 21, 2009. We're up here at Mr. Curtis' home in Conroe, Texas, and we're going to be talking about Mr. Curtis' experience with Conoco in the early deepwater and TLP developments.

JT: Could you tell me your full name, Mr. Curtis?

LC: Yes. My full name is Lawrence B. Curtis, and the B stands for "Buck." People call me "Buck."

JT: When and where were your born?

LC: I was born in 1924.

JT: Where at?

LC: Grand Junction, Colorado.

You mentioned the Colorado School of Mines. Tell me a little about how some of that training influenced your future work in deepwater, if it did at all.

LC: I graduated from the Colorado School of Mines in 1949 with what they called a professional degree in petroleum engineering, which was more between a Master's and a B.S., actually, and it was the only place in the country that had such a degree. The background I received educationally from the Colorado School of Mines, of course, was the basis upon which I conducted my whole career in the oil business and was the reason I was hired by Conoco to go to work for them way back in 1949.

JT: When were you hired by Conoco and in what capacity?

LC: I went to work for Conoco in the fall of 1949 as a petroleum engineer trainee. They had a training program that each petroleum engineering hire had to go through in order to work for the company. It was intended to give you a feel for what is conducted in the oilfields in way of roustabouting, pumping, and all the little things that have to be done to produce crude oil and go to the refinery for making refined products.

JT: Where was this training facility?

LC: I started in the actual oilfields in Big Spring, Texas. It was the Howard Glasscock oilfields. I roustabouted for several months, and then I pumped or was on a lease for a couple months, and then I was on a drilling rig as a roughneck and did all those various things.

JT: So the idea is to put the college graduate in a real-world scenario so he can get kind of a broad-based experience in how everything works.

LC: It was to give the college graduate the experience of knowing exactly what goes on in the oilfields, even though you're not there. You know what has to be done in the oilfield to keep it running.

JT: How long did you go through this training?

LC: It was about fifteen months.

JT: What was the first job you were hired for?

LC: After I completed the training program, which was in 1950, I was assigned to Hobbs District in New Mexico. This district was part of the production area on what's known as the Central Basin Platform of Texas and New Mexico, a huge Permian-type reef production. That was the basis for my early effort in the oilfields; it was all onshore, all in West Texas or New Mexico. Then I was transferred to the Rocky Mountains, where I was involved in the Rocky Mountain drilling and production effort.

JT: What would you say would be your expertise in those early days? Were you working with production equipment?

LC: I was a petroleum production engineer, which dealt with making the well plans and the drilling of wells. It dealt with the completion of the wells. It dealt with producing the wells by some means and processing the production on the surface until you transferred custody, either internally to a refinery or to some other company that would take the crude oil and refine it.

JT: After your stint in Wyoming, at some point I'm assuming you made your way down to the Gulf Coast.

LC: I never did work in the Gulf of Mexico until much later, and then it was not directly. The Gulf Coast was the area that Conoco first engaged in offshore, just like most of the other companies, beginning way back in the 1950s. The decision was made that we would enter the offshore production area, which was mostly the shallow waters of the Gulf of Mexico off the Louisiana coast and off the Texas coast in both states, and Conoco was a big player in that early effort. We had a name. It was called the CATCO Group, C-A-T-C-O, I think it was. Those stand for the initials of the companies, and Conoco was the operator.

I used to listen to the engineers who were involved in the Gulf of Mexico talk about some of the problems they had, but most of the time the problems that they talked about were completion problems. The sand would flow or you'd get stuck. You wouldn't be able to drill. Or you'd get a blowout. Things like this were the focus way back in those early days. The platforms from which you drilled were all in shallow water, and you could use what we call template-type platforms, which were constructed of tubular members, like a bridge, and planted on the seafloor and piled into the seabed.

JT: When did you get your first call to go from onshore to offshore?

LC: I didn't get a call to go from onshore to offshore until I was transferred to New York as the chief engineer of international. I was the chief engineer because I was the only one. [laughs] Conoco was engaged in exploration around the world.

We didn't have any production at that time. This was way back in 1962 and '63. We had a little production from Venezuela that we obtained by an acquisition from the San Jacinto Company, and they also owned a small piece of the group in Iran. It was a very small percentage, but they did have a presence, and that was the only production that Conoco had internationally, which wasn't very much.

But we were actively engaged in exploration work, primarily in northern Africa and Egypt and Libya. Conoco, under the company name of Sahara, was operating the Egyptian stuff while Marathon, under the name Marathon, was operating the stuff in Libya. It turned out that Libya was the big oilfield find for this group, which included Conoco, Marathon, and Amerada in equal proportions.

A number of big oilfields were found in the Sahara Desert in Libya. Some of the development work was under way beginning in 1962 and '63, and that required a change of thinking. The production rates and the wells' production rates were so different from what we were dealing with in the United States that you had to adjust our thinking. Pipelines were not just two- and three-inch stuff. We talked about nothing less, really, than ten- or twelve-, fourteen-, fifteen-, twenty-inch pipe, because the production volumes that we were getting in Libya were so large. This was all onshore in what was known as the Sirte Basin. Production from Libya came under the direction of an operating committee, of which Conoco supplied one of the members, and I was that membership for a while. It reached 1.1 million barrels a day, and that was an achievement that was done in about five years and had never been done before. So Libya became a big oil producer kind of overnight.

While all this was going on, Conoco was in the process of obtaining a concession off the coast of Dubai in the Arabian Gulf. They not only had the offshore, they also had the onshore concession in Dubai, almost the entire country, and a huge big chunk of the offshore. The initial effort by Conoco was in 1963, and in 1964 we started drilling wells onshore and encountered a number of drilling problems with salt sections that caused pipe to collapse and caused Conoco management to kind of scratch their heads and wonder if they really ought to be going forward. We were spending so much money on correcting these problems.

But offshore, we had seismically determined that there was a huge structure out there that we ought to drill before we ever left that place, so we drilled that well, and it was a huge discovery. It tapped what was commonly known as the Thamama in the Arabian Gulf and produced in Abu Dhabi and other areas, but it also encountered a section of what we called the Mishrif, which was an unconformable detrital limestone section of high thickness, anywhere from zero to three or four hundred feet, high porosity and great volumes of oil in place and also high transmissibility. We could get wells that would produce at twenty-five, thirty thousand barrels a day.

This became a project for Conoco beginning in 1966, and it was the birth of a whole lot of new ways to think about developing offshore production, much different than had been going on in the Gulf of Mexico. Instead of building one platform on which you placed everything, the wells, the production equipment, and so forth, we did it differently. We did it with small well platforms that we could place out in any spot in the field area and drill six wells, directionally, to reach spots that we wanted to reach, and these were tied back to a central production platform. Then the central production platform was tied to storage units which consisted of what we called the kazzans, which were open-butted, large-volume storage tanks planted on the seafloor.

JT: Can you spell that, kazzan?

LC: K-a-z-z-a-n-s. Kazzans, in Arabic, means treasure storage. The oil for them was a real treasure. It began the birth of all the things that you've read about in Dubai since.

JT: Would you say at the same time in the sixties most of the activity in the Gulf of Mexico was either one or two wells and a platform, and very small production compared to what was going on offshore Dubai with multiple wells and very large production?

LC: Relatively. The production obtained in the Gulf of Mexico, in terms considered in the United States, was relatively high production. It was good economic production. But internationally, we were obtaining big wells, and one well would produce as much as twenty-five, thirty thousand barrels a day. That's in Libya *and* in offshore Dubai, in the Arabian Gulf. So your thinking had to change. Up to this point in time, in all the oilfields offshore, the oil was brought ashore and placed in storage tanks onshore. Then it was exported from those storage tanks by piping it back offshore to an offloading buoy or dock where the tankers could come in, and then it was exported to some consuming country in the world like Japan or Europe or the United States.

Well, we had to lay pipelines ashore, put in huge amounts of storage, and once they're full, they're no good to you, plus it takes a huge amount of machinery to run them and a huge manpower pool. These are extra costs that aren't needed. You can have the operation stay totally at sea. And that's what happened in Dubai. That operation at the Fetah field is the first one in the world where the total operation; drilling, production, processing, and offloading and export, were all right there in the field area.

JT: Can you spell that, Fetah?

LC: F-e-t-a-h. That was the beginning of my offshore experience. I figured prominently in much of the effort to convince the Sheikh of Dubai, who was a very progressive individual and was really trying to make his country into something very special. I'm not talking about the current leadership, which are the sons, but I'm talking about the old man, who was also called Sheik Rashid. He was a very savvy individual, and you could explain to him. Even though we didn't talk the same language and I had to have a translator, I could explain something to him and he would understand very quickly.

He approved of doing this. Almost every other place that you could go to in the world would not have approved this. They would want the oil to come on their shore so that they could see it and show their people, and it's a good reason, but it doesn't accomplish anything for them. You can send their people back offshore and they can see it out there, too, which is what we did.

JT: So he was able to think out of the box, or were you able to convince him to think out of the box.

CL: Right. He was very extremely good.

JT: How did you come about that position to be able to be in communication on a regular basis with this country and working on this particular project?

CL: When I was transferred to New York, I was in international, which Dubai is a part of. It was everything internationally except Canada. Canada and the U.S. were operated by the U.S. folks of Conoco, and everything else was operated by the international group, which was stationed in New York City. That became a part of my responsibility when I was transferred up there as an engineer. All the drilling operations and the development operations, the production and the design of equipment that you'd use to produce with, all of that was under my purview. I didn't have anybody to begin with, but I gradually built an engineering staff in New York City to help me, and we did a lot of great things.

JT: Tell me a little bit more about this large storage tank offshore. Was this an idea that you came up with?

CL: No. The tank existed; it was designed by Chicago Bridge and Iron. We were searching for a way to keep all of the oil equipment at field site, which meant we had to have storage for the crude oil out there to accommodate the ingress and egress of tankers, according to a schedule that they could meet, maybe offloading every three or four days. In other words, we figured that we would need about a million to a million and a half barrels of storage to handle a hundred thousand barrels a day of production. We needed a ten-day swing so the tankers could get in and offload and get out, and the full volume of storage would be operable and functional. But we were looking around to try to figure out what we would do for that storage and, of course, the first thing that comes to mind is to use old vessels, anchor them, put the crude oil in there, then offload from those vessels. And that's what we did, in part.

But the air-water interface in the Arabian Gulf is a very, very harsh environment for anything metal. The metal just exfoliates at a pace that you can hardly believe. So if you can get steel materials out of that air-water interface, you can save yourself a lot of maintenance money.

JT: Put it under water.

LC: Yes. So we determined that the environment under the sea was a whole lot more friendly and it required much less maintenance than at the air-water interface. We couldn't do away with the platforms that penetrated the air-water interface because we had to have production processing gear in order to get the oil to a state that was shippable.

JT: Was CB&I into building water tanks and various other kind of tanks?

LC: Yes. They built storage tanks all over the world. They designed a submerged storage tank on the idea that if you can place it beneath the sea, it's in a benign environment and it's right there for use. Of course, they were really thinking internationally at the time.

So we looked at the preliminary design that they had and figured out that it needed considerable modification for us to be able to accept it or use it, and also some testing to prove that we could anchor it to the seafloor. You see, if you fill this tank with oil against a huge surface area, it's buoyant. A huge amount of uplift is put in place, and it would bring the tank to the surface, so we had to anchor it down with piling around the periphery of the tank.

JT: You said this thing didn't have a bottom, correct?

LC: It had no bottom. It was positioned in an exactly leveled position, and the oil produced was placed into or run into the tank or pumped into the tank from the top, so it displaced the water down and out the bottom. So you always had the difference between the gravity of the oil and the water as a potential energy to move the oil out, and if you had big pipelines, you could move it at big rates.

JT: You didn't need any big pumps.

LC: We needed much, much less horsepower. We had pumps, but we could move a hundred thousand barrels an hour with very little horsepower because we were using the potential energy of the sea.

JT: What was the capacity of this tank?

LC: It was 500,000 barrels. Half a million barrels were stored.

JT: What depth water was it placed in?

LC: The depth of the water was anywhere from a hundred to a hundred and eighty feet. Where they were placed was about a hundred and fifteen or twenty feet, so it was not real deep water. The main thrust here was to keep the total operation at sea where you had minimal equipment installation, and you didn't have huge personnel requirements. Also, we determined that the tank would have another great benefit that would eliminate huge capital input to process the crude and remove salt, which is mostly in the water that's in the crude.

The production that came into the tank was hot coming out of the reservoir. It came into contact with the crude that was in place, and any water that was in there would be heated up, and that's how you separate oil and water. This cleaned up the crude oil to put us way below the specifications on salt, so we could ship the oil directly out of this tank right onboard the tankers. It was perfectly clean.

JT: Big cost saving.

LC: It didn't cost anything. All the other operations around the Gulf had big desalting installations; they spent millions of dollars in investing to do that. We did not need it.

JT: This is kind of an aside. Have you tracked over the last forty years underwater storage tanks, and has this particular project in any way influenced—

LC: I tracked it for a many years when I was active, and I don't know of any other place in the Arabian Gulf where they have submerged storage even today. But in the North Sea, it was used extensively by a number of the operators; but instead of steel, it was concrete. Those were huge concrete tanks just set on the seafloor with a gravity system holding them down. They had a bottom. They wouldn't buy the idea that you could leave them open. However, the way they've designed them, the way the water displaces them, they now function more like an open tank.

But it had a number of huge advantages, and the thing that it did, in my estimation—and perhaps other folks in the industry won't say this, but I certainly saw it in the time I was involved—it caused people to think differently about how you could do things offshore. We did so many things brand new for the first time in Dubai that we had great confidence that we could handle almost any situation.

We transferred oil with turbine meters. That had never been done before, and we proved them, and they were accepted, and it cut down hugely on the capital cost. In the initial development plan, we had four six-well platforms and a central processing platform where we tried to reach a hundred to a hundred and twenty-five thousand barrels a day. Each of the well platforms were placed strategically on a geometric spot where oil could be reached, and initially it was only three platforms. We were just going to go down the strike of the structure at the top and start production. But the scheme that we used where we could use six-well platforms, you could tie back to the central platform by just adding another six-well platform. This was the process that we used that was very beneficial and really had not been done, at least to our knowledge, up to this point in time.

JT: And this was at the Fetah field?

LC: At the Fetah field. So we started out and we added one more platform, what we called the A, B, and C platforms, and we added a D platform, because geophysically we could see the onlap of what was known as the Mishrif, and it thickened dramatically. We didn't know where the oil-water contact was. We knew it was productive from the original well, but we did not know how far down a dip the oil column extended.

So we put in this well platform, the D platform, and these little platforms didn't cost a lot of money. They weren't very huge. As a matter of fact, I'll tell you in a minute the total development for a hundred and seventy thousand barrels a day was 56 million dollars. That did the whole thing; storage, platforms, drilling, processing, all of it was done offshore sixty miles from Dubai for 56 million dollars.

JT: In 1963?

LC: No. We started in 1966, and it went on production in 1969. But with these little well platforms, we could be drilling the wells while everything else was being done. We were trying to take advantage of shortening the timeframe down from discovery to production, because it costs a lot of money to have all that capital tied up in no income.

JT: Now that's just about how everything is done.

LC: But that began the process of how you think about things. And when we talk about Hutton, it did a lot of these things.

JT: You guys were able to use the experience of Dubai and apply it.

LC: Oh, yes, we learned a lot.

JT: Let's get into that a little bit. If you want to preface it by some of your other work or some of the other research that you had done, but tell me about when you first heard about Hutton.

LC: Hutton was a field that we discovered in the North Sea, and it's a part of the Jurassic production zone. Shell really was the one that opened the door for the Jurassic production in the North Sea. We had a lot of gas production, which was kind of an extension from the Groningen onshore Holland into the North Sea, especially the southern part of the North Sea.

Then Phillips discovered Ekofisk, which is not Jurassic production; it's Chalk production. But Shell was the first to find Jurassic production and opened that door for production in the North Sea, which is very large production. We used concrete to develop a lot of that stuff in the North Sea; concrete tanks and concrete platforms built by a Norwegian company and a Dutch company that had a lot of experience in reinforced concrete. So they just were pursuing their business, and it was done simultaneously to develop production in the North Sea. Phillips used a reinforced concrete big storage tank to store this production for Ekofisk, and it was after Dubai. They had confidence that it could be done after we did Dubai, and CB&I bid on it. They bid steel tanks for the same, but were not selected.

What question am I on? [laughs]

JT: About the first time you heard about Hutton.

CL: The Hutton field was discovered, and it wasn't really one of the barnburner fields. It had a nice section, but the recoverable reserve that we determined was somewhat limited, and we had to figure out a way to develop it economically and to do it the way we did it on a field called Murchison, which was really a much better field than Hutton. We couldn't do it. The cost of bottom-founded platforms and development there was just out of the question for Hutton because it didn't have the same reserve base and productivity. So we had to try to figure out a way to do it that was a lot less costlier than what we were spending on Murchison — which was also a Conoco operation in the North Sea— and much less than what anybody else was spending also. They were also spending comparable amounts for comparable reserve sizes.

JT: Was that a fixed platform?

CL: Yes, they were using fixed platforms.

JT: Were you guys thinking how do we make this cheaper, how do we maximize reserves?

CL: Yes. And, of course, in the background is all this business of being able to go deeper. If you look at a bottom-founded platform, this is what Shell did in the Gulf of Mexico with such platforms as Cognac and Bullwinkle. They just added steel upon steel and built in sections and then added them to gut and put them out in the water, and they had, by brute strength, enough steel, they could withstand the forces. But the cost to do this was going up exponentially, so we had to find a way to cut out the steel, and the only way you could do that was have a floating system or go to subsea.

JT: Were weather conditions in the North Sea also a determining factor?

CL: The environment in the North Sea was second to none. It was terrific. You could expect storms that were just unimaginable, hundred-foot waves, winds that would hit eighty, ninety miles an hour. So the environmental systems that we were designing for hadn't really been touched before, till they came along. So your platforms for that area had to be much stiffer and stronger and stouter than they were in the Gulf of Mexico, where the environmental system is not so rough.

So we started to look at how we could develop this without having a great giant platform there and a huge processing unit on top of it, so we began to explore that. In the 1960s, we were beginning to think along this line. We had joined a group called SEAL, which was an industry consortium run by the French, primarily, where you'd have interface of wells drilled with subsea completions, and you'd produce them subsea into a manned intervention on the subsea. Then we joined another group called the Lockheed Group, which was out of the northwest, Seattle, which also had Mobil as a strong supporter, and it was an industry group. But they were both trying to develop oilfields in the deep water offshore subsea with manned intervention. You'd put a capsule down there that a man could go down in and you'd run the production to the capsule and be controlled there, but you'd have to use a diving capsule to go down, and this would have to be done day after day.

It was our analysis—and this is what Roger was involved in—that this was not something that was going to be done. You wouldn't be able to find enough people that would go down and essentially put their life on the line all day long to produce these wells on the seafloor, especially in real deep water, and we were beginning to think way beyond five hundred feet, which was deep water then. We were thinking in terms of thousands of feet, and we knew that there were sedimentary basins across the world that were in this category, that contained oil, and would be developable if we could find a system that could take us to that depth.

After being in these industrial groups looking at subsea, we finally said, "We're not going to do that. We can't do that. We're going to have to go back to the air-water interface at the surface for manpower," and that's what we did. We dropped out of all the subsea things, except where it was just ancillary to another system, like subsea injection wells. That was fine. We could do that just like anybody else. Subsea also had some other problems: pressure interface and control systems. These have all been solved now, so it's quite a prominent system and being done all across the world. So it's also viable and has reached water depths beyond where the TLP goes.

But the TLP concept that we were working on was bringing the wells up. We would have everything at the air-water interface so that personnel did not have to go down below the surface of the water, except in maybe an inspection system and then very limited, if any. We wanted a system that we could inspect without having manned intervention.

Well, along about this time in the late 1960s, there was talk about tension-leg platform scale-model tests.

JT: Had Hutton been found yet?

LC: No. I'm giving you the background now. We were working this subsea scene pretty hard, and we were looking at floating production platforms using semi-submersibles and just continuary tethering of the platform, which was inadequate for the environmental storm system you had in the North Sea and actually is inadequate for the Gulf of Mexico, too, and we could see this. So we had to do something different. We had to figure out some different way to hold these platforms in place.

What happened to me, on a flight between New York City and Dubai, I was flying with [Hal Nabors,] the man who became president of Dubai Petroleum Company after we found oil in the Middle East off Dubai, and we were talking about this deepwater business, just having a conversation. He said, "You know, why can't you just take a barge that floats, and put some tethers vertically down on it, chains or something to just hold it?" And I thought to myself, "Well, why not?"

JT: Chains to the seafloor?

LC: Yes, just chains to the seafloor.

JT: To hold the barge.

LC: To hold the barge, yes. And it struck me, "Well, why not?" I knew that the environmental forces would be a big problem and you could get into resonance problems, because everything has a natural period, but you wouldn't know this until you studied it. I said, "I don't know why. It's worth thinking about."

And at that moment in time, this idea was planted in my mind, and, of course, we were doing work in Dubai later. We later did things in Dubai that began to draft from this, like anchoring that big tank to the seafloor so that it wouldn't be pulled up, and using an excess of buoyancy, we didn't want that excess in the tank, but we had it and we had to deal with it, so it's just the same problem in reverse.

So by planting thirty pilings and cementing them into the Arabian Gulf and then running the test to make sure that they would really hold, we did that in conjunction with CB&I. We did a lot of tests with them to prove that this system would work, and that was one of them. We beaded the tunnels in which the pilings were placed so that the concrete that we placed there would have a better hold on the tank. We run all those tests, and there wasn't any reason we couldn't do it, so we did it. And it worked just like clockwork.

JT: Do you remember what year that flight was where you sat with the future president of Dubai Petroleum Company?

LC: It was in the 1960s, after we found oil in Dubai, so it was probably 1967.

JT: Long flight, probably had a lot to talk about with similar interests.

LC: I made a lot of them.

JT: People with similar interests on those flights, I bet.

LC: Yes. Anyway, all this stuff was working together, and, of course, we were quite happy with what we were doing in Dubai, and the company was getting a lot of focus from doing these things, especially in the eastern press. Not so much in Gulf Coast press, where the oil business was more prominent. But in the eastern press we were getting a lot of coverage, and the PR folks in Conoco loved it. We were getting good press in the Arabian Gulf from the countries we were in. We were known as a very progressive company and could execute very well, especially after we did the Dubai project and it went just like clockwork.

I'll tell you a story. I don't know if you want this on the tape or not. But Mr. Hal Nabors, who's this president [of Dubai Petroleum Company] that I flew across the

Atlantic with, sent a telegram to Rashid, who was in London undergoing an operation. It turned out that we did this during the same time that the Apollo hit the moon. The same day that the Apollo landed on the moon, Hal Nabors sent a telegram to Rashid in London, saying that the kazzan had been planted within centimeters—and we did this without satellites— of the spot it was supposed to be and was successfully sunk, and that they were in the process of anchoring it to the seafloor. Then he ended the telegram saying, "Understand something happened on the moon today." [laughs]

JT: The kazzan looks like the lunar capsule to some degree. That's kind of ironic.

LC: It had some big technical problems that we had to solve, one of which was the anchoring to the seafloor. Another was corrosion, and then another one was the entry of the crude oil into the tank. And then, of course, placing it out there and the intersection. You can see up there where the cone is. Do you see a cone at the top of the circular part?

JT: Right.

LC: There are huge stresses where that cone intersects the tank when you sink the tank, and we had to control the sinking. So there's a little bottle inside that tank that has nothing but air in it and it controls the sinking. So once it went down, the air came out the side. I showed you the picture. Air comes out and then water fills in behind, but then you upright the tank by putting a little water inside the little tank in the middle, and that gets it into a perfectly flat position for further sinking down to the seafloor, and you control the sinking with that little tank in the center. So that interface has a little tank and the big tank all tied in there, and that weld is a very critical one. That taught us a lot about welding also.

JT: Tell me a more about that.

LC: To successfully get this tank onto the Arabian Gulf, we had to be able to execute this sinking and place it exactly where we wanted it. The shape of that cone is like it is because that's how you get minimal stresses involved, and we ran a finite element analysis of the stress system on this tank and had to change the welds procedure and the weld geometry a little bit in order to have it come within the limits that we as Conoco wanted.

JT: Welds, w-e-l-d?

LC: Welds, w-e-l-d-s, yes. But CB&I went along. They were great. We worked together.

JT: Did you build this in Dubai?

LC: Yes, this was built in Dubai, right offshore. It's called Chicago Beach.

JT: That's it right there.

LC: CB&I built it, it was their project. It was built to their original design but we modified it a little. It worked great; it's still functioning.

JT: So this was a piece of the larger new concept that you guys had come up with in the Fetah field.

LC: Yes. Keep everything at field site, never move crude oil except for export out of the field site. This saved a lot of capital investment, saved a lot of costs running it, manpower. The initial production only cost ten cents a barrel, but we were selling the oil for a buck and a nickel. You know, these were heady days.

JT: So the first sign of Hutton was in the mid-seventies?

LC: Hutton was discovered in the mid-seventies, before 1975.

But I wanted to tell you a little bit more of how we approached this project. Once we finally decided that the TLP was the way to go, and we did this on the basis of very scanty data that came out of this test on the West Coast off of California. It was sponsored by Deep Oil Technology, which was a subsidiary of Fluor, and they were using steel cables. We quickly realized that we couldn't do that, that that wouldn't work, that we had to go to something else.

Originally we just went to drill collars because they're so stout. But we got of off that very quickly, and just said we didn't need to do that; we'll just use well casing or tubing or pipe, put it all on the outside, build the whole tether onshore, tow it out there, and then sink it. There were a lot of ways to get around costs that were in this original effort that we wouldn't do again, we didn't do again.

JT: So from the end of the Dubai offshore Fetah development to Hutton, you specifically, and your teams in general, were working on a new way of thinking.

LC: I ran the international operations for Conoco out of New York, and Dubai was one of them. Libya was another. The North Sea was another. I was in charge of the production operations around the world, and I was transferred to Houston in 1972 to lead a group called Production Engineering Services. It was about 140 engineers at the time I came in, and it ended up consisting of 230 engineers. The group was created to solve the severe technical problems that we were going to be facing as we developed things clear across the world. That way we could move in a high level of technical expertise into a system and then move them out after it's done.

We got the advantage of having these people being utilized in every place that they were needed across the world rather than just one spot. So that concept was developed in Conoco, and it worked amazingly well. We had really high-powered engineering people in this group that could address any engineering problem. I was selected to lead them. I came down from New York to Houston, and we were involved in all the international operations and a good many of the ones going on domestically also to a different degree.

Anyway, it was during this period that we decided that we could maybe develop Hutton using a TLP, because we went through a preliminary look at it to see what it might cost, and we thought we could do it quite a bit cheaper than what it would cost to do a bottom-founded structure.

JT: Were all of these engineers working out of Houston, or were they spread out across the country and the world?

LC: These particular engineers were Houston-based, but they could be assigned, and a lot of the folks that you saw in that film were assigned out of my engineering group into that project, probably half of them anyway.

JT: So when was the experiment off of California with that small TLP?

LC: I was just trying to think of that. I can't tell you exactly. I think the data started coming in to us in about 1974. It was a one-third-scale triangular-geometry tension-laid platform held to the seafloor off Catalina Island with bridge-type cables that you could run off a reel. This was an advantage to using cables. You could run them off a reel. But we later discovered that you could also run tubulars off a reel and we did, and we still do, and that way we eliminated a lot of the problems that with cable.

JT: I would imagine that corrosion is probably the biggest problem.

LC: Yes, corrosion's a big one, but there are other problems too. It gets so heavy that it breaks under its own weight.

JT: Tubular steel is hollow.

LC: Yes. There are a lot of things involved here.

JT: So what you guys were looking at? Was it reports? Was it engineering specs? What type of material were you looking at?

LC: We got the data from the model test, and it was very scanty, but we massaged it a little bit and extended it with some model tests that we did in Steven Basin back east in New Jersey, to be able to apply the information to a full-fledged unit. And we said to ourselves, "You know, we really can't do this unless we pick an actual case."

The one that we knew and we liked to work with because it was sitting right there and it was uneconomic going the other way was Hutton. Hutton is named after a famous British geologist, by the way. I've got his history around somewhere, but I don't know where it is. Anyhow it was too radical to do this. It was so radical, how were you ever going to sell this idea? How would you ever get this across?

So I asked the guy who was heading the domestic part of Conoco's production to fund it.

JT: To fund the research?

LC: To fund the research, and he could do it. He could fund it through PRD, which is Production Research, and he said he would because it had huge implications for the company and also for industry. But we really were worried more about our company than we were about the rest of the industry. We wanted to be ahead of them, for one thing. And he did this, so we picked a good team to do a very preliminary look, and I hired two naval architects and one marine engineer to come in. These folks were Ph.D.'s in the business, so I could really dig deep into the subject. They were in PES in Houston. We had the funding and we had the access to PRD right there if we needed to do any kind of testing; metallurgical-type testing mainly.

So we began to put together a project and looked at Hutton. Nobody knew it except us in Houston, and we did this for at least six, eight months. We all came together and went over what we had found, we all had input, and we decided it could be done, even in the North Sea.

JT: How many men were in the team?

LC: At that time, maybe fifteen. That was the original preliminary look. Then we decided, well, you're never going to sell it unless you can get the engineering people of all these companies we had. They have to line up with us. They're going to have to join with us, or we'll never be able to sell this to the managements of these companies. So we pulled off another deal. We said, "Let's go second the engineers from these other companies to have them work on the project. Let's get them in. It's high powered, but we ought to be able to get their best people." That way we get a new cross-section of thinking in on this also.

JT: Why not just stick with the Conoco hands?

LC: Because you couldn't sell it.

JT: Couldn't sell Conoco management?

LC: These engineers could go back to their management and talk to them about what's happening here.

JT: And put all the management heads together and say, "Let's all do this together as a joint venture."

LC: Well, no; that all came a lot later. As a matter of fact, the joint venture was already there. They were in it because they were part of the concession agreement. We had all these operators, and in order to get them all to line up to spend their money in this project, they certainly had to know a hell of a lot about it, and we recognized that right off the bat. We also said we've got to get some regulatory people involved and we've got to get the certifying people involved. So we got Lloyd's of London and we got BNOC, British National Oil Company. They were heavily involved all the way. That's how we sold it.

Anyway, do you want to go to lunch?

JT: Yes, this is a good pause.

[End of interview]