SHELL OIL COMPANY

ORAL HISTORY PROJECT

Interviewee: Mike Forrest

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Bio

Forrest got his B.S. in geological engineering from St. Louis University and joined Shell Oil in 1955. He moved through the company and became Senior Geophysicist for the New Orleans E&P area. It was here that he documented the bright spot phenomenon that changed the way Shell and the industry searched for hydrocarbons. He continued working for various branches of the company with the highlights being from 1965-1975. During that time he discovered bright spots and was heavily involved in preparing for various Gulf of Mexico lease sales. In 1978 he became Division Exploration Manager for the Frontier Division, Western E&P, and in 1979, Pacific Frontier Division. He became General Manager for Shell Offshore in 1984. Finally, in 1987 he was elected president of Pecten International. He served in that position until his retirement in 1992.

Summary

Tremendous interview from an important figure in offshore exploration. Extensive discussion of bright spots including discovery, documentation, implementation, and how where the term came from. Chronological discussion of lease sales from 1960 until 1974 and then more discussion on the move to deep water. Excellent information on the quality of various fields, Cognac, Alaska, etc. Insight into his years with Pecten including mention of Brazil and Cameroon. He ends the interview with a commentary on the 3-D Seismic.

Tape #1, Side A

TP: This is an interview with Mike Forrest on June 29, 1999. The interviewer is Tyler Priest. I thought we would just start off today, Mike, by having you talk a little bit about your background and how you got involved with Shell.

MF: I like to think to myself …. how I got into geophysics. I am essentially a geophysicist. Even though during my last few years at Shell, I was a general manager and vice-president, I still think of myself as a geophysicist. When I was in school, in grade school and high school, I liked math, science and chemistry. I was going to go to college in my hometown . . . St. Louis University, and just like many young people, I didn't know what I wanted to study. I selected geophysics ….a little bit of science, a little bit of math and physics. I decided to go into geophysics for a year or two. But stuck with it….. continued studies in geophysics. That was a good decision, good fortune for me.

After two years in college at St. Louis U., several of my fellow students were writing oil companies for summer jobs. So, I wrote Shell and others, and Shell offered me a job in the summer of 1953. I was on a seismic crew . . . laying out seismic cables, and I worked on the survey crew and drilling crew. I planted geophones that are used to record the seismic data. That's when I really found what petroleum geophysics was all about. And then I worked with Shell again during the summer months in 1954. As my 1955 graduation was approaching, I sent a job application to Shell and they hired me fulltime. It is a long time ago,

but it seems like it only occurred recently… time flies by.

Back in those days, Shell had their own seismic crews. They don't anymore… it is all contract now. I went to work on a seismic crew because Shell started young people there for initial training, and I worked there for three years.

TP: In the St. Louis office?

MF: No. Gulf Coast.

TP: Gulf Coast?

MF: In small towns along the Gulf Coast. South Louisiana. There are no oil fields near St. Louis.

TP: I meant the Mid-Continent . . .

MF: Gulf Coast. We shot seismic in rice fields in south Louisiana.

TP: I remember seeing photos in the *Shell News* of seismic crews trudging through the swamps . . . I suppose maybe you were one of . . .

MF: Well, I helped. Then in 1959 . . . January, 1959 is a critical date . . . that is when I was transferred to the offshore division. Shell may have called it a different name

at that time.

TP: Marine division.

MF: Yes. Marine division. They brought me in to learn how to draw structure maps, seismic interpretation, after I had been on a crew for three years learning how to acquire seismic data. And so, in 1959, I moved to New Orleans. Started very slowly, but then quickly learned about seismic mapping. In 1960, I was involved in my first offshore lease sale.

TP: The first federal sale?

MF: The first federal offshore bidding was in 1955, or 1953. This was several years later. We didn't have so-called seismic stacking technology that you hear about today. When I look back, we had very primitive technology, but it was state-of-the-art at that particular time. I worked on the 1960 lease sale… plus another lease sale in 1962. That was a big one. The 1962 sale, at the time, was the biggest offshore lease sale. They read the bids over two days

TP: Why was this one so big? Was it an area-wide?

MF: At that time, sale blocks were nominated by the oil companies who told the government which blocks they would like to bid. The government would then select which blocks the industry liked and they would put those up for bid. They

normally would only put up so many blocks, you know, they selected a limited number of blocks to be bid per sale. For some reason, in 1962, I guess the government wanted to speed up the process, get more wells drilled and increase oil production, by having a larger lease sale. I am not sure exactly why, but it was twice as big as previous sales. Every lease sale had a certain type of theme, a technical theme that Shell used. In 1962 sale, the theme was piercement salt domes. Oil is often trapped in many sands on the flanks of piercement salt domes.

TP: Piercement?

MF: These are salt plugs. Offshore has a thick layer of salt at depth, and the salt is squeezed up when sediments are deposited on top of the salt. A shallow salt plug is called a piercement salt dome. Our main effort was playing flanks of those salt domes.

Big lease sale and Shell did real well. The exploration manager there was Ronnie . . .

TP: Knecht?

MF: Yes, Ronnie Knecht. He passed away a few years ago. But Ronnie… the 1962 lease sale was his pride and joy. And he did a hell of a job. After the lease sale, they transferred me to run a seismic party. My first three years with Shell were

spent working on a seismic crew, and now, from 1962 to 1965, I was a seismic party chief. I was one of the last party chiefs who managed the seismic acquisition and made structure maps, because a lot of the fellows who were named party chief after that did not know much about structure mapping. But I had mapping experience from 1959 to 1962 in the offshore group. Seismic party chief job was fu. Hated to leave. Shell transferred me out in 1965. It probably was the right time because I was dead tired, working 12 hours a day, six days a week.

Shell put me back into the offshore division. That was in 1965. I stayed there in different assignments until early 1976. I was working in offshore Louisiana . . Louisiana first, and then offshore Texas, and then back to Louisiana. There was a big sale in 1967. And the main technical theme for Shell at that sale was paleostructure. Have you heard that word before?

TP: Yes.

MF: You know, you need a good structural trap, and it has to be there early so that oil is trapped as it migrates up from deeper source rocks. So we mapped paleostructure which indicates the structure was formed early. This was the technical theme in the 1967 sale; I worked on a prospect east of the Mississippi river… it was identified as one of the best prospects of the sale by management. It was called prospect number 370. Has Billy Flowers mentioned 370?

TP: Yes, he may have.

MF: Prospect 370 was a gentle dipping structure. I made all the maps and did other technical studies and turned the work in to management. I didn't know what we were going to bid. We ended up winning almost every block with fairly high bids for that time period. It didn't work, drilled dry holes, found some non-commercial gas pay. While I was mapping the prospect, I noticed a high amplitude seismic event at about one second on the seismic, about 3,000 feet, over the crust of the structure. I showed the strong seismic event to some of the division technical people and to management, and most thought the strong event was caused by a tight streak, a high velocity zone. I found a few months later, after a few wells were drilled, that a gas filled sand was present at 3,000 feet, about 25 feet of gas pay. Didn't know it then, but this was the first bright spot.

TP: Can you explain for the lay person, what a high amplitude event is?

MF: Reflection amplitude is one of the primary measurements from seismic. We set off an explosive charge and a wave path, or a wave front, goes down through the earth and is reflected back to surface by layers in the earth over a time period, usually measured in milliseconds. A string of cables and geophones is pulled along the surface of the water and as the seismic wave is reflected back to the surface, the data is recorded. So, if you've got a strong reflection. If you have a 6,000 feet per second rock overlying a 10,000 feet per second rock, a strong amplitude will be recorded. If you have a 6,000 feet per second rock overlying a

6500 feet per second rock, the seismic reflection will be weak. I am grossly oversimplifying it. Basically, seismic measures travel time and the amplitude of the reflected wave, and structural dip can be mapped by following a seismic reflection. Seismic is used to map a structural trap that could be full of gas and oil.

As stated earlier, Prospect 370 had a strong reflection at about 3000 feet deep.. Most technical people thought it was caused by a tight zone, or high velocity zone. Later, the well logs indicated that the strong event was a low velocity interval, the gas sand.

I was transferred to offshore Texas area, in Houston from New Orleans, in 1967. I was assigned to map prospects in a province called Plio-Pleistocene which was in much deeper water, at the time, 300 feet to 600 feet. Now, of course, deep water is 3,000 feet to 6,000 feet. I was geophysical project leader. This is about the time when we started to record and process true amplitude data. I don't know whether Billy Flowers mentioned anything about true amplitude, but we could measure the amplitude better, the relative amplitude from trace to trace, much better than we could previously.

TP: No, he didn't mention true amplitude data. He might have, but I don't remember.

MF: The quality of the seismic was better. We were switching recording and processing technology, using computers, from analog to digital. That was the

beginning of the digital revolution.

TP: And so, that is why you were getting better seismic data.

MF: I am not a data processor. I am an interpreter, but the new digital data had better relative amplitude changes. So, I was mapping prospects in the Plio-Pleistocene, which is composed of very young rocks, and I was mapping on high-quality seismic, probably some of the best seismic that we had at that time. I kept observing strong seismic events on tops of structures. This was in the fall of 1967 and the spring of 1968. I showed the data to other geophysicists. I'd say, “What the hell are these events? Are these tight zones”? And then I read . . . I liked to spend about a half hour every morning reading technical journals. I received some Russian abstracts one day that were translated to English and started skimming them. One article described how the Russians were mapping oil and gas pays using seismic data. I wondered if these strong events that I observed on the seismic lines could be gas and oil pays, gas and oil zones? I pointed this out to management, but these were the days when we used seismic only to map subsurface structure, so I did not generate much interest in the strong seismic events.

TP: O.K., this is where I was confused. So, you weren't really using seismic to pinpoint where the pays were, just to delineate the structures, is that right?

MF: It was both. At the time, 1967 and 1968, we used seismic to delineate structures

but now I thought we possibly could also map oil and gas pays. You may have heard the word stratigraphic geophysics, which is a detail study of the seismic amplitude, patterns and other characteristics. In 1967, we only mapped structures… no attention was paid to the amplitude and other seismic geometric patterns. Seismic reflection technology was: map a structural crest, the high, and drill a well on it. That is all we were really doing back in those days. I mentioned my strong amplitude observation to several Shell people and everybody said, "Interesting"……..

At this time, I made an error, which I will talk about later.

TP: These Russian abstracts? What were they, technical papers?

MF: Yes, purely technical. This is when I first had the idea that strong seismic amplitudes could be related to oil and gas pays? The federal government only put blocks up in lease sales that oil companies nominated. Not one company nominates, but a lot of companies nominate. All the Plio-Pleistocene prospects that I was working were included in the general 1968 Texas lease sale area but the official sale tracts had not been announced. The official sale announcement did not include any of the Plio-Pleistocene prospects.

TP: And this is in, which lease?

MF: This is the offshore Texas sale, in 1968. And, we would have beaten the industry.

TP: State sale?

MF: No.

TP: It was federal?

MF: Federal government. The water depth was about 200 feet to about 500 feet. And we had the prospects mapped cold. We would have won leases on every prospect. The same acreage was up for sale in the 1973 sale. I'll come back to that. An area that was included in the 1968 sale was over a large fault area called Corsair Trend, which was a Shell name.

TP: Corsair?

MF: Yes. Billy Flowers didn't mention Corsair trend?

TP: He might have.

MF: Picaroon?

TP: Picaroon . . . yes.

MF: Did he mention prospect Picaroon? Picaroon is a structure in the Corsair Trend.

It is a big fault system with several large structures.

TP: Right. He mentioned that.

MF: Shell management assigned me to quickly review the Corsair Trend blocks that were included in the lease sale, along with several other technical staff. These were large anticlines and, to make a long story short, we bid five million dollars per block and other companies were bidding eight to ten times our bid, they were bidding 40 and 50 million dollars and we couldn't believe it. Other companies were filling these big structures up with lots of oil. We thought it was going to be gas, and much smaller reserves, and we were right. But, we'd rather have it the other way around. You would rather drill for oil and find it.

Next, I was transferred back . . .

TP: And so, Shell didn't get . . .

MF: Shell lost almost every bid. I think we bought one block in the sale. And some management was upset. A manager from Royal Dutch Shell, even though we were still separate at the time, came over and gave us all kinds of hell for our low bids. It turns out that we were right. There were only small gas fields in the so-called Corsair trend. Shell did find, in the mid-1980s, significant deep gas on Picaroon, one of the Corsair Trend prospects. That is what Billy may have talked to you about. The deep prospect is different.

TP: So, were you using bright spot interpretations on this?

MF: No. Bright spot was just kind of a crazy idea at this time and I was the spokesman. In 1968, I was transferred from Texas to offshore Louisiana, and I was assigned to map Bay Marchand field in preparation for a lease sale. Ronnie Knecht bought the first Shell block in 1964. A little block…. a sliver block where Shell had developed several million barrels of oil. An adjacent block was up for bid in 1968. We shot new seismic and I mapped for two or three month. We bid and won the block. Shell made a $20,000,000 bid. The next bid was $16,000,000, by Chevron, who was a key player in that area. We beat Chevron and everybody was very happy. Bay Marchand oil pays were fairly deep. I mapped a strong seismic event that fit the structural trap. After we drilled several wells on the new block, we noted the strong event correlated to a thick sand full of oil, about 120 feet of oil, called the "O" sand. We checked the logs and couldn't see velocity or density changes that would cause a bright spot. Remember when I was mapping in Texas, we had no well data because it was a frontier area, so at Bay Marchand, we could tie the seismic to the well logs. We studied the logs at Bay Marchand. You can calculate rock velocities from well logs and estimate what the seismic should look like at that well site.

TP: So, you are correlating the logs with the seismic?

MF: Yes. If you correlate the logs to the seismic, you can make a seismic trace from

the well log. It is called a synthetic seismic trace. You compare the synthetic to the seismic data. Anyway, the synthetic showed no strong event at the Bay Marchand “O” sand level. A few years later, we drilled downdip across the oil-water contact which was located right at the edge of the bright spot event.

So, about that time . . . this is getting to be long . . .

TP: No, go on. This is good.

MF: Then I was assigned to work the next offshore sale, which wasn't until 1970, but it was originally scheduled for 1969.

TP: Yes, Billy Flowers talked about that.

MF: In late 1968, Shell named me geophysical project leader. There were two of us working the Plio-Pleistocene trend in offshore Louisiana. This area was east of and on trend with the offshore Texas area that was not up for bid in 1968. As project leader there, I started mapping the prospects and noting strong seismic events within structural traps. I was the joke of the office. We geophysicists would drink coffee together and some would say, "Here comes that guy with those bright events." And they would laugh.

Now, I goofed. Early on, I should have tried to document the significance of the bright seismic events by studying some of the shallow water fields where we had

well data. Did not have well data in the frontier sale area. One day in late spring 1968, the chief geophysicist, Glenn Robertson, came in and said, "Why don't you document these bright looking events with well data". Since I had worked offshore twice, I knew many of the Shell oil and gas fields. I pulled data on about six fields where I knew there was shallow gas pay. Spent two weeks putting together a package of six fields; included a map and showed an outline of the gas accumulation with the key wells highlighted. I checked the sonic and the density logs and correlated with the seismic. Every gas pay was very soft, and what I mean by soft is, the overlying shale may have been about 7,000 feet per second velocity, and the gas sand dropped way off to about 3,000-4,000 feet per second. So, a very strong soft seismic event could be observed on the seismic, correlated with the gas pay. Had some wells off structure where the sand was wet and it didn't show a good seismic event and the velocity change in the sand was much less than when gas was present. So, I put together this six-field package. I will never forget this. I put together this six-field package and made a presentation to management and said, "I am out of here. I've got two weeks vacation." Came back after two weeks and everyone said, "You missed it." I said, "What did I miss?" They said, " we showed your data package to exploration senior management, R.E. McAdams. And he went bananas. He's got the research people working on it. They are sending a research team over to work in the offshore division. McAdams has the whole company looking for a bright spots." I said, "All this happened while I was gone?"

TP: And no one knew how to reach you? They didn't call you while you were on

vacation?

MF: No one called me. Probably did not know where I was. Many people ask me about the coined word, bright spot. I was talking to Lloyd Otteman, retired Shell production general manager about two years ago. He said, "You named bright spots." I said, "You know, Lloyd, I hate to tell you, but I didn't." He said, "You didn't?" I said, "No. I do not know in detail how that coined word got started," which is now very well-used in the industry. You see it in publications, you see it everywhere. I said, "what happened is early 1969, I was the biggest joke in the office, and exploration staff would say, 'here comes that guy with those strong seismic events.' And then one day at coffee, one person said, 'yes, those events are bright.' This was followed by some one who mentioned bright spot, and I have no idea who it was." That is how things happen. This is how some coined words and phrases start.

TP: But it is associated with you nevertheless.

MF: Yes, it is associated with me, but many people thought I sat down and said, “what are we going to call these strong seismic events?”

TP: What did you refer to these things as, if not bright spots?

MF: Bold events. We used bold events for awhile, you know, strong reflections. Or, strong amplitudes that was present on the crest of a structure.

TP: But nothing as catchy as bright spots?

MF: No. The term bright spot caught on. Bright spots are mentioned in thousands of publications around the world. And the word bright spot was coined in early 1969 in Shell Oil Company.

TP: Let me ask you something: So, the spring of 1969 is when McAdams . . .

MF: Early summer of 1969.

TP: The summer of 1969, is when McAdams and the rest of Shell Oil Company got really excited about this?

MF: Yes.

TP: When did you know, in your mind, that you were right about what you were seeing?

MF: Probably when I was working on the six field package, which, by the way, I wish Several friends have asked if I had a copy of the 1969 fields studies. I have thought about writing Shell Offshore, or calling some of my old friends to see if that six-field study package is still in the Shell files. That would be good document.

TP: Oh, it would be a tremendous historical document. You don't know what happened to it?

MF: Well, I haven't checked. I can do it. In fact, I have been looking for a really good reason to look for it, so I can follow up if you want me to.

TP: That would be great.

MF: It is probably digitized. Somebody told me everything is digitized now.

TP: So, it must have been real exciting for you to see your theory validated by the data.

MF: Yes. Another interesting story. After I returned from my two-week vacation, management sent me over to what we called BRC, our research lab. The name has changed. I was in a room with several research people. Apparently, they had just written a paper about two or three months earlier stating they did a study on direct detection of hydrocarbons using seismic . . . it wasn't called bright spots . . . and they did not believe it would work, because the amplitude contrasts were so low. Usually, when you record a seismic event, it comes from a small velocity contrast. The contrasts were anticipated to be from 6,500 feet per second to about 6,000 feet per second or something in that order of magnitude. I guess nobody looked at the well logs. This was back in the days when we had separate

exploration and production functional organizations. If we would have had petrophysicists working with exploration staff, we would have caught on much quicker because the petrophysicists would have recognized the large velocity changes on the logs. A sonic log across a gas pay has a huge soft event, as we called them, low velocity change, such a large change that you had to see a significant reflection on the seismic.

At that time, I went back to being a geophysical project leader, and management brought in several research guys, and they formed a special study team. My skill area was drawing maps and finding oil. We, the operations and research people, talked all the time. We were right down the hall from each other. We discussed why bright spots were identifying oil and gas pays on some prospects, but not in others. Over the next two years, we had what I call peak and valley days. No, let's say the next year. Peak and valley. What does that mean? We all would get all excited over a certain bright spot, we used the words bright spot now, and we drilled it and made a good well. Management would go through the ceiling, you know, a good success. The next one we drilled was dry and they'd hit the floor. So, I called it peak and valley days.

TP: Now, this was in 1969-1970, you are talking about?

MF: This was 1969 and early 1970. You had to keep in mind this is common in any new concept. In any new concept, new ideas, new technology, there are always peaks and valleys. Something works one week, the next week it fails, until the

physics is better understood and you have good case histories.

TP: And such high expectations for it.

MF: The next week, it falls apart because something was wrong.

TP: All right. Let's stop right here.

[PAUSE]

TP: So, we had left off with what?

MF: O.K., we left off in mid-1969 with bright spots. I told the story how we named bright spots. It was a group effort. Then, it went up to senior management, and after they saw the six field study package, they were excited. Then we started to look for bright spots on essentially every Shell gas and oil field. And we started to look for bright spots on all new prospects. We brought in the special skilled guys, the research people. I returned to my job as project leader getting ready for the big lease sale which was supposed to be in late 1969 but it was postponed a year until late 1970. There was a small sale in the spring of 1970. It was either the fall of 1969 or the spring of 1970, I don't recall.

TP: Do you remember when the big lease sale was postponed?

MF: No, it was just government policy, procedures, I don't know.

In the small early 1970 lease sale, our staff recognized a prospect east of the Mississippi River, a low relief structure, and it had a bright spot on it. Between 1968 and 1970, a lot of these studies were kept confidential, very quiet, very secretive. It wasn't like today -- you didn't have as many people going from company to company, but everything eventually leaks out. During 1970, friends in the industry started to ask me about bright spots. 'What are you guys working on?' 'Some kind of a bright spot, what is that?' And, of course, I played the game. 'I don't know what you are talking about.' Anyway, Mobil outbid Shell on the prospect ease of the river so management was concerned that they were using bright spots.

So then, we went to the big 1970 sale, the Posy sale. This is interesting. We used to call our prospects one, two, three, you know . . . numbers. And then we got up to prospect 169, 269, 369; it became a mess to remember the numbers. So, 1967 or 1968, we had an exploration manager who said, 'Get rid of these numbers. You have to start using prospect names.' So, we did it by groups or themes. We had Posy, Orchid, Tulip, all flowers. We had a flower patch and had a tree patch . . . etc.

TP: And later Shell used cartoon characters like Bullwinkle, Popeye, yes.

MF: Yes. But "Posy". We bought one block in the 1970 sale, Eugene Island 331 on

the west flank of the crest. That was my prospect. I did all the structure mapping and bright spot outlines. And we bought the block off structure for $13,000,000 We lost the crest block. Shell bid $13,000,000 on the crest and Pennzoil bid $28,000,000. Now, if you talked to Billy Flowers . . . we had new technology, bright spots . . . we could recognize direct pay using seismic, but we didn't really push it. We didn't really use it as much as we could have used it.

TP: In the smaller sale, you are talking about?

MF: No, in the big one on late 1970.

TP: Oh, in the big one?

MF: In the Posy sale, we only bought six prospects. Management was disappointed. But, it turned out all six of them were decent fields. But, we had two big ones, especially prospect Posy. But, we were conservative. On Posy, I mapped eight bright spots using 2-D seismic. We didn't have 3-D yet. We thoroughly analyzed the amplitudes anomalies. I believe management was sensitive about the peak and valley days, and especially when you had to spend significant money on a bonus. And so, we ended up only using two of the eight bright spots. Later, after well logs were available on all the blocks on the Posy structure, all eight bright spots were oil or gas pay, plus additional pay zones. Posy, Eugene Island 330 Field, is the largest field in federal waters on the Louisiana and Texas shelf, water depth up to 1000 feet . . . over 700 million barrels across several blocks. I estimate the

Shell block has about 150 million barrels.

Another problem is some Shell management thought that there was no block in the Gulf of Mexico worth over $20,000,000. And I think the highest bid we made was about 15 or 18 [million].

TP: And Pennzoil bid 28?

MF: 28 on the crest block, which is the best block on the structure. And we bid 13. It was a Pennzoil group. Interestingly, there was a Pennzoil manager, now retired . . . I can't think of his name. I know him . . . but he has made many presentations about Eugene Island 330. That's their block on the crest. He has given this talk all over the world since about 1981. And I would sit in the audience, saying to myself, that's my talk! He's giving my talk! Well, we made an error. We all learn from the past. If you have a new technology and if you think it is correct, you should go with it. We were very proud of what we accomplished, but we could have done much better.

TP: You could have taken more advantage of it.

MF: Yes, in the Posy sale. The next big lease sale was in 1972. The best prospect was called Pine, South Marsh Island 130. I call this the Pine lease sale. Now, we pushed it. We all recognized what we had done right and wrong in 1970, being too tight, too conservative. So, in 1972, we went . . .

TP: And, by this time, had other companies understood what was going on?

MF: Yes. By 1972, most, not all, but most of the companies, were using bright spots in their prospect analysis.

TP: Pennzoil hadn't used bright spots in their analysis of Eugene Island 330.

MF: Not the way we did. Posy is a big, fairly simple structure. I think they just said, this is a large anticline. It must be full of oil. And it was. They may have recognized the bright spots, but I do not believe any company, other than Shell, was quantifying the amplitudes in 1970. In 1972 and 1973, some companies started doing bright spot studies on prospects on a very qualitative manner and many dry holes were drilled. We tried to quantify the amplitude. We had programs to measure the amplitude and thickness, and draw the bright spot outline very carefully to check the tie to structural closure.

The next sale was in 1973, in the Plio-Pleistocene, offshore Texas, the same area that I had worked in 1968, but was not included in the sale. All the Texas acreage up for bid in 1973, and we were stonewalled. We bought only one block. The industry bid on these bright spots with very high bids. Many companies were using bright spot technology. Plus, remember in 1973, oil prices went up.

TP: Was this after the embargo, the lease sale?

MF: It was right about the time, I don't remember the exact date. So, we got beat badly in the 1973 sale. It was probably the right thing, as I look back, because we would never have made any money on the prices paid for the leases.

The next sale was in 1974. I call this the Cognac sale. Prospect Cognac was in 1,000 feet of water. It was a big step out. The prospect was full of amplitudes, full of bright spots. Sometimes I refer to bright spots as amplitudes. I was project leader again. We put one of our best geophysicists mapping Cognac, plus another geophysicist studying the bright spots. We bid on oil using bright spots. By that time, we had a detailed process of probability analysis, probability of oil. For example, 60 % probability of oil, 80% probability of gas. We won three out of four of blocks on Cognac. After discovering oil, we formed a unit with the other leaseholder, Amoco. We installed a giant offshore platform, Cognac platform.

You mentioned Sam Paine. these platforms were supposed to cost $50,000,000 apiece, one for each of the four blocks. We didn't anticipate that we were going to form a unit. The partnership decided to build one platform. The construction group estimated the cost at $100 million. Well, it went up to $250,000,000, and Sam was going through the wall. Sam was the offshore production general manager. The platform eventually cost $250,000,000 or $300,000,000, whatever it was, and we estimated 100,000,000 barrels of oil plus 500 bcf of gas. I think now it's near 200,000,000 barrels oil, and Shell keeps redeveloping it.

I was working in Houston in the late 1970s, and I called New Orleans one day to speak to a production manager and asked, "How is Cognac doing?" The answer was break-even economics. You probably heard the saying; big oil fields get much bigger. Just like Pine did, and now Cognac. The larger reserves plus the high oil prices in the late 70's and early 80's made Cognac very profitable.

TP: So, did you used bright spots on Cognac?

MF: All bright spots. Every bid from 1970 on was based primarily on bright spots with additional potential estimated using trap analysis.

TP: Was it a close bid for Cognac?

MF: Cognac covers four offshore blocks. We won three of them easily. We should have won the fourth one. I was the part of the team that changed the value order of the four blocks. After drilling, we found out that Amoco had won the best block. We got beat by about $10 million, $80 to 70 million. We had called the southwest block the best. That was the first time that Shell bid over $100,000,000, actually $112,000,000.

TP: And a couple of year's earlier, management was worried about $20,000,000?

MF: Yes, three years earlier. Also, we bid the Posy sale with 100% Shell bids, whereas we bid Cognac with several partners.

We mentioned Jack Threet. I see Jack about twice a year these days. Jack was very concerned about Cognac making a profit. The Cognac sale group was in Houston for a presentation to senior management, to John Bookout, president of Shell. Several guys in the group liked to party and drink. We were having cocktail hour and I heard somebody say, "We're going to eat." I turned around and most of the group was gone, and I am left sitting next to Jack Threet and Sam Paine. I said, "Where did they go?" Jack said, "Why don't you come eat with us?" I found out it later that this was prearranged. We sat down for dinner and they grilled me for an hour and a half over dinner. "We want you to tell us why you think this is such a good prospect." I had to go through the whole technical story.

TP: Cognac?

MF: Yes. So, the next morning, I said, "Jack, you guys tricked me last night!" He replied. “We just wanted to be sure” -- I think we bid $250,000,000 Shell net out of a total $750,000,000 -- "whether we should bid all this money!" Cognac is a 200,000,000 barrel oil field. Sounds big, but it is not big field when you look around the whole world.

TP: When you look at Saudi Arabia, yes.

MF: But Cognac is a large field in the offshore Gulf. The Gulf of Mexico has many

fields, 10,000,000 barrels up to about 400,000,000 or 500,000,000 barrels. There are many more small fields than large fields. So, the way you make money offshore is the cumulative number of oil and gas fields. Of course, each field must pass an economic threshold test. If you find a 100,000,000 barrel field offshore, you feel terrific. It is a good find. But the critical thing about Cognac is that it was in 1,000 feet of water. And they built that platform in three pieces. I am sure you've talked to Sam ….

TP: Yes, mating them in the water, it was quite a project.

MF: Many good people were involved. Tom Hart. Have you heard that name?

TP: Oh, yes. We were not able to interview him.

MF: He's dead. We discussed Jack Threet. Ray Thomasson. Have you ever heard of Ray?

TP: Yes, but I don't know where to reach him.

MF: He's in Denver. If you want to talk to him, I can give you his phone number.

TP: That would be great.

MF: He left Shell a long time ago, but he was the exploration manager during the Posy

sale. J.T. Smith, a geochemist, played a key role. He is still living.. Had lunch with him two or three weeks ago. Dick Grolla was the head geophysicist for offshore. And, of course, Billy Flowers. Billy was always the person who pushed us technically. He would make sure that we used the most state-of-the-art geophysics in every lease sale. He was very good at that. Tom Hart and Billy Flowers used to have this dialog: Billy used to always say, "Tom, you are not bidding enough. Tom, you have to raise these bids." Tom had the last word on the bids back in those days. So, one meeting we were presenting to Bookout, whoever it was,the president of Shell, the bid was, let's say $27,000,000 . . . Billy said, "You've got to bid more, you're bidding too low." So, Tom said, "All right, Billy, how much do you want to bid?" And Billy said, "Oh, 28!" [laughter]

TP: To feel a little more secure, right!

MF: But not 35! And there are lots of other stories, like Bay Marchand. There was another block that came up for bid in Bay Marchand field, offsetting to the south. We bid $64,000,000 on it. The next highest bid was about $800,000, and there is a long story about that but . . .

End of Side A

Tape #1, Side B

TP: So, I was about to say, you and the other geophysicists, it must have been nerve wracking, realizing that, you know, you were the ones responsible for the money,

or for valuing these properties.

MF: The reason I started listing names is because occasionally we get together except, of course, Tom. Leighton Steward. Have you ever heard of Leighton Steward?

TP: No.

MF: He is with Burlington, vice-chairman with Burlington, and about ready to retire. He was exploration project leader, and then exploration manager offshore. I would have to think about which years. Leighton likes to tell the story on me. You have to know Leighton, he talks slow. He says, "One night, I was at the office." There was a lot of night work when we prepared for lease sales. And he says, he points to me, "in comes Mike, and he had this seismic line, this well log in his hands, and he said, 'Leighton, look at this.'" "And I said, 'My God, you could see the gas pay on the seismic.' And he said, 'I remember that just like it happened yesterday.'" He likes to tell that story, and I'm hiding my head. But anyway, we all get together occasionally and talk about the best times in our Shell career? Even Tom said this, the best years were 1968 until about 1975. It was thrilling to work these lease sales. And, you know, I had the best job in the world. I was a project leader most of the time, but I used to visit the offshore seismic crew, and tell them where to shoot. And then I would make the maps, and help the other geophysicists who worked for me, and then we would have the meetings and I would present it to senior management. So, I was involved from the seismic crew, acquisition of the data, to the mapping, to the bidding. Even though I was

not a key player in the bidding, I was primarily on the technical prospect side, and we were presenting all this data to the Shell senior management. So, I saw the whole picture. It was really fun. I have five kids. If you talk to my wife, she will say it was not fun for her, because I wasn't home very much. You know how that goes.

TP: Yes. But just the mind boggling figures that you were bidding for these prospects, and realizing that you had to stand behind those.

MF: Yes, but, you know, we never thought of it that way because we were successful. It worked. And in later years, we explored for stratigraphic traps using bright spots. Many of these stratigraphic traps are found only with bright spots.

TP: Using seismic to identify the pays . . .

MF: The oil and gas pays . . .

TP: In the stratigraphic trap?

MF: Yes, in the stratigraphic trap. That is the only way that you would find them. Otherwise, you would be drilling wells at random. So, these were thrilling days. I worked so many years in the offshore area that I got to know most of Shell's offshore fields. I started offshore work in 1959, so I could tell you something almost about every Shell field up until when I left offshore in 1987.

I've got one more story to tell about offshore: deepwater. When Shell transferred me out for the last time in 1987, the production department general manager said to me, "You are the history book around here. How are we going to work without you here?" Then…... .

TP: Going back to the early years, everyone identified . . . South Pass 24 and 27 and Main Pass 69 . . .

MF: Shell has sold most of these fields; they were discovered in the 50's.

TP: What were some of the other legendary fields in the history of Shell offshore that you acquired, say, in the 1960s and 1970s.

MF: We discussed many of the 70's discoveries, based on bright spots. There were also many smaller fields. In the 60's, South Marsh Island 73 is a large field, several hundred million barrels, and Shell had part of it. Oil sands on the flank of a large salt dome. Also, South Pass 70, located east of the Mississippi delta. There were no bright spots because it was bad data, bad seismic, but a good field. Another is South Pass 65, which was bought in the 1967 sale. I wasn't in the management meeting, but people said that the question was asked if any other prospects were ready bid? Another prospect was shown, a low relief structure, a fault trap, near South Pass 70. I didn't map this prospect, but I knew what was going on, and management decided to bid this block at $800,000. It turned out to

be a hundred million barrel field. Another good discovery South Pass 62, leased in the 1962 sale.

This is an interesting story. In 1962 . . . I am jumping around . . .

TP: No, that's fine.

MF: In 1962, we were getting ready for this big lease sale. Senior management from Houston, I assume, asked for some prospects to bid on in deepwater. Deepwater, at the time, was about 300-500 feet. We had one area that looked like it was a shallow salt dom. We interpretated the prospect as piercement salt dome, from gravity data. Most piercement salt domes have oil trapped on its flanks. A week before the lease sale, we were asked to shoot a few seismic lines to verify the salt dome interpretation. We shot a grid based on the salt outline from gravity. We shot three seismic lines across the salt dome, and we shot two crosslines. We received the data and there was no prospect, no salt dome. Could not believe it. It turns out that everything was so rushed, the crew had mislocated the seismic lines. We sent the crew back to shoot the correct locations and we then had another set of lines over the area. The map looked like a crowfoot. We interpreted the data over the weekend, and management bid $188,000. We won the block. No competition. But it was in 400 feet of water, and nobody was drilling in 400 feet of water at that time. And so, this was the last prospect drilled, the last prospect drilled from the 1962 sale. It was a 100,000,000 barrel oil field, may have been one of the best fields in that sale. Remember what I said earlier. Many of the

fields in the offshore Gulf are 25 million to 50 million barrels. If you found 100,000,000 barrels or greater, it is a good one.

TP: This was at South Pass 62?

MF: South Pass 62. But the point is, the reason we were even bidding, the whole key in this oil business is getting there first with the right technology with the right people and the right strategy. That is the key everywhere, even right now, get there first. We were leasing prospects in 300 to 500 feet of water, when the industry hadn't even thought about it.

And then, another field in deeper water was West Delta 105. There was another West Delta field. Anyway, three good fields were found because management said push into deeper water.

TP: Get into deeper water and you will find some way to profitably extract the oil.

MF: Yes, to make money using technology, exploration and development technology.

TP: One other question I had: Lloyd Otteman mentioned Sam Mitchell from the production side . . .

MF: Yes, he is a petrophysicist. Retired.

TP: Related to the bright spot . . .

MF: I don't remember Sam actually working on it.

TP: Oh, really?

MF: Sam knew all about it. I think Sam was a chief petrophysicist at the time, or manager of petrophysics . . . .

TP: I guess Lloyd was just talking about the fact that you and Sam worked together, and the exploration and production coming together.

MF: We used to talk, but whether we actually worked together? I have known Sam for 30 years, since 1968 or 1970, so Sam was there. I think probably Lloyd wanted Sam because he knows the well logging side, the petrophysical side. As I said earlier, you can make a seismic trace from a log, synthetic seismic from the logs. He knows all the well logging technology. I know Sam was involved, but I can't recall him being actively involved.

TP: O.K.

MF: Anyway, that is the amplitude story and one of the highlights of my Shell career. There is one more highlight . . .

TP: What sort of advantage did it give Shell and over what period of time?

MF: It gave us an advantage. Not as much as you think. It gave us an advantage from the 1970s sale and the 1972 sale; it gave us an advantage because we used bright spots, even though we were conservative in the early years. It gave us an advantage because, in those days, we were using our own seismic crews. We used to shoot a lot of data. We would shoot lines at about a one half-mile grid. Other companies were using a mile or two seismic grid. I remember one meeting with some outsiders from another company, they looked at our map and said, 'are those all seismic lines?' We had our own boats to shoot many seismic lines over prospects, and we did quantitative bright spot analysis. And we did a hell of a job mapping the structure and carefully outlining the bright spot areas. We talked to management who accepted our concepts and our prospects and put the money behind it.

TP: And they believed in technology.

MF: Mobil Oil was not far behind us.

TP: How about Chevron?

MF: Chevron was probably a little bit farther behind us, but Mobil was . . . I hear two stories from Mobil . . . Jim Hohler, that name probably doesn't mean much to you

TP: Hohler?

MF: Jim Hohler. Jim was a rising star in exploration. He was exploration vice-president, I guess, that's what the title was, for the U.S. Gulf Coast, both onshore and offshore, back in 1967 and 1968.

TP: Hohler was with?

MF: Shell. So, he knew all about these bright spots. Then he quit Shell about 1969 and went to Mobil.

TP: All right, yes.

MF: He went to Mobil. I talked to one friend who worked for Mobil who told me that Jim came over from Shell and said, "You guys had better get working on these so-called bright spots because Shell has it and it looks like it is going to work". That was one story. The second story, I talked to another retired Mobil friend and he said, "Oh no, we didn't need Hohler. We did bright spots on our own." But anyway, Mobil was right behind us. And we lost a couple of good prospects to Mobil.

I remember there was one prospect, I can't remember the name of it, but it was a combination fault and stratigraphic trap. And we bid $35 million, or thereabouts, and they bid $50 or 60 million. It is a big gas field, all bright spots.

TP: So, some people suspect that Hohler….

MF: Of course, but you can't mention that. But we definitely had a technical advantage because we used bright spots on every prospect. By the way, it kept us out of some areas. It is not just what you find, but it is what you stay out of. There were some big bid blocks that we didn't bid on, some big blocks that went for high dollars that we didn't bid on because we couldn't see the amplitudes to support it. Some companies bid a lot of money and then discovered a much smaller field than was forecast.

TP: So, did you test just about every prospect with bright spot? Did you use bright spot to determine . . .

MF: Every prospect. Yes. We also had trap analysis. Have you ever heard of trap analysis?

TP: No.

MF: Urban Allen, did that name come up?

TP: No, I don't recall.

MF: Well, he has passed away, but Urban and I worked together on Bay Marchand in

1968, and he had this concept of trap analysis which is: sand against sand across a fault does not trap whereas sand against shale traps. In the 1970 sale as well as the 1972 and 1974 sales, we used trap analysis quite a bit. We would certainly risk trap analysis reserve potential a lot more than bright spots. We gave trap analysis about 30% chance of success; whereas, bright spots, the probability or success was 70 to 90%. From mid-1969 on, every prospect was scanned for bright spots, with a very tight grid 2-D seismic data. No exploration 3D seismic was used until the late 80's.

I had an interesting conservation a couple years ago with a Chevron retiree….

You recall that I left the offshore in January of 1976. I was exploration operations manager for onshore Gulf Coast, Mississippi, south Louisiana, south Texas. In January, 1978, I was transferred to Houston.

TP: You were doing the Pacific frontier?

MF: Yes, also the Pacific Frontier division: California, Beaufort Sea, Bering Sea. I will talk about that in a few minutes.

So, I was talking one day to a friend from Chevron? He asked, "Mike, why didn't Shell use their bright spot technology?" I said, "We did." He said, "No. You did not really start using it until several years after you found it." That was his impression as an outside. He was probably referring to Shell's conservative

bidding in the early 70's. After the mid 70's, Shell used bright spots very aggressively in bidding. In about 1980, Shell bid on a prospect, I will never forget it, $120,000,000. I was working in Houston. I asked Jack Threet. I said, "How big is that prospect we bid?" He replied, 120 BCF gas. I said, "Jack, you are paying one dollar per MCF." That was unheard of at that time. I said, "Why don't you give me some of that money so I can do some exploration in West Texas and Oklahoma." He said, "No. Because your Texas and Oklahoma prospects are a lot more risky and it will take a lot more time to make a profit. This offshore prospect is a gut cinch of being 120 BCF field," which, by the way, it was.

I am sure people like Billy Flowers did not like to talk about it, but we could have used bright spots much stronger in the early 70's than we did. We could have bought more oil fields. We should have taken more risks with it. I would be really surprised if Billy didn't say something about this.

TP: Oh, he did. He mentioned about how you had it, but didn't really use it until 1972, but he didn't go into much detail over the reasons why.

MF: Anyway, bright spots were very successful. When I retired from Shell in 1992, they gave me a map, I've got it on my wall in my study at home. It is a sketch of the offshore -- Louisiana and Texas. And Shell offshore staff noted every field that I was associated with using bright spots. There must be 25 fields on there – mostly on the shelf. The only deep-water prospect noted is Auger. Many were 25

million barrel fields, 50 million barrel fields that cumulatively made a lot of profit, make a lot of money. We found approximately two billion barrels of oil, hell of a lot of oil and gas. But we probably could have done better, if we would have pushed bright spot application in 1970-1972.

TP: Well, I guess, my impression is that Shell has a sort of conservative mentality about . . .

MF: We weren't conservative with Cognac. Cognac, we pushed it to the limits. That was 1974. Shell was not conservative after the mid 70's.

TP: Yes, like you said, after 1973, it is a whole different ball game in some ways.

MF: We pushed Cognac all the way.

TP: Maybe people regretted not having pushed it in 1970.

MF: Yes. After that, the competition had bright spots and technical studies were being published. But Shell is recognized around the industry as being the first to use bright spot technology.

I would like to make another point. Back in 1968, when I told you about how I gave this talk to the researchers, and they said, no, no, direct detection of hydrocarbons will not work. The point is many of new ideas come from the

operations people who know the data. I knew the data. I am a data hog or a data hound, and I knew the data. I started asking questions using seismic data. Why is a certain seismic event so strong and why does the high amplitude fit the structure closure? It looks like an oil field. That's how bright spots started. At the same time, the research people doing studies without seeing the data said it doesn't work! So, it is a good case where you need operations and research people working together. Once we showed bright spots to the research people, they helped tremendously. But, some of the best ideas come from the operations people.

TP: My impression is that by the 1960s, communication between the operations side and the research side was good, or better than it had been in the past . . .

MF: Teamwork. I have been involved with other companies since I left Shell. I have worked with another company in Dallas for five years, and then I have been working for a couple companies doing part-time consulting. I then realized that Shell had good teamwork. We didn't know it, but we had good teamwork. Even though we had exploration and production as separate organizations, even though we were operations and research, we had good teamwork. But we sometimes patted ourselves on the back about our technical capabilities. We always thought that we were better than the competition and, by the way, all the competition used to talk about us: 'at Shell, they always think they are better. Shell people think they know how to do it better than anybody else.' Competitors told us that many times.

TP: Well, it was true, if everyone thought that.

MF: As mentioned earlier, I moved to the onshore Gulf Coast in 1976. You don't want to hear about that. Nothing significant.

TP: You were in Mississippi . . .

MF: Yes, onshore Mississippi, onshore south Texas and south Louisiana. There were a few fields found but nothing significant.

TP: You said you left offshore in 1975, is that right?

MF: Yes, worked onshore in 1976-1977. In 1978, Shell moved me to Houston as exploration manager of the Alaska Division, later changed to the Frontier Division?

TP: Well, Pacific Frontier Division, 1979, it says here. Frontier Division, Western E&P region.

MF: There were several Beaufort Sea and Bering Sea lease sales. These were the two last frontier areas in the U.S. And gigantic structures, especially, in the Bering Sea. Prudhoe Bay field was on the North Slope, onshore. And we were exploring onshore and offshore. A very costly area to work, cold weather, ice sheets in the

winter time. Temperatures in the winter are minus50. It is a hell of a place to work.

TP: The price of oil was high enough . . .

MF: Yes. We bid on two or three lease sales in the offshore Beaufort, and we won quite a bit of acreage. We drilled several well. We participated in the Mukluk dry hole. Most wells have gas and oil shows but couldn't find anything that was economic, so Shell is out of the Beaufort Sea. One thing that made the Beaufort Sea so interesting was that it had excellent source rocks, a good oil charge, lots of oil. The problem was finding a big enough trap and thick enough reservoirs. Every well drilled found oil and gas, but not enough to be economic.

Recently, Prudhoe Bay oil production has been declining, and because the pipelines, roads and other infrastructure are present, several oil companies, not Shell, but several oil companies are now exploring for smaller oil fields.

TP: In the Beaufort Sea?

MF: Both offshore and onshore, west of Prudhoe Bay, onshore. East and west onshore Prudhoe Bay. Also offshore. Oil companies can now make money on a field that is one hundred million barrels to three hundred million barrels. We couldn't touch these. It had to be bigger. The exploration cycle. This is how the exploration business goes, the exploration business in north Alaska has recently come back,

because of the infrastructure around Prudhoe Bay and nearby fields development.

We bid in the offshore Bering Sea. There are three basins: Norton Basin, St. George Basin, and Navarin Basin, which adjoins Russia. This was big structure country, but there the question was, 'is there going to be any oil there?' It was not like Prudhoe Bay where known source rocks are present. It was also a question of size and profitability. This was Shell Oil. Remember, we are operating as Shell Oil, separate from Royal Dutch. This was Shell Oil's number one play because it was a large frontier province and the company needed large discoveries, admittedly, high risk.

TP: Because your reserves were going down, ratio of reserves to production?

MF: We worked so hard. Shell needed to find two hundred million barrels of oil a year just to stay even, to stay flat, replace their production. And so, the Bering Sea was a high priority for Shell Oil. To make a long story short, we bid on many prospects, spent a lot of money, drilled several very bad wells, expensive dry holes. I transferred to offshore again in 1984 as general manager, exploration.

TP: General manager of exploration.

MF: A couple of other things though: north of the Navarin, there is another basin offshore called Chukcki.

TP: Right, I have heard about that.

MF: The Chukchi Sea. I was only involved early on, acquiring new seismic data. But it was the same story in the Chukchi. There were three or four gigantic structures, and I think Shell discovered some oil but it was not economic. I was not there for that. But a friend in Shell told me that Shell spent approximately two billion dollars in the Alaska bid rounds including drilling. I don't know what the real number is, but spent something like two billion dollars and didn't have anything to show for it, over a period of eight to ten years. That's the oil business.

TP: About 1983, that is when Bookout and people decided to make the big bets on the really deep water in the Gulf of Mexico?

MF: Well, Bookout didn't make the bet. He went along with the bet.

TP: That's what I mean!

MF: [laughter]

TP: He was the one who made the decision.

MF: He had the final decision. I don't know whether anybody even mentioned the big sales up in the Beaufort and Bering, in Alaska.

TP: People don't emphasize it.

MF: Nobody likes to talk about it!

TP: Shell has not had a stellar record in Alaska. They missed out on the Purdon Bay, which I know hurt people for a long time.

MF: O.K., in 1984, I went back offshore Gulf of Mexico as GM of exploration.

TP: This was right after the 1983 sale which was the first area wide sale .

MF: Yes, 1983 was the first big area wide sale, and Shell bought a lot of prospects. It is interesting because management thought it was going to be the last big sale. Of course, the government has had area wide sales every year since 1983, and companies are still finding oil and gas fields on new leases in old areas on the shelf. But, 1983 was the first area wide sale.

TP: This meant you didn't have to nominate . . .

MF: You didn't nominate. Everything was up for bid. This was a good for Shell because we still had our own seismic boats, we had all lots of seismic to interpret. We thought we had a jump on the competition. Billy Flowers was the vice-president in New Orleans, and he leased a lot of good prospects. Shell bought Bullwinkle at that time, and Popeye, although Popeye was not as good as

originally thought. Also, Powell. And they bought many other prospects in the shallow water. The shelf prospects did not have the potential to be big fields but they keep adding up, they are cumulative. But Shell also bought a lot of junk.

I arrived back in New Orleans in August, 1984. We had just gone to a sale offshore Texas where management decided to go out in a little bit deeper water. The production department had a rule: explore out 15 miles from 600 feet of water. Has anybody mentioned that?

TP: No.

MF: Well, we could put a steel platform on the sea floor in 600 feet of water, up to 1300 feet of water but much more expensive than at 600 feet water. Then we could use subsea wellheads and pipeline to transport oil and gas from the wellhead to the platform. At the time, 15 miles was all they could really pipe hydrocarbons using he technology of the day. Today, it is 75-100 miles. So, the production people would draw the 15-mile line, and in the spring of 1984 lease sale, Billy and the other management only bid on a few deep-water blocks inside the 15-mile line. Management was caught off guard by a few other companies who moved out further in deeper water than we did. So, Shell management -- Tom Velleca, Shell chief geophysicist at that time, played a major role -- formed a special team of exploration people to work the August, 1984 Texas sale. The team quickly did the technical work and Shell bid on about 10 prospects, generally low bid levels, and won about 6 or 7 of them. One is Auger. It was just

one of the one of the 7 prospects leased. Nobody realized its potential at that time. I showed up in New Orleans in 1984 as we planned to shoot new seismic. A review of the old seismic indicated that Auger may be the best prospect. It appeared to be much bigger we first thought, a good prospect. Using new seismic, the best potential was at 15,000 feet depth where we had two strong amplitudes. We added two additional blocks in the 1985 sale. The well was planned and drilled when I was transferring to Pecten in 1987. Best oil pay is at 18,000 or 19,000 feet, which was associated with a very weak seismic event at that time we bought the leases and drilled the wildcat well. New seismic and a 3D showed a good deep bright spot at 19,000 feet, after the well was drilled.

I just came from bidding in the Bering Sea, the Navarin Basin, and we had management discussions comparing the Bering Sea to the Gulf of Mexico deep water. I said, "I just came from the Bering Sea where we spent millions of dollars on prospects where there is no infrastructure and there is no proven oil source rock. And yet, in the Gulf of Mexico, we are not willing to take risks going out into deeper water. This is a proven oil province." I recall meetings with production people and we asked to get rid of the 15-mile rule? And finally, Gene Voiland, offshore division production manager -- he is currently a manager with Shell in California . . . I saw him a few months ago, and he said, "Don't you remember? You kept asking us what size reserves do we need in deep water to be economic? What size oil field do we need in 2,000 feet of water? How much do we need in 5,000 feet of water?" And he said, "We finally came back to you with the statement 'If you find one hundred million barrels we will find a way to make

it economic.'" And, on that basis we expanded our bidding into deeper water. That is all we had . . .

TP: This is before the tension leg platforms?

MF: People were speaking about tension leg platforms.

TP: It was still on the drawing board?

MF: It was on the drawing board. And so, this is in 1985 and 1986, when we bought Mensa, Mars, the rest of Auger, because we originally had only two blocks on Auger. We already had Tahoe and Powell, which Billy bought in the 1983-1984 sales. There were some others, I can't remember the prospect names, but that's when we stepped out into 3,000-5,000 feet of water.

TP: And from the exploration side, you knew that these were good?

MF: These were all bright spot prospects. This is part two of the bright spot story. We only bid on bright spots in the deepwater. And some of them, we only had sparse seismic coverage. And some of them, we couldn't even map a trap. But the bright spots suggested oil and gas pays. Most of the time, we were the only bidder because we were the first company. It is just like the story I told on South Pass 62 in 300 to 400 feet of water. Now, we were in 5,000 feet of water. We were the first ones. Very few companies were bidding against us.

TP: This was 1985, 1986?

MF: Yes.

TP: So, this was about the time of the crash in oil prices and people were . . .

MF: That didn't bother us. We kept on going!

TP: That might explain why other people were not very willing to take the risk.

MF: Yes. We went to Bookout in 1985 with Mensa, and we had three million dollars on the two blocks, and he asked us raise the bids to five million dollars. He was always an optimist. And we were the only bidder. We were first. Mensa had a classic bright spot, a high chance of success. We were using contract data, called spec data, but we had skilled people who knew how to recognize good prospects. We later leased blocks in 6,000 feet of water, 7,000 feet of water. Nobody knew how to develop deepwater oil fields at that time.

I was working this past spring for another oil company, they were having a hard time with deepwater economics. They were running spreadsheets, lots of numbers. When we completed our consulting project, I talked a senior manager and I said, "I need to tell you how Shell did deep water economics in 1985-1986." I said, "Our engineers told the exploration people that if we found one hundred

million barrels fields, they would work like hell to make it economic. This is all we had." He was amazed. In 1986, most of the industry thought Shell was crazy to be leasing so heavy in deepwater. In fact, there were some people who worked inside Shell thought we were nuts. And, Royal Dutch Shell, I don't know whether John Bookout mentioned this or not, but Royal Dutch Shell thought we were nuts, because, in the late 1970s, Royal Dutch was part of a worldwide deepwater drilling program around the world. And they found zero, nothing.

TP: Where were they exploring?

MF: That is the key question. They were exploring in odd places. They were exploring in frontier basins. You know, frontier, where there is usually no oil. The deepwater Gulf of Mexico is just going down dip in a proven oil province. I saw John about two years ago. He called me on the phone, and I went to see him. We got to talking about the past. I said, "John, I know management at Royal Dutch was giving you a bad time about our deep water exploration" . . .

TP: This was around the same time of the buyout. It must have been a . . .

MF; It was right after the buyout. He said, “Yes. Royal Dutch executives, including the chairman, attended the board of director meetings.” Royal Dutch managed Shell Oil through the Board. He stated there was discussion about deepwater, but it was never mentioned inside the board meetings because, with outside directors, they didn't want the outside people to think we were fighting internally. He said,

"Right after the board meeting, I was quickly asked, 'What are you guys doing in deep water?'" I said, "Well, John, what did you do about it?" He said, "Nothing. I just let you guys keep drilling!" And we had even some of our own people in Shell were getting very nervous. We were drilling wells that cost ten or fifteen million dollars which, by the way, now cost twenty or twenty-five million dollars. I don't know how much money we put into it deep water before we knew we had a success. Probably over a billion dollars. The big turnaround came when Shell developed prospect Auger and the wells came in at twenty thousand barrels a day.

TP: The high rate of production.

MF: The engineers were thinking about the fields up on the shelf, which is a different type of sand, a different type of reservoir and trap, and much smaller production rates per well. The shelf is mostly shallow water sand with many faults on the structures. You have to drill many wells to get the oil out. In the deep water, the reservoirs are called turbidites, deposited over the shelf edge. You drill into one of these turbidite reservoirs at a good location, over a big area, about one hundred feet thick of excellent sand quality.

TP: It would produce a tremendous amount of oil…..

MF: The wells have high production rates. The high rate surprised everybody.

TP: But even people at Shell, did anyone suspect this?

MF: Not that big. Everyone knew we needed high rates to be economic and the exploration wells indicated that high rates were possible. But, you need a real life test to be sure. The high rate wells meant larger reserves per well and therefore fewer wells needed to drain the oil. Shell reduced the number of development wells on Auger from 25 to 8 or 10. Most of these wells were deep, expensive. This saves a lot of money and improves the economics. Plus, you get the oil out faster.

TP: That shows that just going on faith . . . they had no idea . . . they weren't able to predict the economics of the real deep water.

MF: Shell went on faith, that is, technical studies that indicated high rates but did not have good test data, from 1985 to about 1992. They went on faith for about five or six years. No other company would have ever done that. I used to go to offshore management meetings with other company general managers and vice presidents. We used to meet, Shell and Mobil, etc., about every three months, in New Orleans. There was one fellow who came up to me, from Chevron, he said, "Mike, I presented deep water to our senior management. They said no way, they won't touch it." This was about 1987. He said, "We can't ever dream of making money in 3,000-5,000 feet of water." He said, "They won't touch it." I hadn't seen him in about 4 or 5 years and then met him in 1993 or 1994 in San Diego, California. He came running up to me. "I haven't seen you for a while." I said, "How are you doing?" He said, "I couldn't wait to tell you. We are in deepwater

big!"

Another person at Chevron was recently on a panel with me. We were rotating on answering questions, and he said, "We did a study of Shell deep water versus our company, Chevron. Shell has a rapid increase in deep-water production while Chevron is much less. Shell has beaten us in deepwater production increases, five to one." So, why did we do so well in deep water? It was Shell Oil's management saying keep it up, because I tell you, a lot of oil companies would say quit. We had a lot of management staying power.

TP: Based on Shell's offshore record, you just were willing to keep taking it further.

MF: Yes. And we used amplitudes, bright spots. Every well we drilled usually had some pay in it. It wasn't always economic but we really used the amplitudes all the way. We used the bright spots all the way. In addition, we were out there first, so we bought a lot of leases on some good prospects at a reasonable price. In addition, we had courageous engineers. There were a lot of engineers in other companies that like to dot every "I". We had engineers who were willing to take the gamble and understand that new technology will change the economics. I mean, new technology is going to make these oil fields profitable. The economic threshold is probably not one hundred million barrels, it is probably more like two hundred million barrels. It all depends on the geology and the water depth . . .

TP: But, even if it is one hundred million barrels, with the increase rate of production .

. .

MF: Yes. So, it is combination of things. We just reviewed my life with Shell, a few highlights . . . back in the Posy, Pine, and Cognac days and now the deep water.

TP: You mentioned something way back. We are jumping around again, but way back in 1962, where you had noticed that there might have been a gas play . . .

End of Tape #1, Side B

Tape #2, Side A

MF: You must be referring to the 1968 Texas lease sale. There were two prospects: one shallow, that was bid on by the industry in 1968, and they thought it was going to be big oil and it was only small gas. But there is a large down in the south fault, I'll sketch this, unfortunately, won't be on the tape. Back in 1968, the main play was shallow, say, 5,000 to, 8,000 feet. In later years, we had much better quality seismic data. You've got to remember, the seismic data gets better every year -- new acqusition techniques and improved processing. We used to be able to map down to 8,000 feet using old 2-D seismic. Now, we can map to 25,000 feet with excellent quality seismic. New seismic showed a large deep structure with possible bright spots. We used the same prospect name, Picaroon. And Shell discovered several hundred BCF of gas. I was not in offshore then . . . it was in 1981 or 1982., somewhere along in there. But the wells were high cost. It is deep, very high pressures, also some H2S is present in the gas. I don't think it made a lot of money, but from overall geological and geophysical side, plus, drilling the wells, on the engineering side, it was terrific. The technical work was

excellent. I am out of date. As I said earlier, big fields usually get much bigger, so Picaroon may have made more money than what I originally thought. These were deep wells, 16,000-18,000 feet, and these were twenty, twenty-five million dollar wells, high-cost project.

TP: I just wanted to go back to it because I thought you were planning to . . .

MF: Billy liked prospect Picaroon. Billy probably mentioned Picaroon.

TP: Yes, that is why I wanted to . . .

MF: In fact, Billy gave a nice talk on Picaroon years ago, at a conference, a geology conference. I think he got the top prize or the best paper.

TP: Oh, really?

MF: I don't remember the details.

TP: Well, so, you were general manager of Shell Offshore from 1984 to 1987?

MF: Yes

TP: And then?

MF: Pecten.

TP: Pecten. Do you want to talk about your time as president of Pecten?

MF: Yes. It was fun. Up to that time, I had spent my entire career in the U.S., and my boss, Bob Howard, called me on the phone and said, “You are going international”. I said, "Oh, I don't know anything about international." I was with Shell for 37 years, and I had a new job every three to five years. Every change was kind of like a different company. I was with the offshore, deepwater, and now Pecten.

TP: People moved around a lot.

MF: The real expert on Pecten is Marlan Downey. I took his spot when he retired. Marlan was . . .

TP: Was he the first president?

MF: No.

TP: Oh, no, Pecten goes way back . . .

MF: To about 1970. But Marlan was involved with Pecten for 8 or 10 years. He was first general manager for exploration, then he moved up to president. So, Marlan

knows more about Pecten than me. I do have several Pecten highlights. One was Yemen. We took 20% interest of a play in Yemen, which worked out very well. I think Shell recently sold it, but it was very profitable . Another area is Cameroon, West Africa. The Cameroon play is all bright spots. You can recognize every gas and oil pay on the seismic. Bright spot technology led Pecten to Cameroon in the late 1970s. Management and technical people realized that they could work Cameroon just like we were doing offshore Gulf of Mexico, using bright spots. But the big problem in Cameroon was whether you'd find oil or gas. In offshore Louisiana, you find gas, you are happy. You sell the gas very quickly. In Cameroon, if you find oil, you are happy, but if you find all gas, you are not happy because . . .

TP: No market.

MF: There is no market. There are a lot of gas wells. I made many trips to Cameroon. They are nice people. But, one of my early trips to Cameroon, in 1987-1988, the man who was our resident manager said, "You know we are out of business here in 1995." I said, "What do you mean?" He said, "These fields are all going to decline." I said, "What are you producing now?" He said, "Thirty thousand barrels a day. We have the future production charted out." Well, Shell recently tried to sell its Cameroon properties, and I was consulting for a company at the time who was trying to buy it, so I saw all the information on it. I was flabbergasted because Pecten Cameroon was still producing thirty thousand barrels a day! Maybe more, thirty-five thousand. And here it was, 1998, this

occurred last year. The reason for Pecten's success was new technology, it was 3-D seismic, drilling deviated wells and horizontal wells. It was teamwork, E&P teamwork. Cameroon was fun and successful.

Pecten was active in Syria. You should talk to Marlan Downey about Syria. I went there several times. Safe place to travel. We had just started producing sixty thousand barrels a day -- that is total gross, not just our interest. When I retired in 1992, we were producing four hundred thousand barrels a day. My staff gave me a chart when I retired showing the large production increase. Every job I have had, it should have been the previous manager who should get most of the credit for success. This is a long-term business. All I did in Syria was say, "Keep drilling, guys. Keep shooting more 3-D seismic." I think it is reasonably profitable and about 2 billion barrels of oil. Talk to Marlan about Royal Dutch Shell taking over the operatorship from Pecten in 1987. You know, we operated during the first discoveries. You may not want to mention this. Pecten is going to be a very sensitive subject to write about. I spent 15% of my time fighting with management at Royal Dutch Shell. For example, we'd go to Yemen, and Royal Dutch Shell would call me and say, "What are you doing in Yemen?" My reply was "Looking for oil." they responded "We don't want you there." I said, "You don't have any right to keep us out. I'm going to Yemen."

One time, the exploration chief at Royal Dutch Shell called me, mad as hell, he said, "Indonesia? What are you doing in Indonesia?" I said, Wait a minute, we are not in Indonesia. We have not been to Indonesia." It turned out it was Pecten

Trading Company, the group that buys and sells Shell Oil Company oil. All they heard was Pecten so they blamed it on us! So, for five years, we fought Shell. I went to The Hague one time with the Pecten production general manager. We arrived in the morning, at nine o'clock. The phone rang. I was trying to get a couple hours' sleep before the afternoon meeting. A secretary said that Ric Charlton wanted me to join him for lunch. Ric said, "Mike, tell me how many years you guys have been in the oil business in Pecten?" I said, "I have only been here a couple of years, but Pecten has been around for 20 years." Ric said, "That's my point. We have been doing this for 100 years. You guys don't know shit about this international oil business!" [laughter] So, he was one of the group that hated Pecten.

I think the only reason Pecten lasted as long as it did was because John Bookout had some kind of high level deal. Nobody knows.

TP: It had a difficult birth back in the early 1970s.

MF: It was started because of a minority shareholder issue, minority law suit. But there were other reasons to start Pecten. The U.S. tax situation you know how tax rules change all the time. And there was another thing. Some of our exploration management thought that we could use U.S. high tech to be a successful international company. Geophysics is one example.

TP: Apply it elsewhere?

MF: That we could apply it elsewhere. But after 1985, when Royal Dutch bought Shell Oil, all the public stock, 29% outstanding, everybody said that was the end of Pecten But it stayed around for another 10 years. I was traveling on a plane one time going over to Europe, sitting next to a fellow and he said, "Hey, what are you reading, Shell material?" I said, "Yes, I am with Shell." He said, "Which part?" "Pecten." He said, "Oh, you are one of those guys!" They hated us!

TP: They just felt like it was a nuisance?

MF: It was a nuisance.

TP: Competitor?

MF: Yes, we were a competitor to Royal Dutch Shell, but we thought it was healthy. So, the Pecten history is going to have to be very carefully written.

TP: I mean, there are only a few countries, really, the ones you mentioned . . .

MF: Well, we used to look in other places. For example, China. We had a partnership with Phillips in China. It is still producing.

TP: Malaysia?

MF: Yes. We were in partnership there with Royal Dutch Shell. We sold it to them about 1992. I started the process of selling it because we could never agree on strategy. We had a partnership on two blocks in Malaysia with Royal Dutch Shell. They were active in all phases of the energy business. We had different objectives. The older guys, like Marlan Downey, will tell you that Royal Dutch didn't know what to do with the first exploration block when we joined them in the early 70's, and Pecten helped Shell a lot in the exploration phase of drilling. These are big blocks. Offshore Louisiana blocks, you know, are only three miles by three miles, about six thousand acres. International blocks are big. They can range from 500,000 acres up to two million, three or four million acres.

Shell Malaysia was running their business as a total country enterprise. They had four or five exploration blocks for exploration and development plus several gas projects, downstream. So, they had a country strategy whereas we had a one or two block strategy. We were partners in only one area. So, sometimes, they would come back to us with what they wanted to do with their operating budget and their drilling plans. It didn't fit our ideas at all because they had a corporate plan for their whole country, and we were just thinking about one area. In 1991, I visited the Shell Malaysia manager in Kuala Lumpur and I brought up the idea, "why don't we, Pecten, sell our interest to Shell?"

TP: Well, it is tough to just do it piecemeal in each country.

MF: And we did sell to Shell. All these deals with Royal Dutch Shell were done by Jack Little. He would only let me carry things so far with negotiations because pretty soon, the president of Shell Oil was involved. Frank Richardson was there at the time. Have you seen Frank?

TP: We have an interview with him. I didn't interview him personally, but yes.

MF: How is his wife doing? His wife was sick when he retired.

TP: I am not sure. I haven't met him at all. I will ask.

MF: I haven't seen him since . . . He wrote me a note after I retired. I was in a meeting one time with Frank Richardson and Jack Little, and they wanted to know about current activity in Pecten. I was presenting my report and Frank's secretary brings him a note. Frank dropped his head and left our meeting. Came back and said, "That was the Royal Dutch chairman. He was asking about Pecten!"

TP: What an uneasy working relationship it must have been for the president of Pecten.

MF: It was tough. But I treated it as a fight. Bookout used to have operations meetings every quarter. All the subsidiary presidents had to come in and give presentations about our operations. We rotated so we didn't have to give a talk

every time. Then John would take us out to lunch. John always liked Pecten and the international business.

TP: The symbol of Shell Oil's independence, in some ways.

MF: I guess. But anyway, we are sitting at lunch and, off the bat, John says, " Mike, what is going on at Pecten?" I said, "Oh, I've got a couple of issues." "What are they?" So, we went over all the issues, the whole lunch hour. He and I traded comments during the entire lunch period. John said, "Mike, don't let those Royal Dutch Shell guys get away with that. "Don't let them do that to you. Treat them like another oil company." Afterwards, Jack Little, who was my boss, said, "Mike, don't ever do that again." I said, "John started it!" So, it was constant conflict. And so, it was time for Pecten to unite with Royal Dutch. It happened about two years ago. I think Pecten did add some good assets to the Shell portfolio over the years. Pecten also became reasonably profitable at the end. When I got there in 1987, we were not making money. Zero net income.

In 1991, Pecten made one hundred million dollars profit, which was the best year we ever had to that date. I heard two or three years later, they made over two hundred million dollars net income. So, Pecten did reasonably well. But, the Royal Dutch people always had a negative statement about Pecten. For example, they said Pecten profits eventually would be passed to Royal Dutch Shell, and Shell Oil had to pay a dividend tax. Believe it was a 10% dividend tax. We used to counter by saying, but isn't paying a tax, a dividend tax, better than not having

anything to pay taxes on? At least we've got some profitability, got some oil and gas reserves.

TP: Maybe Bookout felt scarred by his experience in the buyout and saw Pecten as a way of just asserting Shell's independence in some way.

MF: We had a project in offshore Brazil. We discovered a 400 BCF gas field, called Merluza, in about 400 feet water. I signed the final contract, but most the work was done by others before I arrived at Pecten.

TP: Which basin was that in, in Brazil?

MF: Santos Basin. Not the Campos, where the big oil fields are located. I traveled to Brazil many times to visit our staff and Petrobras. We badly overspent in the development phase, which meant very poor economics. It's an interesting story.

TP: Was this one of these risk contracts?

MF: Yes, a risk contract.

Marlan Downey, again, he knows the early part of the story better. I just signed the contract and then we moved ahead with development. It was supposed to cost two-hundred twenty-five million dollars to develop, and we ended up spending almost three-hundred seventy-five million. For a lot of reasons there were a lot of

problems in Brazil, and there were several different reasons why the cost went up. I was catching holy hell from Jack Little and Frank Richardson. Jack Little kept saying, "Ask Petrobas if they want to buy it back. Let's just get out." Before one trip, I advised Jack, "I am going down to see Petrobas. I may talk to them about buying us out." George Carlson and I made a presentation to Petrobras management. We discussed all the problems, why the cost was increasing and asked them if they were interested in buying us out. And they said, put it in writing. This surprised us. So, we went back to our office and put it in writing. I said, "George, we need to put a sentence in there about getting final approval from our management or board of directors." He said, "No, that just makes it weaker." I said, "O.K., leave it out. Jack doesn't have any problems, he just wants rid of it." A few days later, Jack had a copy of the letter and he called me down to his office and he said, "You can't do this." I said, "Jack, you've been telling me for months, sell Merluza to Petrobas." He said, "But it doesn't say board of directors approval." I said, "You would have taken the money. Besides, they don't have the money. They are not going to pay us two hundred million dollars." At that time, we had spent two hundred million dollars. I said, "They are not going to pay us two hundred million. They don't have any money." Jack was doing his job being tough with me. Shell Oil management hated Brazil and said they would never return, but Brazil has changed again and Royal Dutch is leasing new blocks.

TP: The Campos Basin is really not. They've opened up the offshore . . .

MF: They've opened up the offshore, mostly deep water. Petrobras had a recent bid round and even though Merluza may not be very profitable, Shell likes having this gas field in offshore Brazil. It provides continuity.

TP: Shell still has it? Who has it now?

MF: Pecten has it 100%. Well, Royal Dutch . . . now it is all one company. But Petrobras operates the field. That was another issue. In these risk contracts, as soon as we finished building the platforms, drilled the wells and started production, we had to turn the field over to Petrobras. Some of our management said, "Petrobras is going to run you dry. They are going to make money on the operating costs."

TP: Padding it . . .

MF: Use a lot more people than they need. But, I understand Petrobras has not done that at all. This just shows how things change. We had coordination meetings once a year, where we discussed Pecten and Royal Dutch, activities. One time, someone mentioned Brazil, and I said, "Do you want to hear about Brazil?" And one of the Shell executives said, "It's yours. We don't talk about Brazil." But today, Brazil has strategy value for Royal Dutch Shell, and they have leased several offshore blocks in the recent bid round.

So, you just heard my life story in Shell!

TP: It's been very interesting and enlightening.

MF: But, as I said, the two highlights were the 1968-1975 timeframe, not only bright spots but also discovering all those oil fields. The second highlight was in the deepwater. The largest field in deep water is called Mars, about seven hundred million to a billion barrels. I was exploration general manager at the time Shell leased Mars acreage. This is how it happened. We were finalizing our bids. I believe we had already been to senior management. We just showed them the top ten prospects. Several co-workers have told me most of this. I can't remember all the details. We had the final technical meeting and I said, "Guys, is that all the prospects?" And Roger Baker said, "I've got one more." He showed us the data. It was Mars. I vaguely remember this. I said, "It looks just as good as some of the other prospects we are bidding on. Bid it." And so, we bid Mars, $200,000 a block for two blocks.

TP: Was that all?

MF: Yes. This was a so-called spec bid. Shell drilled Mars in 1988, after I left. And they brought in BP as a partner. It was still considered to be a very high risk, called a 10% chance of success. With amplitude anomalies, bright spot prospects, 10% is high risk. The prospect was on the flank of a shallow salt dome, but way down flank, almost a stratigraphic trap. And Shell brought in BP as a 30% partner because they thought it was too high risk, and in 1988, the budget was

very tight. I was told this story, after several wells were drilled and Shell realized Mars was a 700,000,000 barrel field, management from Royal Dutch asked "Why did you bring in BP?" See, BP has always been Royal Dutch's …..

TP: Nemesis?

MF: Nemesis. Concern. And, now BP will be bigger than Shell, with the Amoco and Arco mergers. I can remember visiting The Hague about 1990 or 1991, talking to their senior management, and the one executive said, “we know Exxon very well” because Shell and Exxon were partners throughout western Europe. He followed up, "the company we are really concerned about is BP." And today, BP merges with Amoco and Arco, making them larger than Shell. In my opinion, we educated BP on the deepwater. We gave them a big start in the deep water. John Bookout had retired. John didn't want partners in the deepwater. He wanted Shell Oil at 100%. He thought deep water was an opportunity for very large fields, possibly a billion barrel field.

TP: In order to spread the risk, you had to bring others in.

MF: Right, spread the costs. So, do you have any additional questions?

TP: Well, the only thing I wanted to ask you about is 3-D seismic.

MF: Oh, yes. 3-D.

TP: I am thinking maybe just explain what kind shift, or what kind of advance it was over 2-D seismic.

MF: Yes, 3-D seismic. It is controversial who shot the first 3-D. It's like who finds an oil field? Just like a large oil discovery. You ask 10 people who worked the prospect, and ask, "who found this field?" They will all raise their hand because they all felt like they had found it. There are two or three companies that will say that they shot the first 3-D. It was probably back in the 1960s. But 3D was not actively used until the early 1980s. The main problem was processing time and cost. 2D seismic lines are usually acquired every mile or half a mile, but for 3D, we had to shoot a line 200 to 300 feet, so the seismic boats had to go back and forth.

TP: 3-D is just building the map structures in three dimensions, right?

MF: Yes. 3D does two things for you. It gives you a three-dimensional view, especially when you have steep dip. With 2D seismic, you are not sure where steep dips actually coming from, and 3D clarifies the location of the steep dip. Another thing is it gives you a seismic trace about every 100 feet. What is the advantage of that? After a couple of wells are drilled on a prospect . . . remember you can take the logs and make a synthetic seismic trace . . . you can think of a seismic trace every hundred feet as being another well log. So you get a lot of data, helps make a more accurate structure maps and much better bright spot

work. The application of 3D seismic was held it up because of the cost of shooting the data and the processing, also processing time. Today, seismic boats tow six to eight, sometimes ten seismic recording cables; I know one with sixteen cables, behind the boat. And they are each about 300 feet apart. And these cables, they used to be about 10,000 feet long. Now, they are 20,000 feet long, with a one-boat operation. So, companies can shoot 3D data much quicker now and at a much cheaper price than they could before. In addition, the processing time is much faster. 3-D seismic has had a huge impact, especially over proven oil and gas fields. Companies are shooting 3-D over a field that they believe is almost depleted. You find new opportunities. And you find that some of the previous wells were not drilled in the right places.

TP: So, not necessarily for drilling wildcats but for proving to be . . .

MF: 3D seismic use started across proven oil fields. It wasn't until the mid to late 1980s when we started to shoot these large area 3-D seismic surveys to identify exploration prospects. But they are mainly used on a gas and oil field basis, just trying to make sure that you drilled all the wells at good locations to drain the oil from the field. In addition, 3D was used on fields that the field size was questionable. Sometimes a couple wells are drilled on a prospect, some gas and oil is found, but not yet economic. You can shoot a 3-D survey and try to do a much better job mapping the traps and identifying bright spots to map pay thicknesses. Sometimes the field is larger than the original estimate, which makes money; or if the field appears small and non-economic, just drop it. So, 3D was

first used in field development.

In 1987, we started shooting the first large area 3-D exploring for new prospects. In the deep water Gulf, seismic contractors are shooting what they call speculative 3-D, where they shoot 3-D on their own cost, on their own bill, or they may have two or three pre-committed companies that share the risk and some of the cost. Then the contractors resell that data over and over again. Spec 3D seismic has had a huge impact in the offshore gulf; plus the U.S. onshore, places like West Texas where companies are finding a lot of small fields, one well field and two well fields, which are very profitable for smaller oil companies, but not for the big companies who need large fields.

TP: They have good data . . .

MF: Yes. 3-D has taken off, but you have to be careful: sometimes you can shoot too much 3-D. Sometimes, you are better off drilling the well and then thinking about a 3-D survey.

TP: It is still costly, right?

MF: Yes. I know one project where we, not Shell, shot ten million dollars worth of 3-D, and we drilled an expensive non-commercial well, and we probably could have drilled the well a year earlier using 2D seismic. The highest risk was reservoir quality. 3D could not help us with reservoir risk, so we could have drilled the

well on 2-D, and then shot 3-D if we found a major field. Large area 3-D seismic surveys are sometimes controversial because you can spend too much front-end money before finding hydrocarbons. But there is no question that, in a proven oil field or gas field, 3-D is very valuable tool.

In the deep water, there are big structures in the deep water. But there are also lot of stratigraphic changes in the rocks. Plus, deepwater wells cost twenty, twenty-five million dollars. So it is a tradeoff. If an exploration well costs one million dollars, you may drill the well first and then do a 3-D afterwards. But when you have a twenty-five million dollar well, you might as well, if the 3-D is going to cost two or three million, you might as well do the 3-D first. It's a relative thing. So, most companies will not drill a deep water well . . .

TP: Without a 3-D . . .

MF: Without a 3-D seismic survey, especially since all deepwater oil fields have bright spots, which can be mapped with 3D. There is a lot more computer power today to process seismic. Many companies are now using prestack depth migration processing. Seismic data is recorded in time, travel time of the reflected seismic waves. The time down to a certain geologic marker and reflected back to the surface. For many years, geophysicists made time maps, because often we were not working in areas with complex geology, and if we thought the time maps were good enough. But when you get in deep water, you have sharp changes in water depth, two to five thousand feet over a short distance. Water velocity is only

5,000 feet per second, whereas the rocks below the sea floor may be a velocity of 7,000 feet per second. You must correct for the water depth changes. In addition, remember we were talking earlier about salt domes? We used to think that salt came up from a thick deep salt layer and formed shallow piercements salt domes, usually simple shaped domes. Today, we have discovered that salt has moved in all directions and is present in many shapes and form. High quality 3-D seismic can map these salt wedges and salt canopies that have unusual shapes. The deepwater Gulf has a lot of salt, shallow salt especially, and salt velocity is 15,000 feet per second. If a prospect is located over a two to three thousand feet water depth change, plus shallow salt is present, 15,000 feet per second, over normal sediment with velocity of about 10,000 feet per second, you have hell of an imaging problem. So, we are now processing in depth with a program called prestack depth migration processing. It is very time-consuming and costs quite a bit of money. But most companies nowadays will not drill a deepwater well unless they have a full suite of 3-D seismic processed in depth. And this not just offshore deep water; it is a problem everywhere. We, as geophysicists, have been using time maps for years. The engineers and drillers think in terms of depth, feet instead of seconds. So, geophysicists have to put seismic lines into depth so we have a better understanding of the geology and so we can relate better with the engineers and drillers.

A friend told me that one billion dollars worth of 3-D has been shot in south Louisiana in the last four years, and nobody has found a big new gas field attributed to using 3D. Some good wells were drilled but not a big new find.

The problem with the oil industry . . . you recall I told that story in about 1967 or 1968, about bright spots and management going peak and valley…. same thing happened with 3-D. Some companies thought 3-D was going to solve all their problems. 3-D was going to find all the oil they ever needed to find. 3-D seismic is a powerful exploration and development tool, but it is not the only tool. You have to still do good geology and good everything else, good engineering. Shell started to use 3D extensively in the offshore Gulf about 1984 … it helped us a lot.

TP: Is there a company or group of individuals who really pioneered the development of 3-D, or was it more of an industry-wide thing?

MF: Bob Graebner is a geophysicist in Dallas. bHe worked with GSI, was president at one time. Western bought GSI. Bob is now a consultant. He and two other geophysicists got a special geophysical award from the SEG, Society of Exploration Geophysicists, a few years ago for their work in implementing the use of 3D seismic. It is just like when we started bright spots. It is hard to pin it down who started 3D.

TP: It leaks out into . . .

MF: Well, it is hard to pin down who was responsible for starting 3D. I've a friend who used to work for Exxon, and he is real proud of the fact that Exxon shot the first 3-D in 1964. Exxon has all the data recorded at that time. Then you hear

about somebody else that shot a 3D survey in 1958. But the important point is that 3-D really didn't get going strong until 1980-1985, when we could properly shoot it and properly process it at a reasonable cost, and also show several economic successes using 3D seismic.

TP: Well, is there anything else that you want to add?

MF: If I think of anything, I'll e-mail.

TP: Yes, or any individuals . . . I suppose you need to get going. I was going to ask you about McAdams.

MF: McAdams was a character. I did not know him very well. I did not actually work for him. He retired from Shell in 1970. But I will always remember . . . I've got two stories about him. One is in 1970, I was working in the offshore division, just a project leader, and that was right after we started talking about amplitudes and bright spots. I hadn't seen him in a couple of years, because I was not a senior manager. I was walking down the hall in the offshore division office to visit the drafting group, and I saw McAdams turn the corner down the hall. And I said to myself, I don't know him that well. So, I go in the drafting office, and he follows me in. He says, "Mike?" I said, "Yes?" "Hi, Mac." He said, "Thank you for all the work you've done for Shell." And he walked out. Anyway, that was 1970. He called me a few years ago. I was working with an oil company in Dallas . . . he had a new idea for deep-water exploration. I am not going to go into what it was

but it was a new idea. He said, "I would like to come to Dallas and visit." I said, "Yes, come on down." He said, "I'll call you back." I said, "Mac, I haven't talked to you since you left Shell in 1970." He said, "Yes, but we all keep track of each other."

TP: What year was this roughly? Do you remember?

MF: It was either 1994 or 1995. Charlie Blackburn was still working there.. I was with Maxus. Maybe 1994. Anyway, he called me two weeks later and said he had a sick wife. His wife passed away about a week later. So, I called him back. He said, "You know, I've got to take care of some personal business. I'll call you in one week." And then, a week later, he died. So, we never did get together, although I did talk to a friend who was working with him on his new technology. Billy Flowers can tell you more about McAdams, because he worked for him directly for a number of years, and he can tell you all the stories about McAdams. He ran a one-man show. He called all the shots. You probably wouldn't be able to do that nowadays. It was a different era. And he was known as a rough and tough son-of-a-bitch, but the people who worked for him directly say he wasn't that way at all. I guess he was exploration vice-president for 15 years, from 1955 to 1970.

TP: Yes.

MF: Tom Hart, exploration vice president during the late 70's and again in the late

80’s, is the one who helped me. He gave me a lot of these good jobs in Shell. He and I got along well with each other. He was a very bright man with a good sense of humor. Has anybody told you about some his stories?

TP: A little bit. I got a little flavor but not a whole lot.

MF: He was big man -- six five (6'5"), and his mind was sharp as a tack. He would tell jokes and stories. And he was sent over to Royal Dutch Shell in a key job in the late 70’s and came back. People thought he was going to move up in Shell Oil. He never did because he could not keep his mouth shut in meetings. He would be in front of the president of the company and make some crazy statement. Of course, everybody would laugh but how can you make a guy president of the company when he's a jokester! But he was very bright, a very bright guy. He was fast.

Some of the mangers we worked for, we had to make a full presentation, call it number one up to ten. We would go to Hart who didn't like to sit long. We would get to three and he would say, "Is this the answer?" He would jump to our conclusion. I'd say, "Yes." He said, "Just go do it."

TP: He didn't waste time.

MF: So, he knew where we were headed. Is there anything else?

TP: No, that's good.

MF: You've got all this on tape? O.K.

TP: We'll shut this off here.

THE END