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Interviewee: Moses, Fred
Interview Date: September 21, 2002

OFFSHORE ENERGY CENTER

ORAL HISTORY PROJECT

Interviewee: FRED MOSES

Date: September 21, 2002

Place: Houston, TX

Interviewer: Dr. Joseph Pratt

Side A

JP: This is an interview with Fred Moses for the OEC Hall of Fame. The interviewer is Joe Pratt. The date is September 21, 2002.

FM: Bernie Stall of Amoco said, "There should be some cooperation between these industries and bring what has been learned in these other industries, or the aspects of structural safety, bring them to bear on the problems of offshore structures."

JP: So, at the time, you were teaching?

FM: At the time,I was teaching. I was doing research and some consulting.

JP: Had your research been on the other industries?

FM: Well, it was on highway bridges, for example; building safety and ship safety to some extent. But that was the first time I looked at the problems of offshore oil platforms.

JP: What were the key analytical similarities between the other types of safety and the offshore platforms?

FM: I think that safety has been an evolutionary process in the structural engineering field. From a very deterministic point of view; it has evolved to where the safety is looked at from a risk point of view, and the recognition exists that there is never 100% safety. There is always some element of risk in all of the engineering activities we undertake. There is always an element of risk, whether it is a bridge, a building, a ship, an airplane, or an offshore structure. So, the common thread is to characterize these risks and try to deal with them in the way that best utilizes the resources that are available.

JP: So, about what year would you have entered the world of risk and reliability in oil platforms?

FM: I would say about 1973.

JP: When you entered, what did you find in terms of the thinking about safety and the practice about reliability?

FM: Well, like many of the areas of structural engineering at that point, it was a very deterministic approach. I used very specific factors that had been used before and there was no searching for the optimum approach to risk control.

JP: I am saying reliability and safety, are those seen as two slightly different categories?

FM: No, I do not think so.

JP: Reliability meaning will the platform stand up to what it has to stand up?

FM: I think there is the additional issue of are you making the best use of the resources? Are you putting the structural material, so to speak, in a way and utilizing it in a way that best resists the threats? To look at all of the threats in a common framework, I would say, is the reliability approach.

JP: Is 1973 still the year where they are kind of overbuilding many platforms - just building in extra weight and things for safety?

FM: Not only building in extra weight, but also putting the weight where perhaps it should not be going. I would not say that they necessarily overdesigned, but they did not balance it because the statistics were not available on the best utilization of resources.

JP: When you say the 1973 deterministic approach where you

applied various traditional factors, what would the main traditional factors be? Hurricanes?

FM: Well, the traditional factors had evolved and migrated from the building design. In fact, many of the safety factors were identical to those used in the building codes of many years ago. They had migrated because the industry grew so quickly. It did not have a historical database so you are doing a steel offshore structure where you look at steel buildings and see what is done there.

JP: On the steel buildings, had much of the work and design been shaped by hurricanes?

FM: In buildings, no; it was subject to gravity loads, wind loads, some earthquake effects. In buildings the factors of safety have dropped dramatically over the years as people have learned more about the behavior of buildings and how to best utilize resources for building safety.

JP: So, what you are bringing is safety and economic efficiency?

FM: Yes.

JP: How to be safe without spending so much money that you are not economically viable.

FM: If you do not think economics, it is a lot easier to talk about higher and higher safety levels. But, you also want to do the economics in a way that balances the risk. For example, it can be very safe with respect to some gravity effect but not safe enough with respect to a hurricane or an earthquake.

JP: In your work offshore, how important were hurricanes in your calculations?

FM: Oh, extremely important.

JP: Can you talk about that a second?

FM: Well, a hurricane is the major risk in the offshore. There is some risk, of course, of overloading some components with gravity loads, particularly the foundations, but the major risk is the hurricane risk.

JP: When you entered the business, was there much good information about the forces a hurricane could unleash on a platform or was it in the middle of that process?

FM: It was in the middle of that process. There were some hurricanes in the mid 1960s that did cause some major damages and, as a result, the industry learned a great deal about the effects of hurricanes.

If you look back at platforms designed in the late 1950s, there was not the recognition of what hurricane forces could actually do to a structure.

JP: Where did you go for that data?

FM: Well, it was collected in the industry. All of my work was done in very close cooperation with the industry - with the oceans groups of various offshore companies.

JP: In the API already or does that come later?

FM: No, my work started with an industry cooperative group that Amoco put together. At one time it had over 20 participants of major oil companies, some of the consulting firms, the offshore, and some of the government agencies. The idea was to put together, in an open forum, what each of us knew and bring that together to improve the product.

JP: And what was Amoco's motivation?

FM: Amoco with Bernie Stahl organized this and their approach was to have a forum where we could bring the information to bear, educate those that were not up to speed, and come out with a better product.

JP: Let me be sure I have his last name.

FM: Bernie Stahl.

JP: There is a lot of that impulse in offshore. Compared to most competitive industries, there is a kind of fraternity of knowledge because there are so many difficult things you have to know to be successful.

FM: Well, not only that, there is also an industry standard like the American Petroleum Institute standard that everyone is going to live with. So, it is in everyone's interest to develop information to improve that standard.

JP: Help me understand, from an engineer's point of view, how the thinking on hurricane design evolved from 1973 forward.

FM: Well, I think it evolved from using deterministic descriptions and trying to incorporate probabilistic considerations. What is uncertain about a hurricane?

Well, there is the uncertainty of its occurrence, but there is also the uncertainty about its magnitude direction. There is uncertainty about the forces that it can generate. In addition, there is the uncertainty of the platform's ability to resist these forces, including the steel structure, the foundation. All of these uncertainties get meshed together to produce an overall safety estimate.

JP: In the Gulf of Mexico, which I assume was a lot of your early work, were there key hurricanes that advanced knowledge? Pat Donnelly told us that Hurricane Camille in 1969 really forced people to get serious about it.

FM: Right. It seems to go in cycles. There seemed to be periods where there had not been significant hurricanes, and then you get some major hurricanes like Camille that wake people up and say 'we have a serious problem.' Andrew did that as well.

JP: Were there others between 1973 and Andrew that seem particularly important to you?

FM: Not especially, no, but Andrew became a very significant event for us.

JP: Even though it did not affect the offshore industry like Camille did?

FM: Well, it did because Andrew was a test of the later specification. Camille tested the earlier work and Andrew tested the later work. In fact, Andrew served to prove, if you will, that the standards were good.

JP: And it did that?

FM: It did that.

JP: Whereas, Camille proved that . .

FM: . that the standards needed to be improved. There were some platforms damaged in Andrew, but they were all of the earlier vintage. Those that had been designed with the better standards, the later standards, stood up very well to Andrew.

JP: I assume you are still consulting?

FM: Yes.

JP: Are you fairly confident that this problem is comprehended correctly; that there will not be more big

surprises with a future hurricane?

FM: That is always there, of course, because whenever you deal with uncertainty and risk you never say never. There is always the possibility. Certainly, the force of Andrew was greater than expected. Are we getting climatic changes? That is an issue for the future.

JP: Would it change your whole calculus if the hurricane intensity changes?

FM: Absolutely. With this climatic warming, the hurricanes will become more and more severe.

JP: Is there anything else you would like to add about the engineering aspects of the evolution of knowledge about safety?

FM: Well, I think it has paralleled in the offshore industry what we saw in other industries - like highway bridges, like buildings, like aircraft. We need to meld together all of our uncertainties to come up with our best estimate of risk; not to say we have eliminated risk, but to manage that risk.

JP: Again, I will ask you to repeat a bit, but identify for

us the key overlaps. Where are the areas where we really learn from power plants and bridges and the airlines that we apply to offshore?

FM: Well, we need to consider both the environmental threats and the capacity of the system to resist overload. I should point out that, because it is a complex procedure, a designer has to come out at the end of the day with the sizes of thousands and thousands of elements of a system. There is a tendency to look only at individual components of a system - what is the size of this beam, what is the size of that connection, the size of this piling - and one of the things that is forced on you by the reliability approach is to look at the entire system. That failure is not just a simple element, but a failure of the system itself. In the offshore, you are worried about pushing a structure over; that is a system response to the hurricane. You are not concerned with just individual damages of members.

In a building, much of what you do is service oriented. You do not want people to feel that the building is shaking or that the floor is sagging. This is not the major issue in the platform. There, the issue is will it fall over?

JP: It is certainly not an issue on those TLPs, is it?

FM: No!

JP: I think it is very important for us to understand the role of the API. There is a cooperative impulse to have an industryjacademic effort to identify the key issues and to share the data because safety is involved. Can you talk about how that proceeded and who the key actors were in the API? You were involved for almost 20 years - how did that produce the comprehensive study in 1993?

FM: The industry is very fortunate that it has this forum to bring together the best knowledge, and that the best knowledge does not just sit with the individual companies, but is brought forth into a public forum where it can be discussed, criticized, improved, and so on. That forum has been the American Petroleum Institute. That type of forum does not always exist in industries where there is a competitive advantage to companies to keep the information proprietary. I think the advantage to the companies has been to get it into the public domain and get it accepted by the industry, and everybody then uses those standards. American Petroleum Institute has been that forum.

JP: You said that Bernie Stahl helped to create this. Were there other people who carried the ball?

FM: Oh, absolutely. After we had that industry cooperative group from about 1973 to about 1976, 1978, it was agreed that the next step was to move the knowledge into the realm of the American Petroleum Institute. That was pushed by people such as Jack Irick of Exxon, Jim Lloyd of Exxon, Pete Marshall (Shell); they were all instrumental in having the American Petroleum Institute take on the responsibility of incorporating this risk approach in the design of platforms.

JP: Once it was in the API it was the creation of a standard API committee?

FM: Well, API funded research and the funded research aimed toward improving its standard. It had a standard of practice, a recommended practice. The recommended practices are supported by research by various committees.

JP: How long had the recommended practices had been on the books?

FM: Oh, at that point . . .

JP: Before you started?

FM: Oh, well before.

JP: But you were just making a better .

FM: That is right. It had evolved from building design, and then at this stage it began to evolve towards what we call the reliability approach. I should point out that in other industries like buildings and bridges there has been the same migration from a very deterministic approach toward a reliability-based approach for the codes of practice.

JP: With improvements in reliability and improvements in cost analysis coming together.

FM: Exactly. That has occurred in buildings. It occurred maybe six or seven years ago in highway bridges where the reliability approach has been adopted as the standard approach to the design of bridges.

JP: Is there a federal government role in any of this?

FM: In the offshore industry?

JP: Well, in the reliability industry in general.

FM: Certainly in the other areas of buildings and bridges the federal role is evident. Federal and state governments are responsible for building codes. They are also directly responsible for the bridge code. In the offshore industry, I think there has been close support by the various regulatory groups - MMS, the Mineral Management Service, and others who have responsibility for the offshore. They have looked to the American Petroleum institute for the lead in providing the standards. When American Petroleum Institute provided that leadership, then they supported that leadership and, in fact, made those standards the government standards.

JP: I teach courses on regulation. There is a body of literature that says just that: when industry self-regulates effectively, government will tend to stamp it and say fine. And then, when you have a disaster, the government will look at it.

FM: Exactly. They have the best of both, in a way. But that is exactly what happened in the offshore.

JP: The offshore industry largely avoided disasters in this era?

FM: I think so, yes.

JP: So, Camille kind of woke people up to the idea that there are strong forces out there that they had not reckoned with?

FM: Also, there is the advantage that the problems in the offshore Gulf of Mexico have never involved the loss of life. You have loss of platforms, but because of the significant hurricane . we are in a hurricane warning now so they are shutting down facilities; they are evacuating personnel from the platforms. If there were to be platforms failing, there would not be any loss of life.

That is not true in other regions of the world. In other regions of the world, the government has taken a greater role because there has been loss of life - in the North Sea, in the Norwegian sector.

The government role generally is to look at life and environmental safety. There have not been any great spills as a consequence because, again, you can shut down the platform. And even if the platform fails, there should not be any spillage of oil into the Gulf.

JP: That is what reliability design does . it says how much safety and reliability is needed on a risk assessment basis and here is how to pay for it?

FM: Right, and you do not have the uncertainty of what is the cost of a human life? What is the cost of an environmental spill? That is very difficult to deal with in the Gulf of Mexico because it is strictly an economic issue. How much should you spend to keep a platform from falling down?

JP: Has that number changed dramatically? Has your profession changed much as you go from fixed platforms to TLPs to other forms of oil recovery?

FM: I think the concepts have now migrated and cover the TLP and the jackup rigs - all of these are controlled by the same concepts.

JP: Just a different set of structural rules?

FM: Right, and different levels of uncertainty, perhaps, but the same concepts.

JP: When ■ look at your resume, it strikes me you have lead a really interesting life to be both an academic and an

active participant in industrial activities. Could you talk about the cooperation between the offshore industry and academics?

FM: There have been a number of academics that have contributed to the offshore industry, and I think it has gone both ways: they have learned a lot and the industry has learned a lot. We have been able to take concepts and developments in the offshore and bring them into our classroom, and take some of our research and bring them to the offshore industry. I think it has been a very good give-and-take; a very good example of how the industry and the academic interact.

JP: At Case Western at University of Pittsburg, did you teach courses that were specific to offshore or were you mainly teaching reliability?

FM: I was teaching reliability. The students always knew, 'well, this is real life now, this is not just an imaginary exercise but this is a real life exercise of how to deal with these problems.'

JP: Did many of your students go into the oil industry?

FM: Yes, they did.

JP: And then you worked with them as a former professor?

FM: To some extent.

JP: Mainly Ph.D. students or master's students?

FM: Master's, Ph.D.s, and some undergraduates did take jobs in the oil industry, as well.

JP: You started to talk a moment ago about the differences in the Gulf of Mexico and the rest of the world. It would be interesting, I think, for people to have your reflections on the worldwide cooperation on these issues - how it was the same and different in various areas.

FM: Well, the worldwide cooperation has been extensive. For example, the API criteria based on risk has migrated to an ISO which is an International Standard Organization document. As far as I am aware, that is the first time that the needs have been such that it has transcended national interests. You would never get a bridge code, for example, or a building code adopted by another country. National interests are always dominant and each country wants its own building code and its own bridge code; cooperation is relatively minimal. Whereas, in the offshore industry this cooperation has been major.

Now, of course, there are issues that are unique to various parts of the world - in the North Sea, for example, platforms are different than the Gulf of Mexico platforms, in many respects. They do not have the hurricane warning. The investments are very, very large relative to the Gulf of Mexico. So, there are other issues to be dealt with, but they can still be dealt with in the same framework.

JP: When was the first time you went to the North Sea or became involved with North Sea issues?

FM: Probably the early 1980s. My wife and I and family spent a year in London at the Marine Center at Imperial College working with Michael Bakers and others. And I had some connection even earlier with Marathon's U.K. operation and some of the other companies which have operations in the North Sea.

JP: This might be an unanswerable question, but when you first went to the North Sea issues, how different were they from what you had been doing for 10 years in the Gulf of Mexico?

FM: They were different because of the scale of some of their platforms.

JP: What were the first projects that you worked on in the North Sea?

FM: Well, again, these were very specific to the code issues; in other words, how the code should be modified for North Sea operations. Do we know the information to the same extent that we know in the Gulf of Mexico? Keep in mind that at that point, they did not have the same historical backgrounds to characterizing extreme storms and so on that we might have had in the Gulf of Mexico. They did not have a history of hundreds of platforms to build and to justify this risk approach.

JP: How do North Sea storms differ from hurricanes from an engineering point of view? Do they generate different issues you have to worry about?

FM: Well, they sometimes come with severe currents which changes the technical nature, but they also come without the warning. They will be occupied platforms during that period and they will not be shut down in the same way. There is just no opportunity to do that, so your risk is much greater. Also, for some countries, their offshore platforms are a much greater percentage of the economy, so to speak, and they cannot afford to lose some of those structures. I dealt with platforms in Australia and

those structures were a major component of the economy in Australia. You just do not want to lose those structures.

JP: Which part of Australia is that?

FM: That was Woodside. It was the gas platforms.

JP: So, is that physically somewhat like the Gulf of Mexico?

FM: Physically it is, but the economics were different.

JP: You said earlier that one of the good things about the Gulf is that you know you can evacuate the people, so you are talking about cost but not cost of lives. What were the key events in the North Sea that showed that it was different?

FM: Well, Piper Alpha, for example, and the fire that occurred there. The Alexander Keeland in the Norwegian sector where there was major loss of life.

JP: Have you worked mainly on fixed platforms and not drilling platforms?

FM: Mainly on fixed.

JP: Are other people similar to you working on that other set of questions? Is there another code?

FM: Well, there are separate code issues associated with that. I have worked on some issues related to the jackup rigs, for example. They are just somewhat related but different than the fixed platforms.

JP: Because those did have serious problems in the early North Sea, the technology did not transfer very well?

FM: That is right, and there are differences.

JP: Australia was about when?

FM: The mid 1980s, primarily.

JP: That is applying the general knowledge from the rest of the world to a relatively new but growing offshore sector?

FM: Right.

JP: Is the Australian government much more involved because it is such an important part of the economy?

FM: I dealt with one of the consulting companies, so I cannot say.

JP: What about the North Sea governments?

FM: Oh, they are actively involved.

JP: To the extent that they are the leaders?

FM: No, the leadership is with the industry with the major companies providing the technical basis. They are sort of looking over the shoulders of the industry, so to speak. To an extent greater than in this country, the Norwegians and the English have developed their own government agencies that have some capability. But, I think the leadership is still with the industry.

JP: What would you consider your major publications that would be of use to us in understanding and filling in the technical parts of the interview?

FM: Well, our major thrust became development of the American Petroleum Institute standard - the load resistance factor standard - and behind that are a series of reports produced every other year that supported the development of that document.

JP: The API report?

FM: The API report.

JP: The big one was 1993.

FM: That was a culmination. Those reports had two functions: one, to present the technical information; the other function was educational to educate either new engineers in the industry or people who had not been previously exposed to the reliability issues to what the basis of these codes was.

JP: And the codes were specific to offshore?

FM: They were specific to offshore and they had a basis behind them that was different than they were used to.

JP: What was the response to the bigger port in 1993?

FM: At that point they had adopted a preliminary; what we call the load in resistance factor design approach - the LRFD. LRFD had been adopted already in buildings and in bridges and now it was being adopted in the offshore industry. That became a necessity because the offshore industry had relied to some extent on codes from other

aspects; for example, the building code for design of steel structures. Now that building code had migrated to an LRFD or reliability-based code and it was necessary for the API to do the same.

JP: Are there sources that we should be aware of that might be of use to us in exhibits for the general public? You can say that a lot of this is educational and that is part of our job also.

FM: There are, of course, paper exhibits. There are reports published by the American Petroleum Institute that document the development of these procedures.

JP: So, in your case, this is not an academic endeavor? You are not publishing an academic journal?

FM: There have absolutely been some offshore technology conference proceedings. I did have a paper with Rich Larabee who was also very active. He was with Shell. Rich and I published some papers for the offshore technology as well as the American Society of Civil Engineers. These were public forums in which we could present results and open ourselves up to questions and scrutiny and so forth.

JP: To sum up with a general question: Are there things that you would like to say for the record about your work in the industry, either the technical part or the personal part?

FM: Well, I have worked with some of the most talented engineers I have ever met. People like Jim Lloyd and Bernie Stahl and Rich Larabee and Pete Marshall are among the most talented and creative engineers. They were also lots of fun to work with. For me personally, it has been a major part of my professional activity.

I had great support from my wife, Tanner; enthusiasm, humor, and creativity. I have tried to bring some of that to the offshore industry and I have had wonderful cooperation. We used to meet regularly with representatives of different companies. They always knew how to ask questions. They were always interested in us.

I have to say, it has not been as easy in other industries. The offshore has evolved quickly and it has evolved in response to challenges. It was not just 'let's do business as usual.' You can see the evolution of the size of these offshore platforms; the costs and the economic importance transferred to the people working

for it. It was not, 'Well, I will do it the way I did it last year and get away with it!' It was more, 'How can I make it better and how can we keep safety in the forefront?' There are just some very talented people in this industry.

JP: It is more fun if you are doing cutting edge work that keeps changing and keeps challenging what you have done in the past as opposed to functioning in a steady state where you can only make a little difference.

FM: Exactly.

JP: You get a TLP and a concept of a whole different kind of structure.

FM: Absolutely, but I think the fact that you can deal with a TLP is a consequence of having these talented people in the industry.

JP: It sounds like you like to deal with the industry in addition to professors.

FM: Yes, it is a great diversion!

JP: In your own career, it sounds like this made a lot of

difference, particularly in your classroom.

FM: Absolutely. Bringing these examples in and sometimes actually bringing in the people to give seminars to our students. our students knew that the offshore industry was a challenging career to go into. There were opportunities for them to utilize academic-based research in an important industry.

JP: I appreciate your time and I congratulate you on your award.

THE END