AFFIDAVIT OF ROBERT GLENN BEA

STATE OF CALIFORNIA)
)
COUNTY OF CONTRA COASTA)

I, ROBERT GLENN BEA, having first been duly sworn, depose and say:

1. My name is ROBERT GLENN BEA and my business address is Department of Civil and Environmental Engineering, Center for Catastrophic Risk Management, University of California, Berkeley, CA 94720. I am employed as a professor in the School of Engineering at the University of California Berkeley. I have held this position since January of 1989. Prior to that, for seven years I held the position of Vice President and Senior International Consultant at PMB - Bechtel's Ocean Engineering Division located in San Francisco, California.

2. My current responsibilities include teaching at the graduate and undergraduate levels, research, and I am faculty co-director of the Center for Catastrophic Risk Management. My research is focused on risk assessment and management of engineered systems. Most recently, I have served as a member of a team of engineers sponsored by the National Science Foundation who have investigated the causes of the failure of the flood defense system for the greater New Orleans area.

3. My educational background includes a Bachelor of Civil Engineering and Master of Engineering from the University of Florida and a Doctor of Philosophy from the University of Western Australia.

4. Attached hereto as Exhibit 1 is a current version of my curriculum vita. This is attached to support my competency to attest to the matters stated herein. Of particular importance to my testimony is my background in the oil and gas industry. After entering this

industry in 1960, I worked in offshore drilling, production, engineering and construction and was located in southern Louisiana, Mississippi, and Texas. Starting in 1965, I served as Chief Offshore Civil Engineer and Manager of the Central Engineering Division for Shell Oil Company located in New Orleans, Louisiana. My later assignments included managing the Marine Research Division of Shell Development Company and serving as a production engineer for several of their offshore fields in the Gulf of Mexico. I have been recognized by the U.S. Department of the Interior Minerals Management Service, the National Academy of Engineering, and the industry for my pioneering contributions to development of offshore oil and gas technology.

5. The purpose of my affidavit is to discuss the key issues associated with the dispute between the state of Louisiana and the United States Minerals Management Service and Department of the Interior over Outer Continental Shelf oil and gas activities and their effect on the state's coastal zone.

6. In summary, it is my conclusion based on my experience in this region with oil and gas development and production and my subsequent research that the oil and gas industry Offshore Continental Shelf (OCS) activities have had undeniable effects on the coastal zone of Louisiana. While many of these effects have been positive and benefited the state of Louisiana and the United States (hydrocarbon resource development and associated industry and commerce), there have been a wide variety of unintended adverse environmental consequences that have contributed and unless mitigated will continue to contribute to the degradation in hurricane flood protection for this area. Construction and operation of the facilities associated with hydrocarbon extraction have had a wide variety of direct effects including localized subsidence, accelerated erosion, and salt water intrusion.

These direct effects have made substantial contributions to loss of coastal wetlands, marshes and barrier beaches that are of vital importance in providing flood protection for this area. Loss of these natural defenses clearly demonstrated their critical influences in the failure of the flood defense system for the greater New Orleans area in the wake of hurricane Katrina. Of even greater potential impact is the necessity of restoration of these natural defenses in provision of adequate and sustainable flood protection for southern Louisiana.

7. I will address the following issues in the remainder of this testimony:

a. What is the fitness of current infrastructure to withstand future storm flooding impacts?

b. What were the impacts of the 2005 storms on the offshore infrastructure and what are the anticipated future impacts of storms?

c. Given the continued land loss as a result of OCS activity, what does it take to provide adequate flood protection?

d. How is the OCS infrastructure influenced by the flood protection for southern Louisiana?

8. The current public and private infrastructure in southern Louisiana is not adequately protected against future storm flooding impacts. With the current flood protection infrastructure, experience has demonstrated that very significant to catastrophic flooding events associated with intense hurricanes can be expected in southern Louisiana about every 50 years. At this time, authorization is being sought in the United States Congress for the U.S. Army Corps of Engineers to provide "100-year" flood protection. Clearly, this level of flood protection for the involved public and industrial - commercial enterprises is not sufficient. Highly developed areas that must confront such natural hazards such as the Netherlands provide "1,000 year to 10,000 year" protection for industrial - commercial facilities and protected public areas. Current economic analyses, historic precedents, and

standards-of-practice indicate that such levels of flood protection are warranted for southern Louisiana. The oil and gas industry has engineered its Louisiana offshore production platform infrastructure to be able to resist the effects of hurricanes that have return periods of 1,000 years (unmanned) to 10,000 years (very important drilling and production structures evacuated in advance of hurricanes). It does not make sense to continue to protect this area as we have in the past.

9. The impacts of the 2005 storms (Katrina, Rita) were catastrophic for the public and commercial - industrial infrastructure of southern Louisiana. Current estimates of damage to onshore facilities is in the range of $200 billions to $400 billions (direct, indirect). Impacts on the OCS oil and gas industry also were very severe. More than 150 platforms were either destroyed or not useable following hurricanes Katrina and Rita (the largest number of platforms lost in a storm in the history of the offshore industry). More important were losses of pipelines and associated oil pollution incidents and the impacts on coastal refineries and offshore industry shore bases. Impacts on U.S. hydrocarbon production and prices continues to this date.

As of this date, many of the offshore facilities have not been repaired. Re-establishment of the "pre-Katrina" flood protection for southern Louisiana is still underway. While several major oil companies have decided to resume their activities in this area, others have decided to move their personnel to other areas and to further bolster the defenses of their industrial facilities in this area.

Given the clear evidence that one can expect greater numbers or more intense hurricanes during the next several decades, one should expect that unless definitive measures are undertaken in the near future to provide adequate flood protection, more frequent and more damaging hurricane flooding can be expected. Given similar evidence regarding global warming and its effects on rainfall, one should also expect more severe and more frequent potential floods from the Mississippi River and its tributaries. Development and maintenance of adequate flood protection for southern Louisiana must become a priority for the United States if the public and industrial - commercial enterprises in this area are to be maintained and further developed.

10. There is clear evidence that past and current oil and gas activities have made and continue to make substantial contributions to degradations in the natural defenses against hurricane surges and waves in coastal Louisiana. Several international oil and gas companies have recognized this responsibility and have joined in the efforts to help mitigate these effects. Artificial canals and waterways dug for shipping, barge traffic, drill rig access, and pipeline construction have contributed primarily through introduction of saline water into otherwise fresh water dominated areas. Erosion has also been accelerated by these facilities and activities. In some areas, extraction of oil and gas (and in some cases, sulfur and fresh water) have led to accelerated subsidence. All of these works and activities have contributed significantly to the loss of natural defenses such as barrier beaches, wetlands, and marshes. In several important cases, it was the loss of these natural defenses that contributed to the unanticipated breaches of flood protection facilities that protected the greater New Orleans area during hurricane Katrina and led to repeated flooding during hurricane Rita.

As a part of the investigation of the failure of the flood defense system for the greater New Orleans area during hurricane Katrina, we considered what would be required to provide adequate flood protection in the future. As discussed earlier, the first element that had to be addressed was the level of flood protection that should be provided. The results indicated protection levels for developed areas in the range of 1,000 years (moderate to high consequence areas) to 10,000 years (very high to catastrophic consequence areas).

The next consideration was how could such levels of protection be provided? We explored two approaches. The first approach was a traditional engineered system approach that depended on the heights of levees and flood protection. Considerations of subsidence and other natural elements, serviceability, construction, maintenance, economics, and quality of life indicated that this approach would not be sustainable. The second approach was a non-traditional approach that relied on re-establishment of selected natural defenses supplemented as necessary with engineered facilities. This approach proved to be potentially sustainable.

Consequently, our recommendation to be explored and developed for going forward was based on re-establishing selected natural defenses as a first approach supplemented with engineering defenses to provide adequate and sustainable flood protection; nature first - engineering second.

11. Every part of the OCS oil and gas infrastructure is impacted by the flood protection that is provided in southern Louisiana. This includes the infrastructure required to explore for, develop and produce, transport, refine, distribute, and market hydrocarbon and associated resources. The most important part of this infrastructure is people. The oil and gas industry requires and employs a large number of highly trained and qualified people to conduct its operations. It is of vital importance to the oil and gas industry to protect this important part of its infrastructure. In the onshore areas, a public infrastructure of transportation facilities (roadways, railroads, bridges, waterways), power supply facilities, schools, health care and sanitation facilities, and water supply facilities are needed to provide support for the people that serve directly or indirectly the oil and gas industry and the other

social, governmental, industrial - commercial entities. As demonstrated by the failure of the flood defense system in the wakes of hurricanes Katrina and Rita, all have important influences on the OCS oil and gas infrastructure. It is in the interest of the United States to provide and maintain an adequate level of flood protection for the coastal zone of Louisiana, and the future development of OCS oil and gas activities share an important part of this responsibility.

FURTHER AFFIANT SAITH NOT.

ROBERT GLENN BEA, PH.D.

Subscribed and sworn to before me this 18 day of July, 2006.

JAVIER GALDON
COMM. #1666507
NOTARY PUBLIC - CALIFORNIA
CONTRA COSTA COUNTY
COMM. EXPIRES MAY 13, 2010
MGC1

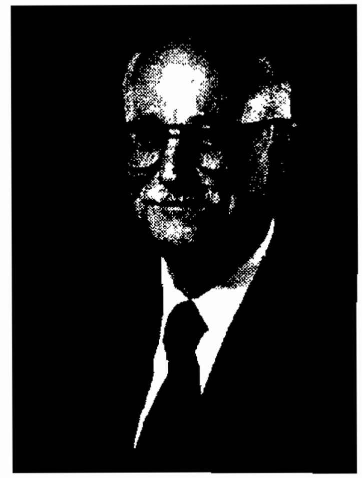
Notary (signature)

JAVIER GALDON
Notary (printed or typed)

My Commission expires:

MAY 13 2010

RESUME Professor Robert G. Bea



POSITION
Professor, Department of Civil & Environmental Engineering

DATE & PLACE OF BIRTH
14 January 1937, Mineral Wells, Texas

EDUCATION
1956, A. A., Jacksonville University
1959, B. S. in Civil Engineering, University of Florida
1960, Master of Science in Engineering, University of Florida
1961-1976, Post-graduate studies at Tulane Univ., Rice Univ., Texas A&M Univ., Bakersfield College, and University of Houston, Harvard Executive MBA program
2000, Ph.D., Center for Oil & Gas Engineering, University of Western Australia

LICENSES
Registered Professional Civil Engineer in Louisiana, Texas, Florida, Alaska, Washington, Oregon, California. Registered Professional Geotechnical Engineer in California. Registered Land Surveyor in Louisiana.

PROFESSIONAL ASSOCIATIONS
American Society of Civil Engineers, Academy of Management, The U. K. Safety and Reliability Society, American Society of Mechanical Engineers, American Petroleum Institute, National Academy of Engineering

EXPERIENCE
1954-1959: U. S. Army Corps of Engineers, Engineer-in-Training
1959-1960: S. S. Jacobs Construction Co., Construction Estimator
1960-1976: Shell Oil Company (Manager, Head Office Civil Engineering Group; Chief Mechanical Engineer, Production Division; Offshore Division Construction Engineer, Head Office Production & Financial Control; Royal Dutch Shell Ltd. Production & Financial Control, Shell Development Company (Manager, Offshore Technology Development Group)
1976-1981: Ocean Services Division, Woodward-Clyde Consultants(Vice President, Chief Engineer, Geotechnical, Structural, Environmental, Field Operations)
1981-1989: PMB Engineering - Bechtel Inc. (Vice President, Senior International Consultant)
1989 - : University of California (Professor)

PRIMARY EXPERTISE
Ocean Environmental Conditions and Forces (earthquakes, wind, waves, currents, mudslides, ice)
Foundations Design and Construction (field explorations, soils testing, piles, mats, pipelines)
Structures Design, Construction, Maintenance, Re-qualification
Reliability & Safety Assessments; Human & Organization Factors in Quality & Reliability of Engineered Systems

HONORS
Fellow, American Society of Mechanical Engineers, 2003
Blakely Smith Medal Lifetime Achievements in Ocean Engineering, Socicty of Naval Architects & Marine Engineers, 2001
Ocean, Offshore & Arctic Engineering Division Professional Contributions Award, 2001
Corporate Leadership Award, U.S. Department of the Interior Minerals Management Service, 2000
Offshore Technology Pioneer Award, Energy Center, 1998
Offshore Mechanics & Arctic Engineering Technical Achievement Award, American Society of Mechanical Engineers, 1997
National Academy of Management, 1994
National Academy of Engineering, 1989
Fellow, American Society of Civil engineers, 1989
Marine Board, National Academy of Engineering, 1989 - 1995
Society of Professional Engineers Project of the Year for 1993
United States Coast Guard Research Commcndation, 1992
American Society of Mechanical Engineers OMAE Technical Achievement Award, 1997

EXHIBIT
1

Institution of Engineers Australia Eminent Speaker Award, 1990
American Society of Civil Engineers Croes Medal, 1978
Bechtel Fellow Award, 1987
J. Hillis Miller Engineering Award, 1960

CONSULTING ABROAD

Canada, Greenland, England, Norway, Denmark, France, Spain, Angola, Nigeria, Gabon, Saudi Arabia, Kuwait, India, Thailand, China, Indonesia, Borneo, Australia, New Zealand, Mexico, Venezuela, Brazil, Chile, Argentina, Trinidad, Japan

PUBLICATIONS

370 refereed journal and conference publications. 390 non-refereed book, report, and conference publications.

CONTRIBUTIONS TO THE FIELD OF RELIABILITY OF ENGINEERED SYSTEMS

Published book summarizing 40 years of work on quality and reliability of engineered systems titled *Human and Organizational Factors in Quality and Reliability of Engineered Systems*, 2000, University of Western Australia, University of California Berkeley. Introduced an engineering based philosophy, approach, and assessment process for the management of human and organization error in reliability of marine structures: *Reliability Based Design Criteria for Coastal and Ocean Structures*, The Institution of Engineers Australia, 1990; "Management of Human and Organizational Error in Operational Reliability of Marine Structures," *Proceedings of the Second Offshore Symposium on Design Criteria and Codes*, Society of Naval Architects and Marine Engineers, April 1991; "Operational Reliability of Marine Systems," *New Challenges to Understanding Organizations*, McMillan Publishers, 1993; "Human and Organizational Errors in Operations of Marine Systems: Occidental Piper Alpha and High Pressure Gas Systems on Offshore Platforms," *Proceedings of the Offshore Technology Conference*, May 1993; *The Role of Human Error in Design, Construction, and Reliability of Marine Structures*, Ship Structure Committee, SSC-378, 1994; "Management of Human Error in Operations of Marine Systems," *Marine Technology Society Journal*, Spring 1994; "Human and Organization Factors in Design, Construction and Operation of Offshore Platforms,:" *Journal of the Society of Petroleum Engineers*, Sept. 1995; "Life-Cycle Reliability Characteristics of Minimum Structures," *Proceedings of the 15th International Conference on Offshore Mechanics and Arctic Engineering*, Florence, Italy, June 1996.