

April 15, 2008

LTG Robert L. Van Antwerp
Chief, U.S. Army Corps of Engineers
HQUSACE
441 G Street, N.W.
Washington, DC 20314-1000

Dear General Van Antwerp:

SUBJECT: External Review Panel
Preliminary Review Comments on IPET Draft Volume VIII
Engineering and Operational Risk and Reliability Analysis

In this letter, the External Review Panel (ERP) of the American Society of Civil Engineers (ASCE) presents our comments on Draft Volume VIII, *Engineering and Operational Risk and Reliability Analysis*, dated November, 2007, prepared by the U.S. Army Corps of Engineers' Interagency Performance Evaluation Task Force (IPET). The role of the ERP is to provide an objective, independent technical review of the IPET's activities and findings.

The ERP has reported its specific technical comments informally and directly to the IPET; we will provide our final comments on completion of Volume VIII. In this letter, we provide some input regarding broader issues and concerns.

Scope of Study

The ERP commends IPET for undertaking perhaps the single largest and most complex attempt at detailed risk analysis of major public infrastructure. We recognize the enormity of this task and the tremendous amount of work that has been done and is still in progress for preparation of Volume VIII.

Risk in the New Orleans Area

The repair work that has taken place since Katrina struck has improved and strengthened the hurricane protection system and has reduced risks relative to pre-Katrina conditions. However, even with these improvements, the question remains: What is the current level of risk to citizens of the New Orleans area, and is this risk reasonable and acceptable?

Risks may be viewed in many ways: Issues such as life, property, the region's economy, and quality of life. Hurricane Katrina resulted in the loss of more than 1,000 lives in the New Orleans area, and produced storm surge elevations with return periods between 100 and 400 years. IPET's analyses show that with the current hurricane protection system, most of the city and



region will be flooded to an extent worse than what occurred in Katrina at least once every 500 years (see Figures 1 and 2).

It has become common in the design of engineered facilities to employ a risk-based methodology, e.g., to design for the 100-year storm or 500-year flood. We provide the following examples of risk-based design criteria for engineered structures where life safety is a major concern:

- Major dams in the United States are designed so that the probability of a failure causing more than a thousand fatalities is less than once every 100,000 to 1,000,000 years.
- Dams and coastal protection systems for densely populated regions in The Netherlands are designed for storm surge occurrences with a return period of 10,000 years.
- The recently completed flood protection system on the Red River in Grand Forks, North Dakota, and East Grand Forks, Minnesota, was designed so that the levees, pump stations, and gate closures would have a 90 percent probability of withstanding a 250-year storm, with the levees built to prevent overtopping from a 500-year storm. This level of protection was chosen based on a risk analysis that incorporated economics, hydraulics and hydrology. The design included relocation of neighborhoods, elevating roadways to reduce the consequences of risk, developing backup power generation, and implementing an ongoing testing plan for closures and pump stations. Note that there were no lives lost in the severe 1997 flood that motivated this work and that involved the evacuation of 50,000 people. The probability of having even a single fatality in this system is much less frequent than once every 500 years.
- Major buildings and bridges in California are designed to withstand earthquakes that occur less than once every 2,500 years.

If the ability to evacuate or shelter people has not been dramatically improved, the data suggest that a 500-year storm could cause loss of life in the New Orleans area similar to that of Katrina. As indicated above, risk-based guidance used for design of other types of hazards would place this level of risk in the New Orleans area far above that employed for other engineered structures. The ERP has not studied evacuation plans for the New Orleans area.

In addition to the risk to human life, the risk to property and the quality of life for the people of New Orleans is very high. Flooding of the magnitude shown on Figure 2 would cause massive devastation to property, to communities, to the economy and to the people. The probability for this level of flooding, once per 500 years, is equivalent to a ten percent probability that it will be exceeded one or more times in the next 50 years. In our opinion, a one-in-ten chance every 50 years of catastrophic flooding of a city and loss of property, life, and life-style is unacceptable as a design basis for an engineered system. Nevertheless, this appears to be the reality of the current situation, and that reality must be properly communicated and managed until improvements are made.

In summary, the ERP believes that the draft IPET report shows that the risk to citizens in the New Orleans area with the current hurricane protection system is much higher than would be accepted for many other engineered life-protection systems. There may be other areas of the U.S. with similar or even greater risks, but the ERP has not studied these.

Recommendations

With the strongest possible urgency, we recommend that the Corps of Engineers take a proactive leadership role in three areas:

1. Clearly communicate to the public the serious risk of catastrophic flooding in the New Orleans area with the existing hurricane protection system. The public needs to be informed of the fact that the risk, should a major hurricane strike, is life threatening and potentially as bad as or worse than it was from Katrina. The message should not be sugar-coated, must be in clear, easy-to-understand language and, in our opinion, needs to come from the engineer who designed and is responsible for the hurricane system (namely, the U.S. Army Corps of Engineers). We urge the Corps to be proactive in discussing the risks because the natural tendency of people is to downplay those risks. We urge the Corps to assume this role in a manner consistent with an engineer's responsibilities to the public.
2. Argue vigorously for the best possible evacuation and emergency response plan. No one understands, or should understand, the limitations of the hurricane protection system better than the Corps of Engineers. It is the responsibility of the engineer to hold paramount the health, safety, and welfare of the public. Given the known limitations of the current hurricane protection system and the risks identified by the IPET report, we believe that the Corps has a responsibility to advocate forcefully and vigorously for comprehensive evacuation and emergency response planning. This planning should meet or exceed the acceptable standard of practice that exists for evacuation and emergency response planning in our nation. Evacuation and emergency planning appears to be the only means available in the near term to provide significant additional protection to human health and welfare in the New Orleans area. Commitment to continued and significant improvements in emergency planning may easily wane. The Corps, as the engineer for the system, has a responsibility to keep the urgent need for such planning at the front of the public's consciousness even though the Corps may have little or no direct involvement in evacuation or emergency planning.
3. Proceed with urgency to improve upon the hurricane protection system and non-structural elements. We understand that work to improve the hurricane protection system has been in progress for some time. In view of the risks to people and property in the New Orleans area, we urge that this work continue to completion as quickly as possible. A variety of non-structural elements such as floodplain management and emergency response are also needed to enhance protection and should be part of a comprehensive protection strategy. We strongly encourage a clear and continuous discussion of how improved designs and practices can reduce

risks, current and future, especially to human life. And if improvements are slow to be implemented, we urge the Corps of Engineers to continually update the public of the consequences of delayed action in terms of risk to people living in the New Orleans area.

Completing Volume VIII

We look forward to reviewing a complete version of Volume VIII as soon as it becomes available. The methodology for analyzing risk will be invaluable in guiding risk reduction efforts by providing essential, quantitative assessments. As we previously have communicated, we encourage IPET to include the following items in completing Volume VIII:

1. Assessments of the risks to human life and property in addition to the assessments of flood-level frequencies that are currently presented in Volume VIII.
2. Thorough analyses and discussion of the results, including sensitivity studies to better understand what input parameters, what assumptions, what physical characteristics, and what components in the protection system are driving the results.
3. Illustrative examples, including an analysis of the performance predicted in a storm with a similar track, size, and intensity as Katrina, and comparisons of real data with the input to and results from the predictive model.
4. Conclusions, including answers to the questions listed in the charge to IPET and on the first page of the Executive Summary of the draft report.
5. A supplemental, non-technical summary that is meant for the general public in New Orleans.

In summary, we believe that IPET's work in Volume VIII underscores the enormous need and challenge to protect the people of New Orleans and other communities from the inevitable future extreme hurricane. We continue to recommend that the Corps work with the City of New Orleans and with other entities to develop a strategy for comprehensive, systematic management of flooding risks that includes the development and implementation of effective warning and evacuation plans and land-use plans as well as levees, flood walls and gates. To act other than with extreme urgency when the residents of New Orleans are exposed to such a high level of risk seems intolerable to the ERP.

We thank you for the opportunity to provide this independent technical review. If you have any questions, please feel free to contact the ERP Chair, David E. Daniel.

Respectfully submitted,

The ASCE External Review Panel

Figure 1
Flooding Depth from Hurricane Katrina, 2005 (taken from IPET, Volume I)



Figure 2
Flooding Depth to be Exceeded at a Frequency of Once per 500 Years with 2008 Hurricane Protection System (compiled from <http://nolarisk.usace.army.mil/>)