US Army Corps of Engineers
Mississippi Valley Division

Corps Hurricane Response

Task Force Hope Status Report

June 20, 2007

SPECIAL ISSUE

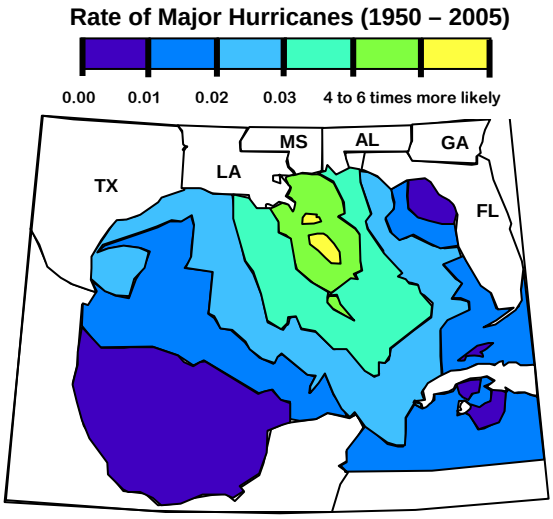
Corps Rolls Out Risk Analysis

Systematic method gauges risk throughout Hurricane Protection System

The 51st Chief of the U.S. Army Corps of Engineers (USACE) established the Interagency Performance Evaluation Task Force (IPET) to provide independent findings on how the New Orleans Hurricane Protection System (HPS) performed during Hurricane Katrina. IPET included more than 150 nationally recognized experts from more than 50 different organizations (federal, state and local government agencies; academic institutions and the private sector) with two levels of outside peer review.

The Secretary of Defense commissioned a special panel of the American Society of Civil Engineers to conduct external reviews; and the National Research Council is also conducting an external review.

IPET released its draft final report on June 1, 2006. This report, along with over 4,300 related documents, is available from the IPET public web site, *https://IPET.wes.army.mil*. The risk analysis products will be released on June 20, 2007.



An illustration from the risk analysis presentation showing frequency of major hurricanes along the Gulf Coast.

Risk is displayed as the likelihood of relative loss in terms of life and property. The risk analysis shows the performance and vulnerability of the 37 sub-basin areas in southeast Louisiana under a wide range of possible future hurricanes ranging from 50-year to 5,000-year-plus storms. Separate risk calculations, performed by super computers, were based on the hurricane protection system that was in place pre-Katrina (August 29, 2005) and the system in place as of June 1, 2007. This is the first ever systematic method of looking at risk.

The data compiled in the analysis is very complex. Given the public's questions about relocation, rebuilding and recovery, the Corps recognized the importance of presenting the information in an easy–to-understand format so citizens can use the analysis to make informed decisions.

In May, the Corps began discussing the risk analysis information at meetings with selected groups. The first meeting was with the Mayor of New Orleans' office. Other meetings included neighborhood associations; local businesses; academia; state, parish and local governments; the insurance and banking industries; the Levee Authorities; etc. Input from these audiences helped shape the message that will be presented June 20.

The risk and reliability modeling tool is the first of its kind. It assesses risk for hurricanes in the New Orleans

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Important and Useful Web Sites

To Obtain Additional Information on Risk Analysis, the Hurricane Protection System, IPET or Corps Projects in General
go to the links below

Risk Analysis

http://NOLArisk.usace.army.mil

Interagency Performance Evaluation Task Force
https://IPET.wes.army.mil.

The New Orleans District Corps of Engineers

http://www.mvn.usace.army.mil/

The Hurricane Protection System

http://www.mvn.usace.army.mil/hps/

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area and has the potential for being used by other communities to assess the reliability of their protection systems. It provides a means for risk-informed decisions by leaders, individuals, groups and businesses. By insisting on a forensic look at what caused the breaches during Hurricane Katrina, the Corps developed a teaching and learning tool that enables New Orleans and other communities to make more informed decisions as well as better plans for reducing risk.

Sharing risk analysis with the public underscores the Corps' commitment to public safety, to communicating transparently, to effectively preparing for and responding to disasters, and to comprehensively enabling Gulf Coast recovery.

Corps of Engineers presented risk analysis products to select local groups whose input helped mold the final presentation

"We have a highly technical assessment that we wanted to make understandable and useful to the general public; so we presented it to small community groups and asked for ideas." *- Lt. Col. David Berczek, the Corps' leader on risk analysis*

Over the past weeks, the Corps of Engineers has conducted informational sessions with select local groups to begin the process of educating and informing the public on the products in the risk analysis.

These groups also assisted the Corps in making the highly technical products presentable to the general public in an understandable manner. This was a vital part of the pre-release of the risk analysis products.

By June 20, sessions will have been held with the following groups:

- Mayor of New Orleans' office
- Parish Presidents/Councils (Orleans, Jefferson, St Bernard, Plaquemines)
- New Orleans Business Council
- Louisiana Recovery Authority
- Local colleges and universities (Tulane, Harvard Alumni, Dillard, Loyola, others)
- "Make It Right" group
- Neighborhood Empowerment Network Association
- Bank Executives
- Levees.org
- Flood Protection Alliance
- Greater New Orleans, Inc.
- State Insurance Commissioner, CPRA, DOTD
- Southeast Louisiana Levee Protection Authorities – East and West Banks
- Engineer News Record sponsored Construction Business Forum
- Convention and Visitors Bureau
- New Orleans Realtors
- Neighborhood Partnership Network

FAQs

The risk analysis model is a first-of-its-kind product that naturally invokes questions. Here are answers to some of the most frequently asked.

Q: What does risk mean?
In the simplest of terms, risk is a measure of harm or loss associated with an action. For this particular situation, risk is the likelihood of loss of life or property as a result of flooding caused by hurricanes.

Q: Why was the risk assessment done?
Risk assessment is essential to understanding and quantifying risk so that it can be managed. It is a comprehensive look at the storm hazard, the protection system, consequences and the relative risk. As a powerful and informative tool for southeast Louisiana, it has applications for other coastal areas, as well as for levees and other similar projects across the country. This is probably the most important thing to come out of the IPET. It is not finished; this is just the start. These tools will be improved with additional use to provide information for officials and citizens to make informed decisions. The Corps is moving to risk-based analyses in their projects, and we hope this will be a prime vehicle for their future work. All of these efforts are aimed ultimately at increasing public safety, now and in the future.

Q: What was involved in performing the risk analysis?
Risk assessment involved almost 63,000 hurricane hydrographs or water level records; 1,450 reliability relationships (protection system); and 68 consequence relationships (life or property).

Each of the 134 levees or floodwall reaches and each of the 350 specific gates, transitions and other features in the protection system had 152 storms run for the pre-Katrina and current day conditions. Each scenario estimated water entering a protected area by rainfall, overtopping and possible breaching. Chance of flooding to different levels was determined for each natural drainage sub-basin. Potential loss of life or property was determined for different flood levels by sub-basin. The chance of flooding and the losses are combined to estimate the risk.

Q: What can I learn from the risk analysis? How will it help me?
From the risk analysis we can see areas that have an increase of 5 to 6 feet of protection with the current conditions from what they were before Katrina. Other areas have 1 to 2 feet of increased protection. Using the risk information, planners can see what areas throughout the whole system or even specific structures within it that need improvement. Our intent is to provide information in these analyses for everyone – officials and the public – to make their own decisions.

This information provides the ability to make more informed decisions, such as whether to raise a home, move or take other measures to increase personal safety. Risk and reliability analysis can also provide information about:

- How various future storms might affect different areas of the protection system;
- The average annual chance for flooding and to what depth;
- Possible weak points in

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Dr. Ed Link Explains Risk Analysis to Corps Employees

(USACE Photo)

Last month, Dr. Ed. Link, Director of the Interagency Performance Evaluation Task Force, presented risk analysis products to employees of the Corps.

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the system;

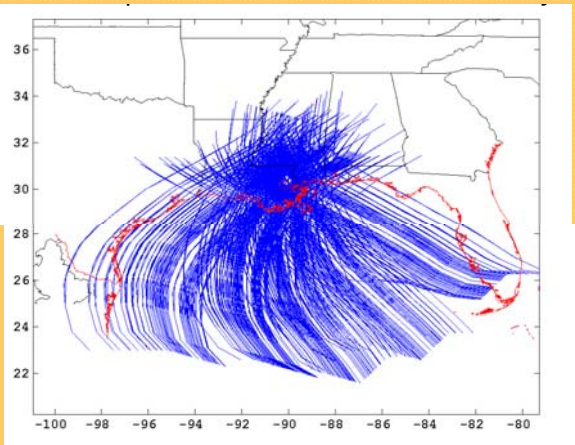
- Improvements that provide the best protection; and
- Risky areas for property or people and which may need redevelopment limitations.

Q: Does this study prove that the City really needs "Category 5" protection? Do you have a model that can show us how safe we'd be with Category 5 protection?

The Saffir-Simpson hurricane scale, the Category 1 to 5 system, relies on wind and barometric pressure to measure hurricanes. It is useful for weather forecasting, but woefully inadequate for coastal protection decisions. For instance, in 1969 Hurricane Camille was a Category 5 hurricane when it hit the Mississippi coast with a 19 to 20-foot storm surge. Katrina was a Category 3 storm that hit the Mississippi coast with a 28-foot storm surge, the highest to hit a U.S. coastline. The IPET and other research show that storm size and intensity are more important than the Category 1 to 5 scale. For engineering decisions related to coastal protection, it is more realistic to use a probability for a certain destructive storm. A 100-year storm means that such a storm has a 1 percent chance of occurring in any given year. Katrina was a 400-year storm or a hurricane with a 0.25 percent chance of occurring in any year. Research shows that specifying a category of storm to define the threat and the appropriate level of protection is not realistic or sufficient. This risk study gives us the tools and information needed to adequately design the system needed for large storms that produce significant surge and waves.

Q: What will the risk products show?

Risk products can show a variety of useful information for planners and the public to make informed decisions. Information products can be tailored to show or address specific concerns, such as overall risk by sub-basin, risk for specific features (gates, transitions, etc.), risk to people or property, etc. They will show depth of flooding and the annual chance for loss of life and property. They will also show hurricane protection system areas that are more vulnerable than others.



Hurricane Paths Considered in the Risk Analysis

Q: How specific are risk analysis results? Can it provide information for a specific street address, census block, zip code, sub-basin, parish or region?

Consequence information for both potential fatalities and potential loss of property is available for natural sub-basins, which are the natural drainage areas for the parishes. There are 37 natural drainage sub-basins covering Orleans West Bank, New Orleans East, Orleans Main, St. Bernard, Jefferson East and Jefferson West, Plaquemines and St. Charles. Risk assessments weren't done for all sub-basins in Plaquemines Parish.

Information on the potential depth of flooding will be accurate to approximately plus or minus one foot.

The IPET was given information by Louisiana authorities on fatalities at the sub-basin level. Property information was available on a more precise level and, therefore, shows more precise results (down to census block) about potential loss of property.

Q: How should the city and parishes use the information in the risk analysis? How should Corps, GCR, FEMA, Administration use it?

The IPET risk products support the entire recovery effort. We believe the information they provide will be useful by the city, parishes, GCR, FEMA and others in making system-wide decisions for the future, but we cannot tell anyone how to use it.

The Corps will use the information to make short-and long-term decisions about designing the 100-year storm protection system and to identify vulnerabilities and evaluate alternatives to achieve higher levels of protection.

Q: This looks like a great way to forecast damage to the area from specific storms. How useful is the risk model in this respect?

The risk model is not useful to forecast damage from a specific storm. It is designed to provide a "big picture" look.

RISK & RELIABILITY

Fact Sheet & Definitions

The U.S. Army Corps of Engineers established the Interagency Performance Evaluation Task-force (IPET) to provide independent findings on how the New Orleans hurricane protection system performed during Hurricane Katrina. IPET gathered and analyzed data to answer five basic questions:

1. **System** (*what was the status of the protection system on August 29, 2005?*)
2. **Storm** (*what exact forces did Katrina put on the system?*)
3. **Performance** (*how did the system respond?)*
4. **Consequences** (*understanding the flooding and the losses – both economic and loss of life)*
5. **Risk** (*what is the risk and reliability of the system after June 1, 2006?)*

Risk Analysis

The risk analysis modeling employs physics, mathematics, engineering, hydrology, geology and meteorology, and incorporates 3 main factors when determining risk:

- **Hazard** (probability of storms, their surge and waves)
- **Protection System** (performance of levees, floodwalls, other structures)
- **Consequences** (loss of life, property, etc.).

Storm Types

The probability of a storm occurring is typically communicated in one of two ways; as a percentage, or as a #-year storm. Here are some examples:

- a "*100-year storm*" = a storm that has a 1% chance of occurring in any given year

- a "*50-year storm*" = a storm that has a 2% chance of occurring in any given year

- a "*5000-year storm*" = a storm that has a .02% (one fiftieth of one percent) chance of occurring in any given year

Katrina was a 400-year storm = .25% (one quarter of one per cent) chance of occurring in any given year)

Incorporating Hazard

Incorporating hazard into risk involves modeling the chances of possible future hurricanes. IPET factored the chances by using a suite of 152 different possible future storms, ranging in severity from a 50-year storm (2% annual chance of occurring) to a 5000-year storm (.02% annual chance of occurring).

The hurricane hazard for probable future storms included central barometric pressure; maximum winds; size of the storm (diameter of maximum winds); speed of the storm; and direction of the storm. Modeling this complexity required IPET, in cooperation with FEMA, NOAA, Corps of Engineers, universities and private industry, to develop a new, advanced hurricane modeling method that will be used by all organizations in future coastal work.

One of the critical pieces of information IPET had to determine was the ***water levels*** from surge and waves from this broad range of storms (around the complex Louisiana coast), which varied at hundreds of different locations around the 350-mile protection system. Using this new hurricane modeling method, IPET ran 152 possible future storms from the range of hurricanes discussed earlier on supercomputers to determine the expected storm surge and waves. IPET also added expected rainfall from the hurricanes. ***This model provided the critical water levels needed for the risk analysis.***

Factoring in the Hurricane Protection System

Extremely complex, the Hurricane Protection System spans 350 miles of protection structures, that were added, repaired, or are currently being improved. IPET evaluated areas that breached and areas that did not breach.

IPET identified 134 levee and floodwall reaches around the New Orleans area (each reach ranged from hundreds of feet to a couple of miles) and 350 specific structures (gates, floodwalls, transition points, etc.) that were considered uniform and representative of the whole system. IPET considered the following factors in identifying these representative reaches and structures: design, maintenance, construction, soil foundation characteristics, erosion values and other inputs.

IPET used the water levels com-

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"As the Army Corps of Engineers moves closer to completing the revised cost estimate for the 100-year hurricane protection in greater New Orleans, I would like to reemphasize the President's continued commitment to providing 100-year hurricane protection for the area."

- Donald E. Powell, Federal Coordinator for Gulf Coast Recovery

President Bush inspects hurricane protection system work on a Louisiana visit in Spring 2006.

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puted earlier to drive the analysis of the reliability of the hurricane protection system. The water levels of each storm were applied at many different locations to estimate how the individual reaches and structures would likely perform. This calculated the probable reliability of the system and considered, by geographic area, the probability of overtopping and erosion that could cause breaches, foundation failures, etc.

The results of the analysis were broken down by sub-basin. Results show the probability of flooding (to various depths) or the potential volume of flood water inside the protected areas. Numerous results are calculated for each water level range produced by the various storms, as well as the vulnerability of each component (structure or reach) of the system. The results from the Hazard and the System analyses are then applied to the Consequences model.

Determining Consequences

Risk is calculated for probable loss of life and property down to the sub-basin level. To realistically show how changes in the system affected consequences, all risk analysis scenarios were run with the pre-Katrina population and property information so that the results are not skewed by current lower population densities and/or varying rebuilding efforts.

Modeling Products

Risk modeling products include a variety of maps, graphs, and other information and will show (by sub-basin or region):

- probability of inundation (getting your feet wet, to deep water flooding)
- risk to population or property
- relative risk by parish
- principal sources of risk (by parish, sub-basin, reach) from breaching, overtopping, flooding from a transition point or special feature, etc.
- specific sources of risk (i.e., a gate or structure).

Conclusion

Risk products will profile pre-Katrina and current protection system conditions. This will show the dynamics of risk and the effects of system improvements, current and future, on risk and vulnerability. This information will be useful for officials and the public to make their own informed decisions. The Risk products for the 100-year elevation levels of the protection system will be done this summer by the New Orleans District using the IPET Risk models.

This is the first systematic look at risk for the entire protection system. This complicated and new risk analysis process is the prototype. As we do more risk analysis work, it will become easier, and the tools will be modified and simplified for widespread future use in Louisiana and in other areas.

Contact Information

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Hurricane Protection Office
(504) 862-2126
Louisiana Recovery Field Office
(504) 681-2317

The *Status Report Newsletter* supports the information program for Task Force Hope and its stakeholders. It also serves as the primary tool for accurately transmitting the hurricane recovery work to stakeholders. This is an online publication and open to public distribution.
This issue and past issues can be found at:
www.mvn.usace.army.mil/hps

Comments and questions may be sent to the Status Report Newsletter editor at:
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