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# CONTRIBUTIONS FROM ESRA TECHNICAL COMMITTEES

## What happened after the Katrina Flood?



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One of the biggest natural disasters in the United States of America was the impact of the Katrina hurricane in 2005. The city of New Orleans flooded almost completely and more than 1000 fatalities have been counted. For the people who lived in New Orleans there are two worlds now: one before Katrina and one after Katrina. One of the most impressive books about this the impact on human live conditions of this disaster is 'Code Blue: A Katrina Physicians Memoir' by dr. Deichman. He tells the inside story of the hellish nightmare of those who struggled to survive the ordeal were cast into. Bodies stacked up in the chapel as the temperature soared in the overcrowded hospital and the situation became increasingly desperate. Doctors, nurses and staff worked around the clock caring those inside and trying to evacuate the facility. They expected that the government would help them to evacuate, but after three days of surviving the hospital was evacuated without support of the governmental agencies. Allegations of euthanasia in this hospital would later make headlines across the world, but these rumors lacked any basis in reality.

The Katrina disaster happened four years ago. The city of New Orleans is not rebuild completely yet, and it is expected that it will also not be rebuild completely. About one third of the population did not return to the city and live now somewhere else. Before the flood, New Orleans was already a city in decline, and that does not help to rebuild the city. The economic condition of the region is still not very healthy, but the safety against flooding has been improved in the past few years. The flood defences have been rebuild, and are in a better state than before the flood. Also, storm surge barriers are build now to keep the storm surge water out of the city. It is always a pity that such a big disaster is necessary in order to take the necessary protection measures. It is estimated that the flooding probability will be improved from 1/30 before the Katrina flood to 1/100 yr<sup>-1</sup> after the proposed measures are implemented. But is that safe enough? In the Netherlands, for example, we have protection levels of 1/10.000 yr<sup>-1</sup>, that is almost a factor 100 higher than in the USA. This topic has been studied in the ‘Dutch Perspective’ study, in commission of the US Army Corps of Engineers by a Dutch consortium of experts. Part of the study has been the answer of the question “how safe is safe enough”. The results of the study are reported in Results of the Risk Analysis are also reported in the article of Jonkman *et al.*, 2009.

“How safe is safe enough?” This question is a classical question. However, it has to be answered in the design of engineering systems. The question is how much safety society desires at which costs, and thus how much risk is tolerated. This is of course a political decision. However, information about the consequences of this decision is often desirable, and risk management techniques may be helpful to provide this information (“risk based informative decision making”). Risk is generally defined as the product of probability and consequences. The principles of risk analysis are widely used in several engineering fields, for example in nuclear and chemical engineering. In Flood Risk management, we see a tendency that risk analysis techniques are applied more often. The consequences are often measured in ‘economic damage’ and ‘loss of life’.

In the *Dutch perspective on Coastal Louisiana* the Risk Based Design approach of flood protection systems has been applied to the New Orleans metropolitan area. In the so-called economic optimization the incremental investments in more safety are balanced with the reduction of the risk to find an optimal level of flood protection. Although the analyses are preliminary and not yet fully realistic the presented outcomes indicate that for densely populated areas, such as the central parts of New Orleans, it could be justified to choose a higher protection level than the currently proposed level of 1/100yr<sup>-1</sup>. In figure 1 the results of a simplified cost-benefit analysis are shown for one of the dike-ring areas in New Orleans. It can be seen that even higher protection levels of 1/1000 yr<sup>-1</sup> can be defended on economic grounds. The results of the economic optimization can be considered as technical advice that can be used as input for the (political) decision-making. Adding loss of life issues would result in even higher protection levels. It is an interesting question how to include ‘loss of live’ in establishing protection levels against flooding in low-lying countries. In a new article we will elaborate on this issue.

R.E. Deichman, *Code Blue: A Katrina Physicians Memoir*, Rooftop Publishing, 2007.

S.N. Jonkman, M. Kok, M. van Ledden and J.K. Vrijling, *Risk-based design of flood defence systems – a preliminary analysis of the optimal protection level for the New Orleans metropolitan area*. Journal of Flood Risk Management (to be published)

J. Dijkman, et al. *A Dutch Perspective on Coastal Louisiana. Flood Risk Reduction and Landscape Stabilization*, Netherlands Water Partnership, in commission of the USA Corps of Engineers, 18 October 2007.

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