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**Edouard MICHAUX**  
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# Oil Spill Risk Analysis

Supervisors  
**Petrissa Eckle & Peter Burgherr**  
(Laboratory for Energy Systems Analysis, PSI)

Professor  
**Alexander Wokaun**  
(Head of the General Energy Research Department, PSI)

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## **Abstract**

This report summarizes the master thesis work on oil spill risk. The purpose of the analysis is to estimate the frequency, in incidents per year, and severity, in tonnes of oil spilled per incident, of oil spills between 1974 and 2010 using the comprehensive PSI based ENergy related Severe Accidents Database (ENSAD). The thesis is divided into two parts; the first part conducts a worldwide analysis of oil spill risk while the second focuses on oil spill risk in the Gulf of Mexico (GOM) offshore oil production. A descriptive and statistical analysis of the data was conducted dividing the data between infrastructure types: “ship”, “pipeline & storage/ refinery” and “platform/ rig/ well” spills. For the GOM case study, the data was divided between “pipelines”, “shallow platform” and “deep & ultra-deep platform” spills. The severity of oil spills was modeled with a generalized Pareto distribution, to measure specifically the risk of very severe accidents. Bayesain analysis was used to find uncertainty ranges. The final results are also given in the form of return periods.

For the worldwide analysis, the results show large differences among infrastructure subtypes. For severity below 10 000 tonnes “pipeline & storage/refinery” spills have the lowest return period followed by “ship” spills and lastly “platform/ rig/ well” spills. For severity higher than 100 000 tonnes return period is lowest for “platform/ rig/ well” followed by “ship” and finally “pipeline & storage/refinery” spills. Spills from offshore platforms and rigs exceeding the 670000 tonnes of the *Deepwater Horizon* oil spill were found to have a return period around 19 years with 5% and 95% quantiles of 7 years and 49 years respectively. Based on this result this accident cannot be considered an outlier. The return period of ship spills has diminished in the 2000 decade compared to the 1990s. The GOM case study revealed that depth was an important explanatory variable of offshore oil spills. Deep and ultra-deep water installations were found to have a much lower return period of spill incidents compared to shallow platform installations. Exploration related spills are the greatest source of risk in deep water offshore oil production.

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