

# Well complexity affects offshore HSE incident rate

**WELL COMPLEXITY APPEARS** to increase the probability of HSE incidents, while water depth and time spent on a well are not significant variables influencing HSE outcomes.

Those are among the conclusions drawn from research based on an analysis of more than 8,000 wells in the US Gulf of Mexico.

In a paper prepared for the 2001 IADC Health, Safety & Environment Conference in Houston, "Oil spills, workplace safety, and firm size: Evidence from the US Gulf of Mexico-revisited," **Christopher J Jablonowski, Pennsylvania State University**, described the study. The study covered the period 1990-1998.

The reasons for the high influence of well complexity on HSE incidents, he said, are likely the increased exposure to pipe handling and similar high risk activities and the "dilution of focus on incident prevention due to the increased number of individual tasks associated with more complex wells."

Evidence also rejects the hypothesis that company profiles and operating environment (MMS District) have an effect on HSE outcomes, said Mr Jablonowski. Previous studies also found no evidence supporting a distinction among company types.

As the industry evolves with new technology and expansion into untested basins and horizons, the challenge to industry executives and policy makers is not only to maintain motivation and continual performance improvement, but to prepare for changes in the operating environment that are fast approaching, said Mr Jablonowski.

In the Gulf of Mexico, several changes are underway that are transforming the overall character of E&P operations.

"Shifts in the profile of operating companies, deeper water operations and more complex wells all contribute to this transformation."

## **STUDY HYPOTHESIS**

The broad hypothesis of the research is that unsafe behaviors are a function of the environment created on site by the companies involved, the features of the

well that increase risk and exposure, and the overall operating environment in industry. The goal was to examine which of these can explain the occurrence of HSE incidents.

Companies involved in drilling a well have a strong influence over HSE performance; much of this influence lies with the drilling contractor.

Although the drilling contractor employee's accountability to the operator is short term, that does not mean that oil companies cannot have an influence on HSE outcomes.

Some companies go to great expense to provide additional training prior to the start of a project, and some micromanage the drilling process to increase the focus on safe operations, said Mr. Jablonowski.

The second group of variables that influence HSE outcomes are well specific complexity variables.

Finally, the overall operating environment may influence HSE outcomes. Rapid escalation in drilling activity brings less experienced workers into the field as drilling contractors staff previously idle rigs.

The regulatory environment may influence outcomes, too. If certain MMS Districts demonstrate less stringent enforcement, one could expect more incidents in that District.

## **KEY VARIABLES**

Some variables discussed here were deleted from the analysis due to a data problem, but are included for discussion.

In the study, an HSE incident is any spill, injury, or well control incident associated with drilling or workover operations (including vessel interaction with it) and any downhole production operations.

The company variables used in the analysis had to do with the fact that an oil company has an influence over HSE outcomes. If expectations on workers are high, if additional training is provided and if enforcement is strong, a safety conscious workplace will result.

There is a perception that majors are

more concerned with HSE, and "in a sense, a company with a brand name has more to lose than its anonymous counterpart, and will have a different payoff function with respect to HSE incidents," said Mr Jablonowski.

Previous research commented on the perception that majors are typically better equipped to achieve these goals, although that research did not support that perception.

Scope is a "dummy" variable used in the study to indicate whether or not the operator is integrated into downstream activities. Companies with broader experience are likely to be more knowledgeable of HSE and more capable of implementing successful prevention programs.

The scale variable represents the worldwide level of drilling activity. Companies with more drilling operations are likely to be more sophisticated (if only by accumulated experience) and should be more aware of HSE pitfalls and prevention. In this study, a company was considered to capture the benefits of scale if it possessed more than 1 billion bbl of liquid reserves or more than 5 tcf of gas reserves.

Brand is an additional dummy variable indicating whether or not a company has retail gasoline sales. A company with a brand name has more to lose in the case of a disaster.

## **WELL COMPLEXITY VARIABLES**

Well complexity increases the frequency of routine activities that are known sources of HSE incidents. Complexity also increases the incidence of unusual operations such as handling stuck drill pipe, casing and logging tools. And it increases the number of individual tasks that must be performed, potentially diluting the focus on HSE incident prevention.

The depth variable in the study refers to measured depth plus the true vertical depth of the well. Increased measured depth means longer bit runs and wiper trips, increased pipe handling, and longer casing strings and casing job duration. TVD is a proxy for maximum bottom hole pressure; increased pres-

sure increases the risk of well control incidents.

The reach variable is the horizontal distance between the surface location and the bottom hole location. As reach increased, complexity increases.

Water depth was also a variable in the analysis. As water depth increases, the transition to floating operations is inevitable.

More complex operations such as mooring, station keeping, riser management and deepwater well control may increase the likelihood of injury and spills.

Increased time on a well increases the raw exposure time for injuries, said Mr Jablonowski. Project fatigue may cause workers to become less careful, increasing risk. However, safety continuity is a benefit of longer projects because it provides the opportunity to establish and enforce safety expectations, decreasing risk.

The type of well was another variable in

the study. While exploration wells may contain more geologic uncertainty that tends to increase the likelihood of well control incidents, production wells are not immune to uncertainty.

Production well paths may be less conservative in well design based on the perceived quality and quantity of data available during well planning, although exploration well paths are becoming increasingly complex to penetrate multiple targets in one wellbore. The effect of this variable is uncertain.

## OPERATING ENVIRONMENT

A third set of variables pertains to the overall operating environment. The historic cyclical nature of the drilling sector may influence HSE outcomes, for example. Crew experience was considered. Crews do not sit on standby in lean years but are dismissed and move on to new jobs. When drilling activity increases, new crews must be recruited and trained. Anecdotally, said Mr Jablonowski, these new recruits suffer a

higher risk of injury than their more experienced counterparts.

The MMS District in which a well is drilled may also be a variable in HSE results. The incidence of injuries and spills may be affected by how strict an enforcement environment exists.

## FURTHER ANALYSIS

As a result of the research, Mr Jablonowski identified three areas that deserve further attention:

- It is important to collect the data required to estimate the effect of the drilling contractor, as the most influential party on site, on HSE outcomes;
- An assessment of whether turnkey drilling affects HSE outcomes is warranted because many E&P companies avoid turnkey drilling, citing a concern for HSE;
- A thorough analysis of a stylized data set using Monte Carlo simulation could provide empirical guidance. ■