
# Defence in Depth Module

## Diverter Barrier



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# Safety Talks

## Defence in Depth Module

## Diverter Barrier Support Material

### Script

In this program I'll be analysing the failure of the barriers or controls that should have prevented the Macondo blowout in the Gulf of Mexico. If any one of these barriers had worked as intended, the blowout would not have occurred. In examining why they all failed, I'll be looking at how independent the barriers were, or rather, how interdependent they were. The barriers behaved like falling dominos. Once one fell, all the others followed. What happened at Macondo was the failure of the system of defence in depth. It wasn't just one or two barriers that failed, but the whole system.

Located 77 kilometres off the coast of Louisiana the huge floating drilling rig called the Deepwater Horizon had just completed drilling an ultra-deep well.

The bottom of the well was five and a half kilometres below sea level.

The Macondo blowout resulted in the death of eleven people, as well as an environmental catastrophe. This was the biggest oil spill in US history, twenty times the size of the Exxon Valdez oil spill in Alaska.

As a result of the blowout, two series of events happened. There was an explosion and fire on the one hand, and on the other, there was a massive oil spill and environmental disaster. These are independent of each other. They are essentially separate events. So when we look beyond the blow out, we need two pathways, not one. Both of these pathways should have been equipped with barriers. It seems that the barriers along both pathways all failed. The Swiss cheese model assumes a linear framework, but this is clearly not sufficient in the present case. You cannot just extend the Swiss model to the right of the blowout. We need to generalise the model in some way. The way we generalise it is by using a bowtie model.

The idea of the bowtie is that there is a so-called top event: something like a blowout. There are several pathways to a top event and each of those pathways must be blocked with barriers, and there are several kinds of consequences that flow from the top event. Each of those must be blocked with barriers as well.

Look first at the top path. This is the path that led to the fire and explosion that caused the multiple fatalities. The first of the barriers that should have been in operation was something called a diverter.

The idea was that if you get a large amount of material coming out of the well you can divert it immediately overboard into the sea. This reduces the risk of explosion on the rig itself. However, the material coming out of the well contains the oil-based drilling fluid, and if you divert this overboard, oil goes into the sea, becoming reportable, as an environmental event. You do not want to do this unless you absolutely have to. If it is a small release, you don't want to divert it. The alternative is to keep it on board and put it through something called a mud gas separator. This separates the mud (or the drilling fluid) from the gas, and retains the drilling fluid on board and vents the gas to atmosphere. If there is a small quantity of material coming out of the well, this idea makes sense as you end up without a reportable environmental event. So there is a choice to be made here about the default position for the diverter: should the equipment be normally left in the position that diverts material overboard, or in the position that puts it through the mud/gas separator and keeps it on board?

If the primary concern is to prevent a major accident, the default position will be to send the material overboard. If the primary concern is to prevent small scale environmental spills, the default will be to keep the material on board. In fact the default was to keep the material on board, and when the blowout occurred this lead, almost immediately, to an explosion. The choice being made here undermined the effectiveness of the diverter as a barrier. Essentially the assumption being made was that the earlier controls in the sequence would make blowout virtually impossible. The only thing they really had to worry about was a small scale environmental event, not a full scale disaster, because the earlier barriers would have made that impossible. Again, the effectiveness of the barrier was undermined by beliefs about the effectiveness of the earlier barriers in the system.

## Suggested Discussion Questions and Answers

1. Do you assess Barrier effectiveness?
   - Group discussion
2. How do you assess Barrier effectiveness?
   - Function of adequacy and reliability
     - 'Adequacy' tells you to what extent a properly functioning Barrier will interrupt a particular scenario
     - 'Reliability' is a function of Escalation Factors which are "conditions that lead to increased risk by defeating or reducing the effectiveness of barriers"