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**Defence in Depth Module**

**Fourth Barrier: Monitoring**



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Safety Talks

Defence in Depth Module

Fourth Barrier: Monitoring Support Material

**Script**

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.

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.

The first barrier was a physical barrier - a cement plug.

The second barrier was not even intended to be an independent barrier. It was something they were going to use if they thought the cement job might have failed. If there was some doubt about the cement job, they would use a cement evaluation tool to check on what the situation was.

The third barrier or control was a well integrity test.

The fourth barrier or control in the sequence is monitoring.

Between the sea floor and the sea surface there is a piece of pipe called a riser. Before the drilling rig can move away, after finishing drilling the well, it has to remove the riser, and before it can remove the riser it has to replace what is inside the riser – drilling fluid also known as mud – they have to replace that with sea water. They have to pump sea water in and pump mud out, and when the riser is completely full of sea water they can then remove it.

Drilling fluid is roughly twice the density of sea water. As you remove the denser fluid in the riser, you are reducing the pressure in the well. At some point, if the cement was not properly sealed, the well was going to flow. That is what happened, as they were pumping mud out and sea water in:- eventually, the fluids in the oil and gas sands began to flow upwards.

The rig crew should have been monitoring the well to detect this possibility, but they weren’t. Monitoring the well essentially meant checking that the volume of sea water going in was equal to the volume of mud coming out. If more is coming out than is going in, then you know that the well is not sealed and that oil and gas is beginning to come up the well. The way to monitor what is coming out is to put the fluid into tanks where you can measure it. They weren’t doing this. They were diverting it straight overboard into a supply vessel and not measuring what was coming out. For hours on end, they failed to carry out the monitoring exercise in the way they should have.

Why were they doing that? The answer is: in order to save time. So why were they willing to take this short cut? Because they believed that the earlier two barriers were in place. First, the engineers had declared that the cement was successful. Second, the well integrity test had been done, and those carrying out the test had declared that the well was properly sealed. In these circumstances the crew frankly thought that monitoring was a waste of time and did not give it the attention it deserved. Their belief in the success of the earlier two barriers undermined this last barrier. So it was that when the well began to flow and ultimately oil, gas and mud spewed out onto the deck of the Deepwater Horizon, it caught the crew completely by surprise.

**Suggested Discussion Questions and Answers**

1. Name some common shortcuts
	1. You can't fool safety devices - but we remove or wedge back safety guards so they won't protect us!
	2. We shouldn't take a chance when operating heavy equipment - but we don't use the seat belt that is provided!
	3. We know that flames or sparks are not permitted around flammable liquids - but some of us smoke around them!
	4. A protruding nail in a guard rail can cause an injury - but we don't bother to remove it or bend it over.
	5. Horseplay causes a lot of injuries on the job - but many of us continue to play practical jokes.
	6. A circular saw can amputate a finger - but we insist on using the saw without a guard!
	7. We know the safe way to climb a ladder - but we climb it with one hand full of tools!
	8. We should wear our personal protective equipment - but we leave our goggles strapped up on our hard hats!
	9. We know better than to use chemicals without reading the MSDS - but we use the chemical anyway!
	10. We should wear a life jacket when working over water - but we go out over the water without one!
	11. A bump or bruise to the head can really hurt - but we continue to work without our hard hats.
	12. It's dangerous to block firefighting equipment - but we stack boxes of material in front of fire extinguishers!
	13. We know not to work within 10 feet of a power line - but there's just one more load of steel to be unloaded and it won't happen to me!

Toolbox Topics, *Shortcuts are Killers*, viewed 3February 2014, <http://www.toolboxtopics.com/Construction/Oldies/Shortcuts.htm>

1. What can be done to manage shortcuts?
* Introduce ‘shortcuts’ as a topic (use this topic as an example) and develop a program around:
	+ Consulting with employees/contractors and endeavouring to identify where shortcuts are taken and importantly why.
	+ Reviewing all (safe) work practices with employees/contractors
	+ Encouraging employees/contractors to provide solutions
	+ Adding ‘shortcuts’ to the induction program
	+ Scheduling a periodic review