



# INNOVATION AND TECHNOLOGY

CASE STUDY | June 2009

## Metocean Team Makes Waves for Woodside

Woodside's oil and gas resources are located in remote, offshore fields. These fields are often in areas where storms can be severe and the forces of currents and waves can present significant challenges for the extraction and production of oil and natural gas.

It's not surprising that understanding the meteorological and oceanographic, or "metocean", conditions in which we operate is essential to ensure we design our facilities and equipment safely.

Our metocean engineers ask questions such as "How big will the biggest wave be?", "How strong will the strongest winds be?" and "What effect will those forces have on our pipelines, platforms and other facilities?" They also estimate likely downtimes from extreme weather and identify the best weather windows for offshore installation work. Finding the answers can be complex and time-consuming.

### The Challenge

In Australia, Woodside produces oil from four floating production storage and offloading (FPSO) vessels. Three of these are located off the North West coast of Australia, an area known for destructive tropical cyclones.

Each of these vessels has the ability to disconnect from their moorings in the event of bad weather and steam to safety. However, disconnection requires production to be shut down and reconnection needs to be at a time when conditions are calm. On average it takes about 10 days from disconnection to restarting production.



*Nganhurra FPSO*

These facilities and our offshore gas production platforms share in common sub-sea production systems, which can include pipes, flowlines, umbilicals and manifolds. Ocean currents generated by large underwater waves – known as "solitons" – have the ability to impact the stability of these systems.

On the North West Shelf, our pipelines sit on the ocean floor, rather than buried in the sea bed. In normal conditions heavy, steel and concrete pipelines wouldn't move but in a once-in-100-year storm where wave heights can reach 22m and winds can gust to 270km/hr even the bottom of the ocean is in turmoil.

## The Projects

Our metocean engineers have come up with a number of solutions to help us to operate safely in a challenging and sometimes hostile marine environment. These initiatives include:

- Developing models to better predict cyclone behaviour, which in turn may prevent unnecessary disconnection of our FPSOs.
- Using “second-order wave theory” to help design the 180km pipeline that will transport gas from offshore fields to the onshore Pluto LNG gas plant that is currently under construction. Conventionally, engineers use linear or “first order wave theory” to calculate wave forces. First-order wave theory calculates the likely forces exerted by the crest or trough of a wave from the sea surface to the sea bed. First order wave theory indicated the Pluto pipeline would move an unacceptable amount, making secondary stabilisation such as concrete gravity anchors or rock dumping necessary. To get a more accurate picture the metocean team applied an industry-first use of second-order wave theory to the Pluto pipeline, which takes into account subtle changes in the mean sea level as wave sets pass through, in turn changing the wave-induced forces on the pipeline. Applying second-order wave theory to the Pluto pipeline showed expensive pipeline stabilisation measures were unnecessary. Second order wave theory will now be considered for all future pipeline systems.
- Researching the occurrence and effects of internal waves on our facilities. Internal waves are just like surface waves except they occur underwater in certain conditions where less dense, warmer surface water comes into contact with denser, colder deep water. They can break like surface waves and the undulations as they move through the ocean at up to 1.5 metres a second can exert considerable forces on pipelines and other subsea equipment, moored vessels and drilling units. Predicting the conditions under which they can occur and the effects when they do is an important part of planning the development of all our assets in Australia's north.

## Achievements

The solutions developed by our metocean engineers are being applied across Woodside and have resulted in multi-million dollar savings through better facility design and enhanced production, without compromising the safety of our people, environmental protection or the integrity of our operations.

## More Information

All stakeholders are invited to contact Woodside for additional information at:

[sustainabledevelopment@woodside.com.au](mailto:sustainabledevelopment@woodside.com.au)