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Operator Competence and Capacity – Lessons from the Montara Blowout

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Abstract

The blowout of the Montara H1 well in the Timor Sea off the northwest coast of Australia in August 2009 was the first such incident in Australian offshore waters for 25 years. This paper analyses critical decisions made by individuals on the rig and in onshore management in the period leading up to this catastrophic event. The concepts of operator competence and capacity are then used to demonstrate that the operator of the facility PTTEPAA had significant management and system deficiencies in areas such as understanding of the need for multiple barriers, management and technical supervision, integrity assurance and the use of risk assessment to justify departures from established standards. The paper concludes by pointing to changes in regulatory policy regarding safety that may be justified to more effectively prevent such incidents in the future.

1. Introduction

Loss of well control incidents, known commonly as blowouts, are a well-known hazard in the offshore oil and gas industry. There were 39 blowouts on the US Outer Continental Shelf in the period 1992 to 2006.[1] The Australian offshore industry had experienced six blowouts prior to Montara (with the last one being in 1984).[2] The Deepwater Horizon blowout in the Gulf of Mexico only eight months after Montara has acted as a further graphic reminder (if it were required) of the damage that such incidents can cause.

As a result of the potential for disaster, and because of the large sums of money involved, well construction activities are tightly controlled, both within operating companies and by regulation. How is it then, that in 2009, the Australian offshore industry could experience an incident like the Montara blowout? As will be described in this paper, those responsible for the technical integrity of the hazardous work involved in drilling and completing the well demonstrated a poor understanding of the hazards inherent in the work they were doing or the measures that should have been in place to manage those hazards. The prevailing attitude was apparently one of forging ahead regardless. This seems to have been the case for those on the facility and those in onshore technical and management positions.

This analysis is based primarily on written statements provided to the Montara Commission of Inquiry by various personnel and the Report of the Montara Commission of Inquiry. The key individuals involved are the offshore Drilling Supervisors and Senior Drilling Supervisors. They reported collectively to the onshore Drilling Superintendent, who in turn reported to the Well Construction Manager. These individuals are all representatives of PTTEPAA (for simplicity referred to in this paper as PTT).

Whilst PTT holds the Production Licence for Montara, the offshore drilling work was conducted using a contract drilling rig, the West Atlas, owned by Atlas Drilling. Atlas personnel had only an indirect role in the actions surrounding the blowout. Similarly, Halliburton acted as a specialist subcontractor to PTT in relation to cementing activities and the Halliburton technician played a role in the activities around the cementing of the casing shoe (described at length below), but the overall sequence of events was driven by PTT. Although, as part of the Commission of Inquiry, PTT attempted to draw both contractors into the responsibility for safety and integrity of the H1 well, the Inquiry had no hesitation in finding that the role of both contractors was limited. Since the focus of this paper is on the competence and capacity of PTT as the operating company, details of actions taken by contractors are not covered in any detail here.

It should be noted that this paper describes technical aspects of well construction activities only in sufficient detail to allow an accurate assessment of human and organisational issues related to the decisions made. As such, it focuses on the actions

[1] Izon D, Danenberger EP and Mayes M., 'Absence of fatalities in blowouts encouraging in MMS study of OCS incidents 1992-2006' (2007) July/August *Drilling Contractor*.

[2] Advice from Geoscience Australia referenced in Report of the Montara Commission of Inquiry, http://www.ret.gov.au/Department/Documents/MIR/Montara-Report.pdf, p 38.

of PTT personnel primarily in comparison to the existing company standards. It is beyond the scope of this paper to evaluate those standards from a technical perspective. Whilst the Commission of Inquiry found that if PTT had operated in accordance with their own standards it is likely that the blowout would not have occurred, it should be noted that the Inquiry was also critical of some aspects of those standards.

Safety cases were first introduced to the Australian offshore oil and gas industry following the Piper Alpha disaster in the UK sector of the North Sea in 1987 which resulted in 167 fatalities and the complete loss of the facility. In 2009, for historical reasons, well integrity was regulated outside the main Australian safety case regime although the requirements of the well integrity regulations are based on the same goal setting approach. At the time of the blowout, the relevant regulations were administered by the Northern Territory Department of Resources (NT DoR) on behalf of the Australian Commonwealth Government. The institutional arrangements consisted of a single technical person reviewing submissions.[3] The NT DoR had had previous dealings with PTT and "regarded PTT as a good operator".[4] The Commission of Inquiry has made various recommendations regarding changes to these arrangements and, as a first step, responsibility for well integrity has moved to the National Offshore Petroleum Safety Authority (NOPSA) as of mid 2011.

This paper looks specifically at the decisions made by PTT's offshore and onshore personnel that caused the Montara incident and the organisational failings that led to such poor choices. It concludes by touching on the broader implications for safety regulatory policy in the Australian offshore oil and gas industry.

2. The Incident

The Montara Wellhead Platform (WHP), owned and operated by PTT was located in the Timor Sea, 250 km off the northwest coast of the Australian continent. Well H1 was drilled from the West Atlas jack-up drilling rig in March 2009.

The drilling of the H1 well was part of PTT's batch development drilling program, which included plans to drill five wells between January and April 2009. The plan was for the rig to leave the field at that time so that the WHP topside facilities could be installed, and then to return in August to tie back the wells to the Montara WHP. The measures to leave the well in a safe state between these two phases of work were defined by PTT's Well Construction Standard (WCS), although none of these measures were put in place in accordance with this standard. As described in the following sections, some requirements were simply ignored and others were not met adequately.

As planned, activity moved back to the H1 well in August 2009. In preparation for the work, a pressure-containing cap was removed. Despite the fact that there was no significant pressure recorded under the cap prior to its removal, the blowout occurred within hours. Initially, the leaking fluids did not ignite. Oil and gas flowed for more than ten weeks before a relief well was successfully put in place. The drilling of the

[3] Montara Commission of Inquiry Report, p 16.

[4] Montara Commission of Inquiry Report, p 15.

relief well coincided with the ignition of the release. The resulting fire continued for a further two days before the flowing fluids were brought under control on 3 November 2009 and the fire extinguished due to lack of fuel. A month later, the well was finally declared safe.

No-one was injured or killed as a result of this incident. It has to be said that this is more good luck than good management and that, if the blowout had ignited immediately, the result could have been similar to the Deepwater Horizon incident which resulted in 11 fatalities and many injuries. The adverse physical consequences of the Montara event relate to environmental pollution and, even in this area, luck has played a part. Given the light nature of the escaping fluids and the remote location of the well, by far the majority of the hydrocarbon has simply weathered away and relatively little has impacted the Australian coast or marine life.[5]

3. The Immediate Causes of the Blowout

Before looking at the details of the various decisions made regarding well control, this section summarises the flaws in the various well control barriers that should have been in place to prevent a blowout, but were not. At the time of the incident, the H1 well was in the development drilling phase. The well had been drilled and two casing strings set – an outer 13 3/8" casing to a depth of 1640m and an inner 9 5/8" casing to a depth of approximately 3800m. The detailed sequence of events that led to the blowout started with the cementing of the casing shoe at the bottom of the 9 5/8" casing.

PTT's Well Construction Standards (WCS) required two proven barriers to uncontrolled flow from the reservoir to the surface to be in place when the well was suspended.[6] The primary pressure-containing barrier should have been the cemented casing shoe at the end of the 9 5/8" casing (which was close to horizontal at that point). Based on the pressure and flow profiles seen during the cementing operation, it is apparent that the integrity of the cement was never proven and in fact that the outcome was a "wet shoe" with the cement contaminated by drilling and/or reservoir fluids.

Secondary barriers that should have been in place (according to the final well design) were two pressure containing corrosion caps (PCCCs). The well design called for these to be installed on the top of both the 9 5/8" string and the outer 13 3/8" string. In fact, only one was installed (on the 9 5/8" string). Information from the manufacturer of the caps indicates that these are not designed as well control barriers and yet PTT chose to use them for this purpose.[7] The 9 5/8" PCCC was later removed

[5] Whilst the environmental impact of the Montara blowout is limited compared to the Deepwater Horizon incident, there have been impacts felt in West Timor and the Commission of Inquiry has highlighted that the lack of baseline data and the slow response in putting a monitoring plan in place mean that the full extent of the impact of the Montara spill will never be known (Montara Commission of Inquiry Report, p 26).

[6] PTT Well Construction Standard Section 5, reproduced in Statutory Declaration of O'Shea, para 105; Statutory Declaration of Wilson, para 130; and Statutory Declaration of Wishart para 135 in response to the Montara Commission of Inquiry.

[7] Montara Commission of Inquiry Report, p 7.

for operational reasons and then not re-installed. The blowout occurred approximately 15 hours later.

Another form of well control barrier is to ensure that the well is always in overbalance i.e. that the hydrostatic head of fluid in the well bore always exceeds the reservoir pressure and hence the well pressure balance will prevent fluid from flowing up the well bore to the surface. In the case of Montara, it seems to have been assumed by everyone involved that the well was overbalanced but this was not the case. Monitoring of the fluid in the well bore to ensure a sufficient safety margin in the bottom hole pressure had not taken place.

The various barriers to flow from the well that should have been in place prior to the blowout, and their status, are summarised in the following table.

Barrier	**Testing/monitoring**	**Status**
Cemented 9 5/8" casing shoe	Not tested	Ineffective
13 3/8" PCCC	None	Not installed
9 5/8" PCCC	Not integrity tested when installed	Not designed as barrier for blowout. Removed prior to blowout
Overbalanced well fluids	Not monitored	Not achieved

Ultimately, when the reservoir pressure was sufficient to overcome the column of fluids in the well bore, hydrocarbons were able to flow to the surface due to failure of the 9 5/8" cemented casing shoe. This was the only physical barrier to flow that was present on the well at the time the blowout occurred.[8]

Under these circumstances, uncontrolled flow of hydrocarbons to the surface was inevitable. The following section reviews in detail the decisions made in regard to each barrier and discusses why the individuals involved apparently considered at the time that their actions were appropriate.

4. Flawed Decision Making

4.1 Overview

The Commission of Inquiry found that PTT's drilling personnel (offshore and onshore) were "deficient in their decision making and judgements in relation to a number of important matters" and that "the magnitude of this failure reflected a failure of judgement and competence".[9] This section describes some of the decisions that were made, and looks for understanding in the evidence given by individuals as to why, at the time, they apparently considered that the situation was sufficiently safe.

[8] Montara Commission of Inquiry Report, p 7.

[9] Montara Commission of Inquiry Report, p 9.

The water depth at the facility is approximately 77 m.[10] This means that this well cannot reasonably be classified as a deep water well (as has been the subject of much discussion in relation to the Deepwater Horizon incident).

4.2 Misunderstandings about cementing

Cementing is generally understood to be a safety critical activity in well construction. Cemented shoes, cement plugs and similar devices are used as primary well control barriers and cementing problems contributed to 18 of 39 blowouts on the US Outer Continental Shelf in the period 1992 to 2006.[11]

In the H1 well design, the device at the bottom of the casing that was intended to prevent communication from the reservoir to the surface was known as a casing shoe. The shoe and the surrounding space are designed to be filled with cement which, when set, provides a barrier to flow in both the casing and the annulus. During cementing operations for the H1 well, the intention was that a volume of cement sufficient to fill both the well bore and the annulus to the appropriate depth was pumped into the well. The casing shoe arrangement includes two float valves i.e. one-way valves designed to prevent flow backwards from the casing shoe up the well bore. The cement pumping operation also included the running of two plugs into the casing to provide feedback on what was occurring down hole. The location of the plugs can be confirmed by a "bump" or spike in the pressure as the plug reaches the top of the casing shoe.

In accordance with the drilling plan, a pressure test was conducted once the cement plus associated plugs were in place. Constant pressure could be maintained in the system during the test, but at the conclusion of the test, when the pressure was reduced, 16.5 barrels of fluid were returned from the casing string and, after the system was bled down, the pressure started to increase again. This indicates some leakage of fluid back through the float valves. The well was initially shut in and then it was decided by PTT personnel offshore that the best way to fix this problem was to pump the extra fluid back into the well. This would necessarily force fluid back through the float valves into the shoe, creating the possibility of what is known as a "wet shoe" i.e. contaminating the cement with hydrocarbons and/or inhibited seawater from higher up the casing, but those involved failed to recognise this possibility or the potential consequences. Cement that is contaminated with other fluids can provide channels or pathways to flow of hydrocarbons and is therefore lacking in sufficient integrity to act as a well control barrier.

Another contributing factor that seems to have escaped the notice of the people on the facility (and to a significant extent the Commission of Inquiry [12]) was that the bottom section of the well was being drilled close to horizontally. This directly impacts the possible stratification of fluids in the system with dense fluids such as the cement

[10] Montara Commission of Inquiry Report, p 49, para 3.5.

[11] Izon D et al, above n 1 figure 6.

[12] The Montara Commission of Inquiry Report includes (para 3.33) a diagram explaining the cementing of the casing shoe. The diagram shows the arrangement for a vertical well but includes a footnote to the effect that well H1 was horizontal at this point. The following paragraphs describing cementing activities incorrectly use prepositions based on a vertical shoe orientation.

falling to the bottom of the horizontal section making it easier for lighter materials (such as hydrocarbons) to find a flow path along the top of the horizontal casing ultimately leading to the surface.[13] Misleadingly for an operation that is sensitive to gravity, drawings produced by PTT and reproduced by the Commission of Inquiry show the casing shoe arrangement as vertical with a footnote pointing out that the actual arrangement is horizontal.

After pumping the additional fluids back into the well, the next step taken was to maintain pressure on the well and then wait on the cement to harden (known as WOC). No additional tests were done to confirm the status of the float valves or the integrity of the cemented shoe.

Various onshore specialists from PTT and Atlas received detailed reports on the cementing work (variously the Halliburton cementing report, the Atlas Daily Operations Report and the PTT Daily Drilling Report and the PTT cementing report). Each report included an account of the cementing activities that an educated reading would interpret as meaning that the integrity of the cement shoe was at best unproven and, in fact, most likely to have been compromised.

Only in hindsight did the Well Construction Manager and Drilling Superintendent acknowledge that it is most likely that the float valve failed in service (as should have been clear from the additional volume of fluid returned following the initial pressure test)[14] and that the subsequent strategy of pumping the extra volume back into the well most likely resulted in a "wet shoe" (as can be suspected from the pressure profile seen when the fluid was pumped back into the well, specifically the lack of a "bump" as the plugs re-seated).[15] They also acknowledged that, contrary to the assertion in one drilling report that the float valves were re-tested, in fact there was no test done (as there was no reverse differential pressure across the valves that would have shown whether or not flow would be prevented).[16] The onshore Drilling Superintendent concludes that "...the absence of another pressure test meant that, with hindsight and knowing what I know now, the integrity of the H1 Well was not verified".[17]

In summary, despite problems with cement being a common cause of blowouts, and blowouts being a well-known hazard of drilling operations, the cementing operations on the H1 well were carried out in a way that did not ensure the integrity of the resulting arrangement. There were indications available in the pressure and flow data collected that the integrity of the work was compromised, but those involved on the facility apparently did not understand the significance of what was occurring and the

[13] As is acknowledged in the Statutory Declaration of O'Shea, para 73, made in response to the Montara Commission of Inquiry.

[14] See Statutory Declaration of Duncan, para 303, made in response to the Montara Commission of Inquiry.

[15] See Statutory Declaration of Duncan, para 327, made in response to the Montara Commission of Inquiry.

[16] See Statutory Declaration of Duncan, para 334, made in response to the Montara Commission of Inquiry.

[17] Statutory Declaration of Wilson, para 254, made in response to the Montara Commission of Inquiry.

onshore technical staff (who were also managing the overall operation) did not pay attention to the information provided to them by way of standard reports. As the Well Construction Manager summarises, "...the facts about the cementing of the shoe float were contained in distributed reports to well qualified people (including me) but it appears that the circumstances did not call on anyone to analyse that information".[18]

The factors surrounding the decisions made regarding cementing can be characterised as poor technical understanding of the task at hand, lack of supervision and disregard by all parties of the risks involved – that is, the potential consequences of not completing the task in accordance with design.

4.3 Modifications to the suspension plan for well H1

PTT's original well design for H1 included a shallow set cement plug as a barrier to flow from the well during the April to August period when the drilling rig was absent.[19] During the first phase of activity, PTT requested and received permission from the regulator (Northern Territory Department of Resources - NT DoR) at very short notice to change the well design to replace the cement plug with pressure containing corrosion caps (PCCCs) over two casing strings.[20] The decision to replace the cement plug with two PCCCs was documented in a formal Well Construction Change Control Form prepared by the Drilling Superintendent and approved by the Well Construction Manager.[21] The change control form includes fields to record both the HSE impact and the cost impact of the proposed change. In this case, the HSE impact is described as "improved well integrity during suspension and re-entry operations". The cost impact is noted as "savings of up to US$50,000 in rig time" with the basis of the saving noted. Thus the author is proposing not a trade-off between safety and cost, but improvements in both areas.

The change control form provides no information as to why the author was of the opinion that PCCCs would provide a higher degree of well integrity than a cement plug. Some explanation is provided by PTT in a submission to the Commission of Inquiry which states that the considerations for the amendment to the Drilling Program were as follows:
(a) pressure containing corrosion caps allow pressure below the cap to be checked prior to removal, whereas cement plugs do not;
(b) the risk of damaging the casing when drilling out a cement plug; and
(c) a 9 5/8" pressure containing corrosion cap was available.[22]

The PTT Well Construction Standard (WCS) requires "two permanent tested barriers"[23] for a long term suspension such as the planned April to August gap in the

[18] Statutory Declaration of Duncan, para 370, made in response to the Montara Commission of Inquiry.

[19] Statutory Declaration by Treasure, para 13, made in response to the Montara Commission of Inquiry.

[20] Montara Commission of Inquiry Report, p 50, para 3.9.

[21] The form is reproduced as Appendix 5 to the Montara H1 ST1 Well Release Incident Report Rev 0 by PTT dated 2 October 2009.

[22] PTT Submission #1 to Montara Commission of Inquiry, para 105.

[23] PTT Well Construction Standard Section 14, reproduced in Statutory Declaration of O'Shea, para 107, Statutory Declaration of Wilson, para 132, Statutory Declaration of Duncan, para 140 and

Montara drilling program. Details of those items that can be legitimately classed as permanent barriers emphasise the need for integrity testing and include "pressure tested cement plug (min 30m in length)" and "cemented casing with proven TOC". The list does not include PCCCs.

The Well Construction Manager, Drilling Superintendent and one of the Senior Drilling Supervisors maintain that PCCCs are essentially the same as tubing seals which are an allowable permanent barrier in the WCS.[24] Another Senior Drilling Supervisor claimed that PCCCs are superior to cement plugs (another allowable permanent barrier).[25] In fact, as will be discussed further in section 5.5, the vendor of the PCCCs advises that they are not designed to be used as a device to prevent flow from a well.

Even accepting that PCCCs were an acceptable well control barrier, the installed integrity of the devices would need to be tested in order to meet the requirements of the WCS. Critically, the scope change as written contains no information about testing of the integrity of the caps when installed although (as detailed in section 5.5) PTT onshore management/technical personnel claim that they expected such tests to be carried out.

The Commission of Inquiry had no hesitation in rejecting PTT's argument that this change to the well design was made for reasons of well integrity.[26] The decision appears to have been made in order to reduce costs, with no consideration of the need to ensure the integrity of the barrier or the potential consequences of failure of the barrier. As described in the following sections, the impact of this change was further compounded by the casual way in which the installation of the PCCCs was managed.

4.4 13 3/8″ PCCC not installed

As described above, the drilling program was changed so that the cement plug was replaced in the well design by two PCCCs, only one of which was subsequently installed. In this way, an industry-standard well control barrier was replaced by two lesser barriers (performing a function for which they were not designed), and then one of those barriers was not installed.

Whilst the final approved well design calls for a 13 3/8" PCCC as a barrier to be put in place when the well was suspended in March 2009, it was discovered, when the West Atlas returned to the WHP and work on the H1 well was due to recommence in August, that this PCCC had never been installed. The details of why this occurred are unclear although some conclusions can be drawn from the available evidence.

Statutory Declaration of Wishart, para 137. All statutory declarations made in response to the Montara Commission of Inquiry

[24] See Statutory Declaration of Duncan, para 151, Statutory Declaration of Wilson, para 143 and Statutory Declaration of O'Shea, para 118. All statutory declarations made in response to the Montara Commission of Inquiry.

[25] See Statutory Declaration of Treasure, para 12, made in response to the Montara Commission of Inquiry.

[26] See Montara Commission of Inquiry Report, p 11.

One of the PTT Senior Drilling Supervisors has described why the 13 3/8" cap was not installed when work on the H1 was initially suspended. The reason he gives is that the H1 well was going to be used in coming weeks as a place to "park" the blowout preventer (BOP) for operational convenience as required during other activities.[27]This downgrades the function of the PCCC from an important and necessary well barrier to something that could be installed at some unspecified point in the future as a matter of operating convenience.

The Senior Drilling Supervisor noted that the need to install the PCCC on the 13 3/8" string was listed as an outstanding job on a white board in the Drilling Supervisor's office.[28] At the time that the final stages of the suspension work on the H1 well were completed, various reports were sent onshore reporting that the PCCC had been installed. Because the 20" trash cap was installed over the top of the location where the PCCC should have been installed, it was not possible to observe after the event whether the work had actually been completed, but it appears everyone assumed that it had been done, despite the fact that the cap itself (supposedly an important piece of safety equipment) was subsequently returned to Darwin.[29]

PTT's preliminary investigation into the incident published in October 2009 states:

> PTTEPAA's investigation of this incident has determined that, in March 2009, personnel on the MODU facility discovered that a valve in the cap designated for use in the H1 Well was rusted up. It would appear that this is the reason why the cap was not installed in the well. The Drilling Superintendent was however advised by the Drilling Supervisor on the MODU Facility, in an email advice of offline activities at the time of the March 2009 suspension, that the cap was installed.[30]

Contrary to this statement regarding the unserviceable state of the 13 3/8" PCCC, all PTT personnel who later supplied statutory declarations to the Commission of Inquiry deny any direct involvement in this issue and express surprise that the device was not in place.[31]

It is not possible to know with any certainty who first stated incorrectly in a written report that the 13 3/8" PCCC had been installed, and who simply repeated that information without physically confirming the installation. It is clear however that the installation of the device was treated by all involved as relatively unimportant from a safety perspective (given the delay in installation and the casual way in which the work was stewarded). Also, as described in section 4.3, the cost saving in moving to PCCCs was substantial - $50,000 in rig time. If the PCCC was found at the last

[27] Statutory Declaration by Treasure, para 28. (The blowout preventer (BOP) is not functional on the H1 well during these operations. It is simply physically located there whilst activities on other wells are carried out).

[28] Statutory Declaration by Treasure, para 32, made in response to the Montara Commission of Inquiry.

[29] Montara Commission of Inquiry Report, para 3.284.

[30] Montara H1 ST1 Well Release Incident Report Rev 0 by PTT dated 2 October 2009.

[31] Statutory Declaration of Treasure, para 36, Statutory Declaration of Wilson, para 263, Statutory Declaration of Duncan, para 356 and Statutory Declaration of Wishart, para 237. All statutory declarations made in response to the Montara Commission of Inquiry.

minute to be unserviceable (for example due to a rusty valve) and there was a need to change the plan back to a cement plug, this would apparently have resulted in that expenditure of $50,000 being incurred. Under these circumstances, it is hardly surprising that a decision might be made on the run by one or more people offshore to simply ignore the requirement for the PCCC altogether.

4.5 Removal of the 9 5/8″ PCCC and failure to re-install it

Unfortunately the failure to install the 13 3/8" cap had other consequences in that the threads inside the top of that casing string had been unprotected and hence were found to have corroded when the work recommenced on the H1 well in August. The 9 5/8" PCCC that had been installed when the well was suspended in April was then removed to allow cleaning of the threads at the top of the 13 3/8" casing. This course of action was discussed between onshore and offshore PTT personnel and the ultimate decision was made by the Well Construction Manager (who was on West Atlas at the time).

Prior to removal of the cap, pressure measurements indicated no trapped hydrocarbons and no visible hydrocarbons were observed when the cap was removed. This was seen by those involved (including the Well Construction Manager) as an indication that the well was stable and therefore that other barriers (such as the casing shoe and the fluid overbalance) were adequate.[32] In fact, since the integrity of the seal of the 9 5/8" cap on the casing had never been tested, the fact that no significant pressure was recorded does not rule out the presence of hydrocarbons from the reservoir. Following work to clean the threads on the 13 3/8" casing, the 9 5/8" cap was not replaced and the derrick was skidded to another well. There was no ongoing monitoring of the status of the H1 well whist the main focus of activity was on another well.

Since the 13 3/8" PCCC had not been installed as planned and this had apparently resulted in no undesirable side effects between April and August, perhaps it is not surprising that the 9 5/8" PCCC was also not seen as a critical safety device. Not reinstalling the 9 5/8" cap saved some rig time and was seen as acceptable based on the earlier pressure observations and because this arrangement apparently complied with PTT's standards which had changed now that the rig had returned.

Once the West Atlas rig returned to the facility and well operations were planned to recommence, the requirements for well control barriers could be legitimately revised according to the PTT WCS. If the well status is classed as a temporary suspension with a MODU on location, the requirement for "tested, independent barriers"[33] then becomes a single permanent barrier or two temporary barriers. In this case, cemented casing is listed as a permanent barrier (if it has been tested). Hydrostatic pressure of fluid in the well is an allowable temporary barrier "provided that liquid level and density is monitored and maintained".

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[32] Statutory Declaration of Wishart, para 242 (a) and Statutory Declaration of Duncan, para 246. Statutory declarations made in response to the Montara Commission of Inquiry.

[33] PTT Well Construction Standard Section 5 reproduced in Statutory Declaration of O'Shea, para 105, Statutory Declaration of Wilson, para 130, Statutory Declaration of Duncan para 138 and Statutory Declaration of Wishart, para 135. Statutory declarations made in response to the Montara Commission of Inquiry.

Of course in practice the cemented shoe had not been tested and was not an adequate barrier. As described in the following section, the confidence felt by the offshore personnel regarding the status of the well with regard to hydrostatic pressure balance was also unfounded.

4.6 Reliance on overbalance

The discussion so far has related to physical barriers specifically installed to prevent flow of reservoir fluids up the wellbore to the surface. The other way to prevent fluids from flowing up the well is to ensure that, at all times, the weight (or hydrostatic head) of fluids in the wellbore always exceeds the reservoir pressure at the bottom of the well so that there is no driving force for flow to the surface. A well in this state is called "overbalanced".

In the case of Montara, evidence was given that the well design was based on a reservoir pressure that was "normal" - in other words equivalent to the same depth of seawater.[34] This important design data was provided by PTT's geologist. PTT's standards required that, in order to rely on overbalance as a well control barrier, level and density of the completion fluid must be monitored and maintained. The WCS also requires a safety margin between the pressure exerted by the fluids in the well bore and the maximum expected reservoir pressure. In the case of the H1 well, there was no monitoring of the level or density of the fluid and no consideration of the safety margin required to meet the WCS. Inhibited seawater was used as the wellbore fluid which by definition means that the pressure exerted by the column of fluid is essentially equal to the reservoir pressure, without the safety margin that is required by the WCS. Despite this, all PTT personnel assumed that the well was safely overbalanced and that it was reasonable to "count" this as a well control barrier.

These decisions collectively reveal an astonishing degree of overconfidence on the part of all those involved, a serious lack of understanding of basic well control requirements and a substantial disregard of the hazards involved in well operations. All PTT personnel seemed to be of the view that, if a problem were developing, then they would get some clear warning which would be obvious even to people who were not actively looking for such warning signs. In fact, accident analysis usually demonstrates that accidents occur for the most banal reasons and that warning signs are difficult to spot even for those who are actively looking for them. As the Baker panel report into the Texas City refinery fire reminds us:

> Preventing process accidents requires vigilance. The passing of time without a process accident is not necessarily an indication that all is well and may contribute to a dangerous and growing sense of complacency. When people lose an appreciation of how their safety systems were intended to work, safety systems and controls can deteriorate, lessons can be forgotten, and hazards and deviations from safe operating procedures can be accepted. Workers and supervisors can increasingly rely on how

[34] Montara Commission of Inquiry Report, para 3.229. There is also discussion about the exact specific gravity that is reasonably meant by "normal" and the possible range of the specific gravity of seawater, but the overall point discussed here remains valid.

> things were done before, rather than rely on sound engineering principles and other controls. People can forget to be afraid.[35]

It appears that PTT personnel had forgotten to be afraid. The following section describes some aspects of PTT's organisation that contributed to this unfortunate state of affairs.

5. Organisation Competence and Capacity

5.1 The need for competence and capacity

None of the individual failures described above is catastrophic or unprecedented. Even the most experienced and diligent individuals make errors on occasions, but well designed and managed systems have sufficient redundancy, along with the ability to identify and respond to individual errors, so that catastrophic consequences can be prevented. In the case of Montara, PTT was lacking such skills. This meant that the combination of so many poor individual decisions has had profound consequences.

The following sections focus on the organisational failings of PTT considered in terms of the necessary competence of the organisation (skills, experience and knowledge about the necessary tasks and their effective management) and capacity (level of competent resources to meet the demands of normal, abnormal and emergency operations). In order to ensure ongoing safe operations, organisations need both the **competence** to identify the inevitable errors and the **capacity** to do something about them in a timely manner.

5.2 The need for multiple barriers

The preceding discussion has focussed at length on the need for multiple barriers to be in place in order to prevent uncontrolled flow from the well. There are many terms for the safety management philosophy of having multiple barriers in place, as this concept is widespread in engineering and not confined to well operations. Engineers tend to talk about system redundancy or defence in depth. This is a common design principle for systems where the consequences of failure are very significant and/or environmental uncertainties mean that the reliability of individual barriers can be uncertain. Specifically, it is also normal practice in well control as described in various submissions to the Inquiry.[36] Reason's Swiss cheese model is a broader statement of a similar concept from the organisational safety literature, reminding us that defences always have "holes" like Swiss cheese and so multiple defences are always needed to be confident that undesirable outcomes can be prevented. [37]

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[35] *The Report of the BP Refineries Independent Safety Review Panel* (The Baker Panel Report) http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/SP/STAGING/local_assets/assets/pdfs/Baker_panel_report.pdf, at p i.

[36] See discussion of submissions by both the Western Australian and Victorian regulators in the Montara Commission of Inquiry Report, paras 3.195, 3.196.

[37] Reason J, *Managing the Risks of Organizational Accidents,* Ashgate, Aldershot, 1997.

It appears that, at Montara, those involved in the field did not think about either the well design or their activities in such terms. Their assumption seems to have been that, provided any single barrier was in place, it was reasonable to assume it was 100% reliable and that the system was safe enough. On that basis, further barriers could be treated as optional and not really necessary, especially if the associated cost was significant. Based on this attitude, the integrity of the well moved incrementally to a less and less safe position. Starting from a design that called for two tested barriers, the design moved to one barrier that was known to be imperfect and yet untested (the cemented shoe), and two PCCCs called on to perform a function for which they were not designed. Ultimately, the PCCCs were either not installed at all or not tested, and were then ultimately removed.

The barriers concept also reinforces the idea that any incident is the result of multiple failures, probably occurring over an extended period of time, and should not be linked simply to the event that triggers the final accident sequence. One of the Drilling Supervisors shows his lack of understanding of this aspect of such an approach when he states:

> The absence of the 13 3/8" PCCC did not cause the uncontrolled release. In the context of the other barriers that I thought were in place, the H1 well was controlled even without the 13 3/8" PCCC. Even when the 9 5/8" PCCC was removed the H1 well was stable without the 13 3/8" PCCC.[38]

In fact, the well blew out some hours later, so this statement is demonstrably incorrect. An understanding of the role of each barrier and the reasons for its failure to perform the function for which it was designed (whether it failed in service or failed because it had been removed) are important actors in understanding any accident sequence.

The same Drilling Supervisor also stated "The absence of pressure testing for the PCCCs on installation was not causative of the uncontrolled release. The PCCCs did not fail under pressure in any way."[39] This is correct only in the narrow sense that both PCCCs were removed prior to the blowout, making irrelevant any discussion about tests. On the other hand, if the caps had been pressure tested and had been in place, then flow from the reservoir would have been unlikely to reach the surface (putting aside for the moment the fact that the manufacturer states that the caps were not designed for this purpose, they may indeed have limited or contained the flow had they been in place, and that was certainly PTT's position as to their functionality).

The Senior Drilling Supervisor also shows a similar attitude to multiple barriers when he indicates that, with the benefit of hindsight, perhaps he should have been aware of the problems experienced during the cementing of the H1 well, but he notes that

> ...I could have reviewed the Halliburton cementing reports when I returned to the West Atlas on 26 March, 2009, but there was no need for me to do

[38] Statutory Declaration of Wishart, para 236, made in response to the Montara Commission of Inquiry.

[39] Statutory Declaration of Wishart, para 235, made in response to the Montara Commission of Inquiry.

> that at that time and *not reviewing them so far after the cementing took place could not have caused the uncontrolled release*.[40] (Emphasis added).

Of course if the problems with the cementing had been identified, even after the event, then there would have been an opportunity for further action to be taken. As is described in section 4.2, a review of the available information by an appropriately experienced person would have revealed problems with the cementing to the point where it was clear that well integrity had not been proven and was likely to have been compromised. If this had been highlighted, even some time after cementing activities had nominally been completed, then further action could have been taken to ensure that well integrity was maintained, particularly when the rig returned and the PCCCs were removed in order to restart well activities.

It is possible that these individuals made these statements regarding the cause of the blowout in an effort to protect themselves as part of the legal proceedings in train at the time. Nevertheless, their actions prior to the incident show that PTT personnel had a general misunderstanding about the need for and role of multiple barriers in control of the potential for a blowout. This lack of understanding appears to have pervaded the organisation's thinking, impacting almost all technical activities including well design, definition of testing requirements, care taken with what should have been seen as safety critical activities and also monitoring and supervision of safety critical activities.

5.3 Lack of active supervision

One of the most startling failures in the events leading up to the blowout is the failure to install the 13 3/8" PCCC followed by the reporting to onshore management that such a cap had indeed been installed. It is difficult to escape the conclusion that someone (indeed probably several people) knew that the cap had not been installed, and yet reported to onshore management that it was in place.

This event can perhaps best be considered as an indication of the relationship between offshore and onshore PTT personnel. The onshore management team appear to have taken a very "hands off" role in relation to work done offshore. In his statement to the Commission of Inquiry the PTT Drilling Superintendent stated that:

> …if there was an issue with a forward plan that could not be resolved offshore [the Senior Drilling Supervisor] would call me to discuss the issue …Then plans were not normally sent to PTTEPAA's office for review unless there was an issue that could not be resolved offshore…if the Senior Drilling Supervisor…needed additional expertise from onshore staff, he would telephone me…[41]

To emphasise this point, the attitude of onshore management is to assume that offshore personnel were competent and operating in accordance with approved standards **without ever conducting any checks as to whether this was actually the case**.

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[40] Statutory Declaration of O'Shea, para 185, made in response to the Montara Commission of Inquiry.

[41] Statutory Declaration of Wilson, para 33, made in response to the Montara Commission of Inquiry.

The Drilling Superintendent also states that, with regard to checking the reports on cementing operations, he had no reason to check the reports in detail and that he "reviewed the DDR to see if there was any obvious errors or issues. There were none."[42] As the Commission of Inquiry report points out,[43] the role of the Drilling Superintendent was the day-to-day supervision of activities offshore, and this involves much more than simply looking for obvious errors in written summaries of work done, especially work involving such a critical safety function as the cementing of the casing shoe.

The Drilling Superintendent indicates again his overall attitude to supervision when he says:

> …as there were no indications or reasons after 21 April 2009 to think that the wells were not suspended per the DP and subsequent change control, there was no reason to conduct any form of audit to check that all work that was thought to be performed had in fact been completed…[44]

Of course there was evidence available. This was particularly the case in relation to the state of the cemented casing shoe, if only he had looked.

The fact that critical activities were apparently conducted with no supervision is a key failing on the part of the organisation as a whole. It should be emphasised that this is not a matter of considering that employees may be dishonest. The principle of active supervision is that employees take their cue as to what is important from what their superiors pay attention to, and further that people respond to positive reinforcement of appropriate behaviours. If no-one ever asks about well control barriers being in place or checks that integrity tests have been done in accordance with written requirements, then the message given is that these issues are less important than other factors that do receive management attention.

Looking in the statements provided by PTT management to see what was regarded as important reveals the following communication. Five days before the blowout, the Drilling Superintendent sent an email titled Montara Platform Wells Morning Update of 16th April to a wide range of people (including on rig personnel, senior PTT management in Thailand and government representatives) which states:

> Whilst we have been busy drilling some of our guys have been working offline to suspend Montara H3ST-1 and Montara H1. Both wells will be fully suspended by the end of the day. This has saved us about 12-18hrs of rig time by being able to do this activity offline – a job well done.[45]

In these circumstances, it is not difficult to imagine a scenario in which the 13 3/8" cap was found at the last minute to be unserviceable (as PTT initially reported to the

[42] Statutory Declaration of Wilson, para 185, made in response to the Montara Commission of Inquiry.

[43] Montara Commission of Inquiry Report, para 3.123.

[44] Statutory Declaration of Wilson, para 266 (c), made in response to the Montara Commission of Inquiry.

[45] Email - Montara Platform Wells Morning Update dated 16th April 2009.

Commission of Inquiry – see section 4.3) and offshore personnel decided to proceed with installation of the trash cap anyway and suspend the well without the additional barrier. It is perhaps significant that it is the Daily Drilling Report dated 17 April (i.e. the day after the above general note) from the offshore team to onshore management that first reports the fictional installation of the 13 3/8" PCCC. By sending such a report, the offshore personnel were simply confirming what onshore management wanted to hear.

5.4 No separation of engineering integrity and operations functions.

Another unsatisfactory organisational feature revealed by the quotes from the Drilling Superintendent in the previous section is the level of technical discretion given to offshore personnel, in particular the lack of any engineering integrity function at PTT that was independent of line operations activity. To emphasise this point, this means that operational personnel were in control of whether or not engineering input was required, meaning that there was no separation between engineering integrity and operations functions. As is clear from the details of the cementing activity described in section 4.2, the personnel responsible for conducting cementing operations offshore apparently had serious gaps in their technical ability to understand what was occurring offshore and to know at what point they needed to seek specialist advice.[46]

This situation appears to have its roots in the roles previously held by the various individuals involved. The Drilling Supervisor had previously (prior to the operational drilling phase) held the role of Senior Drilling Engineer.[47] In that role, he had been responsible for (amongst other things) the design of the wells. Once the drilling program moved into the operational phase, he took on the role of Drilling Supervisor with all the PTT offshore drilling crew reporting to him including both Senior Drilling Supervisors and all the Drilling Supervisors.[48]

Despite this change in role, the Drilling Supervisor seems to have adopted an attitude to supervising the personnel that was based on providing advice when asked, rather than actively supervising the work that was being done. He stated:

> Although there was appropriate communication between [the Senior Drilling Supervisor] and me on 7 March 2009 there was information that I consider, with the benefit of hindsight, could have been given to me so that I would be better able to make decisions about what needed to be done in the face of the apparent failure of the float valve. In hindsight, the additional information required was about the quantity of fluids that were pumped back into the casing and the variation in the pressures whilst waiting on the cement to set.

[46] In giving evidence to the Commission of Inquiry, the Senior Drilling Supervisor claimed that he had told the Drilling Superintendent about the 16.5bbl returns seen at the end of the cementing operation and that it was the Drilling Supervisor who told him to pump the fluid back into the well, thereby creating the "wet shoe". The Commission of Inquiry had no hesitation in dismissing this version of events (see Montara Commission of Inquiry Report, paras 3.83 to 3.106).

[47] Statutory Declaration of Wilson, para 12, made in response to the Montara Commission of Inquiry.

[48] Statutory Declaration of Wilson, para 16, made in response to the Montara Commission of Inquiry.

> ...my post incident analysis indicates that the 9 5/8" casing shoe most probably did not form an adequate primary tested barrier however on the day *with the information supplied to me*, I had no reason to suspect that it was not an adequate barrier.[49] (Emphasis added).

Putting aside the question as to whether the Drilling Supervisor had not received the information, or had received the information and failed to read it, he seems to have conceptualised his role as one of giving advice when asked, rather than actively supervising or providing a level of specialist technical oversight of well integrity issues.

The Inquiry has highlighted one critical occasion on which the Senior Drilling Supervisor did seek technical advice from the Drilling Superintendent and yet such advice was not forthcoming. This was in the calculation of the volume of cement necessary to be pumped into the H1 well in order to meet the design parameters of height above the reservoir that are specified in the PTT Well Construction Standard. In fact, the calculation submitted by the Senior Drilling Supervisor for checking (and ultimately used as the basis for the volume of cement pumped into the well) was seriously incorrect and yet the Drilling Superintendent did not check the calculation or provide any response.[50]

This total confusion over the role of senior management personnel with an apparently high level of technical knowledge was also seen in the decision not to reinstall the 9 5/8" PCCC after the cleaning of the threads on the 13 3/8" casing. In his statement, the Well Construction Manager (who was on the facility at the time) says that, based on the other barriers in place, "...there was no compelling reason to re-install the 9 5/8" corrosion cap".[51] Contrary to this, he told the Inquiry during the hearing that he had expected that the cap would be reinstalled once the cleaning work was complete and that when he discovered that it had not been installed he did not insist on the basis that "he did not want to give the impression to personnel on the rig that he was trying to teach them how to do their jobs".[52]

In fact, of course, it was the Well Construction Manager's role both to ensure that work was done in accordance with plans (and he apparently planned that the cap would be reinstated) and to ensure the technical robustness of activities undertaken. To leave a well barrier uninstalled for such a reason is clearly an abrogation of both managerial and technical responsibilities. The blowout occurred approximately 15 hours later.

Another source of an independent check on activities might have been the corporate HSE specialists. The Well Construction Manager had overall responsibility for the development drilling activity. He reported to the Montara Project Manager, who reported to the CEO.[53] Corporate HSE functions report via a separate line to the CEO

[49] Statutory Declaration of Wilson, para 259, made in response to the Montara Commission of Inquiry.

[50] Montara Commission of Inquiry Report, paras 3.158 to 3.165.

[51] Statutory Declaration of Duncan, para 251, made in response to the Montara Commission of Inquiry.

[52] Montara Commission of Inquiry Report, para 3.187.

[53] Statutory Declaration of Jacobs (revised), para 4, 17-23, made in response to the Montara Commission of Inquiry.

and appear to have played no role in integrity assurance in drilling activity despite the statement from the Chief Operating Officer that the Well Construction Department works under the Corporate Safety Management System.[54]

Similar issues related to organisational design (that is, structure, roles, reporting lines related to technical specialists) have been highlighted in analyses of other accidents. Analysis of the circumstances surrounding the Texas City refinery accident[55] showed that those with technical responsibility for process safety issues were marginalized by the organisational structure. This left them unable to raise their concerns with senior management in any way that was effective in initiating action. Similarly, the report into the Columbia space shuttle disaster discussed attributes of organisational design related to the power and authority of technical specialists that could be expected to prevent such incidents from occurring again. In particular, the report called for "a robust and independent program technical authority that has complete control over specifications and requirements, and waivers to them".[56]

The situation at PTT seems to have been even more unsatisfactory in that there was no effective engineering input into well operations and no integrity assurance function operating in the organisation with regard to well activities at the time of the blowout. These attitudes can be contrasted with those that HRO researchers tell us are necessary to avoid accidents in the long term, such as preoccupation with failure.[57] Instead, these people as a group seem to have moved to an attitude that assumes everything is fine until proven otherwise. This attitude of trial and error learning in a high hazard environment such as offshore drilling makes the occurrence of a serious incident only a matter of time.

5.5 Rule compliance versus risk assessment

The lack of specific direction from onshore management then apparently leaves work on the rig being done in accordance with PTT's written standards and other documentation. As the Chief Operating Officer stated:

> ...the PTTEPAA system relied upon the personnel involved in well construction *following the requirements of the Well Construction Management System*...it also relied on the expertise of the MODU facility operator's supervisory personnel and the PTTEPAA drilling supervisors to monitor and check that the MODU facility personnel *complied with the drilling programs*....[58] (Emphasis added).

This seems to indicate that what senior PTT management expect from offshore personnel is compliance with written rules and standards. The Well Construction

[54] Statutory Declaration of Jacobs (revised), paras 4 and 26, made in response to the Montara Commission of Inquiry.

[55] Hopkins A., *Failure to Learn: the BP Texas City Refinery Disaster*,CCH, Sydney, 2008.

[56] *Report of the Columbia Accident Investigation Board, Volume 1*,2003 <http://caib.nasa.gov/>.

[57] Weick K and Sutcliffe K, *Managing the Unexpected: Assuring High Performance in an Age of Complexity*, Jossey-Bass, San Francisco, 2001.

[58] Statutory Declaration Jacobs (revised), para 77, made in response to the Montara Commission of Inquiry.

Manager explains the role of one of the key documents, the PTT Well Construction Standard (WCS), in his statement:

> The purpose of the WCS is to provide standards for all aspects of well design, construction, testing, abandonment and intervention that involve a risk to safety, quality or integrity. The WCS are applicable to all aspects of well design, well construction, well servicing and well abandonment. We generated and prepared the WCS through a series of reviews and workshops with the well construction team. However, the WCS was not a prescriptive set of rules to cover every possible scenario but includes processes to risk assess and manage scenarios not considered between document revisions.[59]

The Well Construction Manager is taking a rather different view of the role of the technical requirements (on such critical safety issues as well control barriers) contained in the WCS. This material has effectively been downgraded from something that requires mandatory compliance to playing the role of a guideline that can be varied based on a risk assessment.

The only acknowledged departure from the WCS that was documented prior to the blowout was the decision to change the well design from a cement plug to two PCCCs. As described in section 4.3, various individuals have justified changing the written drilling plan to include PCCCs, despite the fact that this device is not listed as a well control barrier in the WCS. Arguments used by PTT drilling personnel in favour of the change include:[60]

- PCCCs are better than cement plugs
- PCCCs have the same functionality as other devices that are listed in the WCS so they are, in effect, approved
- The WCS allows for two suspension options:
    - Temporary suspension "where the MODU remains on location" and
    - Long term suspension "when the MODU leaves the site. Wells must be suspended so that they can be abandoned with rig-less intervention to meet the standards below." In the case of Montara, the MODU was leaving the site, but there was no plan to abandon the wells so PTT argued that it was reasonable to use the standards applicable to temporary suspension, even for the period when the MODU was elsewhere.

The last claim is clearly spurious. Putting that aside, other claims about the functionality and effectiveness of the PCCCs are not supported by the information supplied from the manufacturer. The Drilling Superintendent says he sent the manufacturer's instructions offshore so that:

> …the caps could be installed as per the manufacturer's instructions. I assumed that those instructions would call for an in situ pressure test after installation and I did not note prior to sending out the manufacturer's

[59] Statutory Declaration of Duncan, para 43, made in response to the Montara Commission of Inquiry.

[60] Statutory Declaration of Wilson, para 152 and Statutory Declaration of Duncan, para 159, made in response to the Montara Commission of Inquiry.

> instructions that they themselves did not call for the PCCCs to be pressure tested once installed.[61]

In fact, the Operating and Service Manual for the PCCCs explicitly states that they are not designed to operate as barriers against blowout and are only meant to be used on a well that has been plugged and secured. It seems likely that, in preparing the risk assessment on the proposed change (described in section 4.3), the Drilling Superintendent did not read any of the material provided by the manufacturer for this critical safety device.[62]

Hopkins has highlighted the interrelationship between risk assessment and rule compliance. [63] He points out that rules are often based on risk assessments and that, as far as possible, risk assessments should be formulated into rules to assist end point decision makers such as those involved in operational drilling activities. He highlights other accidents where the temptation to risk assess one's way out of specific safety requirements has contributed to accidents, as has certainly been the case with Montara.

PTT personnel seemed to have lost touch with any sense of the danger posed by the business in which they were participating. Most of the individuals whose decisions are reviewed in this paper were on the facility at the time of the incident. They could easily have died as a result and yet they showed no appreciation of that potential. Other decision making research in high hazard organisations has highlighted the value of shared stories about past failures as a way of keeping alive the level of respect that is necessary in order to make effective decisions in these circumstances. It seems likely that a "fly on the wall" at PTT would not have heard such stories, but rather talk of operational priorities and cost savings.[64]

6. Conclusions

The fundamental requirement of the type of goal setting regulation used throughout the offshore oil and gas industry in Australia is that operating companies must set their own standards based on the hazards and risks posed by their activities, and then do what they say they will do. PTT failed to comply with its Well Construction Standards (WCS) in numerous ways including:

- failure to test the cemented casing shoe and subsequent reliance on this untested barrier,
- reliance on pressure containing corrosion caps (PCCCs) as a well barrier when these are not approved in the WCS,
- failing to install sufficient barriers to meet the requirements for long term suspension of the well when the West Atlas left the field, and

[61] Statutory Declaration of Wilson, para 198, made in response to the Montara Commission of Inquiry.

[62] See Montara Commission of Inquiry Report, para 3.215.

[63] Hopkins A, 'Risk-management and rule-compliance: decision-making in hazardous industries' (2011) 49(2) Safety Science 110-120.,

[64] Hayes J 'O perational decision-making' in Hopkins A (ed), *Learning from High Reliability Organisations*, CCH, Sydney, 2009, 149-178.

- failure to monitor completion fluid parameters to ensure overbalance and subsequent reliance on this unmonitored barrier during temporary suspension (when the West Atlas returned to the field).

The individuals involved, both offshore and onshore, made a series of bad decisions. These poor choices stem from a lack of organisational competence and capacity to successfully manage an offshore drilling operation. This is revealed in the organisation's lack of understanding of basic safety concepts such as defence in depth, the failure to appreciate the need to separate operational and technical assurance functions and the need to supervise staff, and the failure to set firm standards that cannot be risk assessed away under pressure of cost pressures or immediate operating priorities.

It would be reassuring to think that PTT were alone in such practices, but I have had recent consulting experiences with other international players operating in Australian waters who showed a range of similarly concerning attitudes. In these cases, there has been no serious accident to date.

The Montara Commission of Inquiry reported that "the regulatory regime was too trusting and that trust was not deserved."[65] So far, the regulatory response has been to change the body responsible for administering and enforcing the well integrity regulations from the state designated authorities to the National Offshore Petroleum Safety Authority. Perhaps the fundamental management problems seen at PTT require a different regulatory response – one that addresses directly the competence and capacity that we expect from organisations that we allow to develop our nation's natural resources.

[65] Montara Commission of Inquiry Report, p 18.