Blowouts – Lessons learned by the industry and its regulator

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Background

The Elgin well G4 was drilled in 1997 and started producing in 2001. It was one of 11 high-pressure, high-temperature wells on Total E&P UK Ltd.'s (Total) Elgin Wellhead platform.

From 2004 onwards, sustained casing pressure was evident in the A annulus of well G4, which is an indicator of potential problems with well integrity. If sustained casing pressure (SCP) is not managed correctly it has the potential to result in the casing becoming overpressurised, which can result in loss of containment and ultimately a surface or sub-sea blowout.

In the HPHT areas of the North Sea, including Elgin's location, the hydrocarbon-bearing Hod Formation presents additional well engineering challenges. There is potential for hydrocarbons to flow into the well annuli through damaged casings and/or a poor cement bond, such as a micro-annulus between the casing and the formation.

In 2005 all three annuli of well G4 were exhibiting SCP. In line with standard industry practice Total instituted a program of bleeding off the pressure from the annuli to maintain them within a defined safe operating window.

In March 2010 Total attempted to reduce the influx of hydrocarbons into the A annulus by using a volumetric kill process. The pressure stabilised for a few months until the pressure in the A annulus began to build and continued to increase.

From October 2010 to October 2011 Total continued to bleed-off the A annulus with increasing frequency, increasing the risk to the integrity of well G4. By the start of 2012 the pressure in the A annulus had increased to the point that any failure of the A annulus would immediately threaten to over-pressurise the B and C annuli. On 25 February 2012 the production and intermediate casings in well G4 failed, allowing pressure and hydrocarbons to flow across the three annuli.

Total were concerned that the rate of pressure increase in the C annulus gave them approximately 100 minutes before a blowout could occur and they considered a down-manning operation. However, Total then managed to bleed down the C annulus and stabilise the pressure. Consequently, Total decided not to down man, or halt production from the remaining wells.

Total began a well kill operation 19 days after the failure of the production and intermediate casings, however control of well G4 was progressively lost. On 25 March 2012, pressure increases caused failure of the surface casing, leading to the blowout of well G4. Specialist contractors worked with Total to plan, manage and execute the well kill of G4.

In December 2015 Total pleaded guilty to breach of Regulation 13(1) of the Offshore Installations and Wells (Design and Construction etc.) Regulations 1996 and were fined £1.25 million

Relevant other incidents and the responses to them

During the time Total was operating well G4, there were two other significant blowout incidents – the Montara incident in the Timor Sea, Australia, in 2009 and the Macondo incident in the Gulf of Mexico in 2010. In both cases there was an unexpected influx of well fluids (kick) and loss of hydrocarbons (blowout).

An independent review into the UK regulatory regime chaired by Maitland (Offshore Oil and Gas in the UK – an independent review of the regulatory regime, December 2011) identified areas for improvement. These resulted in a number of actions, including: an increased level of peer review of well design assessment for deepwater wells and auditing of safety case acceptance decisions for mobile offshore drilling units.

In addition, the Oil Spill Prevention and Response Advisory Group (OSPRAG), made up of representatives from the oil and gas industry, its regulators and the trade unions to address, was created to pursue on, the issues raised by the Macondo incident.

One of OSPRAG's recommendations was the establishment of a new pan-industry wide forum to provide expertise in this specialist area, the Well Life Cycle Practices Forum, which is now a permanent group under Oil and Gas UK, (OGUK) to ensure industry continues on the path of improvement.

HSE and OGUK jointly formed the OGUK HPHT working group in 2012 which committed to producing specific guidance for HPHT wells. The guidance captures the key well engineering lessons learned which have been detailed and targeted for well engineers designing HPHT wells. The guidance addresses lessons from previous incidents where there have been issues with well integrity and well control. The guidelines aim to provide recommendations and good practice for HPHT well engineering, well operations and maintenance.

To bring the issues to a wider, international audience, personnel from Total prepared and presented a paper to the Society of Petroleum Engineers International Conference in March 2014: *Elgin G4 Release: What Happened and the Lessons to Prevent Recurrence*

To promote consistency in inspection of offshore activities carried out by duty holders in the UKCS, HSE has published a suite of inspection guides for use by its inspectors to secure regulatory compliance. Four of these guides relate to well control, well integrity and related issues. https://www.hse.gov.uk/offshore/inspection.htm

The Well Control Inspection Guide helps non-specialist inspectors to carry out basic inspection of arrangements for well control during well construction and maintenance. This includes drilling, testing, completion and other well intervention or maintenance/repair (work over) operations, including final decommissioning where the drilling blowout preventers are in use.

The Wells Competency Inspection Guide contains a question set which has been developed from HSE and OGUK well competency guides. This helps non-specialist inspectors support the delivery of consistent and effective wells competence assessment of key offshore wells personnel, including those with roles in administrating the competency frameworks.

The Well Examination Guide reiterates the requirement for duty holders to have a scheme of examination for each and every well to verify that it is designed, constructed and maintained in a safe condition throughout its life from initial design to final abandonment. The examination must be carried out by someone who is competent to do so and independent of line management for the well. The inspection of well examination management systems involves a review of relevant documentation, followed by a set of role-specific questionnaires. The whole package is then captured in a review of management arrangements.

The Well Integrity Inspection Guide provides guidance on how to inspect the management arrangements in place to demonstrate how the well-operator ensures the integrity of its wells, barriers and pressure containment boundary throughout the well life cycle, from design to final abandonment. The well-operator is also responsible for assessing the well risks and reducing them to ALARP, which should be demonstrated to the offshore duty holder who has the primary responsibility for the safety installation and the personnel on board. The effective management of risk is also critical to impaired wells as they age throughout their life cycle. The guide also contains question sets, developed from international standards and guidance and examples of good industry practice.

To help industry and the wider public understand the steps taken by HSE and industry, in response to Elgin, Montara and Macondo incidents and to highlight the availability of the Inspection Guides, HSE published a report "*Elgin blowout report: Events surrounding the blowout and actions taken in response to this and similar incidents",* which is available from the HSE website, https://www.hse.gov.uk/offshore/index.htm

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