MACONDO WELLBORE INFLUX

Findings and recommendations from a forensic analysis

This report draws on interviews and discussions over 15 months with Ronald Sweatman, a scientist-engineer with 45 years of industry experience in the areas of cementing and fracturing. During the course of his participation in the task forces that were assembled after the Macondo accident, he noticed that there were lines of investigation that were not being pursued.

He and a few others formed an informal research group that sought a new approach to reconstructing what happened in the Macondo wellbore on April 20, 2010. The researchers focused on the behavior of the drilling fluid as the temperature differential normalized to the geothermal gradient of the rock formation. They concluded that the unintended change in hydrostatic pressure in the wellbore that occurred as a result of the placement of the Casing Seal Assembly (CSA) induced formation fluids to influx within the first two hours while the cement was still a slurry.

This line of analysis, which was not pursued in other Macondo reports, led to fresh conclusions (Table 1) and new recommendations about training, software and technology (Table 2).

The 10-page interview with Mr. Sweatman will be posted on www.energia.com/interviews.

Contents

INTRODUCTION ............................................................... 2
BACKGROUND .............................................................. 3
DISCUSSION ................................................................ 4
    Findings .................................................................... 4
    Recommendations ....................................................... 5
OBSERVATIONS ................................................................ 5
CONCLUSIONS ................................................................ 6
Charts, tables and related report titles
    Fig. 1. Diagram of the Macondo well on April 20, 2010 .......... 3
    Table 1 Principal research findings .................................. 4
    Table 2 Principal recommendations ................................. 5
    Titles of related MEI reports ........................................... 6
    About this report .......................................................... 7

MEXICO ENERGY INTELLIGENCE® (MEI) is a commercial and policy advisory service offered by BAKER & ASSOCIATES, ENERGY CONSULTANTS, a management consultancy based in Houston. MEI reports facilitate two-way communication between Mexican public and private institutions and the global environment. Our reports examine policy, institutional and cultural issues as they affect the operating environment, energy regulation, and government and private investment in Mexico’s energy sector. Reports are distributed principally on a subscription basis. Energia.com contains public-interest reports, title lists, calendar postings and interviews with stakeholders and observers that are available as a public service.
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INTRODUCTION

THE WAY MR. SWEATMAN DESCRIBES THE RESEARCH PROCESS, it was a matter of connecting the dots. Only a few events of April 20, 2010, could be documented in time; among those were the following “dots”:

1) 00:40 Cement placement completed (per Transocean report);
2) 01:00 Casing Seal Assembly installed at wellhead;
3) 17:00 Negative Pressure Test (NPT) conducted;
4) 21:40 Formation fluids erupt on rig floor;
5) 22:00 Methane clouds explode.

There were few solid data points about what was going on in the wellbore:

1) Pressures and depths of the 5 flowable zones (Fig. 1);
2) Hydrostatic pressure at time of installing the CSA;
3) The coefficient of expansion (contraction) of the drilling fluid;
4) The temperature differential between the mud column and the geothermal gradient;
5) Data released in October, 2010, proved that the cement above flowable zones had formed a competent pressure barrier.

These dots were not much to go on. The researchers published their preliminary findings in an SPE research paper.1 The paper examined two field studies. The second-mentioned study was of the Macondo blowout (but not thus identified).

BACKGROUND

THE MACONDO TECHNICAL LITERATURE is vast.2 There are uncounted technical drawings online depicting the equipment and construction of the Macondo well. To show both

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total distance to the rig floor and the depths of the flowable zones, we needed to borrow from three sources to make a composite sketch (Fig. 1).³

### Titles of reports related to Macondo

<table>
<thead>
<tr>
<th>File #</th>
<th>Published</th>
<th>Updated</th>
<th>Topic</th>
<th>Pages</th>
<th>Chart</th>
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<tbody>
<tr>
<td>1000030</td>
<td>Apr 20, 14</td>
<td></td>
<td>Advances since Macondo: Well Integrity Management Systems &amp; Halliburton’s Technology Center</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

This report comments on selected themes discussed at an industry conference that took place in Houston on April 15-16 on Well Integrity Management Systems (WIMS) and related topics. Presented by DECOM WORLD, it featured diverse speakers from operators and service companies, in addition to an exhibition area for vendors that included IBM as the Gold Sponsor. WIMS seems to have replaced SEMS, a post-Macondo initiative. The report includes observations of a tour of Halliburton’s Houston Technology Center on April 16. Ideas from social science are offered to complement engineering advances.

| 093012  | Sep 30, 12|         | The Political Science of Industrial Safety: Have the Deeper Lessons of Deepwater Horizon Been Learned? | 6     | 0     |

A visit took place to the Deepwater Horizon by a senior, joint safety audit team on the day of the Macondo blow-out. The team focused on occupational safety and ignored issues of process safety (e.g., tests of cement integrity). See The Journal of Energy & Development (Vol. XXXVI, No. 2, pp. 219-226).


| 100103  | Oct 10, 11|         | The Political Science of Industrial Safety | 6     | 3     |

This report seeks to abstract from the events that took place on Deepwater Horizon on April 20, 2010, in order to gain a picture of the inevitable changes ahead in law and regulation that will create a new regime in which both contractors and well owners will be jointly liable for accident prevention and accountability.

| 100093  | Jul 01, 11| Jul 2, 11| BP’s Lessons from BP-Macondo | 4     | 0     |

On June 30, 2011, at a workshop sponsored by the OCS Advisory Board BP's exploration manager for the Gulf of Mexico set forth the principal lessons from the accident at the Macondo well on April 20, 2010. The lessons were grouped in five categories: 1) Prevention, Drilling and Equipment Monitoring 2) Containment, 3) Relief Wells, 4) Spill Response and 5) Crisis Management. The report notes such future-oriented goals do not address changes ahead in the contractual relationships between contractors and the oil company and among oil companies themselves.

| 100088  | May 30, 11| Jun 6, 11| Credit and Blame at BP-Macondo | 12    | 8     |

This report, based on a close reading of much of the public record, complemented by industry interviews, seeks a balanced assessment of credit and blame in regard to the series of accidents at the BP-Macondo well on April 20, 2010. Blame and credit is assigned to industry and government actors for their roles before and after the blowout. The report seeks to apply lessons learned to Mexico’s deepwater aspirations.
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A management briefing is available on the topics covered in this report.

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