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Early Kick Detection

BAST Technology Assessment

This document serves to announce BSEE's intention to evaluate Early Kick Detection (EKD) technology as part of the Best Available and Safest Technology (BAST) Program. Use of cost-effective BAST is required by the Outer Continental Shelf Lands Act (OCSLA) to address significant safety issues on the Outer Continental Shelf (OCS). BSEE believes that this assessment is needed to determine if use of BAST involving kick detection and mitigation can reduce the likelihood of loss of well control (LOWC) events.

BACKGROUND

It has been well recognized that the ability of O&G well operations personnel to quickly detect, recognize, and respond to an influx of formation fluids ("kick") plays a major role in reducing the likelihood of a LOWC. Findings from reports on the Macondo disaster found that failure to recognize signs of a kick contributed to the LOWC. To cite sample statements from these reports:

- From the National Academy of Engineering report (2011) [1], page 68, "*Early detection and control of flow from a reservoir are critical if an impending blowout is to be prevented by a BOP whose use against a full-flowing well is untested.*"
- From the Chief Counsel's Report [2], page 165, "*The Chief Counsel's team finds that rig personnel missed signs of a kick during displacement of the riser with seawater. If noticed, those signs would have allowed the rig crew to shut in the well before hydrocarbons entered the riser and thereby prevent the blowout."*
- From the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Report [3], page 121, *"The drilling crew and other individuals on the rig also missed critical signs that a kick was occurring. The crew could have prevented the blowout—or at least significantly reduced its impact—if they had reacted in a timely and appropriate manner.*"…*"In the future, the instrumentation and displays used for well monitoring must be improved"…"In light of the potential consequences, it is no longer acceptable to rely on a system that requires the right person to be looking at the right data at the right time, and then to understand its significance in spite of simultaneous activities and other monitoring responsibilities."*

Findings by Exprosoft [4], as part of a BSEE funded technical study (TAP 765) found that:

- From page 3, Table 1.1, "Area-specific overview of the number of LOWC events that occurred during different operational phases (2000–2014)", of the 117 LOWC events reported worldwide, 66 or 56% occurred in the US GOM OCS.

[1] "Macondo Well-Deepwater Horizon Blowout", National Academy of Engineering, (2011), pg 68.
[2] "Macondo, The Gulf Oil Disaster", Chief Counsel's Report, (2011), Chapter 4.7 "Kick Detection", pg 165.
[3] "Deepwater,The Gulf Oil Disaster and the Future of Offshore Drilling", National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling", (January 2011), Chapter 4 "Kick Detection", pg 121.
[4] "Loss of Well Control Occurrence and Size Estimators", Exprosoft Report 765AA, 15 Sep 2016, pgs 3, 6 and 11.

- From page 6, Table 1.6, "*LOWC causal factors summary"*, late kick observation accounted for 38% of occurrences for Deep Drilling, 87% for Completion, and 78% of Workovers in killed wells.
- From page 11, "*Efforts to improve the kick detection during drilling, completion, and workover activities will in most cases give a corresponding reduction in the LOWC event frequency.*"

On July 23, 2013, a well operated by Walter Oil and Gas in the Gulf of Mexico (GoM), ST Block 220, had a LOWC event during well completion operations which escalated to an explosion and fire causing damages in excess of $10 million. A panel investigation report [5], page 79, concluded that one of the causes of this accident was, "*Failure of the Rig-floor Crew to recognize the loss of well control in a timely manner made it impossible to follow the well control procedures which called for stabbing the safety valve on top of the work string as an initial step."…* "*The initiation of the emergency procedure sequence to activate BOP elements was delayed because of the Rig-floor Crew's failure to recognize the loss of well control in an early stage."*

Following this event and based on recommendations arising out of Deepwater Horizon, the Chief of the Office of Regulatory Programs (OORP) was requested to determine whether there were cost effective, commercially available technologies that could reduce the risks of LOWC through early kick detection and warning. The process that BSEE utilizes for making this type of evaluation is the BAST Determination Process [6] (BAST DP) under BSEE's BAST Program. This process, developed with input from stakeholders, allows this technical evaluation to proceed in a logical sequence with input from the industry and subject matter experts. The ultimate goal is to develop performance based criteria centered on a review of existing equipment. At several stages during the evaluation, the process may be terminated if BSEE determines that a technical solution is not feasible or if there are other alternative approaches.

The first four steps of the BAST DP have been completed by BSEE and the objective now is to begin the process of engaging the industry and interested parties in this assessment and review process. To provide the reader with background on the assessment, the four steps completed thus far and the next step planned, are listed below.

I. BAST STEP 1.1: SAFETY ISSUE

Based on data from the aforementioned sources, BSEE initiated Step 1.1 of the BAST DP and as a result, determined that sufficient evidence supports BSEE's earlier findings that a potential safety issue exists on the OCS.

II. BAST STEP 1.2: ASSESSMENT AND FINDINGS

[5] "Investigation of Loss of Well Control and Fire, South Timbalier Area Block 220, Well No. A-3", BSEE panel 2015-02 report, 23July2013, pg 79.
[6] BSEE's BAST Determination Process https://www.bsee.gov/sites/bsee.gov/files/fact-sheet/bsee-bast-determination-process-final-november-2015.pdf.

BSEE initiated Step 1.2 – Assessment of the BAST DP to determine whether technology solutions exist that could mitigate the safety issue identified from Step 1.1 above. BSEE met with OCS stakeholders, including drillers, operators, and Original Equipment Manufacturers (OEMs) of kick detection equipment to evaluate systems available on the open market with applicability to OCS operations, capable of providing early warning of downhole kicks. Based on information obtained as result of these discussions BSEE found that various EKD systems are commercially available that could potentially be used to provide improved EKD and reduction or prevention of LOWC events.

III. BAST STEP 1.3: BAST FEASIBILITY ANALYSIS

BSEE initiated Step 1.3 – Feasibility Analysis of the BAST DP to determine the anticipated cost to industry to adopt commercially available technologies necessary to significantly reduce or eliminate the safety issue. BSEE's analysis concluded that it is likely that there are cost-effective technologies that will allow the potential safety issues to be mitigated.

IV. BAST STEP 1.4: TECHNOLOGY IMPROVEMENT OBJECTIVE

In accordance with Step 1.4 of the BAST DP the agency has developed the following Technology Improvement Objective (TIO) which has the potential to improve safety, health or environmental protection associated with LOWC during well operations (drilling, tripping, completion, workover, suspension, etc.).

> ***Based on an evaluation of commercially available technology, what is the lowest volume of formation fluid influx (in bbls) that can be detected and the earliest detection (in seconds) of the influx measurable in a cost effective and feasible manner?***

This TIO performance level could be used to define an acceptable response time for detection of kicks of a specific size.

V. BAST STEP 1.5: PUBLIC NOTICE

In accordance with Step 1.5 of the BAST DP, this TIO is being published for public review on www.BSEE.gov. The agency plans on holding a Public Forum to further explain the BAST DP and allow OCS stakeholders to hold discussions with the agency on the TIO, BSEE's rational for initiating the BAST DP, and the next steps. BSEE welcomes your feedback on the TIO in advance and in preparation of the Forum (date and venue to be announced @ www.BSEE.gov). Send your comment(s) to bastweb@bsee.gov and enter the words "EKD TIO Comment" in the subject line.