The pressure is on for fitting hazards JIP

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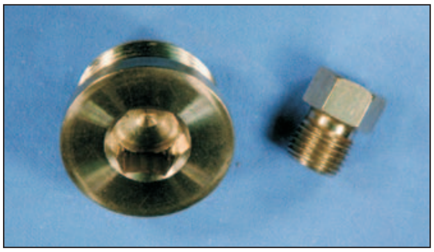
Above: All of the tests will be conducted in a controlled environment inside BakerRisk's test cubicle shown here. Below: An example of some fittings common to oilfield equipment.



INTRODUCTION

BAKER ENGINEERING AND Risk Consultants Inc. (BakerRisk) has initiated a Joint Industry Program to assess hazards common to oilfield equipment companies involved in pressure testing. The study will help interested companies understand and predict hazards in their test facilities, as well as mitigate fragment hazards with effective protective structures. The goal of this program will be to focus on safety issues common to these companies with the results, benefits and costs being shared by all participants.

Failures during high pressure testing are of great concern to companies manufacturing tools and products for drilling, completion and production of oil and gas. Incidents have potentially high consequences in terms of injury, property damage and business interruption.

Most companies do not have the internal resources available to conduct the research necessary to improve understanding of high-pressure testing failures and to develop methods to aid in the prediction of these failures. A Joint Industry Program, utilizing pooled funds from participating companies, is a cost-effective way to conduct R&D to promote the exchange of information related to pressure testing hazards among the participants.

This article presents the scope of work for the pressure testing study regarding fitting hazards that recently began and provides an overview of the organization of the Joint Industry Program.

FITTING HAZARDS TESTING

Purpose: Tests will be conducted to obtain velocity and penetration characteristics of typical fittings released from hydrostatic pressure tests to 30,000 psi. Test fittings representative of those used by participants will be examined. The tests will show the adequacy of alternative protective shields and the accuracy of prediction methods.

Failures of fittings (connections, valves, gauges, transducers, etc.) during high pressure testing are not uncommon. Fitting failures present a serious fragment hazard to personnel in the immediate vicinity. The severity of the threat and the design requirements of protective shielding are determined by the size and velocity of the fragments. Fragment velocity in hydrostatic testing is determined by the pressure, temperature and volume of the water. As test pressure requirements increase, the threat from fragment failures increases, as does the need to assure that shields protecting personnel are suitable for the task.

BakerRisk is unaware of any test data for fitting failures from high pressure tests. Current prediction methods are based on ballistic data developed by the US departments of Defense and Energy, the UK Health and Safety Executive and the American Society of Mechanical Engineers. The basic problem is that there is no specific data on:

• Fitting velocities for high pressures;

• Effectiveness of shields to provide protection from fitting impacts;

• Influence of elevated temperature (and flashing) on fitting velocities.

It is expected that developing this data will validate the predictive models used to estimate fitting velocities and the effectiveness of shielding. Results of the testing program may lead to improvements of the current methodologies used to calculate fragment hazards and shielding requirements.

The primary benefits of this study will be a validated and/or improved basis for the characterization of fitting hazards and cost-effective shielding requirements to protect personnel from fittings. The tests will produce data for the following:

• Evaluation of barrier effectiveness for fittings released from high pressure tests;

• Videos that may be used to illustrate and raise awareness of pressure test hazards;

• Validation of launch velocity and barrier thickness predictions.

TESTING PLAN

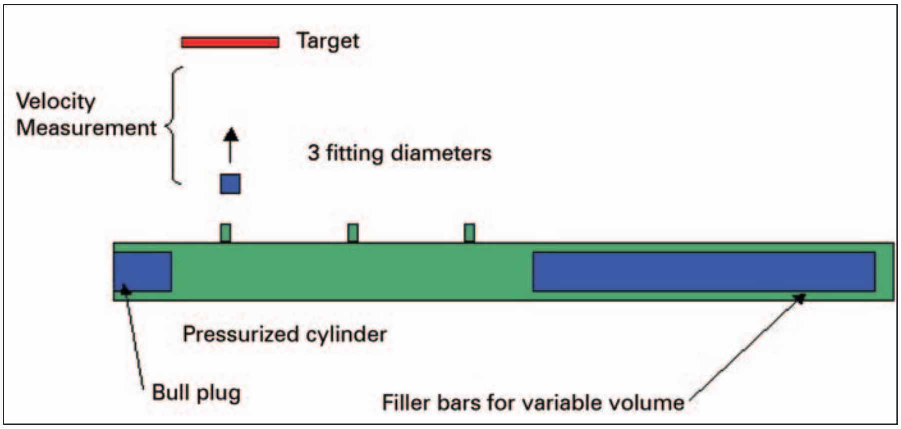
An apparatus for launching fittings

under hydrostatic pressure tests is being constructed at BakerRisk's San Antonio test range. All of the tests will be conducted in a controlled environment inside BakerRisk's test cubicle. The test equipment, shown schematically at right, will consist of about a 5-in. internal diameter by 6-ft long pipe that will be charged with water.

The water medium will be charged to pressures between 1,000 psi and 30,000 psi. The internal pipe volume will be altered using filler bars or other devices over a range of the full volume to ¼ volume. Provisions will be made to allow the pipe to be cleared of any air pockets. A total of 16 different conditions will be tested, each of which will be repeated 3 times, for a total of 48 tests.

Most of the tests will be conducted at ambient temperatures, but the pipe will be wrapped with heating tape to accommodate testing at elevated temperatures up to 450ºF. Three ports (¼-in. to 2-in. diameter) will be spaced along the pipe length. Fittings commonly used in the industry will be fastened to the ports and designed to disengage at a prescribed pressure. A bull plug will also be tested as a potential on-axis projectile for one of the tests.

Various types of targets (i.e., shields) will be evaluated, including steel plates, masonry walls (i.e., cinderblocks) and lexan windows (i.e., safety glass). The pipe will be charged with water and pressurized to a point at which the fittings will be released and thrown into the target plates. These targets will be oriented to receive a fitting impact and evaluated for penetration, perforation and back-face spalling response characteristics, as applicable. Break screens will be used to measure the velocity of the fittings. High-speed cameras will record the flight of the fittings and impact with the target plates.



The test equipment will consist of a 5-in. internal diameter by 6 ft long pipe charged with water.

DELIVERABLES, BUDGET, TIME

The primary deliverable from this study will be a report detailing the data from the experiments. The report will include a comparison between the data and current prediction methods. Based on the results of these tests, recommendations will be provided for shielding personnel from hydrostatic tests.

The fixed budget for this study is $75,000. The cost will be shared equally among the participating companies. The study will be completed in September 2006.

BakerRisk is the organizer and program manager of the Joint Industry Program, which has been organized to support this testing program. Currently there are 6 participants: **Baker Oil Tools**, **Cameron**, **FMC**, **Halliburton**, **Vetco Gray** and **Weatherford**.

The program began with a kickoff meeting on 2 March 2006. BakerRisk will host a review meeting at the conclusion of the study during which results will be presented to the Joint Industry Program participants. This review is tentatively scheduled for September 2006. The meetings are intended to allow open discussion of the study results and to promote the exchange of information among the Joint Industry Program participants. The meetings also will serve as a forum to propose and discuss additional topics of interest and concern for possible future work.

A technical report will be issued, the results of which will be proprietary to the participants. Other proprietary information in the form of software, presentations and videotapes may also be delivered for use by participants as part of the technical findings.

Companies interested in becoming a participant may request a copy of the prospectus and contract from BakerRisk.

POTENTIAL FUTURE PROGRAMS

The current program addresses fitting hazards from hydrostatic testing, which is only one concern when testing oilfield equipment at high pressures. The Joint Industry Program participants have expressed interest in possibly pursuing additional research programs to investigate other problems that are of concern. Some of these additional studies might include:

- Bull plugs that may be thrown as fragments;
- Splitting of the tool into 2 pieces, which can be thrown in opposite directions as fragments;
- Testing with gas (such as nitrogen), which can produce blast loads if a tool fails and cause fragments to be thrown at higher velocities than when testing with water;
- Effectiveness of other barrier or shield construction types.