High temp shearing blind rams exceed API specs

CAMERON DRILLING Systems of **Cooper Cameron Corporation** recently introduced several high temperature shearing blind rams (SBRs) for use in Cameron ram type blowout preventers. These high temperature and H2S resistant SBRs are considered a significant advance in drilling technology.

With the introduction of the high temperature and H2S resistant SBRs, drilling contractors are now offered a significant improvement in drilling safety when drilling at elevated temperatures or in high H2S environments, accordingto Cameron.

Shearing blind rams (SBRs) provide the drilling contactor the ability to shear drill pipe and at the same time seal the well bore in an emergency situation.

Under normal drilling situations, SBRs are designed to function as a blind ram and seals the BOP wellbore which does not contain the drill string or casing.

Cameron developed SBRs for the "U" type ram BOP in the late 1970's. The current series of SBRs are single piece shear rams with blades integral to the ram bodies.

The shearing function is integral with the rams, except in the case of the special rams required for H2S service.

With the introduction of the high temperature and H2S resistant SBRs, drilling contractors are now offered a significant improvement in drilling safety when drilling at elevated temperatures or in high H2S environments, Cameron says.

The elastomeric sealing elements on each ram are the side packers, top seals, and, on the upper ram subassembly, the blade packer or seal. On the H2S SBR, replaceable alloy blades are included.

In addition to the two SBR systems mentioned above, a dual string or "DS" SBR is also available that is capable of shearing multiple tubing strings and large diameter tubulars while maintaining a reliable wellbore pressure seal. This system is not intended as a replacement for the two SBR systems listed above.

Upon initial release of the SBRs, the elastomers used to fabricate the side packers and blade seals were certified for use in mineral oil based drilling muds up to 180°F and limited to 5% H2S.

As a result of a request by **Saudi Aramco** for SBRs suitable for higher temperature service in an H2S environment, Cameron embarked on a development program to manufacture and verify SBRs to meet these requirements.

Saudi Aramco requested SBR elastomers capable of operating for a sustained period of time at up to 350°F and up to 20% H2S.

To manufacture and certify SBR elastomers to meet these requirements, Cameron had to revert to special proprietary elastomer compounds that maintained sufficient strength to seal at 350°F and in high H2S concentrations.

The second issue to be considered was the verification testing criteria for the SBR elastomers. The metal components of the SBR system are capable of operating in the 350°F environment and in high levels of H2S.

The only remaining issue was the testing criteria that should be used in the verification testing.

The API 16A Second Edition criteria applicable for high temperature testing of non-metallic seals and molded assemblies as shown in 4.8.2 of Appendix C of the API document requires a rated pressure hold for one hour after the test articles have achieved a stabilized temperature.

For reasons related to their operations, Saudi Aramco required a longer pressure hold at the elevated temperature.

As a result, Cameron and Saudi Aramco mutually agreed upon a 3-hour pressure hold for all elevated temperature verification testing.

The testing protocol called for escalating temperature testing at 250°F, 300°F, and 350°F. The first phase of testing at each temperature was to successfully complete the API 16A Second Edition, Appendix C, section 4.8.2 one hour pressure hold, then continue on to the three hour pressure hold at the elevated temperature.

It is not safe nor practical to conduct full-scale high temperature BOP tests using H2S.

The H2S resistance of the elastomer compounds used to fabricate the blade and side packers and top seals have been verified under controlled laboratory conditions at Cameron Elastomer Technology and in full-scale field service evaluations.

In the field evaluation, ram packers and top seals molded from the elastomer compounds used in the test program were exposed to up to 35% H2S for 43 days at 190°F with negligible affect on the elastomers.

EQUIPMENT AND TEST SET UP

For testing, a Cameron 13⅝-in. 10,000 psi "U" BOP was selected. The BOP was mounted on a specially designed test "stump" which contained a high pressure stainless steel tubing coil that allowed the circulation of high temperature heat transfer oil in the BOP wellbore cavity.

After the rams containing the high temperature SBR elastomer were installed in the BOP, the wellbore cavity was filled with a synthetic hydrocarbon motor oil to simulate mineral oil based drilling mud.

The BOP wellbore was heated using an external oil heater and circulating the heat transfer oil through the heating coil inside the BOP.

An insulating box was constructed around the BOP body to minimize heat transfer from the BOP into the test area.

Data collection was carried out with a PC based data acquisition system using DasyLab® 5.6 software.

The test parameters monitored were wellbore pressure, BOP ram closing pressure, and temperature.

All test parameters were carefully monitored for appropriate losses and duration.

TEST PROTOCOL

The test protocol called for testing at three different elevated temperatures, 250°F, 300°F, and 350°F for different time durations.

The first phase of testing at each temperature level was the one-hour API 16A Second Edition pressure hold at temperature.

This was followed by a three-hour pressure hold at the same temperature.

At the 250°F temperature level the pressure hold time was extended to 8 hours rather than three hours. New blade packers, side packers and top seals were used at each temperature level.

In accordance with API requirements, a low-pressure test at 300 psi was conducted prior to conducting the 10,000 psi high-pressure hold test.

The packers in all of the tests continued to hold pressure until the conclusion of the testing.

BOP operating pressure was maintained at 1,500 psi to close the BOP rams.

Large bore shear bonnets were used on the 13-5/8-in. 10,000 psi "U" BOP to provide the required closure stroke for the rams and affect a seal of the SBR blade packer.

The testing of Cameron shearing blind ram elastomeric components (blade packer, side packers, and top seals) at 250°F, 300°F, and 350°F indicate a system that exceeds the requirements of API 16A Second Edition, Appendix C requirements.

This testing did not include exposure to H2S. However, Cameron Elastomer Technology notes that it has conducted extensive laboratory testing on CAMLAST and DUROCAM elastomer in high H2S environments.

Ram packers and top seals molded using CAMLAST elastomer have found extensive use in well control situations involving H2S of varying levels with no detrimental affect.

Based on the laboratory testing and field evaluation, Cameron believes the SBR blade, side packers and other high temperature elastomeric components used in this test are suitable for service in up to 35% H2S.

REFERENCE

This article was adapted from the technical paper "Qualification of High Temperature Shearing Blind Rams for Ram Type Blowout Precenters" by **Bruce G Parker**, Cameron Elastomer Technology, presented at IADC World Drilling 2002, held 5-6 June in Madrid, Spain.