

CAMERON TYPE U RAM BLOWOUT PREVENTER
REQUIRED SHEAR PRESSURE CALCULATION FORM

BY: R. M. Church, Jr.
Richard M. Church, Jr. P.E.

CUSTOMER: Hercules Offshore, Inc.

RIG: Hercules 265

LOCATION: E.C. 111, Well 2

DATE: 10-12-2011

OPERATOR: EPL

BOP Size: 13-5/8" Pressure: 10,000 psi

Bonnet Type: LBT (Large Bore Shear with Boosters) Booster size: 11" Ram Type used: ISR

Pipe / Tubular to Shear: 5" 19.5ppf S-135 (0.362" wall thickness)

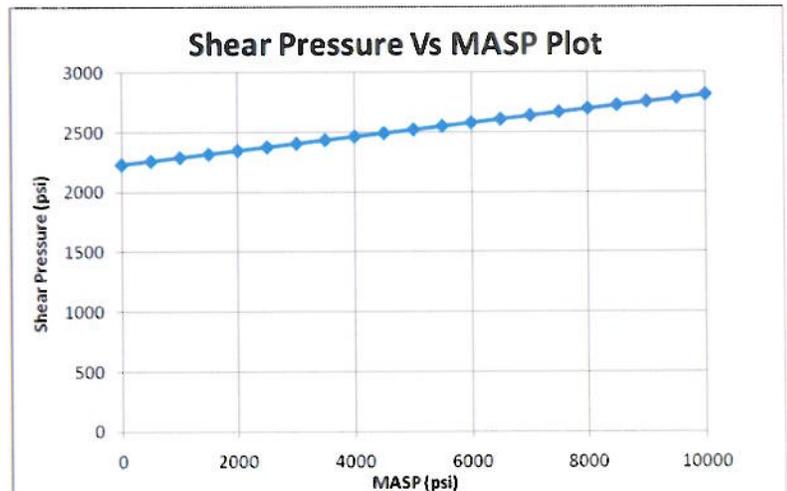
Maximum Allowable Operating Pressure of Bonnet: 3,000 psi

P_w (Wellbore Pressure at the time of the Shear): 6,127 psi

Is the pipe geometry acceptable per PD220-01, Section 5.0 and Cameron Engineering Bulletin EB 702 D? Yes

INPUT VARIABLES:

C₁= 224 BOP / Bonnet constant corresponding to the piston closing area
 C₂= 13 BOP / Bonnet constant corresponding to the piston rod opening area
 C₃= .19 Shear ram type/pipe grade constant
 ppf= 19.5 lbf/ft
 σ_{yield} = 135,000 Minimum Yield Strength of Pipe Material (psi)



Shear pressure, P_{Shear} is calculated using the following equation:

$$P_{\text{Shear}} = \left[\frac{(C_3)(ppf)(\sigma_{\text{yield}}) + (P_w)(C_2)}{C_1} \right]$$

P_{Shear} (Bonnet Shear Pressure) = 2,589 psi

Therefore, since P_{Shear} is less than the maximum allowable operator pressure, the BOP is acceptable for the shearing operation.

Hercules Offshore, Inc.
9 Greenway Plaza, Suite 2200
Houston, TX 77046

October 12, 2011

ATTENTION: George Kelley

RE: BOP shear ram verification for Hercules Offshore, Inc.

Shear testing of a 13-5/8" 10,000 psi W.P. Cameron Type U BOP equipped with large bore shear bonnets and shear boosters was conducted by Church Energy Services on 17th June 2010 (ref. ER 112B). The shear rams used were type ISR. The drill pipe used to shear was 5" 19.5 ppf S-135, .362" wall thickness. No wellbore pressure was used during the shearing operation. The calculated operating shear pressure was 2233 psi and the actual operating pressure required to shear the pipe was approximately 1000 psi (45 % of the calculated pressure). The maximum operating pressure of the BOP actuator was 3000 psi.

Church Energy Services also provided calculations to predict the pressure required to shear 5" 19.5 ppf S-135, .362" wall thickness drill pipe with wellbore pressure. The following information was utilized during calculations.

- Operator Name: EPL
- Well Name: E.C. 111, Well 2
- BOP Equipment: 13-5/8" 10,000 psi W.P. Cameron Type U BOP equipped with large bore shear bonnets and shear boosters with ISR rams.
- Drill Pipe: 5" 19.5 ppf S-135, .362" wall thickness
- MASP: 6,127 psi

The calculated pressure required to shear the above drill pipe with the MASP shown is 2589 psi. After review of the test results and calculations, Church Energy Services hereby certifies that the BOP would shear the pipe based on the calculations and test results from actual pipe shear tests performed as stated above for EPL's E.C. 111, Well 2. The shear rams as identified will shear the 5" 19.5 ppf S-135, .362" wall thickness drill pipe.

Factors affecting shear ram operating pressures:

Many factors contribute to a wide range of shearing forces required to shear drill pipe and wellbore tubular. These may include the pipe material strength, toughness and dimensional differences used in the pipe manufacture. Other factors that can affect shearing performance include the BOP's internal dimensions, which include wear, corrosion and drill bit/tool damage to the ram cavities.

If we can be of any other assistance, please let us know.



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CUSTOMER: Hercules Offshore, Inc.

RIG: Hercules 265

LOCATION: E.C. 111, Well 2

DATE: 10-12-2011

OPERATOR: EPL

BOP Size: 13-5/8" Pressure: 10,000 psi

Bonnet Type: LBT (Large Bore Shear with Boosters) Booster size: 11" Ram Type used: ISR

Pipe / Tubular to Shear: 3-1/2" 15.5ppf S-135 (0.449" wall thickness)

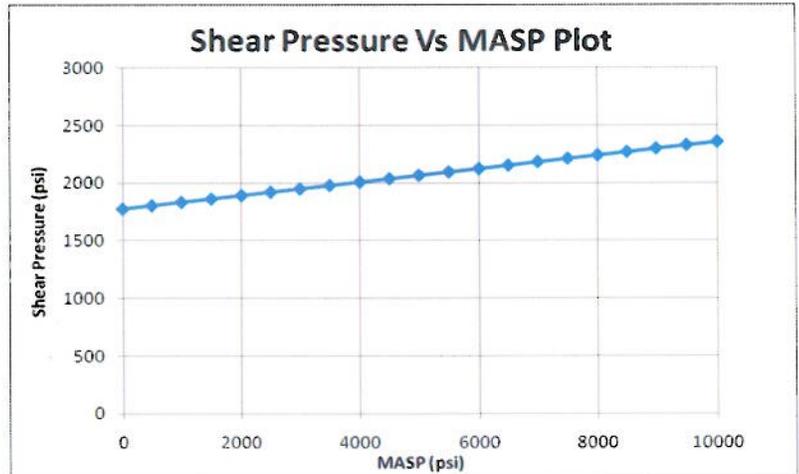
Maximum Allowable Operating Pressure of Bonnet: 3,000 psi

P_w (Wellbore Pressure at the time of the Shear): 6,127 psi

Is the pipe geometry acceptable per PD220-01, Section 5.0 and Cameron Engineering Bulletin EB 702 D? Yes

INPUT VARIABLES:

C₁= 224 BOP / Bonnet constant corresponding to the piston closing area
 C₂= 13 BOP / Bonnet constant corresponding to the piston rod opening area
 C₃= .19 Shear ram type/pipe grade constant
 ppf= 15.5 lbf/ft
 σ_{yield} = 135,000 Minimum Yield Strength of Pipe Material (psi)



Shear pressure, P_{Shear} is calculated using the following equation:

$$P_{\text{Shear}} = \left[\frac{(C_3)(ppf)(\sigma_{\text{yield}}) + (P_w)(C_2)}{C_1} \right]$$

P_{Shear} (Bonnet Shear Pressure) = 2,130 psi

Therefore, since P_{Shear} is less than the maximum allowable operator pressure, the BOP is acceptable for the shearing operation.

Hercules Offshore, Inc.
9 Greenway Plaza, Suite 2200
Houston, TX 77046

October 12, 2011

ATTENTION: George Kelley

RE: BOP shear ram verification for Hercules Offshore

Shear testing of a 13-5/8" 10,000 psi W.P. Cameron Type U BOP equipped with large bore shear bonnets and shear boosters was conducted by Church Energy Services on 17th June 2010 (ref. ER 112B). The shear rams used were type ISR. The drill pipe used to shear was 5" 19.5 ppf S-135, .362" wall thickness. No wellbore pressure was used during the shearing operation. The calculated operating shear pressure was 2233 psi and the actual pressure required to shear the pipe was approximately 1000 psi (45 % of the calculated pressure). The maximum operating pressure of the BOP actuator was 3000 psi.

A 3-1/2" 15.5 ppf S-135, .449" wall thickness drill pipe was reviewed and calculations were compared to the calculated shear pressure required for the 5" 19.5 ppf S-135, .362" wall thickness drill pipe. The 3-1/2" 15.5 ppf S-135, .449" wall thickness drill pipe was calculated to shear at approximately 1775 psi, 21% below the calculated shear pressure of 5" 19.5 ppf S-135, .362" wall thickness drill pipe. These calculations were performed with zero wellbore pressure.

Church Energy Services also provided calculations to predict the pressure required to shear 3-1/2" 15.5 ppf S-135, .449" wall thickness drill pipe with wellbore pressure. The following information was utilized during calculations.

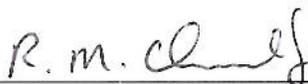
- Operator Name: EPL
- Well Name: E.C. 111, Well 2
- BOP Equipment: 13-5/8" 10,000 psi W.P. Type U BOP with large bore shear bonnets and shear boosters with ISR rams
- Drill pipe: 3-1/2" 15.5 ppf S-135, .449" wall thickness
- MASP: 6127 psi

The calculated pressure required to shear the above drill pipe with the MASP shown is 2130 psi. After review of the test results and calculations, Church Energy Services hereby certifies that the BOP would shear the pipe based on the calculations and test results from pipe that would require a higher shear pressure for EPL's E.C. 111, Well 2. The shear rams as identified will shear the 3-1/2" 15.5 ppf S-135, .449" wall thickness drill pipe.

Factors affecting shear ram operating pressures:

Many factors contribute to a wide range of shearing forces required to shear drill pipe and wellbore tubular. These may include the pipe material strength, toughness and dimensional differences used in the pipe manufacture. Other factors that can affect shearing performance include the BOP's internal dimensions, which include wear, corrosion and drill bit/tool damage to the ram cavities.

If we can be of any other assistance, please let us know.



Richard M. Church, Jr. P.E.
Vice President of Engineering and Quality