WEST ENGINEERING SERVICES

Shear Verification Packet

For

ENSCO 8506

DC 491 #1 ST01 BP00

Job Number: 5703

24 May 2013

P.O. Box 577
Brookshire, TX 77423
U.S.A

WEST ENGINEERING SERVICES
ISO 9001 Certified

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west@westengineer.com

Mr. Steve Woelfel
Drilling Operations Manager
Anadarko Petroleum

24 May 2013

Subject: *ENSCO 8506*, DC 491 #1 ST01 BP00
Reference: Shear Verification per 30 CFR §250.416(e)

Dear Mr. Woelfel:

Please find attached the Blind-Shear Ram Verification and related documents for the *ENSCO 8506*. The calculations were carried out according to the GE Oil & Gas Method and the Distortion Energy Method detailed in *Shear Ram Capabilities Study* No. 3-4025-1001 for the U.S. Minerals Management Service (now BOEMRE). Background equations used for the calculations are shown on each shear calculation spreadsheet near the required shear pressure output cells. Additionally, relevant shear test documentation is included. Should you have any questions or concerns, please feel free to contact us.

Based on the client supplied input data, actual shear test report values and WEST shear calculations, the verified pipe is the hardest pipe to shear in this well program; therefore, the verified pipe also qualifies the other pipe sizes. WEST has used the submitted MASP for calculations and also considers this verification valid for any MASP of lower value. Only pipe from the specified heat treatment batches are verified.

Transmitted via email
Sincerely,

E. G. (Greg) Childs
for WEST Engineering Services, Texas Registration No. F-4672

WEST Job Number: 5703

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Blind-Shear Ram Verification

In accordance with 30 CFR §250.416(e), **Verification that Blind-shear Rams will Shear Pipe in the Hole,** this certificate verifies that, based on cited calculation method, data provided to West Engineering, and actual testing, the equipment listed below is capable of shearing the specified pipe.

NOTE – Verification is only valid for fully functional equipment maintained according to manufacturers and API requirements and operated within design and testing standards as specified within API Specification 16A. This verification requires the same BOP equipment (i.e., blind-shear rams of the same make, model, and size as proposed for the operation) is utilized in all cases. WEST has verified the calculation case as described below; calculations are based on client Input Data Sheet found as Section 5. Verification is not considered valid if the actual case on the rig differs from the calculation case described in this packet.

Client:	Anadarko Petroleum
West Job Number:	5703
Rig:	*ENSCO 8506*
Operator:	Anadarko Petroleum
Contractor:	Ensco
Well:	DC 491 #1, ST01 BP00
Depth (ft):	8,167
EQUIPMENT / CALCULATION INFORMATION	
BOP:	Hydril 18-3/4" – 15K BOP w/ MPL
Type of Shear Operator:	22" Operator
Type of Shear Ram:	BSR (Blind Shear Ram)
Hydraulic Pressure Rating of Operator:	5,000 psi
Hydraulic Pressure Supplied to Operator:	5,000 psi
Maximum Wellbore Pressure at BOP:	9,870 psi
Tested Pipe: See Section 4	6.625" OD, 0.938" wall, V-150
Verified Pipe: See Section 3	6.625" OD, 0.625" wall, S-135
Verified Pipe Yield Strength:	135,000 psi
Verified Tubular Theoretical Shear Pressure Corrected for Wellbore Pressure & Hydrostatic Effects:	3,278 psi
Calculation Method:	Distortion Energy Method detailed in *Shear Ram Capabilities Study* No. 3-4025-1001 for the MMS and GE Oil & Gas Method
Approved Heat Numbers from Presented MTR:	**6.625" OD, 0.813" wall, Z-140:**, 25045, 97677,98475, F0747, F0925 & F0927 from PO 10013-0000231566 **6.625" OD, 0.813" wall, S-135:**, Y1864 & Y1865 from PO 171045-WS-04-4 **6.625" OD, 0.625" wall, V-150:** U21873 & U21876 from PO 10013-0000231566
Unapproved Heat Numbers from Presented MTR:	None

Calculations Performed by: Ted Cole Date: 25 May 2013

Calculations Approved by: Covey Hall Date: 25 May 2013

Verification Approval: Date: 25 May 2013

E. G. (Greg) Childs

for WEST Engineering Services, Texas Registration No. F-4672

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Theoretical Results obtained by stated calculation method,
corrected for MASP and Hydrostatic Effects
Source: Client Input Data Sheet; Section 5

Summary Table of Calculated Theoretical Results:

Pipe	Ultimate Tensile Strength [psi]	% Elong	MASP [psi]	Shear Pressure [psi]	Comment
6.625” OD, 0.938” wall, V-150	173,475	19.8	9,870	3,812	Tested Pipe
6.625” OD, 0.625” wall, S-135	N/A	N/A	9,870	3,278	Verified Pipe
6.625” OD, 0.813” wall, Z-140	170,440	19.1	9,870	3,273	Qualified by verified pipe
6.625” OD, 0.813” wall, S-135	167,900	19.0	9,870	3,216	Qualified by verified pipe
6.625” OD, 0.522” wall, S-135	N/A	N/A	9,870	2,849	Qualified by verified pipe
6.625” OD, 0.625” wall, V-150	171,640	20.9	9,870	2,830	Qualified by verified pipe
5” OD, 0.362” wall, S-135	N/A	N/A	9,870	1,704	Qualified by verified pipe

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Theoretical Results obtained by stated calculation method,
corrected for MASP and Hydrostatic Effects
Source: Client Input Data Sheet; Section 5

Summary Table of Calculated Theoretical Results:

Pipe	MASP [psi]	Shear Pressure [psi]	Comment
6.625” OD, 0.938” wall, V-150	9,870	3,812	Tested Pipe
6.625” OD, 0.625” wall, S-135	9,870	3,278	Verified Pipe
6.625” OD, 0.813” wall, Z-140	9,870	3,273	Qualified by verified pipe
6.625” OD, 0.813” wall, S-135	9,870	3,216	Qualified by verified pipe
6.625” OD, 0.522” wall, S-135	9,870	2,849	Qualified by verified pipe
6.625” OD, 0.625” wall, V-150	9,870	2,830	Qualified by verified pipe
5” OD, 0.362” wall, S-135	9,870	1,704	Qualified by verified pipe

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Tested Pipe Results obtained from Shear Test Report,
corrected for MASP and Hydrostatic Effects
Source: Shear Test Report; Section 7

Summary of Table of Tested Pipe Results:

Tested Pipe:	6.625” OD, 0.938” wall, V-150
Tested Pipe Ultimate Tensile Strength:	173,475 psi
Tested Pipe Elongation:	19.8%
Tested Pipe Actual Shear Pressure:	3,160 psi
Tested Pipe Actual Shear Pressure Corrected for Wellbore Pressure and Hydrostatic Effects:	3,588 psi
Tested Pipe Theoretical Shear Pressure Corrected for Wellbore Pressure and Hydrostatic Effects:	3,812 psi

WEST ENGINEERING SERVICES

Shear Calculation Input Data

WEST is preparing to perform shear verification as required by 30 CFR §250.416(e).
Please input information where indicated in the template below and return to WEST Engineering Services via email to **ntl@westengineer.com or your direct contact at WEST. Please enter data carefully, as any subsequent changes may have cost & schedule impact.**

- If the requested data is not relevant, please enter "N/A" for Not Applicable.

Equipment	
BOP Original Equipment Manufacturer (Shaffer, Cameron, etc.)	Hydril (GE)
Ram BOP Model Designation (U, TL, SL, SLX etc.)	18-15 Compact Ram BOP
BOP Size and Pressure Rating (18 3/4" - 15K, etc.)	18-3/4" - 15,000 psi
Shear Operator Size and BoosterConfiguration or Bonnet Size (22", SBT, LBT)	22"
Shear Ram Type (Ram Design)	Blind Shear
Shear Operator Closing Area (if non-Cameron) [sq. inches]	380
Shear Operator Closing Ratio (if non-Cameron)	14.64
Control Fluid Pressure Gradient [psi/ft]*	0.442
Seawater Pressure Gradient [psi/ft]*	0.445
Elevation of HPU above Sea Level [ft]**	50
Hydraulic Pressure Supplied to Operator on Closing Side [psi]	5,000
Bonnet Hydraulic Pressure Rating (psi)	5,000

Tubular Information Required (include work string and tubing, if applicable)

No.	Pipe OD [in]	Pipe ID [in]	Wall Thickness [in]	Pipe Weight per Foot [ppf]	Pipe Grade (e.g. S-135)	Yield Strength (Nominal) [ksi]	Comments
1	5.000	4.276	0.362	19.50	S-135	135,000	Drilling string
2	6.625	5.581	0.522	34.00	S-135	135,000	Drilling string
3	6.625	5.375	0.625	40.00	V-150	150,000	Drilling string
4	6.625	5.375	0.625	40.00	S-135	135,000	Drilling string (rental)
5	6.625	4.999	0.813	64.00	S-135	135,000	Drilling string (rental)
6	6.625	4.999	0.813	64.00	Z-140	140,000	Landing string
7							

Well Information	
Existing WEST Job # or New Purchase Order No. (if new job) ***	Job 5703 AFE 2058362.DRL / User ZRYQ1
Rig Name	*ENSCO 8506*
Drilling Contractor (rig owner)	ENSCO
Operator (oil company)	Anadarko Petroleum Corporation
Well Name	DC 491 #1 ST01 BP00
Water Depth [ft]*	8,167'
MASP (Maximum Anticipated Surface Pressure) [psi]	9,870 (MAWP)

* This is necessary to accurately calculate the hydrostatic head.
** The marine or barge dept. should be able to provide this information
*** - FR# if PO# is unavailable

Steve Woelfel

Information provided by (please print name above)

Date

Requested Delivery Date for Shear Certification: 11/16/2012

Date

Your service request will be picked up as soon as team member availability allows. However, you should not expect turn around for shear verification requests within less than 7 days.
Also, please note that subsequent changes to input data are likely to delay certification.

Rev - 20120405jeh

Section 6.a.1
Hydril 18-15M BOP BSR, 22" Operator
Test Pressure Corrected for MASP & Hydrostatic
6.625 in. OD, 0.938 in. Wall Thickness, V-150

Change in Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_a - Actual Shear Pressure from Test

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

$= MASP / C_r$

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects*

P_t - Total Shear Pressure $= P_a + P_i + \Delta P_{hyd}$

P_a [psi]	3160	
MASP [psi]	9870	
C_r	14.64	
Increase in Shear Press., P_i	674	psi
Hydrostatic Effect, ΔP_{hyd}	-246	psi
Total Shear Pressure, P_t	3,588	psi

Input

Output

* Calculations shown on a separate sheet

Section 6.a.2
Hydril 18-15M BOP BSR, 22" Operator
6.625 in. OD, 0.938 in. Wall Thickness, V-150

Maximum/Theoretical Drill Pipe Shear Pressure

WEST Engineering Services

$$Fv = 2.31\pi Wall(OD-Wall)(5/OD)^{0.35}\ \sigma_u(Elong\%)^{0.96}$$

A_g - Pipe Cross-Sectional Area = $(OD^2 - ID^2) \times 3.14 / 4$

σ_u - Ultimate Tensile Strength

Elong % - Percent Elongation

$P_r = F_v / A_c$

	Closing Area, A_c	380	in^2			
Pipe	OD [in]	6.625		A_g =	16.759	in^2
	Wall [in]	0.938				
	σ_u [ksi]	173.5				
	Elongation [%]	19.8				
	Required Force, F_v =	1,286	kips	Input		
	Required Pressure, P_r =	3,383	psi	Output		

Increased Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_r - Required Shear Pressure (calculated above)

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

$= MASP / C_r$

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects*

P_t - Total Shear Pressure = $P_r + P_i + \Delta P_{hyd}$

MASP [psi]	9,870		Input
C_r	14.64		Output
Increase in Shear Press., P_i	674	psi	
Hydrostatic Effect, ΔP_{hyd}	-246	psi	
Total Shear Pressure, P_t	3,812	psi	

* Calculations shown on a separate sheet

Section 6.b.1
Hydril 18-3/4"-15K 22" Operator, BSR
6.625 in. OD, 0.625 in. wall, S-135

Maximum/Theoretical Drill Pipe Shear Pressure

WEST Engineering Services

$F_v = (1.18)(0.577)A_g\sigma_y$

A_g - Pipe Cross-Sectional Area = $(OD^2 - ID^2) \times 3.14 / 4$

σ_y - Stated Yield Strength*

$P_r = F_v / A_c$

	Closing Area, A_c	380	in^2		
Pipe	OD [in]	6.625	A_g =	11.781	in^2
	Wall [in]	0.625			
	σ_y [ksi]	135			
	Required Force, F_v =	1,083	kips	Input	
	Required Pressure, P_r =	2,850	psi	Output	

Change in Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_r - Required Shear Pressure (calculated above)

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

$= MASP / C_r$

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects**

P_t - Total Shear Pressure = $P_r + P_i + \Delta P_{hyd}$

MASP [psi]	9870		Input
C_r	14.64		Output
Increase in Shear Press., P_i	674	psi	
Hydrostatic Effect, ΔP_{hyd}	-246	psi	
Total Shear Pressure, P_t	3,278	psi	

* Stated Yield Strength is the client-reported pipe yield stress, generally the nominal yield stress corresponding to pipe grade (135 ksi for S-135).

** Calculations shown on a separate sheet

Section 6.b.2
Hydril 18-15M BOP BSR, 22" Operator
6.625 in. OD, 0.813 in. Wall Thickness, Z-140

Maximum/Theoretical Drill Pipe Shear Pressure

WEST Engineering Services

$$Fv = 2.31\pi Wall(OD-Wall)(5/OD)^{0.35}\ \sigma_u(Elong\%)^{0.96}$$

A_g - Pipe Cross-Sectional Area = $(OD^2 - ID^2) \times 3.14 / 4$

σ_u - Ultimate Tensile Strength

Elong % - Percent Elongation

$$P_r = F_v / A_c$$

	Closing Area, A_c	380	in^2			
Pipe	OD [in]	6.625		A_g =	14.845	in^2
	Wall [in]	0.813				
	σ_u [ksi]	170.4				
	Elongation [%]	19.1				
	Required Force, F_v =	1,081	kips	Input		
	Required Pressure, P_r =	2,844	psi	Output		

Increased Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_r - Required Shear Pressure (calculated above)

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

$= MASP / C_r$

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects*

P_t - Total Shear Pressure = $P_r + P_i + \Delta P_{hyd}$

MASP [psi]	9,870		Input
C_r	14.64		Output
Increase in Shear Press., P_i	674	psi	
Hydrostatic Effect, ΔP_{hyd}	-246	psi	
Total Shear Pressure, P_t	3,273	psi	

* Calculations shown on a separate sheet

Section 6.b.3
Hydril 18-15M BOP BSR, 22" Operator
6.625 in. OD, 0.813 in. Wall Thickness, S-135

Maximum/Theoretical Drill Pipe Shear Pressure

WEST Engineering Services

$Fv = 2.31\pi Wall(OD-Wall)(5/OD)^{0.35}\ \sigma_u(Elong\%)^{0.96}$

A_g - Pipe Cross-Sectional Area = $(OD^2 - ID^2) \times 3.14 / 4$

σ_u - Ultimate Tensile Strength

Elong % - Percent Elongation

$P_r = F_v / A_c$

	Closing Area, A_c	380	in^2		
Pipe	OD [in]	6.625	A_g =	14.845	in^2
Pipe	Wall [in]	0.813			
Pipe	σ_u [ksi]	167.9			
	Elongation [%]	19.0			
	Required Force, F_v =	1,059	kips	Input	
	Required Pressure, P_r =	2,788	psi	Output	

Increased Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_r - Required Shear Pressure (calculated above)

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

$= MASP / C_r$

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects*

P_t - Total Shear Pressure = $P_r + P_i + \Delta P_{hyd}$

MASP [psi]	9,870		Input
C_r	14.64		Output
Increase in Shear Press., P_i	674	psi	
Hydrostatic Effect, ΔP_{hyd}	-246	psi	
Total Shear Pressure, P_t	3,216	psi	

* Calculations shown on a separate sheet

Section 6.b.4
Hydril 18-3/4"-15K 22" Operator, BSR
6.625 in. OD, 0.522 in. wall, S-135

Maximum/Theoretical Drill Pipe Shear Pressure

WEST Engineering Services

$F_v = (1.18)(0.577)A_g\sigma_y$

A_g - Pipe Cross-Sectional Area = $(OD^2 - ID^2) \times 3.14 / 4$

σ_y - Stated Yield Strength*

$P_r = F_v / A_c$

	Closing Area, A_c	380	in^2		
Pipe	OD [in]	6.625	A_g =	10.008	in^2
	Wall [in]	0.522			
	σ_y [ksi]	135			
	Required Force, F_v =	920	kips	Input	
	Required Pressure, P_r =	2,421	psi	Output	

Change in Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_r - Required Shear Pressure (calculated above)

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

= MASP / C_r

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects**

P_t - Total Shear Pressure = $P_r + P_i + \Delta P_{hyd}$

MASP [psi]	9870		Input
C_r	14.64		Output
Increase in Shear Press., P_i	674	psi	
Hydrostatic Effect, ΔP_{hyd}	-246	psi	
Total Shear Pressure, P_t	2,849	psi	

* Stated Yield Strength is the client-reported pipe yield stress, generally the nominal yield stress corresponding to pipe grade (135 ksi for S-135).

** Calculations shown on a separate sheet

Section 6.b.5
Hydril 18-15M BOP BSR, 22" Operator
6.625 in. OD, 0.625 in. Wall Thickness, V-150

Maximum/Theoretical Drill Pipe Shear Pressure

WEST Engineering Services

$$Fv = 2.31\pi Wall(OD-Wall)(5/OD)^{0.35}\ \sigma_u(Elong\%)^{0.98}$$

A_g - Pipe Cross-Sectional Area = $(OD^2 - ID^2) \times 3.14 / 4$

σ_u - Ultimate Tensile Strength

Elong % - Percent Elongation

$P_r = F_v / A_c$

	Closing Area, A_c	380	in^2			
Pipe	OD [in]	6.625		A_g =	11.781	in^2
Pipe	Wall [in]	0.625				
Pipe	σ_u [ksi]	171.6				
	Elongation [%]	20.9				
	Required Force, F_v =	913	kips	Input		
	Required Pressure, P_r =	2,402	psi	Output		

Increased Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_r - Required Shear Pressure (calculated above)

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

$= MASP / C_r$

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects*

P_t - Total Shear Pressure = $P_r + P_i + \Delta P_{hyd}$

MASP [psi]	9,870		Input
C_r	14.64		Output
Increase in Shear Press., P_i	674	psi	
Hydrostatic Effect, ΔP_{hyd}	-246	psi	
Total Shear Pressure, P_t	2,830	psi	

* Calculations shown on a separate sheet

Section 6.b.6
Hydril 18-3/4"-15K 22" Operator, BSR
5.000 in. OD, 0.362 in. wall, S-135

Maximum/Theoretical Drill Pipe Shear Pressure

WEST Engineering Services

$F_v = (1.18)(0.577)A_g\sigma_y$

A_g - Pipe Cross-Sectional Area = $(OD^2 - ID^2) \times 3.14 / 4$

σ_y - Stated Yield Strength*

$P_r = F_v / A_c$

	Closing Area, A_c	380	in^2		
Pipe	OD [in]	5	A_g =	5.275	in^2
Pipe	Wall [in]	0.362			
Pipe	σ_y [ksi]	135			
	Required Force, F_v =	485	kips	Input	
	Required Pressure, P_r =	1,276	psi	Output	

Change in Shear Pressure due to MASP & Hydrostatic Effects

WEST Engineering Services

P_r - Required Shear Pressure (calculated above)

MASP - Maximum Anticipated Surface Pressure (in BOP)

C_r - BOP Closing Ratio (from table)

P_i - Increased Shear Pressure due to Pressure in the Wellbore

$= MASP / C_r$

ΔP_{hyd} - Change in Shear Pressure due to Hydrostatic Effects**

P_t - Total Shear Pressure = $P_r + P_i + \Delta P_{hyd}$

MASP [psi]	9870		Input
C_r	14.64		Output
Increase in Shear Press., P_i	674	psi	
Hydrostatic Effect, ΔP_{hyd}	-246	psi	
Total Shear Pressure, P_t	1,704	psi	

* Stated Yield Strength is the client-reported pipe yield stress, generally the nominal yield stress corresponding to pipe grade (135 ksi for S-135).

** Calculations shown on a separate sheet

Section 6.c

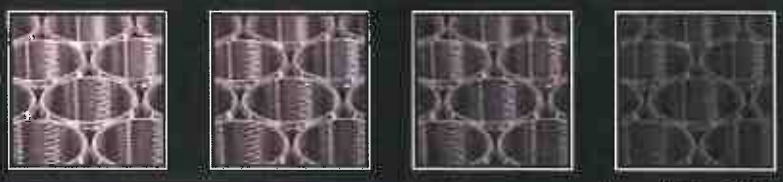
Change in Closing Pressure due to Hydrostatic Head of Control Fluid & Seawater

WEST Engineering Services

Variable	Description	Formula	Value	Units
A_t	Tailrod Area		0.00	in^2
A_c	Closing Area		380.00	in^2
A_r	Ramshaft Area	A_c/C_r	25.96	in^2
A_o	Opening Area	$(A_c + A_t) - A_r$	354.04	in^2
C_r	Closing Ratio		14.640	
G_{cf}	Control Fluid Pressure Gradient		0.442	psi/ft
H_{hpu}	Height of Hydraulic Pressure Unit Above Sea Level		50	ft
H_{cf}	Height of Control Fluid Column	$H_{sw} + H_{hpu}$	8217	ft
G_{sw}	Seawater Pressure Gradient		0.445	psi/ft
H_{sw}	Height of Seawater Column (water depth to BOP)		8167	ft
P_{cf}	Pressure due to Hydrostatic Head of Control Fluid	$G_{cf} * H_{cf}$	3,632	psi
P_{sw}	Pressure due to Hydrostatic Head of Seawater	$G_{sw} * H_{sw}$	3,634	psi
F_{Osw}	Opening Force due to Seawater Head on Operator	$P_{sw} * A_o$	1,286,706	lb
F_{Ccf}	Closing Force due to Control Fluid Head on Operator	$P_{cf} * A_c$	1,380,127	lb
F_{Ctr}	Closing Force due to Seawater Head on Tailrod	$P_{sw} * A_t$	0	lb
ΔP_{hyd}	Change in Closing Pressure due to Hydrostatics	$(F_{Osw} - F_{Ccf} - F_{Ctr})/A_c$	-246	psi

Input
Output

NOV Grant Prideco™



June 28, 2012

Quality Documentation Package

Customer: ENSCO

Purchase Order Number: 10013-0000231566

Sales Order Number: 1000103473

6-5/8"OD .813" WT "H-SERIES" IEU UPSET RANGE 2 GRADE Z-140 DRILL STRING WITH (6-5/8 FH)PIN 8-3/4"OD X 3-1/2"ID 12" TONG SPACE WITH NO HARDBANDING & WITH H-SERIES BENCHMARKS AND (6-5/8 FH)BOX 8-3/4"OD X 3-1/2"ID 15" TONG SPACE WITH NO HARDBANDING & WITH H-SERIES BENCHMARKS WITH 6.907" OD X 72" LONG SLIP-PROOF SECTION

NOV GRANT PRIDECO
NAVASOTA, TX USA

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QUALITY NOV Grant Prideco

Certificate of Testing for Drill Pipe - 1

Mill Chemistry

Mill	Type	Heat No.	C	MN	P	S	SI	CU	NI	CR	MO	V	B	AL
Timken	Heat	25045	0.290	0.790	0.0070	0.0030	0.270	0.180	0.160	1.310	0.690			0.022
Timken	Product	25045	0.290	0.810	0.0060	0.0020	0.280	0.180	0.150	1.340	0.700	0.000	0.0000	0.024
Timken	Heat	25045	0.260	0.800	0.0090	0.0040	0.250	0.180	0.150	1.330	0.680	0.010	0.0003	0.017
Timken	Heat	97677	0.310	0.840	0.0080	0.0030	0.260	0.190	0.130	1.280	0.670			0.024
Timken	Heat	97677	0.290	0.820	0.0090	0.0040	0.250	0.180	0.130	1.277	0.640	0.007	0.0003	0.019
Timken	Product	97677	0.290	0.820	0.0080	0.0020	0.270	0.180	0.140	1.280	0.590			0.023
Timken	Heat	98475	0.270	0.760	0.0130	0.0040	0.260	0.220	0.120	1.350	0.690			0.028
Timken	Product	98475	0.280	0.770	0.0130	0.0030	0.280	0.210	0.120	1.360	0.690			0.024
Timken	Heat	98475	0.270	0.780	0.0150	0.0040	0.250	0.220	0.120	1.370	0.670	0.010	0.0004	0.019

Mechanical Test Data

Specimen	Position	Size	Heat No.	Lot No.	Tensile PSI	Yield PSI	Elong %	RA %
Upset	22	0.500"	25045		169930.0	156580.0	19.5	60.9
Tube	22	0.500"	25045		170440.0	158643.0	19.1	
Tube	8	0.500"	97677		167810.0	156623.0	18.0	
Upset	8	0.500"	97677		168400.0	157665.0	18.1	59.3
Upset	217	0.500"	98475		160640.0	150938.0	20.2	63.3
Tube	217	0.500"	98475		167580.0	156681.0	18.2	
					150 KSI MIN	140-160 KSI		

Longitudinal Charpy-V Notch Impact Data (FT-LBS)

Size (mm)	Temp (F)	Heat No.	Position	A	B	C	Avg	Shear(%)
10 x 7.5 mm	-4 F	25045	22	56.0	57.0	55.0	56.0	70.0
10 x 7.5 mm	-4 F	97677	8	55.0	55.0	56.0	55.3	70.0
10 x 7.5 mm	-4 F	98475	217	58.0	55.0	56.0	56.3	93.0
55 FT-LBS AVG 3/4 SIZE @ -4F								

Grain Size: 6 or Finer

All properties meet the requirements of API Specification 5DP, Latest Edition, Ensco Specification ST-CO-ENG-EQP-001 Rev 11, 12/14/10, NS-1 SPEC. REV 9 6/2007, and NOV Grant Prideco Specification for Grade Z-140. I certify that these tests were conducted in accordance with applicable specifications and that the data contained herein is true and correct.

Lisa Bates

NOV Grant Prideco Representative

June 28, 2012

Date

Customer: ENSCO

Date: June 28, 2012

Sales Order #: 1000103473

Purchase Order #: 10013-0000231566

Description: 6-5/8"OD .813" WT "H-SERIES" IEU UPSET RANGE 2 GRADE Z-140 DRILL STRING WITH (6-5/8 FH)PIN 8-3/4"OD X 3-1/2"ID 12" TONG SPACE WITH NO HARDBANDING & WITH H-SERIES BENCHMARKS AND (6-5/8 FH)BOX 8-3/4"OD X 3-1/2"ID 15" TONG SPACE WITH NO HARDBANDING & WITH H-SERIES BENCHMARKS WITH 6.907" OD X 72" LONG SLIP-PROOF SECTION

Certificate of Testing for Drill Pipe - 1

Mill Chemistry

Mill	Type	Heat No.	C	MN	P	S	SI	CU	NI	CR	MO	V	B	AL
Timken	Heat	F0747	0.260	0.820	0.0050	0.0020	0.310	0.210	0.130	1.280	0.650	0.000	0.0000	0.030
Timken	Product	F0747	0.260	0.820	0.0050	0.0020	0.310	0.210	0.130	1.280	0.650	0.000	0.0000	0.028
Timken	Heat	F0747	0.280	0.820	0.0130	0.0040	0.330	0.210	0.100	1.279	0.630	0.008	0.0007	0.025
Timken	Heat	F0925	0.280	0.840	0.0060	0.0020	0.270	0.190	0.140	1.310	0.650			0.027
Timken	Heat	F0925	0.270	0.810	0.0080	0.0050	0.270	0.180	0.140	1.291	0.640	0.009	0.0006	0.026
Timken	Product	F0925	0.270	0.830	0.0060	0.0020	0.270	0.190	0.140	1.310	0.660	0.000	0.0000	0.026
Timken	Heat	F0927	0.270	0.810	0.0080	0.0020	0.280	0.210	0.110	1.370	0.650			0.024
Timken	Product	F0927	0.270	0.800	0.0080	0.0020	0.280	0.210	0.110	1.360	0.660	0.000	0.0000	0.024
Timken	Heat	F0927	0.280	0.810	0.0060	0.0030	0.280	0.210	0.110	1.375	0.660	0.009	0.0005	0.021

Mechanical Test Data

Specimen	Position	Size	Heat No.	Lot No.	Tensile PSI	Yield PSI	Elong %	RA %
Upset	43	0.500"	F0747		158500.0	148088.0	19.9	64.5
Tube	43	0.500"	F0747		160280.0	149758.0	18.4	
Upset	178	0.500"	F0747		159040.0	146688.0	19.5	63.5
Tube	178	0.500"	F0747		161270.0	150969.0	19.8	
Upset	9	0.500"	F0925		162270.0	150146.0	19.1	65.2
Tube	9	0.500"	F0925		162320.0	150770.0	18.8	
Upset	83	0.500"	F0927		162690.0	150855.0	18.8	61.5
Tube	83	0.500"	F0927		162950.0	150921.0	19.6	
					150 KSI MIN	140-160 KSI		

Longitudinal Charpy-V Notch Impact Data (FT-LBS)

Size (mm)	Temp (F)	Heat No.	Position	A	B	C	Avg	Shear(%)
10 x 7.5 mm	-4 F	F0747	43	67.0	70.0	66.0	67.7	80.0
10 x 7.5 mm	-4 F	F0747	178	62.0	63.0	64.0	63.0	90.0
10 x 7.5 mm	-4 F	F0925	9	58.0	56.0	56.0	56.7	80.0
10 x 7.5 mm	-4 F	F0927	83	57.0	57.0	56.0	56.7	50.0
50 FT-LBS AVG. 3/4 SIZE @ -4F								

Grain Size: 6 or Finer

All properties meet the requirements of API Specification 5DP, Latest Edition, Ensco Specification ST-CO-ENG-EQP-001 Rev 11, 12/14/10, NS-1 SPEC. REV 9 6/2007, and NOV Grant Prideco Specification for Grade Z-140. I certify that these tests were conducted in accordance with applicable specifications and that the data contained herein is true and correct.

Lisa Bates

NOV Grant Prideco Representative

June 28, 2012

Date

Customer: ENSCO

Date: June 28, 2012

Sales Order #: 1000103473

Purchase Order #: 10013-0000231566

Description: 6-5/8"OD .813" WT "H-SERIES" IEU UPSET RANGE 2 GRADE Z-140 DRILL STRING WITH (6-5/8 FH)PIN 8-3/4"OD X 3-1/2"ID 12" TONG SPACE WITH NO HARDBANDING & WITH H-SERIES BENCHMARKS AND (6-5/8 FH)BOX 8-3/4"OD X 3-1/2"ID 15" TONG SPACE WITH NO HARDBANDING & WITH H-SERIES BENCHMARKS WITH 6.907" OD X 72" LONG SLIP-PROOF SECTION

GRANTPRIDECO

March 09, 2004

Quality Documentation Package

Customer: MITSUI TUBULAR PRODUCTS INC

Purchase Order Number: 171045 - WS-04-4

Sales Order Number: 1000006660

6-5/8" OD 50.46 LB.0.813 WT. "H-SERIES" IEU UPSET RANGE 2 GRADE S-135 DRILL STRING

WS 43-01F
NP84986-NP85167
182 Js.

Certificate of Testing for Drill Pipe

Mill Chemistry

Mill	Type	Heat No.	C	MN	P	S	SI	CU	NI	CR	MO	V	B	AL
Timken	Product	Y1864	0.280	0.820	0.006	0.002	0.250	0.210	0.140	1.400	0.650	0.000	0.0000	0.030
Timken	Product	Y1865	0.280	0.820	0.007	0.002	0.280	0.210	0.110	1.420	0.660	0.000	0.0000	0.030

Mechanical Test Data

Specimen	Position	Size	Heat No.	Lot No.	Tensile PSI	Yield PSI	Elong %	RA %
Upset	19	0.500"	Y1864		158300.0	145815.0	17.1	60.8
Tube	19	0.500"	Y1864		157020.0	146205.0	18.3	66.6
Upset	183	0.500"	Y1865		166210.0	152617.0	16.7	58.8
Upset	84	0.500"	Y1865		151150.0	138456.0	18.7	60.3
Tube	183	0.500"	Y1865		166670.0	154550.0	18.8	62.4
Tube	84	0.500"	Y1865		167900.0	156084.0	19.0	66.1
					145 KSI MIN	135 - 165 KSI		

Longitudinal Charpy-V Notch Impact Data (FT-LBS)

Size (mm)	Temp (F)	Heat No.	Position	A	B	C	Avg	Shear(%)
10 x 7.5 mm	72 F	Y1864	19	63.0	63.0	65.0	63.7	90.0
10 x 7.5 mm	72 F	Y1865	183	61.0	60.0	62.0	61.0	90.0
10 x 7.5 mm	72 F	Y1865	84	46.0	46.0	46.0	46.0	95.0
72 DEGREE F. MIN AVG. 40 (full), 32 (3/4), 22 (1/2)								

All properties meet the requirements of API Specification 5D, Latest Edition, and Grant Prideco Specification for Grade S-135.

I certify that these tests were conducted in accordance with applicable specifications and that the data contained herein is true and correct.

Grant Prideco Representative

March 09, 2004
Date

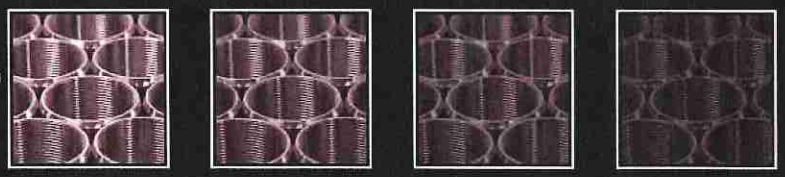
Customer: MITSUI TUBULAR PRODUCTS INC **Date:** March 09, 2004

Sales Order #: 1000006660 **Purchase Order #:** 171045 - WS-04-4

Description: 6-5/8" OD 50.46 LB.0.813 WT. "H-SERIES" IEU UPSET RANGE 2 GRADE S-135 DRILL STRING

GRANT PRIDECO

NOV Grant Prideco™



February 29, 2012

Quality Documentation Package

Customer: ENSCO

Purchase Order Number: 10013-0000231566

Sales Order Number: 1000103472

6-5/8"OD .625"WT "H-SERIES" IEU UPSET RANGE 3 GRADE V-150 DRILL STRING WITH (6-5/8 FH)PIN 8-1/2"OD X 4-1/4"ID 12" TONG SPACE WITH TCS TI HARDBANDING & WITH SMOOTHEDGE FEATURE & WITH H-SERIES BENCHMARKS AND (6-5/8 FH)BOX 8-1/2"OD X 4-5/8"ID 15" TONG SPACE WITH TCS TI HARDBANDING & WITH SMOOTHEDGE FEATURE & WITH H-SERIES BENCHMARKS

NOV GRANT PRIDECO
NAVASOTA, TX USA

NOV Grant Prideco Customer Connection

http://www.nov.com/GrantPrideco/CustomerFeedback

QUALITY NOV Grant Prideco DRILL STRING PRODUCTS

Certificate of Testing for Drill Pipe - 1

Mill Chemistry

Mill	Type	Heat No.	C	MN	P	S	SI	CU	NI	CR	MO	V	B	AL
US Steel	Product	U21873	0.260	0.740	0.0050	0.0060	0.300	0.020	0.010	1.320	0.660	0.005	0.0001	0.033
US Steel	Heat	U21873	0.260	0.740	0.0040	0.0040	0.290	0.020	0.020	1.350	0.640	0.008	0.0001	0.036
US Steel	Heat	U21873	0.260	0.740	0.0050	0.0060	0.290	0.020	0.020	1.370	0.680	0.008	0.0002	0.033
US Steel	Heat	U21876	0.260	0.760	0.0070	0.0050	0.270	0.030	0.020	1.320	0.680	0.006	0.0001	0.028
US Steel	Heat	U21876	0.260	0.740	0.0070	0.0070	0.260	0.030	0.020	1.320	0.670	0.006	0.0001	0.028
US Steel	Product	U21876	0.270	0.740	0.0070	0.0060	0.260	0.030	0.020	1.340	0.670	0.006	0.0001	0.027

Mechanical Test Data

Specimen	Position	Size	Heat No.	Lot No.	Tensile PSI	Yield PSI	Elong %	RA %
Upset	141	0.500"	U21873		166220.0	152016.0	18.5	61.0
Tube	141	0.500"	U21873		170970.0	159894.0	18.9	
Tube	15	0.500"	U21876		172920.0	161590.0	19.5	
Tube	105	0.500"	U21876		171640.0	158750.0	20.9	
Upset	105	0.500"	U21876		168310.0	150438.0	20.1	62.8
Upset	15	0.500"	U21876		170530.0	159569.0	19.1	61.9
					160 KSI MIN	150-165 KSI		

Longitudinal Charpy-V Notch Impact Data (FT-LBS)

Size (mm)	Temp (F)	Heat No.	Position	A	B	C	Avg	Shear(%)
10 x 7.5 mm	-4 F	U21873	141	51.0	53.0	53.0	52.3	70.0
10 x 7.5 mm	-4 F	U21876	15	51.0	51.0	50.0	50.7	50.0
10 x 7.5 mm	-4 F	U21876	105	51.0	53.0	54.0	52.7	75.0

40 ft-lbs min avg, 3/4 size @ -4F

Grain Size: 6 or finer

All properties meet the requirements of API Specification 5DP, Latest Edition, NOV Grant Prideco Specification for V-150, NS-1 Spec Rev 9 dtd 6/2007, and Ensco Specification ST-CO-ENG-EQP-001 Rev 11, 12/14/10. I certify that these tests were conducted in accordance with applicable specifications and that the data contained herein is true and correct.

Lisa Bates

NOV Grant Prideco Representative

February 29, 2012

Date

Customer: ENSCO

Date: February 29, 2012

Sales Order #: 1000103472

Purchase Order #: 10013-0000231566

Description: 6-5/8"OD .625"WT "H-SERIES" IEU UPSET RANGE 3 GRADE V-150 DRILL STRING WITH (6-5/8 FH)PIN 8-1/2"OD X 4-1/4"ID 12" TONG SPACE WITH TCS TI HARDBANDING & WITH SMOOTHEDGE FEATURE & WITH H-SERIES BENCHMARKS AND (6-5/8 FH)BOX 8-1/2"OD X 4-5/8"ID 15" TONG SPACE WITH TCS TI HARDBANDING & WITH SMOOTHEDGE FEATURE & WITH H-SERIES BENCHMARKS

NOV Grant Prideco™

QUALITY DOCUMENTATION PACKAGE

GE Oil & Gas

RPT, Maersk Shear Test

18 ¾" -15M RBOP w/22" 4K Operators

Report: HO10-114 Rev: A1 **Date: 10/2/2010**

Prepared By: Viral Shah

Product Engineer, GE Oil & Gas Drilling Products

Approved By: William L. Carbaugh

Lead Engineer, GE Oil & Gas Drilling Products

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1.0 Scope

This report covers a shear test of drill pipe using an 18-3/4”-15,000psi RBOP equipped with 22”-4,000 psi operators.

2.0 Purpose

The purpose of this report is to provide Maersk and a governing third-party with the shearing pressure required for an 18-3/4”-15,000psi RBOP to shear the following size, grade, and weight of pipe, using blind shear blocks:

- 6 5/8” 0.938 wall V-150

A successful test will prove that the 18-3/4”-15,000psi RBOP equipped with blind shear rams is capable of shearing the pipe listed above, as well as holding low and high wellbore pressure after shearing.

3.0 Procedure

Shear testing was performed in accordance with Hydril Test Procedure 3112106 Sec 13. The low and high wellbore pressure test were held for 10 minutes instead of 3 minutes per Maersk’s request.

4.0 Results

One shear test and the subsequent wellbore pressure tests were completed on the pipe listed above; Table 1 shows the summary of the test results. Table 2 shows the mechanical properties of the pipe sheared.

Table 1

Test	Pipe Description	Regulator Pressure (psi)	Shearing Press. (psi)	Calculated Shear Press. (psi)	Successful Wellbore Pressure
1	6 5/8” 0.938 wall V-150	3,000	3,160	3,006	YES

Table 2 Mechanical Properties of the pipe

Test/ Data File Name	Ultimate Strength (psi)	Elongation %	Heat Treat Number
1	173,475	19.8	98221

5.0 Discussion

The purpose of this test is to determine the required closing pressure to shear the test specimens provided by Maersk and subsequent low and high-pressure sealability. The sample was cut with 3,160 psi net closing pressure. The low pressure and high pressure test passed successfully. Figure 1 shows the plot for closing pressure, opening pressure and net closing pressure against time and Figure 2 shows the plot for wellbore

pressure against time. Figures 3 to 18 show the condition of the blades, shear sample and blocks, before and after the test.

Glossary:

Opening Pressure – The gage pressure measured on the opening side of the operator piston

Closing Pressure – The gage pressure measured on the closing side of the operator piston

Net Closing Pressure – A calculated value obtained from subtracting the opening side pressure from the closing side pressure. The pressure on the opening side is a function of operator piston velocity, outlet orifice size, and outlet back pressure. The closing pressure will always be higher than the net closing pressure when the operator is performing the shearing motion.

6.0 Conclusion

Testing shows that the Hydril 18-3/4" – 15,000 RBOP with 22"-3,000 psi operators is capable of shearing the drill pipe with blind shear rams at the pressures listed in Table 1 and sealing at the low and high wellbore pressures specified.

7.0 Calibration

All Hydril lab instruments are calibrated in accordance with Hydril procedure QI29-115.

8.0 Test Equipment and Facilities

8.1 Test Articles

The components shown in Table 3 are the replaceable ram components used during the test.

Test	Lower Ram Blade		Upper Ram Blade		Upper Top Seal	Lower Top Seal	Lat-T Seal Kit
	Part No.	Serial No.	Part No.	Serial No.	Part No.	Part No.	Part No.
1	3117591	M7701-9	3120904	M7817-8	3117111	3117112	3113891

Table 3 - Replaceable components used in shear testing

8.2 Test Dates

Test was conducted on September 15, 2010.

8.3 BOP Assembly

Hydril 18-3/4" – 15,000 psi compact ram BOP, PN: 3121063

8.4 Test Facility

All testing is conducted at GE Oil and Gas Test and Demonstration Facility, 3300 N Sam Houston Parkway E, Houston, TX.

9.0 Witnesses

Witness	*Company*
Robert Foster	Senior Test Lab Operator, GE Oil & Gas
Sam Plummer	Senior Test Lab Operator, GE Oil & Gas
Phil Englke	DNV
Michael Long	Statoil
Siri Hagerup- Jenssesn	Statoil
Martin Ansbjorn	Maersk

APPENDIX

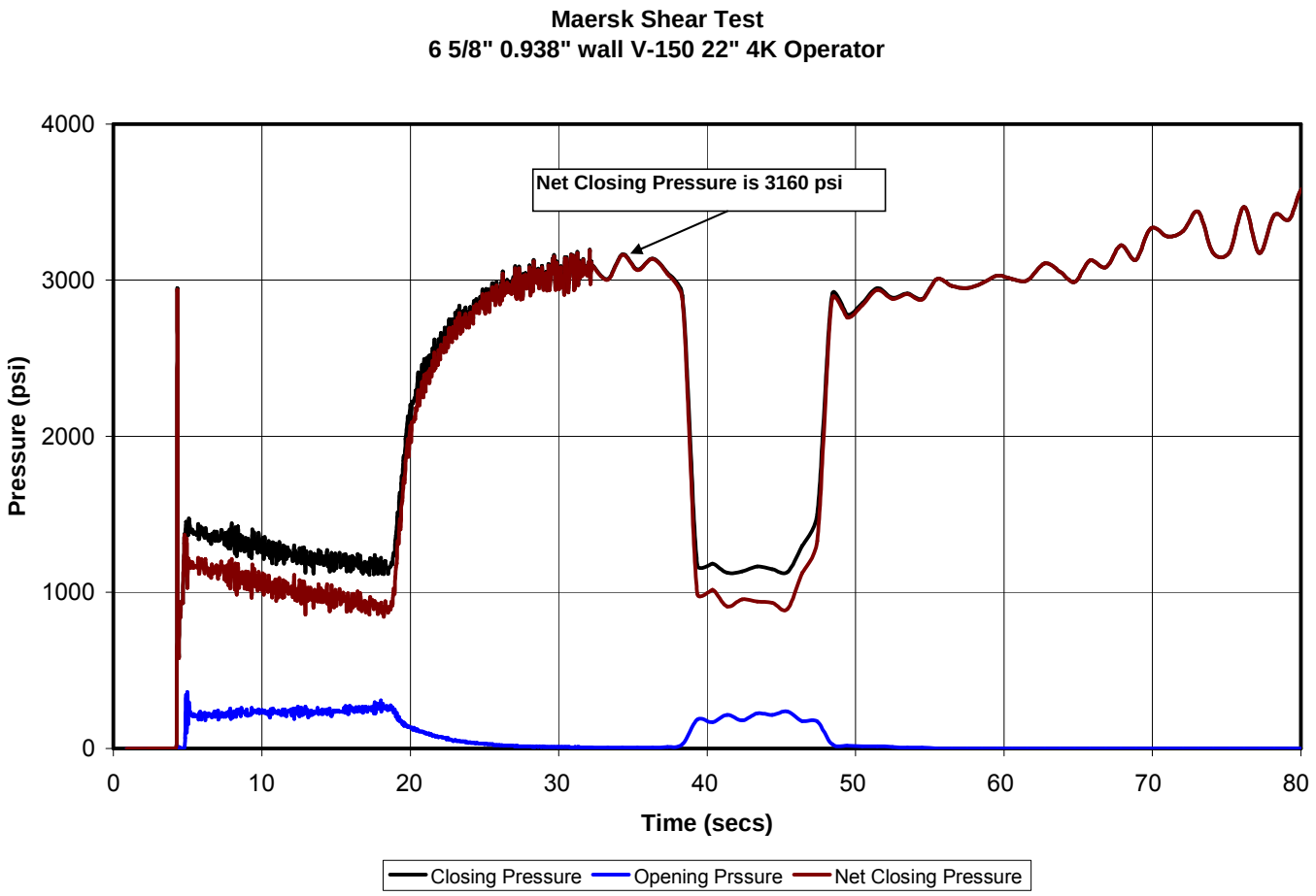

Figure 1 - Shear test pressure plot

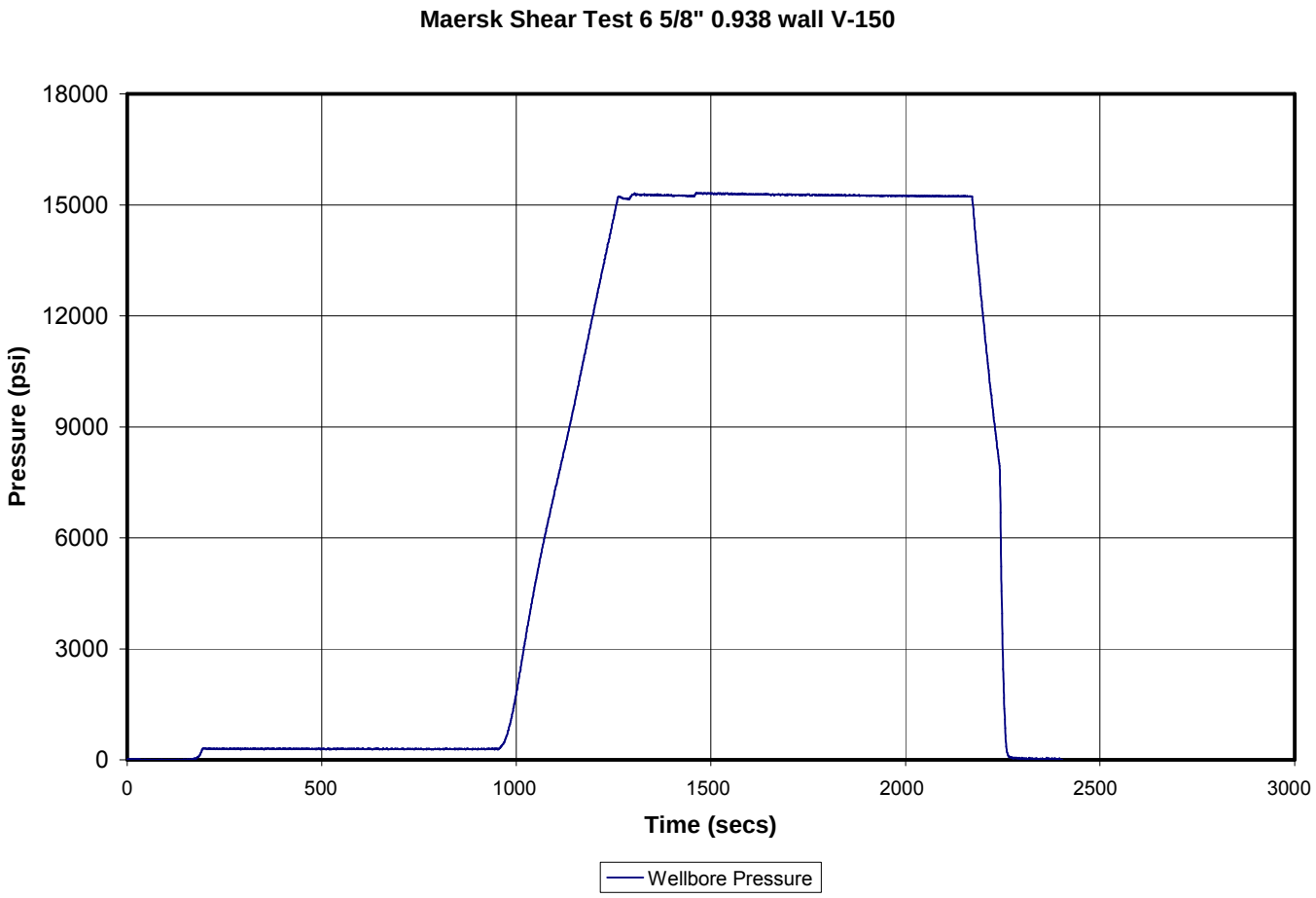

Figure 2 - Wellbore pressure test plot (Test 1)

Figure 3 Condition of Lower blade before the shear test

Figure 4 Another view of the lower blade

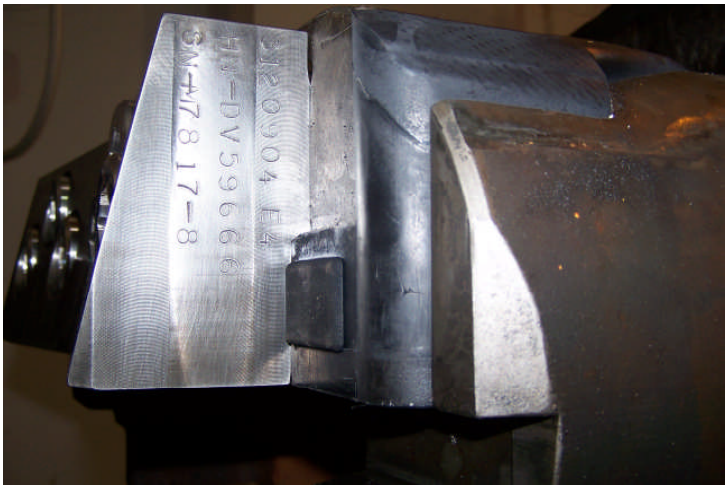

Figure 5 Condition of upper blade before the test

Figure 6 Test sample

Figure 7 Heat number of the pipe

Figure 8 Another view of the shear sample

Figure 9 Shear sample after the test

Figure 10 Another view of the shear sample

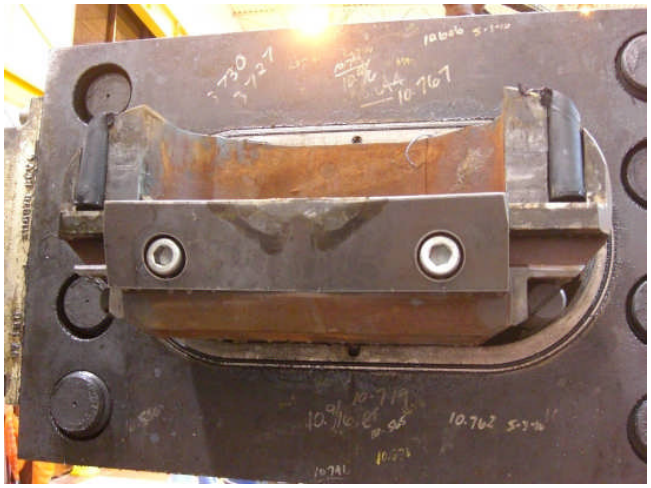

Figure 11 Condition of lower blade after the test

Figure 12 Condition of the lower blade after the test

Figure 13 Another view of the lower blade

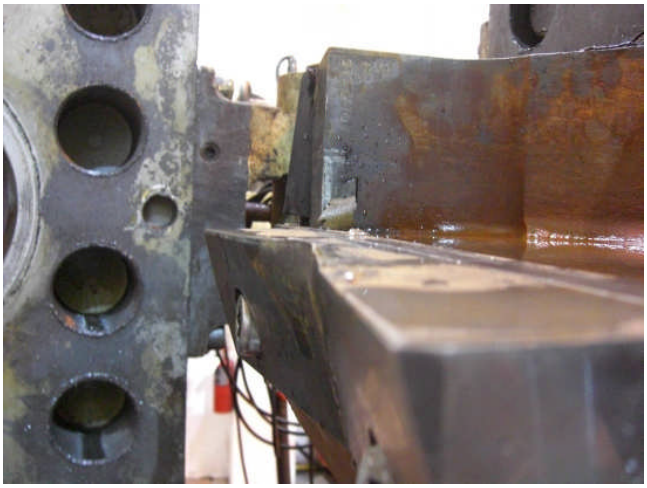

Figure 14 Another view of the lower blade

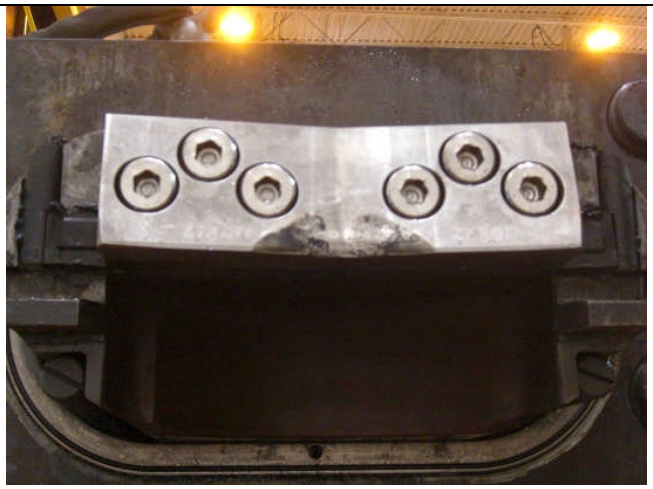

Figure 15 Condition of the upper blade after the test

Figure 16 Another view of the upper blade after the test

Figure 17 Another view of the upper blade after the test

Figure 18 Another view of the upper blade after the test

Serialization Log

Total Number of Joints: 323
Total Length (Ft): 10250.07

Work Order: 1000089708

Pipe Serial No.	Tubo Insp. #	Box Heat Code	Pin Heat Code	Pipe Heat No.	Lngth	Slip Box Heat Code	OD	ID	BD	VT	UT/Mag
NAE32662	78	0936	0894	98221	31.80	0929	✓	✓	✓	✓	✓
NAE32663	106	0936	0894	98221	31.75	0825	✓	✓	✓	✓	✓
NAE32664	84	0936	0894	98221	31.80	0929	✓	✓	✓	✓	✓
NAE32665	60	0936	0894	98221	31.93	0929	✓	✓	✓	✓	✓
NAE32666	57	0936	0894	98341	31.63	0929	✓	✓	✓	✓	✓
NAE32667	62	0936	0894	98341	31.71	0929	✓	✓	✓	✓	✓
NAE32668	118	0937	0894	98221	31.78	0929	✓	✓	✓	✓	✓
NAE32669	29	0936	0894	98221	31.73	0929	✓	✓	✓	✓	✓
NAE32670	134	0937	0894	98221	31.83	0929	✓	✓	✓	✓	✓
NAE32671	92	0936	0894	98342	31.74	0825	✓	✓	✓	✓	✓
NAE32672	79	0936	0894	98221	31.79	0929	✓	✓	✓	✓	✓
NAE32673	99	0936	0894	98221	31.80	0929	✓	✓	✓	✓	✓
NAE32674	33	0936	0894	98221	31.73	0929	✓	✓	✓	✓	✓
NAE32675	20	0936	0894	98221	31.81	0929	✓	✓	✓	✓	✓
NAE32676	121	0936	0894	98221	31.78	0929	✓	✓	✓	✓	✓
NAE32677	95	0936	0894	98342	31.75	0929	✓	✓	✓	✓	✓
NAE32678	120	0936	0894	98221	31.78	0929	✓	✓	✓	✓	✓
NAE32679	25	0936	0894	98221	31.88	0929	✓	✓	✓	✓	✓
NAE32680	59	0937	0894	98221	31.92	0929	✓	✓	✓	✓	✓
NAE32681	12	0936	0894	98221	31.92	0929	✓	✓	✓	✓	✓
NAE32682	77	0936	0894	98221	31.88	0929	✓	✓	✓	✓	✓
NAE32683	147	0936	0894	98221	31.90	0929	✓	✓	✓	✓	✓
NAE32684	28	0937	0894	98221	31.87	0928	✓	✓	✓	✓	✓
NAE32685	15	0937	0894	98221	31.67	0929	✓	✓	✓	✓	✓
NAE32686	96	0937	0894	98342	31.86	0922	✓	✓	✓	✓	✓
NAE32687	100	0936	0894	98221	31.86	0928	✓	✓	✓	✓	✓
NAE32688	127	0936	0894	98221	31.85	0929	✓	✓	✓	✓	✓
NAE32689	81	0936	0894	98221	31.82	0929	✓	✓	✓	✓	✓
NAE32690	126	0936	0894	98221	31.85	0929	✓	✓	✓	✓	✓
NAE32691	137	0936	0894	98221	31.87	0929	✓	✓	✓	✓	✓
NAE32692	146	0936	0894	98221	31.80	0929	✓	✓	✓	✓	✓
NAE32693	31	0936	0894	98221	31.79	0929	✓	✓	✓	✓	✓
NAE32694	103	0936	0894	98221	31.81	0929	✓	✓	✓	✓	✓
NAE32695	75	0936	0894	98342	31.70	0929	✓	✓	✓	✓	✓
NAE32696	97	0937	0894	98341	31.69	0922	✓	✓	✓	✓	✓
NAE32697	80	0936	0894	98341	31.76	0929	✓	✓	✓	✓	✓

Grant Prideco

Customer: QUAIL TOOLS, L.L.P.

Date: June 09, 2009

Sales Order #: 1000089708

Purchase Order #: 86632 Q

Description: 6-5/8" OD .938" WT "H-SERIES" IEU UPSET R2 GRADE V-150 DS W/(6-5/8 FH)PIN 8-11/16"OD X 3-1/2"ID 12" TONG SPACE W/NO HB & W/H-SERIES BM AND (6-5/8 FH)BOX 8-11/16"OD X 3-1/2"ID 17" TONG SPACE W/NO HB & W/SMOOTHEDGE FEATURE & W/H-SERIES BM W/6.906" OD X 72" LONG SLIP-PROOF SECTION

QUALITY DOCUMENTATION PACKAGE

Figure 19 MTRs for 6 5/8" 0.938 wall V-150 pipe

Certificate of Testing for Drill Pipe - 1

Mill Chemistry

Mill	Type	Heat No.	C	MN	P	S	SI	CU	NI	CR	MO	V	B	AL
Timken	Product	98221	0.270	0.770	0.0090	0.0020	0.280	0.200	0.160	1.360	0.710			0.030
Timken	Product	98341	0.260	0.760	0.0090	0.0030	0.280	0.210	0.150	1.360	0.700	0.000	0.0000	0.028
Timken	Product	98342	0.260	0.780	0.0080	0.0030	0.290	0.200	0.160	1.360	0.700	0.000	0.0000	0.023

Mechanical Test Data

Specimen	Position	Size	Heat No.	Lot No.	Tensile PSI	Yield PSI	Elong %	RA %
Tube	245	0.500"	98221		173475.0	161669.0	19.8	
Upset	172	0.500"	98221		168064.0	155161.0	19.5	64.0
Tube	172	0.500"	98221		171905.0	159905.0	20.0	
Upset	245	0.500"	98221		171136.0	159768.0	18.9	60.5
Tube	131	0.500"	98341		169820.0	159451.0	19.7	
Upset	131	0.500"	98341		171800.0	162608.0	19.1	62.8
Upset	148	0.500"	98342		169672.0	156121.0	20.5	61.9
Tube	148	0.500"	98342		170210.0	156412.0	19.2	
					160 KSI MIN	150-165 KSI		

Longitudinal Charpy-V Notch Impact Data (FT-LBS)

Size (mm)	Temp (F)	Heat No.	Position	A	B	C	Avg	Shear(%)
10 x 7.5 mm	-4 F	98221	245	52.0	56.0	54.0	54.0	95.0
10 x 7.5 mm	-4 F	98221	172	57.0	55.0	58.0	56.7	95.0
10 x 7.5 mm	-4 F	98341	131	53.0	49.0	59.0	53.7	60.0
10 x 7.5 mm	-4 F	98342	148	52.0	49.0	54.0	51.7	50.0

45 FT-LBS MIN AVG. 3/4 SIZE @ -4F

All properties meet the requirements of API Specification 5D, Latest Edition, NOV Grant Prideco Specification for V-150, NS-1 SPEC. REV 9 6/2007, and QUAIL SPEC: QU-DP-01, REV 2, DATED 4/09/09, 6-5/8? OD 0.938? WALL SLIP PROOF LANDING STRING. I certify that these tests were conducted in accordance with applicable specifications and that the data contained herein is true and correct.

Lisa Bates
NOV Grant Prideco Representative

June 09, 2009
Date

NOV Grant Prideco

Customer: QUAIL TOOLS, L.L.P. **Date:** June 09, 2009

Sales Order #: 1000089708 **Purchase Order #:** 86632 Q

Description: 6-5/8" OD .938" WT "H-SERIES" IEU UPSET R2 GRADE V-150 DS W/(6-5/8 FH)PIN 8-11/16"OD X 3-1/2"ID 12" TONG SPACE W/NO HB & W/H-SERIES BM AND (6-5/8 FH)BOX 8-11/16"OD X 3-1/2"ID 17" TONG SPACE W/NO HB & W/SMOOTHEDGE FEATURE & W/H-SERIES BM W/6.906" OD X 72" LONG SLIP-PROOF SECTION

QUALITY DOCUMENTATION PACKAGE

Certificate of Testing for Drill Pipe - 1

Mill Chemistry

Mill	Type	Heat No.	C	MN	P	S	SI	CU	NI	CR	MO	V	B	AL
Timken	Product	F2717	0.300	0.900	0.0070	0.0020	0.260	0.220	0.800	0.800	0.800	0.005		0.026
Timken	Product	F2719	0.290	0.900	0.0090	0.0020	0.260	0.240	0.810	0.800	0.810	0.005		0.025

Mechanical Test Data

Specimen	Position	Size	Heat No.	Lot No.	Tensile PSI	Yield PSI	Elong %	RA %
Upset	15	0.500"	F2717		164019.0	153155.0	19.5	61.0
Tube	203	0.500"	F2717		163479.0	152670.0	21.2	
Tube	15	0.500"	F2717		165390.0	154219.0	18.4	
Upset	203	0.500"	F2717		164473.0	154396.0	20.9	62.1
Tube	150	0.500"	F2719		164660.0	153426.0	22.1	
Tube	53	0.500"	F2719		171406.0	160470.0	19.5	
Tube	224	0.500"	F2719		166057.0	156902.0	20.0	
Upset	224	0.500"	F2719		164420.0	153990.0	20.0	64.2
Upset	150	0.500"	F2719		164580.0	154150.0	21.2	62.5
Upset	53	0.500"	F2719		170825.0	159688.0	19.3	58.5
					160 KSI MIN	150-165 KSI		

Longitudinal Charpy-V Notch Impact Data (FT-LBS)

Size (mm)	Temp (F)	Heat No.	Position	A	B	C	Avg	Shear(%)
10 x 7.5 mm	-4 F	F2717	203	55.0	58.0	55.0	56.0	95.0
10 x 7.5 mm	-4 F	F2717	15	52.0	56.0	53.0	53.7	95.0
10 x 7.5 mm	-4 F	F2719	150	53.0	50.0	49.0	50.7	95.0
10 x 7.5 mm	-4 F	F2719	53	47.0	47.0	48.0	47.3	95.0
10 x 7.5 mm	-4 F	F2719	224	55.0	53.0	56.0	54.7	95.0
45 FT-LBS MIN AVG, 3/4 SIZE @ -4F								

All properties meet the requirements of API Specification 5D, Latest Edition, NOV Grant Prideco Specification for V-150, NS-1 SPEC. REV 9 6/2007, and QUAIL SPEC: QU-DP-01, REV 2, DATED 4/09/09, 6-5/8? OD 0.938? WALL SLIP PROOF LANDING STRING. I certify that these tests were conducted in accordance with applicable specifications and that the data contained herein is true and correct.

Ila Bates
NOV Grant Prideco Representative

June 09, 2009
Date

NOV Grant Prideco

Customer: QUAIL TOOLS, L.L.P. **Date:** June 09, 2009

Sales Order #: 1000089708 **Purchase Order #:** 86632 Q

Description: 6-5/8" OD .938" WT "H-SERIES" IEU UPSET R2 GRADE V-150 DS W/(6-5/8 FH)PIN 8-11/16"OD X 3-1/2"ID 12" TONG SPACE W/NO HB & W/H-SERIES BM AND (6-5/8 FH)BOX 8-11/16"OD X 3-1/2"ID 17" TONG SPACE W/NO HB & W/SMOOTHEDGE FEATURE & W/H-SERIES BM W/6.906" OD X 72" LONG SLIP-PROOF SECTION

QUALITY DOCUMENTATION PACKAGE

P.O. Box 577
Brookshire, TX 77423
U.S.A

WEST ENGINEERING SERVICES
ISO 9001 Certified

Tel: (281) 375-5515
Fax: (281) 934-1600
west@westengineer.com

STATEMENT OF QUALIFICATIONS

Introduction

The Department of the Interior, Bureau of Ocean Energy Management (BOEM) issued revisions to 30 CFR Part 250 to implement certain safety measures for Lessees regarding energy development on the OCS. Some include having an independent third party verify and/or certify specific capabilities of BOP and well control systems.

Qualifications

Per 30 CFR 250.416(g1); "*The independent third party must be a… licensed professional engineering firm capable of providing the verification required with this part.*" (See Items 1 - 13).

WEST:

1. is a registered Engineering firm in the state of Texas. A copy of our license is included. (See Section 9)
2. is a Well Control Equipment verification company, established in 1984, that places emphasis on technical excellence.
3. has conducted over 3700 surveys on WCE over the last 27 years for Operators and Contractors.
4. has 13 degreed engineers and 6 licensed professional engineers on staff.
5. draws upon the collective experience of a team of approximately 70 drilling equipment and BOP surveyors, each with an average field experience level of 19 years.
6. performs Failure Modes, Effects, and Criticality Analyses on a wide variety of drilling equipment ranging from Top Drives to Blow-Out Preventers and their control systems.
7. has created a database of Inspection and Test Procedures (ITPs) and Acceptance Test Procedures (ATPs) that detail procedures to ensure fitness-for-purpose.
8. maintains a database of Original Equipment Manufacturer product/engineering bulletins called RigLore, which serves as a single resource for manufacturer engineering history and record of design changes.
9. maintains continuously updated databases for drilling equipment anomalies and lessons learned. WEST also has a searchable failure database.
10. conducted 7 major technical studies over the past 15 years concerning WCE on topics including shear ram capabilities, secondary intervention methods in well control, high pressure high temperature BOP elastomer performance, BOP reliability, BOP multiplex control systems, and applicability of API recommended practices in US regulations. These studies help position WEST on the forefront of best available and safest technology (BAST).
11. provides specialized training and seminars on Well Control Equipment.
12. engineers participate in API standards committees. In this capacity, WEST is involved in revising API standards to meet the latest technological developments in drilling equipment.
13. engineers author and present SPE papers in peer reviewed events on a wide range of topics involving advanced drilling technology, the vast majority of which have been on BOP topics.

Per 30 CFR 250.416 (g2); …"*the firm you are using is reputable, the firm and its employees hold appropriate licenses to perform the verification in the appropriate jurisdiction, the firm carries industry standard levels of professional liability insurance, and the firm has no record of violations of applicable law.*" (See Items 14 – 15).

WEST:

14. is a sufficiently capitalized, insured (limited to a maximum of $1 million per incident), licensed professional engineering firm with no record of violations of applicable law (or ethical guidelines) and is willing to sign a certification under penalty of perjury. (See Sections 9, 10 & 11)
15. is an ISO 9001 certified company.

Jeffry P. Sattler, P.E.
Sr. Vice President, Engineering

Texas Board of Professional Engineers
CERTIFICATE OF REGISTRATION

This acknowledges that

West Hou, Inc.
DBA: West Engineering Services

has fulfilled the requirements of the Texas Board of Professional Engineers to offer and perform engineering services in the state of Texas.

Registration Number	Expiration Date
F-4672	3/31/2013

P.O. Box 577
Brookshire, TX 77423
U.S.A

WEST ENGINEERING SERVICES

Tel: (281) 375-5515
Fax: (281) 934-1600
west@westengineer.com

ISO 9001 Certified

02 August 2011

To Whom It May Concern:

As regards to the use of WEST's engineering professional status in commercial transactions, WEST states that no prior or present violation of applicable law has been charged by others.

Please contact us if you require any additional information.

Sincerely,

Jeffry P. Sattler,

For WEST Engineering Services, Texas Registration No. F-4672

ACORD®

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY) 08/16/2012

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Willis of Texas, Inc.
920 Memorial City Way, Suite 500
Houston TX 77024

CONTACT NAME: Nancy Antill
PHONE (A/C, No, Ext): 713-625-1112 FAX (A/C, No):
E-MAIL ADDRESS: nancy.antill@willis.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Zurich American Insurance Co.	
INSURER B :	
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED
West Hou, Inc. dba WEST Engineering Services
PO Box 577
Brookshire, TX 77423

COVERAGES **CERTIFICATE NUMBER:** 20120530A **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$
	COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	CLAIMS-MADE / OCCUR						MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$
	POLICY / PRO-JECT / LOC							$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$
	ANY AUTO						BODILY INJURY (Per person)	$
	ALL OWNED AUTOS / SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	HIRED AUTOS / NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	$
								$
	UMBRELLA LIAB / OCCUR						EACH OCCURRENCE	$
	EXCESS LIAB / CLAIMS-MADE						AGGREGATE	$
	DED / RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY						WC STATU-TORY LIMITS / OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICE/MEMBER EXCLUDED? Y / N **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N / A					E.L. EACH ACCIDENT	$
							E.L. DISEASE - EA EMPLOYEE	$
							E.L. DISEASE - POLICY LIMIT	$
A	Professional Liability			IPR929637100	07/01/2012	07/01/2013	Limit $1,000,000 Retention $25,000	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER

To Whom It May Concern

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE
Nancy Antill

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